CHAPTER 6

Configuring PPPoE over Ethernet and IEEE 802.1Q VLAN

The Cisco 10000 series router allows the tunneling and termination of PPP sessions over Ethernet links. The PPPoE over Ethernet interface (PPPoEoE) feature enables the Cisco 10000 series router to tunnel and terminate Ethernet PPP sessions over Ethernet links. The PPPoE over IEEE 802.1Q VLANs feature enables the router to tunnel and terminate Ethernet PPP sessions across VLAN links. IEEE 802.1Q encapsulation is used to interconnect a VLAN-capable router with another VLAN-capable networking device. The packets on the 802.1Q link contain a standard Ethernet frame and the VLAN information associated with that frame.

This chapter describes the following features:

For more information, see the "Configuring Broadband Access: PPP and Routed Bridge Encapsulation" chapter in the *Cisco IOS Wide-Area Networking Configuration Guide* and the *VLAN Range, Release 12.2(13)T* feature guide.

PPPoE over Ethernet

The PPPoE over Ethernet feature provides the ability to connect a network of hosts over a simple bridging access device to a remote Access Concentrator. The Cisco 10000 series router supports PPPoE over Ethernet sessions to enable multiple hosts on a shared Ethernet interface to open PPP sessions to the PPPoE server.

The PPPoE over Ethernet feature is described in the following topics:

Feature History for PPPoE over Ethernet

Cisco IOS Release	Description	Required PRE
12.2(4)BZ1	This feature was introduced on the Cisco 10000 series router.	PRE1
12.3(7)XI1	This feature was integrated into Cisco IOS Release 12.3(7)XI1.	PRE2
12.2(28)SB	This feature was integrated into Cisco IOS Release 12.2(28)SB.	PRE2

Restrictions for PPPoE over Ethernet

The PPPoE over Ethernet feature has the following restriction:

- The Cisco 10000 series router currently supports the PPPoE over Ethernet feature on Gigabit Ethernet line cards and Fast Ethernet 8-port half-height line cards. The Fast Ethernet port of the performance routing engine (PRE) does not support the PPPoE over Ethernet feature.

Note The Cisco 10000 series router supports a Fast Ethernet interface for management traffic only.

Configuration Tasks for PPPoE over Ethernet

To configure the PPPoE over Ethernet feature, perform the following configuration tasks:

- Configuring a Virtual Template Interface, page 6-2
- Creating an Ethernet Interface and Enabling PPPoE, page 6-3
- Configuring PPPoE in a VPDN Group, page 6-3
- Configuring PPPoE in a BBA Group, page 6-3

Configuring a Virtual Template Interface

Configure a virtual template before you configure PPPoE on an Ethernet interface. The virtual template interface is a logical entity that is applied dynamically as needed to an incoming PPP session request. To configure a virtual template interface, see the "Configuring a Virtual Template Interface" section on page 3-17.

Creating an Ethernet Interface and Enabling PPPoE

To create an Ethernet interface and enable PPPoE on it, enter the following commands beginning in global configuration mode:

	Command	Purpose
Step 1	`Router(config)# interface GigabitEthernet number`	Creates an Ethernet interface and enters interface configuration mode.
Step 2	`Router(config-if)# pppoe enable`	Enables PPPoE and allows PPPoE sessions to be created through that interface.

Configuring PPPoE in a VPDN Group

To configure a virtual private dial network (VPDN) group for PPPoE and to link the group to the appropriate virtual template interface, enter the following commands beginning in global configuration mode:

	Command	Purpose
Step 1	`Router(config)# vpdn enable`	Enables VPDN configuration on the router.
Step 2	`Router(config)# vpdn-group name`	Associates a VPDN group to a customer or VPDN profile.
Step 3	`Router(config-vpdn)# accept-dialin`	Creates an accept dial-in VPDN group.
Step 4	`Router(config-vpdn-acc-in)# protocol pppoe`	Specifies the VPDN group to be used to establish PPPoE sessions.
Step 5	`Router(config-vpdn-acc-in)# virtual-template template-number`	Specifies the virtual template interface to use to clone virtual access interfaces (VAIs).
Step 6	`Router(config-vpdn)# pppoe limit per-mac per-mac-limit`	(Optional) Specifies the maximum number of sessions per MAC address for each PPPoE port that uses the group.
Step 7	`Router(config-vpdn)# pppoe limit max-sessions number`	(Optional) Specifies the maximum number of PPPoE sessions that can be terminated on this router from all interfaces.

Note You cannot simultaneously configure a broadband aggregation (BBA) group for PPPoE and a VPDN group for PPPoE. If you configure a BBA group and then you configure a VPDN group, the **protocol** command in VPDN accept-dialin configuration mode does not include an option for PPPoE (for example, you cannot specify the **protocol pppoe** command). Use the **no bba-group pppoe** command to re-enable the **pppoe** option for the **protocol** command.

Configuring PPPoE in a BBA Group

Note Cisco IOS Release 12.2(15)BX does not support the configuration of BBA groups using RADIUS. You must configure BBA groups manually.

To configure a broadband aggregation (BBA) group for PPPoE and to link it to the appropriate virtual template interface, enter the following commands beginning in global configuration mode:

	Command	Purpose
Step 1	`Router(config)# bba-group pppoe {name | global}`	Configures a BBA group to be used to establish PPPoE sessions. *name* identifies the BBA group. You can have multiple BBA groups. **global** is the default BBA group used for ATM connections when a BBA group name is not specified.
Step 2	`Router(config-bba-group)# virtual-template template-number`	Specifies the virtual template interface to use to clone virtual access interfaces (VAIs).
Step 3	`Router(config-bba-group)# sessions per-mac limit per-MAC session limit`	(Optional) Specifies the maximum number of sessions per MAC address for each PPPoE port that uses the group.
Step 4	`Router(config-bba-group)# sessions per-vlan limit per-VLAN session limit`	(Optional) Specifies the maximum number of PPPoE sessions under each VLAN.
Step 5	`Router(config-bba-group)# sessions per-vc limit per-VC session limit`	(Optional) Specifies the maximum number of PPPoE sessions for each VC that uses the group.
Step 6	`Router(config-bba-group)# exit`	Returns to global configuration mode.
Step 7	`Router(config)# interface type number`	Specifies the interface to which you want to attach the BBA group and enters interface configuration mode.
Step 8	`Router(config-if)# encapsulation dot1q vlan-id`	Enables IEEE 802.1Q encapsulation of traffic on a specified subinterface in a VLAN. Specify the VLAN identifier.
Step 9	`Router(config-if)# protocol pppoe group group-name`	Attaches the BBA group to the VLAN.

Note You cannot simultaneously configure a BBA group for PPPoE and a VPDN group for PPPoE. If you configure a BBA group and then you configure a VPDN group, the **protocol** command in VPDN accept-dialin configuration mode does not include an option for PPPoE (for example, you cannot specify the **protocol pppoe** command). Use the **no bba-group pppoe** command to re-enable the **pppoe** option for the **protocol** command.

Configuration Example for PPPoE over Ethernet

Example 6-1 shows a PPPoE over Ethernet configuration. In the example, the virtual template *virtual-template 1* is linked to the VPDN group. The configuration also specifies the number of sessions allowed on the VPDN group.

Example 6-1 Using a VPDN Group to Configure PPPoE over Ethernet

```
!Creates a VPDN session group and links it to a virtual template.
vpdn-group 1
    accept-dialin
        protocol pppoe
        virtual-template 1
    pppoe limit per-mac 10
    pppoe limit max-sessions 32000

interface Loopback0
    ip address 172.16.0.1 255.255.255.255

!Enables PPPoE and allows PPPoE sessions to be created through this subinterface.
interface GigabitEthernet1/0/0
    no ip address
    negotiation auto
    pppoe enable

!Configures the virtual template interface.
interface Virtual-Template1
    ip unnumbered loop 0
    mtu 1492
    peer default ip address pool pool1
    ppp authentication chap

!Specifies the IP local pool to use for address assignment.
ip local pool pool1 192.168.0.1 192.168.0.100
```

Example 6-2 creates a BBA group named *vpn-1* and links it to virtual-template 1. The vpn-1 BBA group is associated with VLAN 20.

Example 6-2 Using a BBA Group to Configure PPPoE over Ethernet

```
bba-group pppoe vpn-1
    virtual-template 1
    sessions per-vc limit 5
    sessions per-mac limit 10
!
!
interface GigabitEthernet1/0/0.1
    encapsulation dot1q 20
        protocol pppoe group vpn-1
```

Static MAC Address for PPPoE

The Static MAC Address for PPPoE feature allows you to choose the MAC address to be used as the source MAC address for PPPoE over ATM sessions on ATM permanent virtual circuits (PVCs). You can configure this feature for either a broadband aggregation (BBA) group or a virtual private dialup network (VPDN) group. The feature is applied to all PPPoEoA sessions on ATM PVCs to which the BBA group or the VPDN group is applied.

Note Although the Static MAC Address for PPPoE feature is configurable for VPDN groups, we recommend that you configure this feature for BBA groups.

The configuration of the Static MAC Address for PPPoE feature for BBA groups and VPDN groups is mutually exclusive. If you configure a MAC address as a source MAC address for a BBA group, a VPDN group cannot use this MAC address as a source MAC address for the VPDN group. To apply the BBA group MAC address to a VPDN group, you must manually configure the Static MAC Address for PPPoE feature for the VPDN group as well.

Example 6-3 shows how you can throttle PPP sessions using the MAC address. This example allows a maximum of five sessions from each MAC address. If more than five sessions are attempted from this MAC address, any sessions using that particular MAC address are throttled for 30 seconds.

Example 6-3 Throttling PPP Sessions Using the MAC Address

```
bba-group pppoe PPPoE
 virtual-template 1
 sessions per-vc limit 32000
 sessions per-mac limit 32000
 sessions per-mac throttle 5 1 30
```

To get a list of the throttled MAC addresses, use the **show pppoe throttled mac** command in privileged EXEC mode:

```
Router# show pppoe throttled mac
 MAC(s) throttled
     MAC              Ingress Port
00c1.00aa.006c          ATM1/0/0.101
007c.009e.0070          ATM1/0/0.101
0097.009d.007a          ATM1/0/0.101
008c.0077.0082          ATM1/0/0.101
00b5.00a8.009f          ATM1/0/0.101
00a4.0088.00b5          ATM1/0/0.101
```

Feature History for Static MAC Address for PPPoE

Cisco IOS Release	Description	Required PRE
12.2(4)BZ1	This feature was introduced on the Cisco 10000 series router.	PRE1
12.3(7)XI1	This feature was integrated into Cisco IOS Release 12.3(7)XI1.	PRE2
12.2(28)SB	This feature was integrated into Cisco IOS Release 12.2(28)SB.	PRE2

PPPoE over IEEE 802.1Q VLANs

The PPPoE over IEEE 802.1Q VLANs feature enables the Cisco 10000 series router to support PPPoE over IEEE 802.1Q encapsulated VLAN interfaces. IEEE 802.1Q encapsulation is used to interconnect a VLAN-capable router with another VLAN-capable networking device. The packets on the 802.1Q link contain a standard Ethernet frame and the VLAN information associated with that frame.

Note PPPoE is disabled by default on a VLAN.

The PPPoE over IEEE 802.1Q VLANs feature is described in the following topics:

Feature History for PPPoE over IEEE 802.1Q VLANs

Cisco IOS Release	Description	Required PRE
12.2(4)BZ1	This feature was introduced on the Cisco 10000 series router.	PRE1
12.3(7)XI1	This feature was integrated into Cisco IOS Release 12.3(7)XI1.	PRE2
12.2(28)SB	This feature was integrated into Cisco IOS Release 12.2(28)SB.	PRE2

Restrictions for PPPoE over IEEE 802.1Q VLANs

The PPPoE over IEEE 802.1Q VLANs feature has the following restrictions:

- The Cisco 10000 series router currently supports the PPPoE over IEEE 802.1Q VLANs feature on Gigabit Ethernet line cards and Fast Ethernet 8-port half-height line cards. The Fast Ethernet port of the performance routing engine (PRE) does not support this feature.
- The Cisco 10000 series router supports this feature for PPPoE dialin only. PPPoE dialout (client) is not supported.

Configuration Tasks for PPPoE over IEEE 802.1Q VLANs

To configure the PPPoE over IEEE 802.1Q VLANs feature, perform the following configuration tasks:

The following sections describe how to perform these configuration tasks. For more information, see the "Configuring Broadband Access: PPP and Routed Bridge Encapsulation" chapter in the *Cisco IOS Wide-Area Networking Configuration Guide*.

Configuring a Virtual Template Interface

Configure a virtual template interface before you configure PPPoE on an IEEE 802.1Q VLAN interface. The virtual template interface is a logical entity that is applied dynamically as needed to a serial interface. To configure a virtual template interface, see the "Configuring a Virtual Template Interface" section on page 3-17.

Creating an Ethernet 802.1Q Encapsulated Subinterface and Enabling PPPoE

To create an Ethernet 802.1Q encapsulated subinterface and enable PPPoE on it, enter the following commands beginning in global configuration mode:

	Command	Purpose
Step 1	`Router(config)# interface GigabitEthernet slot/module/port.subinterface-number`	Creates a Gigabit Ethernet subinterface and enters subinterface configuration mode.
Step 2	`Router(config-subif)# encapsulation dot1q vlan-id`	Enables IEEE 802.1Q encapsulation on a specified subinterface in VLANs.
Step 3	`Router(config-subif)# pppoe enable`	Enables PPPoE and allows PPPoE sessions to be created through the specified subinterface.
Step 4	`Router(config-subif)# pppoe max-sessions number`	Specifies the maximum number of PPPoE sessions that can be terminated on this router from all interfaces.

Configuring PPPoE in a VPDN Group

To configure a VPDN group for PPPoE and link it to the appropriate virtual template interface, enter the following commands beginning in global configuration mode:

	Command	Purpose
Step 1	`Router(config)# vpdn enable`	Enables VPDN configuration on the router.
Step 2	`Router(config)# vpdn-group name`	Associates a VPDN group to a customer or VPDN profile.

	Command	Purpose
Step 3	`Router(config-vpdn)# accept-dialin`	Creates an accept dial-in VPDN group.
Step 4	`Router(config-vpdn-acc-in)# protocol pppoe`	Specifies the VPDN group to be used to establish PPPoE sessions.
Step 5	`Router(config-vpdn-acc-in)# virtual-template` *template-number*	Specifies the virtual template interface to use to clone virtual access interfaces (VAIs).
Step 6	`Router(config-vpdn)# pppoe limit per-vlan` *number*	(Optional) Specifies the maximum number of PPPoE sessions under each VLAN.
Step 7	`Router(config-vpdn)# pppoe limit per-mac` *per-mac-limit*	(Optional) Specifies the maximum number of sessions per MAC address for each PPPoE port that uses the group.
Step 8	`Router(config-vpdn)# pppoe limit max-sessions` *number*	(Optional) Specifies the maximum number of PPPoE sessions that can be terminated on this router from all interfaces.

Note You cannot simultaneously configure a broadband aggregation (BBA) group for PPPoE and a VPDN group for PPPoE. If you configure a BBA group and then you configure a VPDN group, the **protocol** command in VPDN accept-dialin configuration mode does not include an option for PPPoE (for example, you cannot specify the **protocol pppoe** command). Use the **no bba-group pppoe** command to re-enable the **pppoe** option for the **protocol** command.

Configuring PPPoE in a BBA Group

Note Cisco IOS Release 12.2(15)BX does not support the configuration of BBA groups using RADIUS. You must configure BBA groups manually.

To configure a broadband aggregation (BBA) group for PPPoE and to link it to the appropriate virtual template interface, enter the following commands beginning in global configuration mode:

	Command	Purpose
Step 1	`Router(config)# bba-group pppoe` {*name* | **global**}	Configures a BBA group to be used to establish PPPoE sessions. *name* identifies the BBA group. You can have multiple BBA groups. **global** is the default BBA group used for ATM connections when a BBA group name is not specified.
Step 2	`Router(config-bba-group)# virtual-template` *template-number*	Specifies the virtual template interface to use to clone virtual access interfaces (VAIs).
Step 3	`Router(config-bba-group)# sessions per-mac limit` *per-MAC session limit*	(Optional) Specifies the maximum number of sessions per MAC address for each PPPoE port that uses the group.
Step 4	`Router(config-bba-group)# sessions per-vlan limit` *per-VLAN session limit*	(Optional) Specifies the maximum number of PPPoE sessions under each VLAN.
Step 5	`Router(config-bba-group)# sessions per-vc limit` *per-VC session limit*	(Optional) Specifies the maximum number of PPPoE sessions to be terminated on this router from all interfaces.

	Command	Purpose
Step 6	`Router(config-bba)# exit`	Returns to global configuration mode.
Step 7	`Router(config)# interface type number`	Specifies the interface to which you want to attach the BBA group and enters interface configuration mode.
Step 8	`Router(config-if)# encapsulation dot1q vlan-id`	Enables IEEE 802.1Q encapsulation of traffic on a specified subinterface in a VLAN. Specify the VLAN identifier.
Step 9	`Router(config-if)# protocol pppoe group group-name`	Attaches the BBA group to the VLAN.

Note You cannot simultaneously configure a BBA group for PPPoE and a VPDN group for PPPoE. If you configure a BBA group and then you configure a VPDN group, the **protocol** command in VPDN accept-dialin configuration mode does not include an option for PPPoE (for example, you cannot specify the **protocol pppoe** command). Use the **no bba-group pppoe** command to re-enable the **pppoe** option for the **protocol** command.

Configuration Examples for PPPoE over IEEE 802.1Q VLANs

Example 6-4 shows a PPPoE over IEEE 802.1Q encapsulated VLAN configuration. In the example, the virtual-template 1 virtual template is linked to the VPDN group. The configuration also specifies the maximum number of sessions allowed on the VPDN group and the number of sessions allowed for each VLAN.

Example 6-4 Using a VPDN Group to Configure PPPoE over IEEE 802.1Q VLANs

```
!Enables a virtual private dial-up network configuration on the router.
vpdn enable
!
!Creates a VPDN session group and links it to a virtual template.
vpdn-group 1
    accept-dialin
        protocol pppoe
        virtual-template 1
    pppoe limit per-mac 10
    pppoe limit per-vlan 100
    pppoe limit max-sessions 32000

interface Loopback0
    ip address 172.16.0.1 255.255.255.255

interface GigabitEthernet1/0/0
    no ip address
    negotiation auto

!Enables PPPoE and allows PPPoE sessions to be created through this subinterface.
interface GigabitEthernet1/0/0.10
    encapsulation dot1Q 20
    pppoe enable
    pppoe max-sessions 10

!Configures the virtual template interface.
interface Virtual-Template1
    ip unnumbered loop 0
    mtu 1492
```

```
    peer default ip address pool pool1
    ppp authentication chap

!Specifies the IP local pool to use for address assignment.
ip local pool pool1 192.168.0.1 192.168.0.100
```

Example 6-5 creates two BBA groups: *VPN_1* and *VPN_2*. The VPN_1 BBA group is associated with *virtual-template 1* and the VPN_2 BBA group is associated with *virtual-template 2*. The VPN_1 group is associated with VLAN 20 and the VPN_2 group is associated with VLAN 30.

Example 6-5 Using a BBA Group to Configure PPPoE over IEEE 802.1Q VLANs

```
bba-group pppoe VPN_1
    virtual-template 1
    sessions per-vc limit 5
    sessions per-mac limit 10
    sessions per-vlan limit 5
!
!
bba-group pppoe VPN_2
    virtual-template 2
    sessions per-vc limit 5
    sessions per-mac limit 10
    sessions per-vlan limit 5
!
!
interface GigabitEthernet1/0/0.1
    encapsulation dot1q 20
        protocol pppoe group VPN_1
!
interface GigabitEthernet 2/0/0.2
    encapsulation dot1q 30
        protocol pppoe group VPN_2
```

Verifying PPPoE over Ethernet and IEEE 802.1Q VLAN

To verify PPPoE over Ethernet and IEEE 802.1Q VLAN, enter the following commands in privileged EXEC mode:

Command	Purpose
`Router# show vpdn`	Displays information about active Level 2 Forwarding (L2F) Protocol tunnel and message identifiers in a VPDN.
`Router# show vpdn session`	Displays information about active Layer 2 Tunnel Protocol (L2TP) or Layer 2 Forwarding (L2F) sessions in a VPDN.
`Router# show vpdn session packet`	Displays PPPoE session statistics.
`Router# show vpdn session all`	Displays PPPoE session information for each session ID.
`Router# show vpdn tunnel`	Displays PPPoE session count for the tunnel.
`Router# show pppoe session all`	Displays PPPoE session information for each session ID.
`Router# show pppoe session packets`	Displays PPPoE session statistics.

Clearing PPPoE Sessions

To clear PPPoE sessions, enter the following commands in privileged EXEC mode:

Command	Purpose
`Router# clear pppoe all`	Clears all PPPoE sessions.
`Router# clear pppoe interface`	Clears all PPPoE sessions on a physical interface or subinterface.
`Router# clear pppoe rmac`	Clears PPPoE sessions from a client host MAC address.

TCP MSS Adjust

The TCP MSS Adjustment feature enables the configuration of the maximum packet segment size (MSS).

When a host (usually a PC) initiates a TCP session with a server, it negotiates the IP segment size by using the MSS option field in the TCP SYN packet. The value of the MSS field is determined by the maximum transmission unit (MTU) configuration on the host. The default MSS value for a PC is 1500 bytes.

The PPP over Ethernet (PPPoE) standard supports a MTU of only 1492 bytes. The disparity between the host and PPPoE MTU size can cause the router in between the host and the server to drop 1500-byte packets and terminate TCP sessions over the PPPoE network. Even if the path MTU (which detects the correct MTU across the path) is enabled on the host, sessions may be dropped because system administrators sometimes disable the ICMP error messages that must be relayed from the host in order for path MTU to work.

In most cases, the optimum value for the max-segment-size argument is 1452 bytes. This value plus the 20-byte IP header, the 20-byte TCP header, and the 8-byte PPPoE header add up to a 1500-byte packet that matches the MTU size for the Ethernet link.

Feature History for TCP MSS Adjust

Cisco IOS Release	Description	Required PRE
12.2(31)SB3	This feature was introduced on the Cisco 10000 series router.	PRE2 or PRE3

Information about TCP MSS Adjust

- This feature works for both PTA and LNS sessions.
- The MSS value is configured globally, so every packet transiting through the router are subject to a rewrite.
- The **per interface** command is only applicable to packets that get punted to the RP, so it is not recommended to use this command.

Restrictions for TCP MSS Adjust

- The TCP MSS Adjust feature only works if the **MaxSegSize** option is the first option included in the packet. If a non-typical TCP packet is received, where MaxSegSize is not the first option in the packet, the TCP MSS Adjust feature configuration will have no effect.

Configuration Task for TCP MSS Adjust

Perform this task to configure the maximum segment size (MSS) for transient packets that traverse the Cisco 10000 Series router, specifically TCP segments in the SYN bit and to configure the MTU size of IP packets.

SUMMARY STEPS

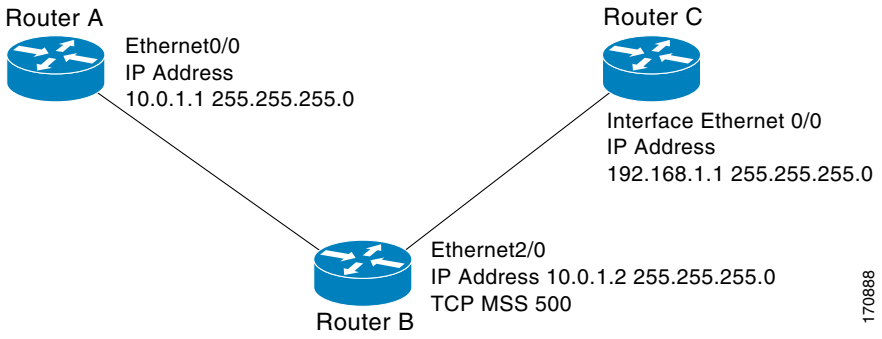
1. **enable**
2. **configure terminal**
3. **ip pxf adjust-mss** *max-segment-size*
4. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**ip pxf adjust-mss** *max-segment-size* **Example:** `Router(config)# ip pxf adjust-mss 1452`	Adjusts the MSS value of TCP SYN packets going through the Cisco 10000 Series router. The *max-segment-size* argument is the maximum segment size, in bytes. The range is from 500 to 1460.
Step 4	**end** **Example:** `Router(config-if)# end`	Exits to global configuration mode.

TCP MSS Adjustment Configuration: Examples

Figure 1 Example Topology for TCP MSS Adjustment



The following example shows how to configure and verify the adjustment value. Configure the interface adjustment value on router B:

```
Router_B(config)# ip pxf adjust-mss 500
```

Telnet from router A to router C, with B having the MSS adjustment configured.

```
Router_A# telnet 192.168.1.1
Trying 192.168.1.1... Open
```

Observe the debug output from router C:

```
Router_C# debug ip tcp transactions

Sep 5 18:42:46.247: TCP0: state was LISTEN -> SYNRCVD [23 -> 10.0.1.1(38437)]
Sep 5 18:42:46.247: TCP: tcb 32290C0 connection to 10.0.1.1:38437, peer MSS 500, MSS is
500
Sep 5 18:42:46.247: TCP: sending SYN, seq 580539401, ack 6015751
Sep 5 18:42:46.247: TCP0: Connection to 10.0.1.1:38437, advertising MSS 500
Sep 5 18:42:46.251: TCP0: state was SYNRCVD -> ESTAB [23 -> 10.0.1.1(38437)]
```

The MSS gets adjusted to 500 on Router_B as configured.

The following example shows the configuration of a PPPoE client with the MSS value set to 1452:

```
vpdn enable
no vpdn logging
!
vpdn-group 1
request-dialin
protocol pppoe
ip pxf adjust-mss 1452
!
interface Ethernet0
 ip address 192.168.100.1.255.255.255.0
 ip nat inside
!
interface ATM0
 no ip address
 no atm ilmi-keepalive
 pvc 8/35
 pppoe client dial-pool-number 1
!
dsl equipment-type CPE
dsl operating-mode GSHDSL symmetric annex B
dsl linerate AUTO
```

```
!
interface Dialer1
 ip address negotiated
 ip mtu 1492
 ip nat outside
 encapsulation ppp
 dialer pool 1
 dialer-group 1
 ppp authentication pap callin
 ppp pap sent-username sohodyn password 7 141B1309000528
!
ip nat inside source list 101 Dialer1 overload
ip route 0.0.0.0.0.0.0.0 Dialer1
access-list permit ip 192.168.100.0.0.0.0.255 any
```

VLAN Range

The VLAN range feature simplifies the configuration of VLAN subinterfaces. By using this feature, you can configure a group of VLAN subinterfaces at one time instead of configuring each subinterface separately. The commands you enter for a group of VLAN subinterfaces apply to each subinterface within the group and are applied to all existing VLANs.

By using the VLAN range feature, you can also configure overlapping ranges of subinterfaces and an individual subinterface within a range of subinterfaces.

The VLAN Range feature is described in the following topics:

Feature History for VLAN Range

Cisco IOS Release	Description	Required PRE
12.2(15)BX	This feature was introduced on the Cisco 10000 series router.	PRE2
12.3(7)XI1	This feature was integrated into Cisco IOS Release 12.3(7)XI1.	PRE2
12.2(28)SB	This feature was integrated into Cisco IOS Release 12.2(28)SB.	PRE2

Restrictions for VLAN Range

The VLAN range feature has the following restrictions:

- The commands you enter in interface range configuration mode (the mode you enter after issuing the **interface range** command) are executed as you enter them. The commands are not batched together for execution after you exit interface range mode. If you exit interface range configuration mode while the commands are being executed, some commands might not be executed on some interfaces in the range. Wait until the command prompt reappears before exiting interface range configuration mode.
- All configuration changes made to a range of subinterfaces are saved to NVRAM, but the range itself does not get saved to NVRAM. To create and save a range, enter the **define interface-range** global configuration command.
- Cisco IOS software does not support the **no interface range** command. To delete a range of subinterfaces, you must delete the individual subinterfaces.

Configuration Task for VLAN Range

To configure the VLAN range feature, perform the following required configuration task:

- Configuring a Range of VLAN Subinterfaces, page 6-16

Configuring a Range of VLAN Subinterfaces

To configure a range of VLAN subinterfaces, enter the following commands beginning in global configuration mode:

	Command	Purpose
Step 1	`Router(config)# interface range {{ethernet | fastethernet | gigabitethernet | atm} slot/interface.subinterface - {ethernet | fastethernet | gigabitethernet | atm} slot/interface.subinterface}`	Selects the range of subinterfaces to be configured. If you specify subinterfaces that have not been previously created, the **interface range** command creates the subinterfaces. Enters interface range configuration mode. **Note** The spaces around the dash are required. For example, the command **interface range fastethernet 1 - 5** is valid; the command **interface range fastethernet 1-5** is not valid.

	Command	Purpose
Step 2	`Router(config-int-range)# encapsulation dot1q` *vlan-id* [**native**]	Enables IEEE 802.1Q encapsulation of traffic and applies a unique VLAN ID to each subinterface within the range. The *vlan-id* argument is the virtual LAN identifier. You must enter a value from 1 to 4095. **Note** VLAN ID 0 is a valid ID, but is not a valid designation of a VLAN. VLAN ID 0 is used primarily to convey class of service (CoS) information on packets that would otherwise be untagged. (Optional) The **native** argument sets the VLAN ID value of the port to the *vlan-id* value. **Note** The VLAN ID is applied to the first subinterface in the range. Each subsequent interface is assigned a VLAN ID, which is the specified *vlan-id* plus the subinterface number, minus the first subinterface number: `VLAN ID + subinterface number - first subinterface number`

Configuration Examples for VLAN Range

Example 6-6 configures the Fast Ethernet subinterfaces with the range 5/1.1 to 5/1.4 and applies the following VLAN IDs to the subinterfaces:

- Fast Ethernet5/1.1 = VLAN ID 301 (*vlan-id*)
- Fast Ethernet5/1.2 = VLAN ID 302 (*vlan-id* = 301 + 2 - 1 = 302)
- Fast Ethernet5/1.3 = VLAN ID 303 (*vlan-id* = 301 + 3 - 1 = 303)
- Fast Ethernet5/1.4 = VLAN ID 304 (*vlan-id* = 301 + 4 - 1 = 304)

Example 6-6 Configuring a Range of VLAN Subinterfaces

```
Router(config)# interface range fastethernet5/1.1 - fastethernet5/1.4
Router(config-if-range)# encapsulation dot1q 301
Router(config-if-range)# no shutdown
```

Verifying the Configuration of a Range of Subinterfaces

To verify the configuration of a range of subinterfaces for VLAN encapsulation, enter the following commands in privilege EXEC mode:

Command	Purpose
`Router# show running-config`	Displays the current configuration, including information about the interfaces and subinterfaces configured on the router and the type of encapsulation configured for each interface.
`Router# show interface`	Displays information about all interfaces and subinterfaces configured on the router, including the type of encapsulation configured for each interface.
`Router# show interface` *interface-type slot*`/`*interface.subinterface*	Displays information about the interface or subinterface you specify, including the type of encapsulation configured.