Asynchronous Transfer Mode Configuration Guide, Cisco IOS XE 17 (Cisco ASR 900 Series)

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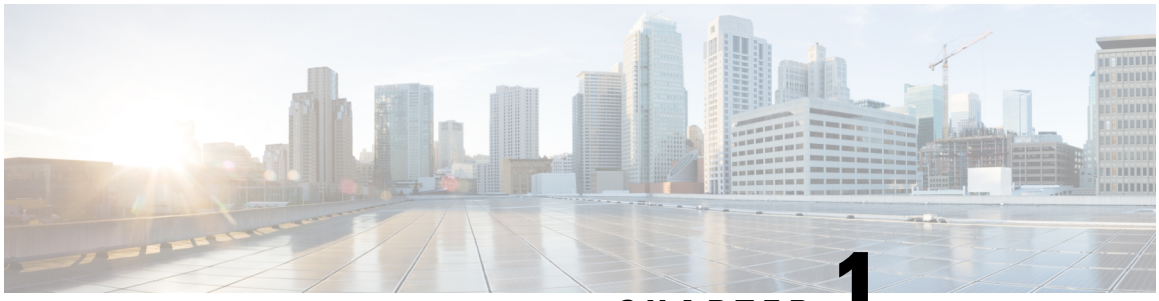

CHAPTER 1

Configuring ATM

Note ATM is *not* supported on the Cisco RSP3 module.

This chapter describes how to configure ATM on the Cisco ASR 903 Series Aggregation Services Routers. Effective Cisco IOS-XE Release 3.18, Clear Channel ATM is supported on Cisco ASR 900 RSP2 Module .

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Information About Configuring ATM Interface

ATM Interface

Asynchronous Transfer Mode (ATM) uses one Virtual Circuit (VC) to carry all traffic to the next hop address. Even with VC multiplexing, a single VC carries all traffic of the same protocol to the next hop address. Though Weighted Random Early Discard (Per-VC (D)WRED) and WFQ can classify and prioritize the packets, they all share one single Quality of Service (QoS) VC.

Note If you have configured ATM on any IM and and you perform a IM OIR, then the standby RSP is reloaded. This is applicable to RSP1 and RSP2 Modules.

Restrictions for Clear Channel ATM

- Operation, Administration, and Maintenance (OAM) is not supported.
- Access Circuit Redundancy (ACR) is not supported.
- Automatic Protection Switching (APS) is not supported.
- Optical Carrier level 12 (OC-12) mode is not supported.
- Clear Channel ATM is not supported for layer 3 on the routers.

Information About Clear Channel ATM

When the clear channel ATM feature is enabled, the entire payload rate over Synchronous Optical Network (SONET) or the Synchronous Digital Hierarchy (SDH) line is used as a single flow of cells or packets. An STS-3c/VC4 container is used to represent the OC-3/STM-1 concatenation types (OC-3 clear channels). Up to four OC-3/STM-1 are supported.

Clear channel ATM supports the following Layer 1 features:

- Framing configuration between SONET and SDH
- Local (diagnostic) and line (network) loopback
- Alarm detection and reporting capabilities
- System, local and line timing options

Effective Cisco IOS-XE Release 3.18, Clear Channel ATM on OC-3/STM-1 is supported on Cisco ASR 900 RSP2 Module .

Clear channel ATM Pseudowire supports the following Layer 2 features:

- Permanent Virtual Path (PVP)

  For configuration examples, see the "Configuring Pseudowire, Time Division Multiplexing Configuration Guide" chapter.

- QoS experimental bits (Exp) marking on ATM Layer 2 interfaces

  For configuration examples, see the "Configuring Pseudowire, Time Division Multiplexing Configuration Guide chapter.

How to Configure ATM

This section explains how to configure ATM on T1, E1, OC-3, and OC-12 interfaces.

Configuring ATM on a T1 or E1 Controller

To configure ATM on a T1 or E1 controller, follow these steps:

SUMMARY STEPS

1. **configure terminal**
2. **card type** {**t1** | **e1**} *slot subslot*
3. **controller t1** *slot*/*subslot*/*port*
4. **framing esf**
5. **linecode b8zs**
6. **cablelength long** *db-loss-value*
7. **atm**
8. **exit**
9. **interface atm** *slot*/*subslot*/*port*
10. **no ip address**
11. **no atm enable-ilmi-trap**
12. **interface atm** *slot*/*subslot*/*port.subinterface* **point-to-point**
13. **pvc** *vpi*/*vci* **l2transport**
14. **encapsulation aal5**
15. **xconnect** *peer-router-id vcid* **encapsulation mpls**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Router# configure terminal`	Enters the global configuration mode.
Step 2	**card type** {**t1** | **e1**} *slot subslot* **Example:** `Router(config)# card type t1 0 1`	Specifies the slot and subslot number of the T1 or E1 interface.
Step 3	**controller t1** *slot*/*subslot*/*port* **Example:** `Router(config)# controller t1 0/1/0`	Enters controller configuration mode to configure the T1 interface.
Step 4	**framing esf** **Example:** `Router(config-controller)# framing esf`	Selects the framing type as Extended Super Frame.
Step 5	**linecode b8zs** **Example:** `Router(config-controller)# linecode b8zs`	Selects the linecode type as binary 8-zero substitution (B8ZS).
Step 6	**cablelength long** *db-loss-value* **Example:** `Router(config-controller)# cablelength long 0db`	Number of decibels by which the transmit signal is decreased.

	Command or Action	Purpose
Step 7	**atm** **Example:** `Router(config-controller)# atm`	Configures the interface for ATM.
Step 8	**exit** **Example:** `Router(config-controller)# exit`	Enters global configuration mode.
Step 9	**interface atm** *slot/subslot/port* **Example:** `Router(config)# interface ATM 0/1/0`	Specifies the ATM interface.
Step 10	**no ip address** **Example:** `Router(config-if)# no ip address`	Removes the interface IP address.
Step 11	**no atm enable-ilmi-trap** **Example:** `Router(config-if)# atm enable-ilmi-trap`	Disables Integrated Local Management Interface traps.
Step 12	**interface atm** *slot/subslot/port.subinterface* **point-to-point** **Example:** `Router(config)# interface atm 0/1/1.1 point-to-point`	Enters subinterface configuration mode and creates a point-to-point subinterface.
Step 13	**pvc** *vpi/vci* **l2transport** **Example:** `Router(config-subif)# pvc 10/100 l2transport`	Assigns a VPI and virtual channel identifier (VCI).
Step 14	**encapsulation aal5** **Example:** `(cfg-if-atm-l2trans-pvc)# encapsulation aal5`	Sets the encapsulation type as aal5.
Step 15	**xconnect** *peer-router-id vcid* **encapsulation mpls** **Example:** `Router(cfg-if-atm-l2trans-pvc)# xconnect 10.1.2.3 1 encapsulation mpls`	Binds the attachment circuit to a pseudowire VC.

Configuring ATM on OC-3 IM with SDH Framing

To configure ATM on OC-3 interface module with SDH framing, perform these steps:

SUMMARY STEPS

1. **configure terminal**
2. **controller sonet** *slot/subslot/port*
3. **framing sdh**
4. **aug mapping au-4**
5. **au-4** *au-4-number* **tug-3** *tug-3-number*
6. **tug-2** *tug-2-number* **e1** *e1-line-number* **atm**
7. **interface ATM** *slot/subslot/port.au-4/tug-3/tug-2/e1.subint point-to-point*
8. **pvc** *vpi/vci* **l2transport**
9. **encapsulation aal5**
10. **xconnect** *remote-ip-address vc-id* **encapsulation mpls**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Router# configure terminal`	Enters the global configuration mode.
Step 2	**controller sonet** *slot/subslot/port* **Example:** `Router(config)#controller sonet 0/1/0`	Enters controller configuration mode to configure SDH.
Step 3	**framing sdh** **Example:** `Router(config-controller)#framing sdh`	Specifies the framing type as SDH.
Step 4	**aug mapping au-4** **Example:** `Router(config-controller)#aug mapping au-4`	Configures the AUG to be derived from AU-4.
Step 5	**au-4** *au-4-number* **tug-3** *tug-3-number* **Example:** `Router(config-controller)#au-4 1 tug-3 1`	Specifies the Administrative Unit type 4 (AU-4) and Tributary Unit group type 3 (TUG-3) numbers.
Step 6	**tug-2** *tug-2-number* **e1** *e1-line-number* **atm** **Example:** `Router(config-ctrlr-tug3)# tug-2 1 e1 1 atm`	Creates an ATM group for the AU-4.
Step 7	**interface ATM** *slot/subslot/port.au-4/tug-3/tug-2/e1.subint point-to-point* **Example:** `Router(config)# interface ATM 0/1/0.1/1/1/1.1 point-to-point`	Specifies the ATM interface as the point-to-point interface type.

	Command or Action	Purpose
Step 8	**pvc** *vpi*/*vci* **l2transport** **Example:** `Router(config-subif)#pvc 10/100 l2transport`	Assigns a VPI and virtual channel identifier (VCI).
Step 9	**encapsulation aal5** **Example:** `Router(cfg-if-atm-vc)#encapsulation aal5`	Sets the PVC encapsulation type to AAL5.
Step 10	**xconnect** *remote-ip-address vc-id* **encapsulation mpls** **Example:** `Router(cfg-if-atm-vc)#xconnect 10.1.1.101 100 encapsulation mpls`	Binds the attachment circuit to the ATM interface to create a pseudowire.

Configuring ATM on OC-3 IM with SONET Framing

To configure ATM on OC-3 interface module with SONET framing, perform these steps:

SUMMARY STEPS

1. **configure terminal**
2. **controller sonet** *slot*/*subslot*/*port*
3. **framing sonet**
4. **sts-1** { **1 - 12** | **1 - 3** | **4 - 6** | **7 - 9** | **10 - 12**}
5. **vtg** *vtg_number* **t1** *t1_line_number* **atm**
6. **interface ATM** *slot*/*subslot*/*port*.*sts-1*/*vtg*/*t1* **.** *subint* **.** *point-to-point*
7. **pvc** *vpi*/*vci* **l2transport**
8. **encapsulation aal5**
9. **xconnect** *remote-ip-address vc-id* **encapsulation mpls**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Router# configure terminal`	Enters the global configuration mode.
Step 2	**controller sonet** *slot*/*subslot*/*port* **Example:** `Router(config)#controller sonet 0/1/0`	Enters controller configuration mode to configure SONET.
Step 3	**framing sonet** **Example:** `Router(config-controller)# framing sonet`	Specifies the framing type as SONET.

	Command or Action	Purpose
Step 4	**sts-1** { **1 - 12** | **1 - 3** | **4 - 6** | **7 - 9** | **10 - 12**} **Example:** `Router(config-controller)# sts-1 1`	Configures the Synchronous Transport Signal (STS) (level)-1 in the SONET hierarchy. For OC-3 interfaces, this value is 1. **Note** The **1-12** value is supported only in OC-12 mode.
Step 5	**vtg** *vtg_number* **t1** *t1_line_number* **atm** **Example:** `Router(config-ctrlr-sts)# vtg 1 t1 1 atm`	Configures the T1 on the VTG . For SONET framing, values are 1 to 7
Step 6	**interface ATM** *slot/subslot/port.sts-1/vtg/t1.subint* **.** *point-to-point* **Example:** `Router(config)# interface ATM 0/1/0.1/1/1.1 point-to-point`	Specifies the ATM interface as the point-to-point interface type.
Step 7	**pvc** *vpi/vci* **l2transport** **Example:** `Router(config-subif)#pvc 10/100 l2transport`	Assigns a VPI and virtual channel identifier (VCI).
Step 8	**encapsulation aal5** **Example:** `Router(cfg-if-atm-vc)#encapsulation aal5`	Sets the PVC encapsulation type to AAL5.
Step 9	**xconnect** *remote-ip-address vc-id* **encapsulation mpls** **Example:** `Router(cfg-if-atm-vc)#xconnect 10.1.1.101 100 encapsulation mpls`	Binds the attachment circuit to the ATM interface to create a pseudowire.

Enabling Configuring the ATM Interface on OC-3 IM

This section describes how to configure an ATM interface.

Perform the following task to enable the ATM interface:

SUMMARY STEPS

1. **configure terminal**
2. **interface atm** *slot/subslot/port.subport*
3. **no shutdown**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal**	Enters global configuration mode from the terminal.

	Command or Action	Purpose
Step 2	**interface atm** *slot/subslot/port.subport* **Example:** `interface atm 0/5/0.1/1/1.1`	Specifies the ATM interface using the appropriate format of the **interface atm** command.
Step 3	**no shutdown**	Changes the shutdown state to up and enables the ATM interface, thereby beginning the segmentation and reassembly (SAR) operation on the interface. • The **no shutdown** command passes an **enable** command to the ATM interface, which then begins segmentation and reassembly (SAR) operations. It also causes the ATM interface to configure itself based on the previous configuration commands sent.

Configuring ATM Interface on TDM IMs

To configure ATM interface on TDM IMs, follow these steps:

SUMMARY STEPS

1. **configure terminal**
2. **card type** {**t1** | **e1**} *slot subslot*
3. **controller t1** *slot/subslot/port*
4. **atm**
5. **exit**
6. **interface atm** *slot/subslot/port.subinterface* **point-to-point**
7. **pvc** *vpi/vci* **l2transport**
8. **encapsulation aal5**
9. **xconnect** *peer-router-id vcid* **encapsulation mpls**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Router# configure terminal`	Enters the global configuration mode.
Step 2	**card type** {**t1**	**e1**} *slot subslot* **Example:** `Router(config)# card type t1 0 1`	Specifies the slot and subslot number of the T1 or E1 interface.
Step 3	**controller t1** *slot/subslot/port* **Example:** `Router(config)# controller t1 0/1/0`	Enters controller configuration mode to configure the T1 interface.

	Command or Action	Purpose
Step 4	**atm** **Example:** `Router(config-controller)# atm`	Configures the interface for ATM.
Step 5	**exit** **Example:** `Router(config-controller)# exit`	Enters global configuration mode.
Step 6	**interface atm** *slot/subslot/port.subinterface* **point-to-point** **Example:** `Router(config)# interface atm 0/1/1.1 point-to-point`	Enters subinterface configuration mode and creates a point-to-point subinterface.
Step 7	**pvc** *vpi/vci* **l2transport** **Example:** `Router(config-subif)# pvc 10/100 l2transport`	Assigns a VPI and virtual channel identifier (VCI).
Step 8	**encapsulation aal5** **Example:** `(cfg-if-atm-l2trans-pvc)# encapsulation aal5`	Sets the encapsulation type as aal5.
Step 9	**xconnect** *peer-router-id vcid* **encapsulation mpls** **Example:** `Router(cfg-if-atm-l2trans-pvc)# xconnect 10.1.2.3 1 encapsulation mpls`	Binds the attachment circuit to a pseudowire VC.

Configuring PVCs

To use a permanent virtual circuit (PVC), you must configure the PVC into both the router and the ATM switch. PVCs remain active until the circuit is removed from either configuration.

When a PVC is configured, all the configuration options are passed on to the ATM interface. These PVCs are writable into the nonvolatile RAM (NVRAM) as part of the Route Processor (RP) configuration and are used when the RP image is reloaded.

Some ATM switches might have point-to-multipoint PVCs that do the equivalent of broadcasting. If a point-to-multipoint PVC exists, then that PVC can be used as the sole broadcast PVC for all multicast requests.

To configure a PVC, perform the tasks in the following sections.

Creating a Permanent Virtual Circuit

To use a permanent virtual circuit (PVC), configure the PVC in both the router and the ATM switch. PVCs remain active until the circuit is removed from either configuration. To create a PVC on the ATM interface and enter interface ATM VC configuration mode, perform the following procedure beginning in global configuration mode:

SUMMARY STEPS

1. Device(config)# **interface atm** *slot/subslot/port* [**.***subinterface-number* {**multipoint** | **point-to-point**}]
2. Device(config-if)# **pvc** [*name*] *vpi /vci*
3. Device(config-if-atm-vc)# **protocol** *protocol* {*protocol-address* | **inarp**} [[**no**] **broadcast**]
4. Device(config-if-atm-vc)# **inarp** *minutes*
5. Device(config-if-atm-vc)# **encapsulation** {**aal5snap**}
6. Device(config-if-atm-vc)# **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	Device(config)# **interface atm** *slot/subslot/port* [**.***subinterface-number* {**multipoint** | **point-to-point**}]	Enters subinterface configuration mode for the specified port on the ATM Interface Module (IM), where: • *slot*—Specifies the chassis slot number in the Cisco ASR 903 Series Router where the SIP is installed. • *subslot*—Specifies the secondary slot of the SIP where the IM is installed. • *port*—Specifies the number of the individual interface port on an IM. • *subinterface*—Specifies the number of the subinterface.
Step 2	Device(config-if)# **pvc** [*name*] *vpi /vci*	Configures a new ATM PVC by assigning its VPI/VCI numbers and enters ATM VC configuration mode. The valid values for *vpi /vci* are: • *name*—(Optional) An arbitrary string that identifies this PVC. • *vpi*—Specifies the VPI ID. The valid range is 0 to 255. • *vci*—Specifies the VCI ID. The valid range is 32 to 65535. Values 1 to 31 are reserved and should not be used, except for 5 for the QSAAL PVC and 16 for the ILMI PVC. ILMI is not supported on the Cisco ASR 903 Series Routers. **Note** When using the **pvc** command, remember that the *vpi /vci* combination forms a unique identifier for the interface and all of its subinterfaces. If you specify a *vpi /vci* combination that has been used on another subinterface, the Cisco IOS software assumes that you want to modify that PVC's configuration and automatically switches to its parent subinterface.
Step 3	Device(config-if-atm-vc)# **protocol** *protocol* {*protocol-address* | **inarp**} [[**no**] **broadcast**]	Configures the PVC for a particular protocol and maps it to a specific *protocol-address*

	Command or Action	Purpose
	Example:	. • *protocol*—Typically set to **ip**or **pppoe**, but other values are possible. **Note** PPP is not supported on the Cisco ASR 903 Series Routers. • *protocol-address*—Destination address or virtual interface template for this PVC (if appropriate for the *protocol*). • **inarp** —Specifies that the PVC uses Inverse ARP to determine its address. • [**no**] **broadcast**—(Optional) Specifies that this mapping should (or should not) be used for broadcast packets.
Step 4	Device(config-if-atm-vc)# **inarp** *minutes*	(Optional) If using Inverse ARP, configures how often the PVC transmits Inverse ARP requests to confirm its address mapping. The valid range is 1 to 60 minutes, with a default of 15 minutes.
Step 5	Device(config-if-atm-vc)# **encapsulation** {**aal5snap**}	(Optional) Configures the ATM adaptation layer (AAL) and encapsulation type.
Step 6	Device(config-if-atm-vc)# **end**	Exits ATM VC configuration mode and returns to privileged EXEC mode.

Verifying a Multipoint PVC Configuration

To verify the configuration of a particular PVC, use the **show atm pvc** command:

```
Device# show atm pvc 1/120

ATM3/1/0.120: VCD: 1, VPI: 1, VCI: 120
UBR, PeakRate: 149760
AAL5-LLC/SNAP, etype:0x0, Flags: 0xC20, VCmode: 0x0
OAM frequency: 0 second(s), OAM retry frequency: 1 second(s)
OAM up retry count: 3, OAM down retry count: 5
OAM Loopback status: OAM Disabled
OAM VC status: Not Managed
ILMI VC status: Not Managed
InARP frequency: 15 minutes(s)
Transmit priority 3
InPkts: 1394964, OutPkts: 1395069, InBytes: 1833119, OutBytes: 1838799
InPRoc: 1, OutPRoc: 1, Broadcasts: 0
InFast: 0, OutFast: 0, InAS: 94964, OutAS: 95062
InPktDrops: 0,  OutPktDrops: 0
CrcErrors: 0, SarTimeOuts: 0, OverSizedSDUs: 0, LengthViolation: 0, CPIErrors: 0
Out CLP=1 Pkts: 0
OAM cells received: 0
F5 InEndloop: 0, F5 InSegloop: 0, F5 InAIS: 0, F5 InRDI: 0
F4 InEndloop: 0, F4 InSegloop: 0, F4 InAIS: 0, F4 InRDI: 0
```

```
OAM cells sent: 0
F5 OutEndloop: 0, F5 OutSegloop: 0, F5 OutRDI: 0
F4 OutEndloop: 0, F4 OutSegloop: 0, F4 OutRDI: 0
OAM cell drops: 0
Status: UP
```

Note To verify the configuration and current status of all PVCs on a particular interface, you can also use the **show atm vc interface** command.

Mapping a Protocol Address to a PVC

The ATM interface supports a static mapping scheme that identifies the network address of remote hosts or routers. This section describes how to map a PVC to an address, which is a required task for configuring a PVC.

Note If you enable or disable broadcasting directly on a PVC using the **protocol** command, this configuration will take precedence over any direct configuration using the **broadcast** command.

See examples of PVC configurations in the section "ATM Configuration Examples, on page 20".

To map a protocol address to a PVC, use the following command in interface-ATM-VC configuration mode:

Command	Purpose
`Router(config-if-atm-vc)# protocol protocol protocol-address [[no] broadcast]`	Maps a protocol address to a PVC.

Configuring the AAL and Encapsulation Type

To configure the ATM adaptation layer (AAL) and encapsulation type, use the following command beginning in interface-ATM-VC configuration mode:

Command	Purpose
`Router(config-if-atm-vc)# encapsulation aal5 encap`	Configures the ATM adaptation layer (AAL) and encapsulation type. • For a list of AAL types and encapsulations supported for the *aal-encap* argument, refer to the **encapsulation aal5** command in the "ATM Commands" chapter of the *Cisco IOS Wide-Area Networking Command Reference*. The global default is AAL5 with SNAP encapsulation.

Configuring PVC Traffic Parameters

The supported traffic parameters are part of the following service categories: Constant Bit Rate (CBR), Unspecified Bit Rate (UBR), Variable Bit Rate Non Real-Time (VBR-NRT), and real-time Variable Bit Rate (VBR). Only one of these categories can be specified per PVC connection so if a new one is entered, it will replace the existing one.

The *-pcr* and *-mcr* arguments are the peak cell rate and minimum cell rate, respectively. The *-scr* and *-mbs* arguments are the sustainable cell rate and maximum burst size, respectively.

To configure PVC traffic parameters, use one of the following commands beginning in interface-ATM-VC configuration mode:

Command	Purpose
`Router(config-if-atm-vc)# cbr peak_cell_rate_KBPS`	Configures the Constant Bit Rate (CBR).
`Router(config-if-atm-vc)# ubr output-pcr`	Configures the Unspecified Bit Rate (UBR).
`Router(config-if-atm-vc)# vbr-nrt output-pcr output-scr output-mbs`	Configures the Variable Bit Rate-Non Real Time (VBR-NRT) QOS.
`Router(config-if-atm-vc)# vbr-rt peak-rate average-rate burst`	Configures the real-time Variable Bit Rate (VBR). (Cisco MC3810 and Multiport T1/E1 ATM Network Module only.)

Enabling Inverse ARP

Inverse ARP is enabled by default when you create a PVC using the **pvc** command. Once configured, a protocol mapping between an ATM PVC and a network address is learned dynamically as a result of the exchange of ATM Inverse ARP packets.

Inverse ARP is supported on PVCs running IP or IPX and no static map is configured. If a static map is configured, Inverse ARP will be disabled.

When PVC discovery is enabled on an active PVC and the router terminates that PVC, the PVC will generate an ATM Inverse ARP request. This allows the PVC to resolve its own network addresses without configuring a static map.

Address mappings learned through Inverse ARP are aged out. However, mappings are refreshed periodically. This period is configurable using the **inarp** command, which has a default of 15 minutes.

You can also enable Inverse ARP using the **protocol** command. This is necessary only if you disabled Inverse ARP using the **no protocol** command. For more information about this command, refer to the "ATM Commands" chapter in the *Cisco IOS Asynchronous Transfer Mode Command Reference*.

For an example of configuring Inverse ARP, see the section "*Example Enabling Inverse ARP* at the end of this chapter.

To enable Inverse ARP on an ATM PVC, use the following commands beginning in global configuration mode:

SUMMARY STEPS

1. **interface atm** *slot/subslot/port.subinterface* {**multipoint** | **point-to-point**}
2. **pvc** [*name*] *vpi* / *vci*
3. **encapsulation aal5snap**
4. **inarp** *minutes*

DETAILED STEPS

	Command or Action	Purpose
Step 1	**interface atm** *slot/subslot/port.subinterface* {**multipoint** | **point-to-point**} **Example:** `Router(config)# interface atm 0/5/0.1/1/1/1.1 {multipoint | point-to-point}`	Specifies the ATM interface using the appropriate format of the **interface atm** command.[1]
Step 2	**pvc** [*name*] *vpi* / *vci*	Specifies an ATM PVC by name (optional) and VPI/VCI numbers.
Step 3	**encapsulation aal5snap**	Configures AAL5 LLC-SNAP encapsulation if it is not already configured.
Step 4	**inarp** *minutes*	(Optional) Adjusts the Inverse ARP time period.

Configuring Broadcast on a PVC

To send duplicate broadcast packets for all protocols configured on a PVC, use the following command in interface-ATM-VC configuration mode:

Note If you enable or disable broadcasting directly on a PVC using the **protocol** command, this configuration will take precedence over any direct configuration using the **broadcast** command.

Command	Purpose
`Router(config-if-atm-vc)# broadcast`	Sends duplicate broadcast packets for all protocols configured on a PVC.

Configuring a PVC on a Multipoint Subinterface

Creating a multipoint subinterface allows you to create a point-to-multipoint PVC that can be used as a broadcast PVC for all multicast requests. To create a PVC on a multipoint subinterface, use the following procedure beginning in global configuration mode:

SUMMARY STEPS

1. Router(config)# **interface atm** *slot/subslot/port.subinterface* **multipoint**
2. Router(config-subif)# **ip address** *address mask*
3. Router(config-subif)# **no ip directed-broadcast**
4. Router(config-subif)# **pvc** [*name*] *vpi* /*vci*
5. Router(config-if-atm-vc)# **protocol** *protocol* {*protocol-address* | **inarp**} **broadcast**
6. Router(config-if-atm-vc)# **inarp** *minutes*
7. Router(config-if-atm-vc)# **encapsulation**{**aal5snap**}
8. Router(config-if-atm-vc)# **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	Router(config)# **interface atm** *slot/subslot/port.subinterface* **multipoint**	Creates the specified point-to-multipoint subinterface on the given port on the specified ATM SPA, and enters subinterface configuration mode, where: • *slot* —Specifies the chassis slot number where the SIP is installed. • *subslot* —Specifies the secondary slot of the SIP where the SPA is installed. • *port* —Specifies the number of the individual interface port on a SPA. • *subinterface* —Specifies the number of the subinterface.
Step 2	Router(config-subif)# **ip address** *address mask*	Assigns the specified IP address and subnet mask to this subinterface.
Step 3	Router(config-subif)# **no ip directed-broadcast**	(Optional) Disables the forwarding of IP directed broadcasts, which are sometimes used in denial of service (DOS) attacks.
Step 4	Router(config-subif)# **pvc** [*name*] *vpi* /*vci*	Configures a new ATM PVC by assigning its VPI/VCI numbers and enters ATM VC configuration mode. The valid values for *vpi* /*vci* are: • *name* —(Optional) An arbitrary string that identifies this PVC. • *vpi* —Specifies the VPI ID. The valid range is 0 to 255. • *vci* —Specifies the VCI ID. The valid range is 32 to 65535. Values 1 to 31 are reserved and should not be used, except for 5 for the QSAAL PVC and 16 for the ILMI PVC. ILMI is not supported on the Cisco ASR 903 Series Routers. **Note** When using the **pvc** command, remember that the *vpi* /*vci* combination forms a unique identifier for the interface and all of its subinterfaces. If you specify a *vpi* /*vci* combination that has been used on another subinterface, the Cisco IOS XE software assumes that you want to modify that PVC's configuration and automatically switches to its parent subinterface.
Step 5	Router(config-if-atm-vc)# **protocol** *protocol* {*protocol-address* | **inarp**} **broadcast**	Configures the PVC for a particular protocol and maps it to a specific *protocol-address* .

	Command or Action	Purpose
		• *protocol* —Typically set to **ip**or **pppoe**, but other values are possible. **Note** PPP is not supported on the Cisco ASR 903 Series Routers • *protocol-address* —Destination address or virtual template interface for this PVC (if appropriate for the *protocol*). • **inarp** —Specifies that the PVC uses Inverse ARP to determine its address. • **broadcast** — Specifies that this mapping should be used for multicast packets.
Step 6	Router(config-if-atm-vc)# **inarp** *minutes*	(Optional) If using Inverse ARP, configures how often the PVC transmits Inverse ARP requests to confirm its address mapping. The valid range is 1 to 60 minutes, with a default of 15 minutes.
Step 7	Router(config-if-atm-vc)# **encapsulation**{**aal5snap**}	(Optional) Configures the ATM adaptation layer (AAL) and encapsulation type. **Note** Repeat Step 1 through Step 7 for each multipoint subinterface to be configured on this ATM SPA.
Step 8	Router(config-if-atm-vc)# **end**	Exits interface configuration mode and returns to privileged EXEC mode.

Customizing the ATM Interface

You can customize the ATM interface. The features you can customize have default values that will most likely suit your environment and probably need not be changed. However, you might need to enter configuration commands, depending upon the requirements for your system configuration and the protocols you plan to route on the interface.

Configuring MTU Size

Each interface has a default maximum packet size or maximum transmission unit (MTU) size. For ATM interfaces, this number defaults to 4470 bytes.

To set the maximum MTU size, use the following command in interface configuration mode:

Command	Purpose
`Router(config-subif)# mtu bytes`	Sets the maximum MTU size on the subinterface. **Note** The MTU size can be changed for an ATM Layer 3 subinterface only.

How to Configure Clear Channel ATM

This section explains how to configure clear channel ATM on an OC-3 IM.

Configuring Clear Channel ATM on OC-3 IM with SONET Framing

To configure ATM on an OC-3 IM with SONET framing, perform these steps:

SUMMARY STEPS

1. **configure terminal**
2. **controller sonet** *slot/subslot/port*
3. **framing sonet**
4. **sts-1** *sts-identifier* **atm**
5. **interface ATM** *slot/subslot/port*:*sts-1-num*
6. **pvc** *vpi/vci* **l2transport**
7. **encapsulation aal5**
8. **xconnect** *remote-ip-address vc-id* **encapsulation mpls**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 2	**controller sonet** *slot/subslot/port* **Example:** `Router(config)#controller sonet 0/1/0`	Enters controller configuration mode to configure SONET. • *slot/subslot/port*—Specifies the location of the controller. For OC-3, valid ports are from 0 to 3.
Step 3	**framing sonet** **Example:** `Router(config-controller)# framing sonet`	Specifies the framing type as SONET.
Step 4	**sts-1** *sts-identifier* **atm** **Example:** `Router(config-controller)# sts-1 1 - 3 atm`	Configures Synchronous Transport Signal (STS) (level)-1 in the SONET hierarchy. • **sts-1**— Specifies the SONET STS level. • *sts-identifier*—For OC-3, valid *sts-identifier* is from 1 to 3. • **atm**—Specifies clear channel ATM mode for STS.

	Command or Action	Purpose

Step 5	**interface ATM** *slot/subslot/port*:*sts-1-num*
	Example:
	(for main interface)
	`Router(config-controller)# interface ATM 0/1/0:1`
	(for sub-interface)
	`Router(config-controller)# interface ATM 0/1/0:1.1 point-to-point`
		Enters clear channel ATM mode.
		• *slot/subslot/port:sts-1-num*—Specifies the location of the clear channel ATM.

Step 6	**pvc** *vpi/vci* **l2transport** **Example:** `Router(config-subif)#pvc 10/100 l2transport`	Assigns a virtual path identifier (VPI) and virtual channel identifier (VCI). • *vpi/vci*—Specifies VPI and VCI. • **l2transport**—Specifies that the PVC is a switched PVC instead of a terminated PVC.
Step 7	**encapsulation aal5** **Example:** `Router(cfg-if-atm-l2trans-pvc)#encapsulation aal5`	Sets the PVC encapsulation type to AAL5.
Step 8	**xconnect** *remote-ip-address vc-id* **encapsulation mpls** **Example:** `Router(cfg-if-atm-l2trans-pvc)#xconnect 10.1.1.101 100 encapsulation mpls`	Binds the attachment circuit to the ATM interface to create a pseudowire.

Configuring Clear Channel ATM in OC-3 Mode with SDH Framing

To configure clear channel ATM in OC-3 mode with SDH framing, perform these steps:

SUMMARY STEPS

1. **configure terminal**
2. **controller sonet** *slot/subslot/port*
3. **framing sdh**
4. **aug mapping au-4**
5. **au-4** *au-4-number* **atm**
6. **interface ATM** *slot/subslot/port:au-4-num* **.** *subint point-to-point*
7. **pvc** *vpi/vci* **l2transport**
8. **encapsulation aal5**
9. **xconnect** *remote-ip-address vc-id* **encapsulation mpls**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 2	**controller sonet** *slot/subslot/port* **Example:** `Router(config)#controller sonet 0/1/0`	Enters controller configuration mode to configure SDH. • *slot/subslot/port*—Specifies the location of the controller. For OC-3, valid ports are from 0 to 3.
Step 3	**framing sdh** **Example:** `Router(config-controller)#framing sdh`	Specifies the framing type as SDH.
Step 4	**aug mapping au-4** **Example:** `Router(config-controller)#aug mapping au-4`	Configures the AUG to be derived from AU-4.
Step 5	**au-4** *au-4-number* **atm** **Example:** `Router(config-controller)#au-4 1 atm`	Specifies the Administrative Unit type 4 (AU-4) numbers and enters clear channel ATM mode.
Step 6	**interface ATM** *slot/subslot/port:au-4-num.subint point-to-point* **Example:** `Router(config-controller)# interface ATM ATM0/1/0:1.1 point-to-point`	Specifies the ATM interface as the point-to-point interface type.
Step 7	**pvc** *vpi/vci* **l2transport** **Example:** `Router(config-subif)#pvc 10/100 l2transport`	Assigns a virtual path identifier (VPI) and virtual channel identifier (VCI). • *vpi/vci*—Specifies VPI and VCI. • **l2transport**—Specifies that the PVC is a switched PVC instead of a terminated PVC.
Step 8	**encapsulation aal5** **Example:** `Router(cfg-if-atm-l2trans-pvc)#encapsulation aal5`	Sets the PVC encapsulation type to AAL5.
Step 9	**xconnect** *remote-ip-address vc-id* **encapsulation mpls** **Example:** `Router(cfg-if-atm-l2trans-pvc)#xconnect 10.1.1.101 100 encapsulation mpls`	Binds the attachment circuit to the ATM interface to create a pseudowire.

ATM Configuration Examples

The examples in the following sections illustrate how to configure ATM for the features described in this chapter. The examples below are presented in the same order as the corresponding configuration task sections:

Example: Configuring Supported ATM Interface Types

The following example shows how to configure main ATM interface:

```
enable
configure terminal
 interface atm 0/0/0
 no shutdown
```

Example Creating a PVC

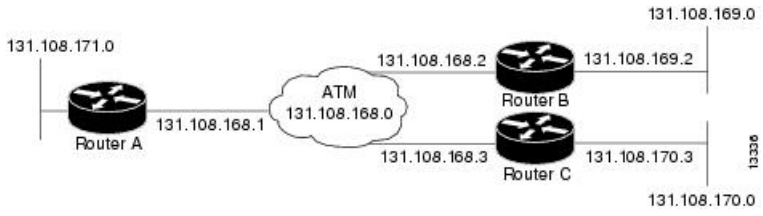
The following example shows how to create a PVC on an ATM main interface with AAL5 encapsulation configured and a VBR-NRT QOS specified.

```
interface 0/5/0.1/1/1/1 point-to-point
 pvc 1/40
 encapsulation aal5
 vbr-nrt 1000 500 50
 exit
```

PVCs in a Fully Meshed Network Example

The figure below illustrates a fully meshed network. The configurations for routers A, B, and C follow the figure. In this example, the routers are configured to use PVCs. Fully meshed indicates that any workstation can communicate with any other workstation. Note that the two **protocol** statements configured in router A identify the ATM addresses of routers B and C. The two **protocol**statements in router B identify the ATM addresses of routers A and C. The two **protocol** statements in router C identify the ATM addresses of routers A and B. For further information, refer to the sections “Creating a PVC” and “Mapping a Protocol Address to a PVC”.

Figure 1: Fully Meshed ATM Configuration Example



Router A

```
ip routing
!
interface atm 0/5/0.1/1/1/1
```

```
 ip address 131.108.168.1 255.255.255.0
 pvc 0/32
 protocol ip 131.108.168.2 broadcast
 exit
!
 pvc 0/33
 protocol ip 131.108.168.3 broadcast
 exit
```

Router B

```
ip routing
!
interface atm 0/5/0.1/1/1/1.1
 ip address 131.108.168.2 255.255.255.0
 pvc 0/32
 protocol ip 131.108.168.1 broadcast
 exit
!
 pvc 0/34
 protocol ip 131.108.168.3 broadcast
 exit
```

Router C

```
ip routing
!
interface atm 0/5/0.1/1/1/1.1
 ip address 131.108.168.3 255.255.255.0
 pvc 0/33
 protocol ip 131.108.168.1 broadcast
 exit
!
 pvc 0/34
 protocol ip 131.108.168.2 broadcast
 exit
```

Enabling Inverse ARP Example

The following example shows how to enable Inverse ARP on an ATM interface and specifies an Inverse ARP time period of 10 minutes.

```
interface atm 2/0/0.1
 pvc 1/32
 inarp 10
 exit
```

PVC on a Point-to-Point Subinterface Configuration Example

```
interface ATM 0/0/0.9 point-to-point
mtu 4470
bandwidth 34000
ip vrf forwarding vrfexample
ip address 192.0.2.1 255.255.255.0
ip mtu 4470
pvc 11/105
ubr 38
```

```
oam-pvc manage
encapsulation aal5snap
!
interface ATM 0/0/0.11 point-to-point
mtu 4470
bandwidth 7000
ip address 192.0.2.2 255.255.255.0
ip mtu 4470
pvc 100/50
cbr 7000
encapsulation aal5snap
max-reserved-bandwidth 100
```

Monitoring and Maintaining the ATM Interface

After configuring an ATM interface, you can display its status. You can also display the current state of the ATM network and connected virtual circuits. To show current virtual circuits and traffic information, use the following commands in EXEC mode:

Command	Purpose
Router# **show arp**	Displays entries in the ARP table.
Router# **show atm class-links** {*vpi* **/** *vci* | *name*}	Displays PVC parameter configurations and where the parameter values are inherited from.
Router# **show atm interface atm** *slot* **/0** Router# **show atm interface atm** *slot* **/** *port-adapter* **/0** Router# **show atm interface atm** *number*	Displays ATM-specific information about the ATM interface using the appropriate format of the **show atm interface atm** command.[2]
Router# **show atm map**	Displays the list of all configured ATM static maps to remote hosts on an ATM network.
Router# **show atm pvc** [*vpi* **/** *vci* | *name* | **interface atm** *interface_number*]	Displays all active ATM PVCs and traffic information.
Router# **show atm traffic**	Displays global traffic information to and from all ATM networks connected to the router and a list of counters of all ATM traffic on this router.

Command	Purpose
`Router# show atm vc [vcd-number | [range lower-limit-vcd upper-limit-vcd] [interface ATM interface-number] [detail [prefix {vpi/vci | vcd | interface | vc_name}]] [connection-name] | signalling [freed-svcs | [cast-type {p2mp | p2p}] [detail] [interface ATM interface-number]] | summary ATM interface-number]`	Displays all active ATM virtual circuits (PVCs) and traffic information. **Note** The SVCs and the **signalling** keyword are not supported on the Cisco ASR 903 series routers.
`Router# show interfaces atm controller.port-channels.subinterface`	Displays statistics for the ATM interface using the appropriate format of the **show interfaces atm** command.
`Router# show network-clocks synchronization`	Displays the clock signal sources and priorities that you established on the router.

[2] To determine the correct form of the interface atm command, consult your ATM network module, port adapter, or router documentation.

Additional References

Related Documents

Related Topic	Document Title
ATM commands	*Cisco IOS Asynchronous Transfer Mode Command Reference*

Standards

Standard	Title
No new or modified standards are supported by this feature, and support for existing standards has not been modified by this feature.	--

MIBs

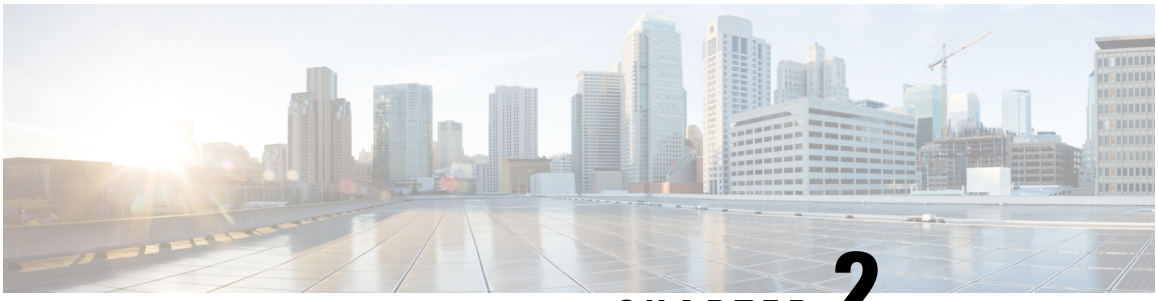
MIB	MIBs Link
• Cisco PVC trap MIB - CISCO-IETF-ATM2-PVCTRAP-MIB	To locate and download MIBs for selected platforms, Cisco IOS XE software releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

RFCs

RFC	Title
No new or modified RFCs are supported by this feature, and support for existing RFCs has not been modified by this feature.	--

Technical Assistance

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



CHAPTER 2

Information About AAL5 L3 Termination

Table 1: Feature History

Feature Name	Release Information	Description
AAL5 Layer 3 termination on OC-12 Interface Module	Cisco IOS XE Cupertino 17.7.1	Supports AAL5 Layer 3 termination on OC-12 interface of the A900-IMA40S interface module: You can configure Layer 2 QoS and protocol IP broadcast on OC-12 ATM Layer 3 interface. With the OC-12 support, you can use full bandwidth on one port. This enables you to create up to 252 connections on port 0.

When ATM feature is enabled, IMs can be deployed for ATM service that delivers high-performance interconnectivity, metro, and intra-point of presence (POP) applications between service POPs for IP/Multiprotocol Label Switching (IP/MPLS) transport (Figure 1).

AAL5 L3 termination can also be deployed at customer premises equipment (CPE) to provide the data component for the service provider networks. The ATM service allows service providers to effectively manage the bandwidth at the edges of the network while implementing value-added Layer 3 service.

Starting with Cisco IOS XE Cupertino 17.7.1, on RSP2 module, you can configure AAL5 L3 termination on the OC-12 interface for A900-IMA40S interface module.

Restrictions for AAL5 L3 Termination

- Main interface cannot be configured as layer 3 Asynchronous Transfer Mode (ATM) interface. Therefore you cannot create layer 3 Permanent Virtual Circuits (PVC) under main interface.
- Point-to-multipoint sub-interface is *not* supported.
- Quadrature Amplitude Modulation (QAM) is *not* supported on ATM L3 Interface.
- Operations, administration, and maintenance (OAM) is *not* supported on ATM L3 interface.
- You *cannot* swap from layer 2 transport ATM to layer 3 ATM interface without deleting ATM sub-interface.
- ATM layer 3 Permanent Virtual Path (PVP) is *not* supported.
- Inverse Multiplexing for ATM is *not* supported.
- ATM adaptation layer 5 Subnetwork Access Protocol SNAP (AAL5SNAP) protocol is supported. AAL0 is *not* supported.
- ATM L3 QoS is *not* supported.
- One port of an interface module (IM) supports only one interface configuration. For example, one OC-3 port can support one of the following configurations and not a combination of configurations:
  - CEM (CESoP or SAToP)
  - ATM
  - IMA
  - DS3

  Different interface configurations can be configured on different ports of the same IM.
- Half-duplex VRF is *not* supported on this router.

Scale Supported for AAL5 L3 Termination

- IMs:
  - A900-IMA16D: The 16 port T1/E1 card supports a maximum of 350 virtual circuits (VCs per port and on the T1/E1).
  - A900-IMA40S: Only 900 VCs can be configured per OC3 IM. 500 VCs are supported in per port on the OC-3 IM.
- Up to 4000 layer 3 interfaces, including Serial interfaces, can be configured.

How to Configure AAL5 L3 Termination

Configuring Layer 3 Terminated VCs

A VC is a point-to-point connection between two ATM devices. A VC is established for each ATM end node with which the router communicates. The characteristics of the VC are established when it is created and include the following for the time-division multiplexing (TDM) IMs:

- AAL mode

- Encapsulation type logical link controller (LLC)/SNAP

PVCs configured on the router remain active until the circuit is removed from the configuration. All virtual circuit characteristics apply to PVCs. When a PVC is configured, all configuration options are passed to the TDM IMs. These PVCs are written to the nonvolatile RAM (NVRAM) as part of the configuration and are used when the Cisco IOS image is reloaded.

When you create a PVC, you create a virtual circuit descriptor (VCD) and attach it to the VPI and VCI. The VCD tells the card which VPI/VCI to use for a particular packet. The TDM IM card requires this feature to manage the packets for transmission. The number chosen for the VCD is independent of the virtual path identifier/virtual channel identifier (VPI/VCI) used.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. controller {**t1** | **e1**} *slot/bay/port*
4. **atm**
5. **interface atm** *interface-number* [.*subinterface-number* **point-to-point**]
6. **ip address** *ip-addressip-address-mask*
7. **pvc [name]** *vpi* | *vci*
8. **encapsulation aal5snap**
9. **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	controller {**t1** | **e1**} *slot/bay/port* **Example:** `Router(config)# controller t1 0/1/0`	Specifies the controller that you want to configure. • **t1**—Specifies the T1 controller. • **e1**—Specifies the E1 controller. • *slot*—Chassis slot number, which is always 0. • *bay*—Card interface bay number in a slot. The range is from 0 to 5. • *port*—Port or interface number. The range is from 0 to 7 for Gigabit Ethernet.

	Command or Action	Purpose
Step 4	**atm** **Example:** `Router(config-controller)# atm`	Provisions an interface to function with ATM capabilities.

Step 5	**interface atm** *interface-number* [.*subinterface-number* **point-to-point**]
	Example:
	OC-3 interface
	`Router(config-controller)# interface atm0/1/0.10 point-to-point`
	Example:
	OC-12 interface
	`Router(config-controller)# interface atm 0/1/0.1/1/1/1.1 point-to-point`
		Specifies an ATM point-to-point sub-interface.
		• *interface-number* —Specifies a (physical) ATM interface.
		• *subinterface-number*—(Optional) Specifies a subinterface number for OC-3 interface. A dot (.) must be used to separate the interface-number from the subinterface-number (for example 2/0.1).
		subinterface-number—(Optional) Specifies a subinterface number for OC-12 interface. A dot (.) must be used to separate the interface-number from the subinterface-number (For OC-12 STM4, the subinterace is 0/1/0.1/1/1/1.1.).
		• **point-to-point**—(Optional) Specifies point-to-point as the interface type for which a subinterface is to be created.

Step 6	**ip address** *ip-addressip-address-mask* **Example:** `Router(config-subif)# ip-address 192.168.0.1 255.255.255.0`	Configures an IP address on the sub-interface. • *ip-address*—Specifies a the IP address. • *ip-address-mask*— Specifies a the IP address mask.
Step 7	**pvc [name]** *vpi* | *vci* **Example:** `Router(config-subif)# pvc 10/100`	Configures the PVC. • **name**—(Optional) The name of the PVC or map. The name can be up to 15 characters long. • *vpi*—ATM network virtual path identifier (VPI) for this PVC. The absence of the "/" and a vpi value defaults the vpi value to 0. A value that is out of range is interpreted as a string and is treated as the connection ID. • *vci*—ATM network virtual channel identifier (VCI) for this PVC. This value ranges from 0 to 1 less than the maximum value set for this interface by the atm vc-per-vp. command. Typically, lower values 0 to 31 are reserved for specific traffic (for example, F4 OAM, SVC signalling, ILMI, and so on) and should *not* be used. The VCI is a 16-bit field in the header of the ATM cell. The VCI value is unique only on a single link, not throughout the ATM network, because it has

	Command or Action	Purpose
		local significance only. A value that is out of range causes an unrecognized command error message. The arguments vpi and vci cannot both be set to 0; if one is 0, the other cannot be 0.
Step 8	**encapsulation aal5snap** **Example:** `Router(config-if-atm-vc)# encapsulation aal5snap`	Specifies AAL5 SNAP for ATM encapsulation on the PVC.
Step 9	**end** **Example:** `Router(config-if-atm-vc)# end`	Returns to privileged EXEC mode.

Configuring Layer2 QoS on the ATM Interface

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. controller {**t1** | **e1***slot/bay/port*}
4. **atm**
5. **interface***interface-number* **atm** [.*subinterface-number* **point-to-point**]
6. **ip address ip-address ip-address-mask**
7. **pvc [name]** *vpi* | *vci*
8. Do one of the following:
   - **ubr***output-pcr* [*input-pcr*]
   - **cbr***rate*
   - **vbr-rt** *peak-rate average-rate burst*
   - **vbr-nrt** *output-pcr output-scr output-maxburstsize*
   - **ubr+***output-pcr output-mcr* [*input-pcr*] [*input-mcr*]
9. **encapsulation aal5snap**
10. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.

	Command or Action	Purpose
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	controller {**t1** | **e1***slot/bay/port*} **Example:** `Router(config)# controller t1 0/1/0`	Specifies the controller that you want to configure. • **t1**—Specifies the T1 controller. • **e1**—Specifies the E1 controller. • *slot*—Chassis slot number, which is always 0. • *bay*—Card interface bay number in a slot. The range is from 0 to 5. • *port*—Port or interface number. The range is from 0 to 7 for Gigabit Ethernet.
Step 4	**atm** **Example:** `Router(config-controller)# atm`	Provisions an interface to function with ATM capabilities.

Step 5	**interface***interface-number* **atm** [.*subinterface-number* **point-to-point**]
	Example:
	`Router(config-controller)# interface atm0/1/0.10 point-to-point`
	Example:
	OC-12 interface
	`Router(config-controller)# interface atm 0/1/0.1/1/1/1.1 point-to-point`
		Specifies an ATM point-to-point sub-interface.
		• *interface-number*—Specifies a (physical) ATM interface.
		• *subinterface-number*—(Optional) Specifies a subinterface number. A dot (.) must be used to separate the interface-number from the subinterface-number (for example 2/0.1).
		• *subinterface-number*—(Optional) Specifies a subinterface number for OC-12 interface. A dot (.) must be used to separate the interface-number from the subinterface-number (For OC-12 STM4, the subinterace is 0/1/0.1/1/1/1.1).
		• **point-to-point**—(Optional) Specifies point-to-point as the interface type for which a subinterface is to be created.

Step 6	**ip address ip-address ip-address-mask** **Example:** `Router(config-subif)# ip-address 192.168.0.1 255.255.255.0`	Configures an IP address on the sub-interface.
Step 7	**pvc [name]** *vpi* | *vci*	Configures the PVC.

	Command or Action	Purpose
	Example: `Router(config-subif)# pvc 10/100`	• **name**—(Optional) The name of the PVC or map. The name can be up to 15 characters long. • *vpi*—ATM network virtual path identifier (VPI) for this PVC. The absence of the "/" and a vpi value defaults the vpi value to 0. A value that is out of range is interpreted as a string and is treated as the connection ID. • *vci*—ATM network virtual channel identifier (VCI) for this PVC. This value ranges from 0 to 1 less than the maximum value set for this interface by the atm vc-per-vp command. Typically, lower values 0 to 31 are reserved for specific traffic (for example, F4 OAM, SVC signalling, ILMI, and so on) and should not be used. The VCI is a 16-bit field in the header of the ATM cell. The VCI value is unique only on a single link, not throughout the ATM network, because it has local significance only. A value that is out of range causes an unrecognized command error message. The arguments vpi and vci cannot both be set to 0; if one is 0, the other cannot be 0.

Step 8	Do one of the following:
	• **ubr***output-pcr* [*input-pcr*]
	• **cbr***rate*
	• **vbr-rt** *peak-rate average-rate burst*
	• **vbr-nrt** *output-pcr output-scr output-maxburstsize*
	• **ubr+***output-pcr output-mcr* [*input-pcr*] [*input-mcr*]
	Example:
	`Router(config-subif)# ubr 100`
	Example:
	`Router(config-subif)# cbr 1000`
	Example:
	`Router(config-subif)# vbr-rt 1000 600 20`
	Example:
	`Router(config-subif)# vbr-rt 1500 1000 10`
	Example:
	`Router(config-subif)# ubr+ 1000 100`
		• Configure unspecified bit rate (UBR) quality of service (QoS) and specify the output peak cell rate (PCR) for an ATM permanent virtual circuit (PVC), PVC range.
		• *output-pcr*—Output peak cell rate (PCR) in kilobytes per second (kbps).
		• *input-pcr*—(Optional for SVCs only) The input PCR in kbps. If this value is omitted, the value of input-pcrargument will equal the value of output-pcr argument.
		• Configure the constant bit rate (CBR) for the ATM circuit emulation service (CES) for an ATM permanent virtual circuit (PVC).
		• *rate*—Constant bit rate (also known as the average cell rate) for ATM CES.
		• Configures the real-time variable bit rate (VBR) for VoATM voice connections.
		• *peak-rate*—Peak information rate (PIR) for the voice connection, in kilobytes per second (kbps). If it does not exceed your carrier's line rate, set it to the line rate. Range is from 56 to 10000.

	Command or Action	Purpose
		• *average-rate*—Average information rate (AIR) for the voice connection, in kbps. • *burst*—Burst size, in number of cells. • Configures the variable bit rate-nonreal time (VBR-NRT) quality of service (QoS) for an ATM permanent virtual circuit (PVC). • *output-pcr*—output PCR, in kilobytes per second (kbps). • *output-scr*—Output SCR, in kbps. • *output-maxburstsize*—The output maximum burst cell size, expressed in number of cells. • Configures unspecified bit rate (UBR) quality of service (QoS) for an ATM permanent virtual circuit (PVC). • *output-pcr*—Output peak cell rate (PCR) in kbps. • *output-mcr*—Output minimum guaranteed cell rate in kbps. • *input-pcr*—(Optional for SVCs only) The input PCR in kbps. • *input-mcr*—(Optional for SVCs only) The input minimum guaranteed cell rate in kbps.
Step 9	**encapsulation aal5snap** **Example:** `Router(config-if-atm-vc)# encapsulation aal5snap`	Specifies AAL5 SNAP for ATM encapsulation on the PVC.
Step 10	**end** **Example:** `Router(config-if-atm-vc)# end`	Returns to privileged EXEC mode.

Configuring Protocol IP Broadcast on ATM L3 Interface

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. controller {**t1** | **e1**} *slot/bay/port*

4. **atm**
5. **interface** *interface-number* **atm** [.*subinterface-number* **point-to-point**]
6. **ip address***ip-address ip-address-mask*
7. **pvc** [*name*] *vpi* | *vci*
8. **protocol ip** *protocol-address* **broadcast**
9. **encapsulation aal5snap**
10. **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	controller {**t1** | **e1**} *slot/bay/port* **Example:** `Router(config)# controller t1 0/1/0`	Specifies the controller that you want to configure. • **t1**—Specifies the T1 controller. • **e1**—Specifies the E1 controller. • *slot*—Chassis slot number, which is always 0. • *bay*—Card interface bay number in a slot. The range is from 0 to 5. • *port*—Port or interface number. The range is from 0 to 7 for Gigabit Ethernet.
Step 4	**atm** **Example:** `Router(config-controller)# atm`	Provisions an interface to function with ATM capabilities.
Step 5	**interface** *interface-number* **atm** [.*subinterface-number* **point-to-point**] **Example:** `Router(config-controller)# interface atm 0/1/0.10 point-to-point` **Example:** OC-12 interface	Specifies an ATM point-to-point sub-interface. • *interface-number*—Specifies a (physical) ATM interface. • *subinterface-number*—(Optional) Specifies a subinterface number. A dot (.) must be used to separate the interface-number from the subinterface-number (for example 2/0.1).

	Command or Action	Purpose
	`Router(config-controller)# interface atm 0/1/0.1/1/1/1.1 point-to-point`	• *subinterface-number*—(Optional) Specifies a subinterface number for OC-12 interface. A dot (.) must be used to separate the interface-number from the subinterface-number (For OC-12 STM4, the subinterace is 0/1/0.1/1/1/1.1). • **point-to-point**—(Optional) Specifies point-to-point as the interface type for which a subinterface is to be created.
Step 6	**ip address***ip-address ip-address-mask* **Example:** `Router(config-subif)# ip-address 192.168.0.1 255.255.255.0`	Configures an IP address on the sub-interface.
Step 7	**pvc** [*name*] *vpi*|*vci* **Example:** `Router(config-subif)# pvc 10/100`	Configures the PVC. • **name**—(Optional) The name of the PVC or map. The name can be up to 15 characters long. • *vpi*—ATM network virtual path identifier (VPI) for this PVC. The absence of the "/" and a vpi value defaults the vpi value to 0. A value that is out of range is interpreted as a string and is treated as the connection ID. • *vci*—ATM network virtual channel identifier (VCI) for this PVC. This value ranges from 0 to 1 less than the maximum value set for this interface by the atm vc-per-vp command. Typically, lower values 0 to 31 are reserved for specific traffic (for example, F4 OAM, SVC signalling, ILMI, and so on) and should not be used. The VCI is a 16-bit field in the header of the ATM cell. The VCI value is unique only on a single link, not throughout the ATM network, because it has local significance only. A value that is out of range causes an "unrecognized command" error message. The arguments vpi and vci cannot both be set to 0; if one is 0, the other cannot be 0.
Step 8	**protocol ip** *protocol-address* **broadcast** **Example:** `Router(config-subif)# protocol ip 192.168.0.2 broadcast`	Configures a static map for an ATM permanent virtual circuit (PVC), switched virtual circuit (SVC), or virtual circuit (VC) class. • *protocol-address*—remote end circuit IP being mapped to same PVC.

	Command or Action	Purpose
Step 9	**encapsulation aal5snap** **Example:** `Router(config-if-atm-vc)# encapsulation aal5snap`	Specifies AAL5 SNAP for ATM encapsulation on the PVC.
Step 10	**end** **Example:** `Router(config-if-atm-vc)# end`	Returns to privileged EXEC mode.

Configuring VRF Enabled ATM L3 Interface

Virtual Routing and Forwarding (VRF) is an IP technology that allows multiple instances of a routing table to exist in the same router at the same time. VRF can be enabled on ATM L3 interface.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. controller {**t1** | **e1**} *slot/bay/port*
4. **atm**
5. **interface** *interface-number***atm** [.*subinterface-number* **point-to-point**]
6. **ip vrf forwarding** *vrf-name*
7. **ip address***ip-address ip-address-mask*
8. **no atm enable-ilmi-trap**
9. **pvc [name]***vpi* | *vci*
10. **encapsulation aal5snap**
11. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • E nter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	controller {**t1**	**e1**} *slot/bay/port* **Example:**	Specifies the controller that you want to configure. • **t1**—Specifies the T1 controller.

	Command or Action	Purpose
	`Router(config)# controller t1 0/1/0`	• **e1**—Specifies the E1 controller. • *slot*—Chassis slot number, which is always 0. • *bay*—Card interface bay number in a slot. The range is from 0 to 5. • *port*—Port or interface number. The range is from 0 to 7 for Gigabit Ethernet.
Step 4	**atm** **Example:** `Router(config-controller)# atm`	Provisions an interface to function with ATM capabilities.

Step 5	**interface** *interface-number***atm** [*.subinterface-number* **point-to-point**]
	Example:
	`Router(config-controller)# interface atm0/1/0.10 point-to-point`
	Example:
	OC-12 interface
	`Router(config-controller)# interface atm 0/1/0.1/1/1/1.1 point-to-point`
		Specifies an ATM point-to-point sub-interface.
		• *interface-number*—Specifies a (physical) ATM interface.
		• *subinterface-number*—(Optional) Specifies a subinterface number. A dot (.) must be used to separate the interface-number from the subinterface-number (for example 2/0.1).
		• *subinterface-number*—(Optional) Specifies a subinterface number for OC-12 interface. A dot (.) must be used to separate the interface-number from the subinterface-number (For OC-12 STM4, the subinterace is 0/1/0.1/1/1/1.1).
		• **point-to-point**—(Optional) Specifies point-to-point as the interface type for which a subinterface is to be created.

Step 6	**ip vrf forwarding** *vrf-name* **Example:** `Router(config-controller)# ip vrf forwarding VPN_A`	Associates a Virtual Private Network (VPN) routing and forwarding (VRF) instance with an interface or subinterface • *vrf-name*—Associates the interface with the specified VRF.
Step 7	**ip address***ip-address ip-address-mask* **Example:** `Router(config-subif)# ip-address 192.168.0.1 255.255.255.0`	Configures an IP address on the sub-interface.
Step 8	**no atm enable-ilmi-trap** **Example:**	Disables the ILMI traps.

	Command or Action	Purpose
	`Router(config-subif)# no atm enable-ilmi-trap`	
Step 9	**pvc [name]***vpi* | *vci* **Example:** `Router(config-subif)# pvc 10/100`	Configures the PVC. • **name**—(Optional) The name of the PVC or map. The name can be up to 15 characters long. • *vpi*—ATM network virtual path identifier (VPI) for this PVC. The absence of the "/" and a vpi value defaults the vpi value to 0. A value that is out of range is interpreted as a string and is treated as the connection ID. • *vci*—ATM network virtual channel identifier (VCI) for this PVC. This value ranges from 0 to 1 less than the maximum value set for this interface by the atm vc-per-vp command. Typically, lower values 0 to 31 are reserved for specific traffic (for example, F4 OAM, SVC signalling, ILMI, and so on) and should not be used. The VCI is a 16-bit field in the header of the ATM cell. The VCI value is unique only on a single link, not throughout the ATM network, because it has local significance only. A value that is out of range causes an unrecognized command error message. The arguments vpi and vci cannot both be set to 0; if one is 0, the other cannot be 0.
Step 10	**encapsulation aal5snap** **Example:** `Router(config-if-atm-vc)# encapsulation aal5snap`	Specifies AAL5 SNAP for ATM encapsulation on the PVC.
Step 11	**end** **Example:** `Router(config-if-atm-vc)# end`	Returns to privileged EXEC mode.

Configuration Examples for AAL5 L3 Termination

Example: Configuring SONET mode on OC-3 IM

```
Router(config)# controller sonet 3/1/0
Router(config-controller)# framing sonet
Router(config-controller)# sts-1 1
Router(config-ctrlr-sts)# vtg 1 t1 1 atm
```

```
Router(config)# interface ATM3/1/0.1/1/1.1 point-to-point
Router(config-subif)# ip address 192.0.1.5 255.255.255.0
Router(config-subif)# pvc 10/100
Router(cfg-if-atm-vc)# encapsulation aal5snap
Router(cfg-if-atm-vc)#
```

Example: Configuring SDH mode on OC-3 IM

```
Router(config)# controller sdh 0/1/0
Router(config-controller)# framing sdh
Router(config-controller)# aug mapping au-4
Router(config-controller)# au-4 1 tug-3 1
Router(config-ctrlr-tug3)# tug-2 1 e1 1 atm
Router(config)# interface ATM0/0/0.1/1/1/1.2 point-to-point
Router(config-subif)# ip address 192.0.2.3 255.255.255.0
Router(config-subif)# pvc 10/100
Router(cfg-if-atm-vc)# encapsulation aal5snap
Router(cfg-if-atm-vc)#
```

Example: Configuring Layer2 QoS

```
interface ATM0/3/2.1/1/1.101 point-to-point

pvc 20/101
  ubr 100
  encapsulation aal5snap
   !
End
interface ATM1/1/0.1/1/1.102 point-to-point
ip address 192.0.2.1 255.255.255.0

pvc 20/102
  cbr 1000
  encapsulation aal5snap
interface ATM1/1/0.1/1/1.102 point-to-point
ip address 192.0.2.1 255.255.255.0

pvc 20/102
  vbr-rt 1000 600 20
  encapsulation aal5snap
interface ATM1/1/0.1/1/1.102 point-to-point
ip address 192.0.2.1 255.255.255.0

pvc 20/102
  vbr-nrt 1500 1000 10
  encapsulation aal5snap
interface ATM1/1/0.1/1/1.102 point-to-point
ip address 192.0.2.1 255.255.255.0

pvc 20/102
  ubr+ 1000 100
  encapsulation aal5snap
```

Example: Configuring Protocol IP Broadcast in the Layer3 ATM Interface

```
interface ATM0/3/2.1/1/1.200 point-to-point
ip address 192.168.1.2 255.255.255.0
```

```
no atm enable-ilmi-trap
pvc 200/10
  protocol ip 192.168.1.2 broadcast ----------(remote end IP)
!
End
```

Example: Configuring VRF Enabled ATM L3 Interface

```
ip vrf VPN_A
rd 100:1
route-target export 100:1
route-target import 100:1
interface ATM0/3/2.1/1/1.200 point-to-point
ip vrf forwarding VPN_A
ip address 10.0.0.1 255.255.255.0
no atm enable-ilmi-trap
pvc 200/10
 !
End
Router# ping vrf VPN_A 11.12.13.14 -------(Remote end IP)
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.0.0.1, timeout is 2 seconds:
!!!!!
```

Verifying AAL5 L3 Termination

- Use the **show atm pvc** command to display all ATM PVCs and traffic information:

  OC-3 Interface

```
Router# show atm pvc
Keys:  C = ATM0/4/0.1/1/1, B = ATM0/4/2.1/1/1,
           VCD /                                                Peak Av/Min Burst
Interface  Name         VPI   VCI Type    Encaps     SC     Kbps   Kbps Cells St
C.1        1            180   181 PVC     SNAP       UBR    1536              UP
B.1        1            180   181 PVC     AAL5       UBR    1536              UP
```

  OC-12 Interface

```
Router# show atm pvc
Keys: C = ATM0/5/0.1/1/2/3, B = ATM0/5/0.1/1/2/2, D = ATM0/5/0.1/1/2/1,
           VCD /                                                Peak Av/Min Burst
Interface  Name         VPI   VCI Type    Encaps     SC     Kbps   Kbps Cells St
C.1        1            180   181 PVC     SNAP       UBR    1536              UP
B.1        1            180   181 PVC     AAL5       UBR    1536              UP
D.1        1            1      4  PVC     SNAP       UBR    1984              UP
```

- Use the **show interfaces ATM** command to display information about the ATM interface:

  OC-3 Interface

```
Router# show interfaces ATM0/4/0.1/1/1.1
ATM0/4/0.1/1/1.1 is up, line protocol is up
  Hardware is A900-IMA4OS, address is 0022.bddd.d4c0 (bia 0022.bddd.d4c0)
  Internet address is 192.168.0.1/24
  MTU 4470 bytes, BW 1536 Kbit/sec, DLY 100 usec,
     reliability 255/255, txload 129/255, rxload 129/255
```

```
  Encapsulation ATM
  Keepalive not supported
     13551261 packets input, 731768094 bytes
     13551227 packets output, 731766258 bytes
     0 OAM cells input, 0 OAM cells output
  AAL5 CRC errors : 0
  AAL5 SAR Timeouts : 0
  AAL5 Oversized SDUs : 0
  AAL5 length violation : 0
  Last clearing of "show interface" counters never
```

OC-12 Interface

```
PE1#sh int ATM0/5/0.1/1/1/1.1
ATM0/5/0.1/1/1/1.1 is up, line protocol is up
  Hardware is A900-IMA4OS, address is f41f.c2ad.2d2d (bia f41f.c2ad.2d2d)
  Internet address is 192.68.1.2/24
  MTU 4470 bytes, BW 1984 Kbit/sec, DLY 100 usec,
     reliability 255/255, txload 201/255, rxload 201/255
  Encapsulation ATM
  Keepalive not supported
     200405982 packets input, 100603802489 bytes
     200416938 packets output, 100609302401 bytes
     0 OAM cells input, 0 OAM cells output
  AAL5 CRC errors : 0
  AAL5 SAR Timeouts : 0
  AAL5 Oversized SDUs : 0
  AAL5 length violation : 0
  Last clearing of "show interface" counters never
```

- Use the **show atm pvc interface atm interface-number** command to display all PVCs on the specified interface or sub-interface:

```
Router# show atm pvc interface atm 0/4/0.1/1/1.1
Key:  C = ATM0/4/0.1/1/1
          VCD /                                              Peak Av/Min Burst
Interface  Name         VPI   VCI Type    Encaps     SC     Kbps   Kbps Cells St
C.1        1            180   181 PVC     SNAP       UBR    1536              UP
```

- Use the **show atm map** command to display the protocol IP broadcast on the ATM interface:

```
Router# show atm map
Map list ATM0/3/2.1/1/1.200pvcC8000A : PERMANENT
ip 191.168.1.14 maps to VC 5, VPI 200, VCI 10, ATM0/3/2.1/1/1.200
        , broadcast
```

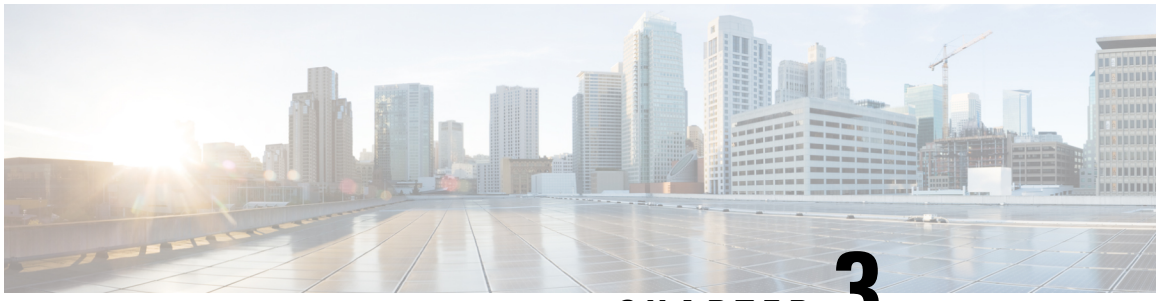
Additional References

Related Documents

Related Topic	Document Title
Cisco IOS commands	Cisco IOS Master Commands List, All Releases
ATM commands	Cisco IOS Asynchronous Transfer Mode Command Reference

MIBs

MIB	MIBs Link
• Cisco PVC trap MIB - CISCO-IETF-ATM2-PVCTRAP-MIB	To locate and download MIBs for selected platforms, Cisco software releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs



CHAPTER 3

ATM Hierarchical Shaping ATM VC into VP Shaping

Traffic shaping is a quality of service (QoS) mechanism that is used to manage the network traffic by shaping the traffic to a specified rate. Traffic shaping enables the network administrator to:

- Control access to the available bandwidth.
- Ensure that the traffic conforms to the policies.
- Regulate the flow of traffic to avoid congestion that can occur when the transmitted traffic exceeds the access speed of its remote target interface.

Traffic shaping uses queues to constrain data bursts, limit peak data rate, and smooth jitters so that traffic will fit within the promised envelope. Traffic shaping limits the throughput by buffering excess traffic instead of dropping packets.

ATM VP/VC hierarchical shaping provides two levels of traffic shaping--per-VC and per-VP--to control or modify the flow of traffic on an interface. The shaping function also ensures that the traffic from one VC does not adversely impact another VC, thus preventing the loss of data. The traffic is shaped first at the VC level and then at the VP level.

Restrictions for ATM Hierarchical Shaping

All virtual channels (VCs) within a given virtual path (VP) must belong to the same ATM service category.

Information About ATM Hierarchical Shaping

ATM Hierarchical Shaping

If a service (or an application) wants to use an ATM network to transport a particular kind of traffic, it must first inform the network about what kind of traffic is to be transported, and the performance requirements of that traffic. The ATM service categories provide a method to relate traffic characteristics and QoS requirements to network behavior. Hierarchical shaping requires that all VCs belonging to a given VP have the same ATM service category. This hierarchy ensures that packets are shaped first at the VC level and then at the VP level. At the interface level, the priority is based on the ATM service category. The service category is determined by the first PVC that is configured under a VP. The priority is in the following order:

1. Constant Bit Rate (CBR)
2. Unspecified Bit Rate (UBR)
3. Unspecified Bit Rate + (UBR+)
4. Variable Bit Rate Non Real-Time (VBR-nRT)
5. Real-time Variable Bit Rate (VBR-RT)

If no service category is specified at the VC level, the default is unshaped UBR. The ATM Hierarchical Shaping feature is supported for the all the above ATM traffic service categories.

For VBR-nRT traffic the output sustainable cell rate (SCR) value that is configured will be taken into account for VC shaping. For UBR traffic, the output peak cell rate (PCR) value that is configured will be taken into account for VC shaping.

The ATM Hierarchical Shaping feature supports over-subscription. Over-subscription occurs when the sum of the configured rate of UBR and VBR PVCs exceeds the line rate.

How to Configure ATM Hierarchical Shaping

Configuring ATM Hierarchical Shaping

Perform this task to configure ATM hierarchical shaping.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface atm** *interface-number* [**.** *subinterface-number* {**multipoint** | **point-to-point**}]
4. **pvc** *vpi* **/** *vci*
5. **exit**
6. **ubr** *output-pcr*
7. **exit**

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	**interface atm** *interface-number* [**.** *subinterface-number* {**multipoint** | **point-to-point**}] **Example:** `Router(config)# interface atm 0/3/2.1 point-to-point`	Configure an ATM interface and enters subinterface configuration mode.
Step 4	**pvc** *vpi* / *vci* **Example:** `Router(config-subif)# pvc 2/200`	Creates or assigns a name to an ATM PVC and enters ATM virtual circuit configuration mode.
Step 5	**exit** **Example:** `Router(config-if-atm-vc)# exit`	Exits ATM virtual circuit configuration mode and returns to subinterface configuration mode.
Step 6	**ubr** *output-pcr* **Example:** `Router(config-if-atm-vc)# ubr 1500`	Configures UBR QoS and specifies the output PCR for an ATM PVC, PVC range, switched virtual circuit (SVC), VC class, or VC bundle member.
Step 7	**exit** **Example:** `Router(config-if-atm-vc)# exit`	Exits ATM virtual circuit configuration mode and returns to subinterface configuration mode.

Configuration Examples for ATM Hierarchical Shaping

Example Configuring ATM Hierarchical Shaping

The following example shows how to configure ATM hierarchical shaping:

```
enable
 configure terminal
  interface atm 0/3/2.1 multipoint
   atm pvp 2
   pvc 2/200
    exit
   range range1 pvc 2/100 2/102
    ubr 4000
    exit
   atm pvp 3
   pvc 3/100
    vbr-nrt 1000 1000

    end
```

Additional References

Related Documents

Related Topic	Document Title
ATM commands	*Cisco IOS Asynchronous Transfer Mode Command Reference*

Standards

Standard	Title
No new or modified standards are supported by this feature, and support for existing standards has not been modified by this feature.	--

MIBs

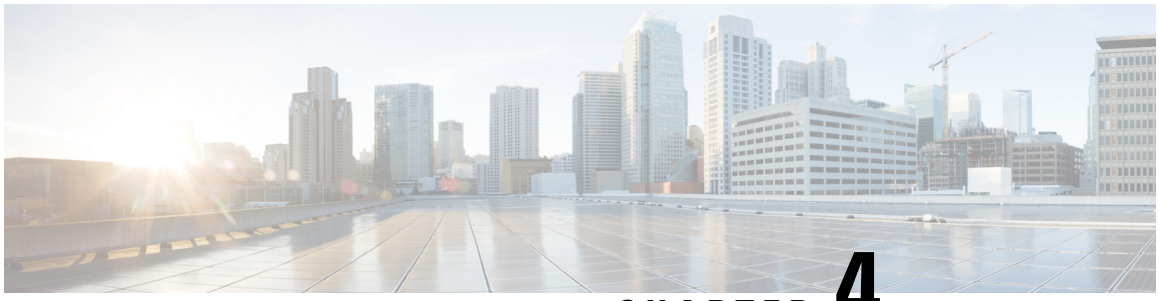
MIB	MIBs Link
No new or modified MIBs are supported by this feature, and support for existing MIBs has not been modified by this feature.	To locate and download MIBs for selected platforms, Cisco software releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

RFCs

RFC	Title
No new or modified RFCs are supported by this feature, and support for existing RFCs has not been modified by this feature.	--

Technical Assistance

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



CHAPTER 4

N:1 PVC Mapping to PWE with Nonunique VPIs

The N:1 PVC Mapping to PseudoWire Emulation (PWE) with Nonunique virtual path identifiers (VPIs) feature maps one or more ATM permanent virtual circuits (PVCs) to a single pseudowire (PW). There are two modes of AAL0 encapsulation, N:1 and 1:1 mapping. In N:1 mapping, multiple unrelated virtual path identifier/virtual channel identifier (VPI/VCI) are carried over a single Multiprotocol Label Switching (MPLS) PW. This is an efficient mapping method because less resources are used from the MPLS network. In 1:1 mapping, a single VPI/VCI is carried over a single MPLS PW. Benefits of this feature include the following:

- Aggregate quality of service (QoS) can be applied to related PVCs.
- Bandwidth is conserved with the reduction in the number of pseudowires that are used.

Note This is not applicable for Cisco ASR 900 RSP3 Module.

Restrictions for N:1 PVC Mapping to PWE with Nonunique VPIs

- N:1 permanent virtual circuits (PVC) mapping configuration is supported only on multipoint subinterfaces; it is not supported on main interfaces or point-to-point subinterfaces.
- N:1 PVC mapping mode is not supported on Access Circuit Redundancy subinterfaces.
- Preconfigured PVCs cannot exist on the multipoint subinterface on which you want to configure N:1 PVC mapping.
- An attachment circuit that has been bound to a pseudowire cannot be removed unless all Layer 2 virtual circuits (VCs) have been removed.
- Layer 3 PVCs cannot be configured on N:1 subinterfaces.

- Cell packing values configured under a VC class attached to the PVC, main interface, or subinterface will not be inherited by N:1 PVCs.
- Operation, Administration, and Maintenance (OAM) functionality is not supported on N:1 Layer 2 PVCs. OAM cells coming from the customer edge (CE) network will be treated as normal data traffic and will traverse through the pseudowire.
- Only ATM adaptation layer type 0 (AAL0) encapsulation is supported for N:1 PVCs.
- The service policy configuration can be configured only at the subinterface level for N:1 PVCs.
- ATM N:1 and PVP modes cannot be configured on different subinterfaces that belong to a physical interface.
- You cannot change the ATM interface mode from point-to-point to multipoint or from multipoint to point-to-point.
- If you change a layer 2 ATM interface to a layer 3 ATM interface, traffic will not flow.

Information About N:1 PVC Mapping to PWE with Nonunique VPIs

N:1 PVC Mapping to PWE with Nonunique VPIs Feature Description

To transport ATM cells over Multiprotocol Label Switching (MPLS), a VC is established between the provider edge (PE) routers on both ends of the MPLS backbone. With the N:1 permanent virtual circuit (PVC) Mapping to PseudoWire Emulation (PWE) with Nonunique VPIs feature, multiple PVCs irrespective of their Virtual Path Identifiers (VPIs), are transported over a single pseudowire configured on a subinterface. ("N:1" refers to the number of PVCs transported over one pseudowire). ATM cells are packed together in a single frame and sent over the single pseudowire. The ATM cell header information is packed together with the cell payload on a per-cell basis in the packets so that packets received at the egress end are unpacked and the ATM cells are mapped to the respective PVCs.

In N:1 PVC mapping mode, the device can pack cells only from a single PVC in an MPLS packet to transmit over a pseudowire; cells from multiple PVCs cannot be packed in a single MPLS packet and mapped to a single pseudowire for transmission. However, if a device receives an MPLS packet that is packed with cells from multiple PVCs, then those cells will be unpacked and sent to the respective PVCs.

How to Configure N:1 PVC Mapping to PWE with Nonunique VPIs

Configuring N:1 PVC Mapping to PWE with Nonunique VPIs

SUMMARY STEPS

1. **enable**

2. **configure terminal**
3. **interface atm** *slot/subslot/port*
4. **atm mcpt-timers** *timer1 timer2 timer3*
5. **exit**
6. **configure terminal**
7. **interface atm** *slot/subslot/port.subslot* **multipoint**
8. **no ip address**
9. **atm enable-ilmi-trap**
10. **cell-packing** *maxcells* **mcpt-timer** *timer-number*
11. **xconnect** *peer-ipaddress vc-id* **encapsulation mpls**
12. **pvc** *vpi/vci* **l2transport**
13. Repeat Step 12 for the number of PVCs that you want to configure.
14. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**interface atm** *slot/subslot/port* **Example:** `Device(config)# interface atm 9/1/1`	Enables the ATM interface and enters interface configuration mode.
Step 4	**atm mcpt-timers** *timer1 timer2 timer3* **Example:** `Device(config-if)# atm mcpt-timers 100 200 300`	Sets the Maximum Cell Packing Timeout (MCPT) values in microseconds. • The MCPT timer sets the time for which the device waits for the raw cells (AAL0 encapsulation) to be packed into a single packet for punting to the pseudowire.
Step 5	**exit** **Example:** `Device(config-if)# exit`	Exits interface configuration mode.
Step 6	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.

	Command or Action	Purpose
Step 7	**interface atm** *slot/subslot/port.subslot* **multipoint** **Example:** `Device(config)# interface atm 9/1/1.1 multipoint`	Enters subinterface configuration mode and creates a multipoint subinterface on the given port on the specified ATM Shared Port Adapter (SPA).
Step 8	**no ip address** **Example:** `Device(config-subif)# no ip address`	Removes the interface IP address.
Step 9	**atm enable-ilmi-trap** **Example:** `Device(config-subif)# atm enable-ilmi-trap`	Generates an Integrated Local Management Interface (ILMI) atmfVccChange trap when an ATM interface or subinterface is enabled or shut down.
Step 10	**cell-packing** *maxcells* **mcpt-timer** *timer-number* **Example:** `Device(config-subif)# cell-packing 20 mcpt-timer 2`	Enables ATM over MPLS to pack multiple ATM cells into each MPLS packet within the MCPT timing.
Step 11	**xconnect** *peer-ipaddress vc-id* **encapsulation mpls** **Example:** `Device(config-subif)# xconnect 10.1.1.1 100 encapsulation mpls`	(Optional) Enables the attachment circuit and specifies the IP address of the peer, a VC ID, and the data encapsulation method.
Step 12	**pvc** *vpi/vci* **l2transport** **Example:** `Device(config-subif)# pvc 10/100 l2transport`	Assigns a VPI and virtual channel identifier (VCI).
Step 13	Repeat Step 12 for the number of PVCs that you want to configure.	—
Step 14	**end** **Example:** `Device(config-subif)# end`	Exits subinterface configuration mode and returns to privileged EXEC mode.

Configuring N:1 PVC Mapping to PWE with Nonunique VPIs using the commands associated with the L2VPN Protocol-Based CLIs feature

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface atm** *slot/subslot/port*
4. **atm mcpt-timers** *timer1 timer2 timer3*
5. **exit**

6. **configure terminal**
7. **interface atm** *slot/subslot/portt.subslot* **multipoint**
8. **no ip address**
9. **atm enable-ilmi-trap**
10. **cell-packing** *maxcells* **mcpt-timer** *timer-number*
11. **end**
12. **interface pseudowire** *number*
13. **encapsulation mpls**
14. **neighbor** *peer-address vcid-value*
15. **exit**
16. **l2vpn xconnect context** *context-name*
17. **member pseudowire** *interface-number*
18. **member gigabitethernet** *interface-number*
19. **end**
20. **pvc** *vpi/vci* **l2transport**
21. Repeat Step 12 for the number of PVCs that you want to configure.
22. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**interface atm** *slot/subslot/port* **Example:** `Device(config)# interface atm 9/1/1`	Enables the ATM interface and enters interface configuration mode.
Step 4	**atm mcpt-timers** *timer1 timer2 timer3* **Example:** `Device(config-if)# atm mcpt-timers 100 200 300`	Sets the Maximum Cell Packing Timeout (MCPT) values in microseconds. • The MCPT timer sets the time for which the device waits for the raw cells (AAL0 encapsulation) to be packed into a single packet for punting to the pseudowire.
Step 5	**exit** **Example:** `Device(config-if)# exit`	Exits interface configuration mode.

	Command or Action	Purpose
Step 6	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 7	**interface atm** *slot/subslot/portt.subslot* **multipoint** **Example:** `Device(config)# interface atm 9/1/1.1 multipoint`	Enters subinterface configuration mode and creates a multipoint subinterface on the given port on the specified ATM Shared Port Adapter (SPA).
Step 8	**no ip address** **Example:** `Device(config-subif)# no ip address`	Removes the interface IP address.
Step 9	**atm enable-ilmi-trap** **Example:** `Device(config-subif)# atm enable-ilmi-trap`	Generates an Integrated Local Management Interface (ILMI) atmfVccChange trap when an ATM interface or subinterface is enabled or shut down.
Step 10	**cell-packing** *maxcells* **mcpt-timer** *timer-number* **Example:** `Device(config-subif)# cell-packing 20 mcpt-timer 2`	Enables ATM over MPLS to pack multiple ATM cells into each MPLS packet within the MCPT timing.
Step 11	**end** **Example:** `Router(config-subif)# end`	Exits to privileged EXEC mode.
Step 12	**interface pseudowire** *number* **Example:** `Router(config)# interface pseudowire 100`	Specifies the pseudowire interface and enters interface configuration mode.
Step 13	**encapsulation mpls** **Example:** `Router(config-if)# encapsulation mpls`	Specifies that Multiprotocol Label Switching (MPLS) is used as the data encapsulation method.
Step 14	**neighbor** *peer-address vcid-value* **Example:** `Router(config-if)# neighbor 10.1.1.1 100`	Specifies the peer IP address and virtual circuit (VC) ID value of the Layer 2 VPN (L2VPN) pseudowire.
Step 15	**exit** **Example:** `Router(config-if)# exit`	Exits interface configuration mode.

	Command or Action	Purpose
Step 16	**l2vpn xconnect context** *context-name* **Example:** `Router(config)# l2vpn xconnect context con1`	Creates a Layer 2 VPN (L2VPN) cross connect context and enters xconnect configuration mode.
Step 17	**member pseudowire** *interface-number* **Example:** `Router(config-xconnect)# member pseudowire 100`	Specifies a member pseudowire to form a Layer 2 VPN (L2VPN) cross connect.
Step 18	**member gigabitethernet** *interface-number* **Example:** `Router(config-xconnect)# member GigabitEthernet0/0/0.1`	Specifies the location of the Gigabit Ethernet member interface.
Step 19	**end** **Example:** `Router(config-xconnect)# end`	Exits to privileged EXEC mode.
Step 20	**pvc** *vpi*/*vci* **l2transport** **Example:** `Device(config-subif)# pvc 10/100 l2transport`	Assigns a VPI and virtual channel identifier (VCI).
Step 21	Repeat Step 12 for the number of PVCs that you want to configure.	—
Step 22	**end** **Example:** `Device(config-subif)# end`	Exits subinterface configuration mode and returns to privileged EXEC mode.

Configuration Examples for N:1 PVC Mapping to PWE with Nonunique VPIs

Example: Configuring N:1 PVC Mapping to PWE with Nonunique VPIs

The following example shows how to configure the N:1 ATM permanent virtual circuit (PVC) mapping to pseudowires with non unique virtual path identifiers (VPIs):

```
Device> enable
Device# configure terminal
Device(config)# interface atm 0/1/0
Device(config-if)# atm mcpt-timers 500 5000 50000
```

```
Device(config-if)# exit
Device# configure terminal
Device(config)# interface atm 0/1/0.1 multipoint
Device(config-subif)# no ip address
Device(config-subif)# atm enable-ilmi-trap
Device(config-subif)# cell packing 20 mcpt-timer 2
Device(config-subif)# xconnect 10.1.1.1 100 encapsulation mpls
Device(config-subif)# pvc 10/100 l2transport
Device(config-subif)# pvc 11/122 l2transport
Device(config-subif)# pvc 19/231 l2transport
Device(config-subif)# end
```

Example: Configuring N:1 PVC Mapping to PWE with Nonunique VPIs using the commands associated with the L2VPN Protocol-Based CLIs feature

The following example shows how to configure the N:1 ATM permanent virtual circuit (PVC) mapping to pseudowires with non unique virtual path identifiers (VPIs):

```
Router> enable
Router# configure terminal
Router(config)# interface atm 0/1/1
Router(config-if)# atm mcpt-timers 500 5000 50000
Router(config-if)# exit
Router(config)# configure terminal
Router(config)# interface atm 0/1/1.1 multipoint
Router(config-subif)# no ip address
Router(config-subif)# atm enable-ilmi-trap
Router(config-subif)# cell packing 20 mcpt-timer 2
Router(config-subif)# exit
Router(config)#interface pseudowire 100
Router(config-if)# encapsulation mpls
Router(config-if)# neighbor 10.1.1.1 100
Router(config-if)# pvc 10/100 l2transport
Router(config-if)# pvc 11/122 l2transport
Router(config-if)# pvc 19/231 l2transport
Router(config-if)# exit
Router(config)# l2vpn xconnect context A
Router(config-xconnect)# member pseudowire 100
Router(config-xconnect)# member atm 9/1/1
Router(config-xconnect)# end
```

Verifying the N:1 PVC Mapping to PWE with Nonunique VPIs Configuration

To verify the N:1 PVC Mapping to PWE with Nonunique VPIs Configuration, use the **show mpls l2transport vc** command in user EXEC or privileged EXEC mode.

```
Router# show mpls l2transport vc

Local intf      Local circuit              Dest address    VC ID    Status
------------    -------------------------  --------------  -------  --------
AT0/1/1.1         ATM CELL ATM0/1/1.1         2.2.2.2       100      UP
```

```
interface ATM0/0/0.1/1/1/1
atm mcpt-timers 20 30 40

interface ATM0/0/0.1/1/1/1.1 multipoint
no ip address
no atm enable-ilmi-trap
cell-packing 2 mcpt-timer 1
xconnect 2.2.2.2 100 encapsulation mpls
pvc 10/100 l2transport
pvc 20/200 l2transport
pvc 30/300 l2transport
```

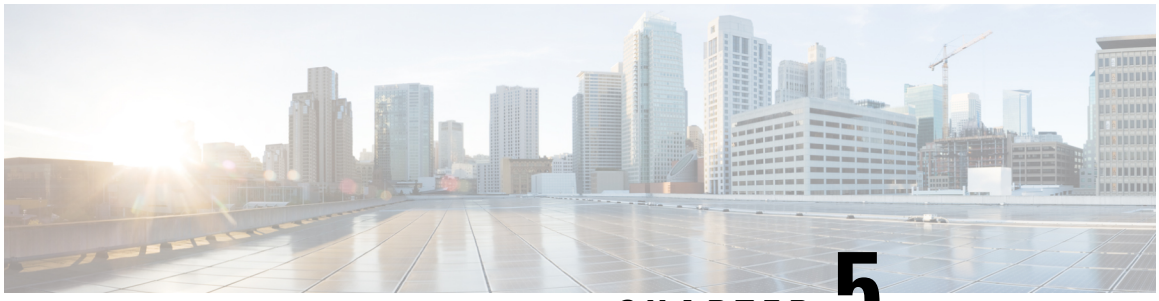
Additional References

Related Documents

Related Topic	Document Title
ATM commands	Asynchronous Transfer Mode Command Reference

Technical Assistance

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



CHAPTER 5

Configuring Pseudowire

This chapter provides information about configuring pseudowire (PW) features.

Pseudowire Overview

The following sections provide an overview of pseudowire.

Asynchronous Transfer Mode over MPLS

An ATM over MPLS (AToM) PW is used to carry Asynchronous Transfer Mode (ATM) cells over an MPLS network. It is an evolutionary technology that allows you to migrate packet networks from legacy networks,

while providing transport for legacy applications. AToM is particularly useful for transporting 3G voice traffic over MPLS networks.

You can configure AToM in the following modes:

- N-to-1 Cell—Maps one or more ATM virtual channel connections (VCCs) or virtual permanent connection (VPCs) to a single pseudowire.
- 1-to-1 Cell—Maps a single ATM VCC or VPC to a single pseudowire.

The Cisco ASR 903 Series Router also supports cell packing and PVC mapping for AToM pseudowires.

Note This release does not support AToM N-to-1 Cell Mode or 1-to-1 Cell Mode.

For more information about how to configure AToM, see the "Configuring an ATM over MPLS Pseudowire" section in the "Configuring Pseudowire" chapter of the Cisco ASR 903 Router Chassis Software Configuration Guide.

Configuring ATM IMA

Inverse multiplexing provides the capability to transmit and receive a single high-speed data stream over multiple slower-speed physical links. In Inverse Multiplexing over ATM (IMA), the originating stream of ATM cells is divided so that complete ATM cells are transmitted in round-robin order across the set of ATM links. Follow these steps to configure IMA:

Note IMA is used as an element in configuring ATM over MPLS pseudowires.

Note The maximum ATM over MPLS pseudowires supported per T1/E1 interface module is 500.

To configure the ATM interface on the router, you must install the ATM feature license using the **license install atm** command. To activate or enable the configuration on the IMA interface, use the **license feature atm** command. For more information about installing licenses, see the Software Activation Configuration Guide, Cisco IOS XE Release 3S.

Note You can create a maximum of 16 IMA groups on each T1/E1 interface module.

Note ILMI is *not* supported starting with Cisco IOS XE Releease 3.15 on the router.

SUMMARY STEPS

1. **enable**

2. **configure terminal**
3. **card type {t1 | e1}***slot [bay]*
4. **controller {t1 | e1}***slot/subslot/port*
5. **clock source internal**
6. **ima group** *group-number* [**scrambling-payload**]
7. **exit**
8. **interface ATM** *slot/subslot/* **IMA** *group-number*
9. **no ip address**
10. **atm bandwidth dynamic**
11. **no atm ilmi-keepalive**
12. **exit**

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	**card type {t1 | e1}***slot [bay]* **Example:** `Router(config)# card type e1 0 0`	Specifies the slot and port number of the E1 or T1 interface.
Step 4	**controller {t1 | e1}***slot/subslot/port* **Example:** `Router(config)# controller E1 0/0/4`	Specifies the controller interface on which you want to enable IMA.
Step 5	**clock source internal** **Example:** `Router(config-controller)# clock source internal`	Sets the clock source to internal.
Step 6	**ima group** *group-number* [**scrambling-payload**] **Example:** `Router(config-controller)# ima-group 0`	Assigns the interface to an IMA group, and set the scrambling-payload parameter to randomize the ATM cell payload frames. This command assigns the interface to IMA group 0. **Note** This command automatically creates an ATM0/IMAx interface. **Note** To add another member link, repeat Step 3 to Step 6.

	Command or Action	Purpose
Step 7	**exit** **Example:** `Router(config-controller)# exit`	Exits the controller interface.
Step 8	**interface ATM** *slot/subslot/* **IMA** *group-number* **Example:** `Router(config-if)# interface atm0/1/ima0`	Specify the slot location and port of IMA interface group. • *slot*—The location of the ATM IMA interface module. • *group-number*—The IMA group. **Note** To explicitly configure the IMA group ID for the IMA interface, use the optional **ima group-id** command. You cannot configure the same IMA group ID on two different IMA interfaces; therefore, if you configure an IMA group ID with the system-selected default ID already configured on an IMA interface, the system toggles the IMA interface to make the user-configured IMA group ID the effective IMA group ID. The system toggles the original IMA interface to select a different IMA group ID.
Step 9	**no ip address** **Example:** `Router(config-if)# no ip address`	Disables the IP address configuration for the physical layer interface.
Step 10	**atm bandwidth dynamic** **Example:** `Router(config-if)# atm bandwidth dynamic`	Specifies the ATM bandwidth as dynamic.
Step 11	**no atm ilmi-keepalive** **Example:** `Router(config-if)# no atm ilmi-keepalive`	Disables the Interim Local Management Interface (ILMI) keepalive parameters. **Note** ILMI is *not* supported starting with Cisco IOS XE Releease 3.15 on the router.
Step 12	**exit** **Example:** `Router(config)# exit`	Exits configuration mode.

Configuring an ATM over MPLS Pseudowire

ATM over MPLS pseudowires allow you to encapsulate and transport ATM traffic across an MPLS network. This service allows you to deliver ATM services over an existing MPLS network.

The sections below describe how to configure transportation of service using ATM over MPLS:

Configuring the Controller

SUMMARY STEPS

1. Router> **enable**
2. Router# **configure terminal**
3. Router(config)# **card type e1 0 0**
4. Router(config)# **controller E1 0/4**
5. Router(config-controller)# **clock source internal**
6. Router(config-controller)# **ima-group 0**
7. Router(config)# **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	Router> **enable**	Enables privileged EXEC mode.
Step 2	Router# **configure terminal**	Enters global configuration mode.
Step 3	Router(config)# **card type e1 0 0**	Configures IMA on an E1 or T1 interface.
Step 4	Router(config)# **controller E1 0/4**	Specifies the controller interface on which you want to enable IMA.
Step 5	Router(config-controller)# **clock source internal**	Sets the clock source to internal.
Step 6	Router(config-controller)# **ima-group 0**	
Step 7	Router(config)# **exit**	Exits configuration mode.

Configuring an IMA Interface

If you want to use ATM IMA backhaul, follow these steps to configure the IMA interface.

Note You can create a maximum of 16 IMA groups on each T1/E1 interface module.

SUMMARY STEPS

1. Router> **enable**
2. Router# **configure terminal**
3. Router(config-controller)# interface atm0/1/ima0
4. Router(config-if)# **no ip address**
5. Router(config-if)# **atm bandwidth dynamic**

6. Router(config-if)# **no atm ilmi-keepalive**
7. Router(config)# **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	Router> **enable**	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	Router# **configure terminal**	Enters global configuration mode.
Step 3	Router(config-controller)# interface atm0/1/ima0	Specifies the slot location and port of IMA interface group. The syntax is as follows: • *slot*—The slot location of the interface module. • *group-number*—The group number of the IMA group. The example specifies the slot number as 0 and the group number as 0. **Note** o explicitly configure the IMA group ID for the IMA interface, you may use the optional **ima group-id** command. You cannot configure the same IMA group ID on two different IMA interfaces; therefore, if you configure an IMA group ID with the system-selected default ID already configured on an IMA interface, the system toggles the IMA interface to make the user-configured IMA group ID the effective IMA group ID. At the same, the system toggles the original IMA interface to select a different IMA group ID.
Step 4	Router(config-if)# **no ip address**	Disables the IP address configuration for the physical layer interface.
Step 5	Router(config-if)# **atm bandwidth dynamic**	Specifies the ATM bandwidth as dynamic.
Step 6	Router(config-if)# **no atm ilmi-keepalive**	Disables the ILMI keepalive parameters.
Step 7	Router(config)# **exit**	Exits configuration mode. For more information about configuring IMA groups, see the Configuring ATM IMA.

Configuring the ATM over MPLS Pseudowire Interface

You can configure ATM over MPLS is several modes according to the needs of your network. Use the appropriate section according to the needs of your network. The sections below show configuration of ATM over MPLS pseudowire types:

Note Release 15.1(1)MR does not support N-to-1 VCC Cell Transport for mapping multiple PVCs, 1-to-1 VCC Cell Mode, or PVC mapping.

Note When creating IP routes for a pseudowire configuration, build a route from the xconnect address (LDP router-id or loopback address) to the next hop IP address, such as **ip route 30.30.30.2 255.255.255.255 1.2.3.4**.

Configuring 1-to-1 VCC Cell Transport Pseudowire

A 1-to-1 VCC cell transport pseudowire maps one ATM virtual channel connection (VCC) to a single pseudowire. Complete these steps to configure a 1-to-1 pseudowire.

Note Multiple 1-to-1 VCC pseudowire mapping on an interface is supported.

Mapping a Single PVC to a Pseudowire

To map a single PVC to an ATM over MPLS pseudowire, use the **xconnect** command at the PVC level. This configuration type uses AAL0 and AAL5 encapsulations. Complete these steps to map a single PVC to an ATM over MPLS pseudowire.

Note Release 15.1(1)MR does not support mapping multiple VCCs to a pseudowire.

SUMMARY STEPS

1. Router> **enable**
2. Router# **configure terminal**
3. Router(config)# **interface atm0/1/ima0**
4. Router(config-if-atm)# **pvc 10/20 l2transport**
5. Router(config-if-atm-l2trans-pvc)# **encapsulation aal0**
6. Router(config-if-atm-l2trans-pvc)# **xconnect 10.0.0.1 40 encapsulation mpls**
7. Router(config-if-atm-l2trans-pvp-xconn)# **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	Router> **enable**	Enables privileged EXEC mode.
Step 2	Router# **configure terminal**	Enters global configuration mode.
Step 3	Router(config)# **interface atm0/1/ima0**	Configures the ATM IMA interface.
Step 4	Router(config-if-atm)# **pvc 10/20 l2transport**	Defines a PVC. Use the **l2transport** keyword to configure the PVC as a layer 2 virtual circuit.
Step 5	Router(config-if-atm-l2trans-pvc)# **encapsulation aal0**	Defines the encapsulation type for the PVC. The default encapsulation type for the PVC is AAL5.
Step 6	Router(config-if-atm-l2trans-pvc)# **xconnect 10.0.0.1 40 encapsulation mpls**	Binds an attachment circuit to the ATM IMA interface to create a pseudowire. This example creates a pseudowire by binding PVC 40 to the remote peer 10.0.0.1.
Step 7	Router(config-if-atm-l2trans-pvp-xconn)# **end**	Exits configuration mode.

Configuring N-to-1 VCC Cell Transport Pseudowire

An N-to-1 VCC cell transport pseudowire maps one or more ATM virtual channel connections (VCCs) to a single pseudowire. Complete these steps to configure an N-to-1 pseudowire.

SUMMARY STEPS

1. Router> **enable**
2. Router# **configure terminal**
3. Router(config)# interface atm0/1/1.1 multipoint
4. Router(config-subif)# **xconnect 10.0.0.1 40 encapsulation mpls**
5. Router(config-subif-xconn)# **pvc 10/20 l2transport**
6. **Router(**config-**if-atm-l2trans-pvc)# pvc 0/41 l2transport**
7. **Router (**config-**if-atm-l2trans-pvc)# end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	Router> **enable**	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	Router# **configure terminal**	Enters global configuration mode.
Step 3	Router(config)# interface atm0/1/1.1 multipoint	Configures the ATM multipoint interface.
Step 4	Router(config-subif)# **xconnect 10.0.0.1 40 encapsulation mpls**	Creates a pseudowire on an ATM interface. This example creates a pseudowire to the remote peer 10.0.0.1.

	Command or Action	Purpose
Step 5	Router(config-subif-xconn)# **pvc 10/20 l2transport**	Defines the first PVC 0/40 and maps it under the pseudowire created in Step 4. Use the **l2transport** keyword to configure the PVC as a layer 2 virtual circuit.
Step 6	**Router(**config-**if-atm-l2trans-pvc)# pvc 0/41 l2transport**	Defines the second PVC 0/41 and maps it under the pseudowire created in Step 4. Use the **l2transport** keyword to configure the PVC as a layer 2 virtual circuit.
Step 7	**Router (**config-**if-atm-l2trans-pvc)# end**	Exits configuration mode.

Configuring 1-to-1 VPC Cell Transport

A 1-to-1 VPC cell transport pseudowire maps one or more virtual path connections (VPCs) to a single pseudowire. While the configuration is similar to 1-to-1 VPC cell mode, this transport method uses the 1-to-1 VPC pseudowire protocol and format defined in RFCs 4717 and 4446. Complete these steps to configure a 1-to-1 VPC pseudowire.

Note Multiple 1-to-1 VCC pseudowire mapping on an interface is supported.

SUMMARY STEPS

1. Router> **enable**
2. Router# **configure terminal**
3. Router(config)# **interface atm0/1/ima0**
4. Router(config-if-atm)# **atm pvp 10 l2transport**
5. Router(config-if-atm-l2trans-pvp)# **xconnect 30.30.30.2 305 encapsulation mpls**
6. Router(config-if-atm-l2trans-pvp-xconn)# **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	Router> **enable**	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	Router# **configure terminal**	Enters global configuration mode.
Step 3	Router(config)# **interface atm0/1/ima0**	Configures the ATM IMA interface.
Step 4	Router(config-if-atm)# **atm pvp 10 l2transport**	Maps a PVP to a pseudowire.
Step 5	Router(config-if-atm-l2trans-pvp)# **xconnect 30.30.30.2 305 encapsulation mpls**	Binds an attachment circuit to the ATM IMA interface to create a pseudowire. This example creates a pseudowire by binding the ATM circuit 305 to the remote peer 30.30.30.2.

	Command or Action	Purpose
Step 6	Router(config-if-atm-l2trans-pvp-xconn)# **end**	Exits the configuration mode.

Configuring ATM AAL5 SDU VCC Transport

An ATM AAL5 SDU VCC transport pseudowire maps a single ATM PVC to another ATM PVC.

SUMMARY STEPS

1. Device> **enable**
2. Device# **configure terminal**
3. Device(config)# **interface atm** *0/1/***ima***0*
4. Device(config-if)# **pvc 0/12 l2transport**
5. Device(config-if-atm-l2trans-pvc)# **encapsulation aal5**
6. Device(config-if-atm-l2trans-pvc)# **xconnect 25.25.25.25 125 encapsulation mpls**
7. Device(config)# **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	Device> **enable**	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	Device# **configure terminal**	Enters global configuration mode.
Step 3	Device(config)# **interface atm** *0/1/***ima***0*	Configures the ATM IMA interface.
Step 4	Device(config-if)# **pvc 0/12 l2transport**	Configures a PVC and specifies a VCI or VPI.
Step 5	Device(config-if-atm-l2trans-pvc)# **encapsulation aal5**	Sets the PVC encapsulation type to AAL5. **Note** You must use the AAL5 encapsulation for this transport type.
Step 6	Device(config-if-atm-l2trans-pvc)# **xconnect 25.25.25.25 125 encapsulation mpls**	Binds an attachment circuit to the ATM IMA interface to create a pseudowire. This example creates a pseudowire by binding the ATM circuit 125 to the remote peer 25.25.25.25.
Step 7	Device(config)# **exit**	Exits configuration mode.

Configuring Cell Packing (Optional)

You can apply the following optional configurations to a pseudowire link.

Cell packing allows you to improve the efficiency of ATM-to-MPLS conversion by packing multiple ATM cells into a single MPLS packet.

SUMMARY STEPS

1. Device> **enable**
2. Device# **configure terminal**
3. Device(config)# **int atm1/0/1.1**
4. Device(config-if)# **atm mcpt-timers 1000 2000 3000**
5. Device(config)# **pvc 0/11 l2transport**
6. Device(config-if-atm-l2trans-pvc)# **encapsulation aal0**
7. Device(config-if-atm-l2trans-pvc)# **cell-packing 20 mcpt-timer 3**
8. Device(config-if-atm-l2trans-pvc)# **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	Device> **enable**	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	Device# **configure terminal**	Enters global configuration mode.
Step 3	Device(config)# **int atm1/0/1.1**	Configures the ATM interface.
Step 4	Device(config-if)# **atm mcpt-timers 1000 2000 3000**	Defines the three Maximum Cell Packing Timeout (MCPT) timers under an ATM interface. The three independent MCPT timers specify a wait time before forwarding a packet.
Step 5	Device(config)# **pvc 0/11 l2transport**	
Step 6	Device(config-if-atm-l2trans-pvc)# **encapsulation aal0**	
Step 7	Device(config-if-atm-l2trans-pvc)# **cell-packing 20 mcpt-timer 3**	Specifies the maximum number of cells in PW cell pack and the cell packing timer that the Cisco ASR 903 Series Router uses. This example specifies 20 cells per pack and the third MCPT timer.
Step 8	Device(config-if-atm-l2trans-pvc)# **end**	Exits the configuration mode.

Example: ATM IMA Configuration

The following example shows how to add a T1/E1 interface to an ATM IMA group as a part of an ATM over MPLS pseudowire configuration. For more information about how to configure pseudowires, see Configuring Pseudowire

Note This section displays a partial configuration intended to demonstrate a specific feature.

```
controller t1 0/0/0
 ima-group 0
```

```
 clock source line

interface atm 0/0/ima0.1 point-to-point
 pvc 1/33 l2transport
  encapsulation aal0
  xconnect 10.0.0.1 33 encapsulation mpls
```

Example: ATM over MPLS

VC Mode for Cell Packing Configuration

CE 1 Configuration

```
interface Gig 1/1/0
no negotiation auto
load-interval 30

interface Gig 0/1/0
ip address 20.1.1.1 255.255.255.0
interface ATM4/2/4
no shut
exit
!
interface ATM 1/1/4.10 point
ip address 50.1.1.1 255.255.255.0
pvc 20/101
encapsulation aal5snap
!
ip route 30.1.1.2 255.255.255.255 50.1.1.2
```

CE 2 Configuration

```
interface Gig 1/0/1
no negotiation auto
load-interval 30

interface Gig 0/1/1
ip address 30.1.1.1 255.255.255.0
interface ATM6/2/1
no shut

!
interface ATM 1/0/1.10 point
ip address 50.1.1.2 255.255.255.0
pvc 20/101
encapsulation aal5snap


!
ip route 20.1.1.2 255.255.255.255 50.1.1.1
```

PE 1 Configuration

```
interface Loopback0
ip address 192.168.37.3 255.255.255.255

!
```

```
interface ATM 0/0/1
no shut

!
interface ATM 0/0/1
atm mcpt-timers 150 1000 4095

interface ATM 0/0/0.10 point
pvc 20/101 l2transport
encapsulation aal0
cell-packing 20 mcpt-timer 1
xconnect 192.168.37.2 100 encapsulation mpls

!
interface Gig 0/1/0
no shut
ip address 40.1.1.1 255.255.0.0
mpls ip

!
mpls ip
mpls label protocol ldp
mpls ldp router-id Loopback0 force
mpls ldp graceful-restart

router ospf 1
network 40.1.0.0 0.0.255.255 area 1
network 192.168.37.0 0.0.0.255 area 1
nsf
```

PE 2 Configuration

```
interface Loopback0
ip address 192.168.37.2 255.255.255.255
!
interface ATM 0/1/1
no shut

!
interface ATM 0/1/1
atm mcpt-timers 150 1000 4095

interface ATM 0/1/1.10 point
pvc 20/101 l2transport
encapsulation aal0
cell-packing 20 mcpt-timer 1
xconnect 192.168.37.3 100 encapsulation mpls



!
interface Gig 1/1
no shut
ip address 40.1.1.2 255.255.0.0
mpls ip

!
mpls ip
mpls label protocol ldp
mpls ldp router-id Loopback0 force
mpls ldp graceful-restart

router ospf 1
```

```
network 40.1.0.0 0.0.255.255 area 1
network 192.168.37.0 0.0.0.255 area 1
nsf
```

VP Mode for Cell Packing Configuration

CE 1 Configuration

```
interface Gig 0/1/0
no negotiation auto
load-interval 30

interface Gig 0/1/0
ip address 20.1.1.1 255.255.255.0
interface ATM4/2/4


!
interface ATM 0/1/4.10 point
ip address 50.1.1.1 255.255.255.0
pvc 20/101
encapsulation aal5snap
!
ip route 30.1.1.2 255.255.255.255 50.1.1.2
```

CE 2 Configuration

```
!
interface Gig 1/1
no negotiation auto
load-interval 30

interface Gig 1/1
ip address 30.1.1.1 255.255.255.0
interface ATM6/2/1
no shut

!
interface ATM 1/0/1.10 point
ip address 50.1.1.2 255.255.255.0
pvc 20/101
encapsulation aal5snap


!
ip route 20.1.1.2 255.255.255.255 50.1.1.1
```

PE 1 Configuration

```
interface Loopback0
ip address 192.168.37.3 255.255.255.255

!
interface ATM 0/0/0
no shut

!
interface ATM 0/0/0
atm mcpt-timers 150 1000 4095
```

```
interface ATM 0/0/0.50 multipoint
atm pvp 20 l2transport
cell-packing 10 mcpt-timer 1
xconnect 192.168.37.2 100 encapsulation mpls



!
interface Gig 0/1/0
no shut
ip address 40.1.1.1 255.255.0.0
mpls ip

!
mpls ip
mpls label protocol ldp
mpls ldp router-id Loopback0 force
mpls ldp graceful-restart

router ospf 1
network 40.1.0.0 0.0.255.255 area 1
network 192.168.37.0 0.0.0.255 area 1
nsf
```

PE 2 Configuration

```
!
interface Loopback0
ip address 192.168.37.2 255.255.255.255

!
interface ATM 0/1/1
no shut

!
interface ATM 0/1/1
atm mcpt-timers 150 1000 4095

interface ATM 0/1/1.50 multipoint
atm pvp 20 l2transport
cell-packing 10 mcpt-timer 1
xconnect 192.168.37.3 100 encapsulation mpls



!
interface Gig 1/1
no shut
ip address 40.1.1.2 255.255.0.0
mpls ip

!
mpls ip
mpls label protocol ldp
mpls ldp router-id Loopback0 force
mpls ldp graceful-restart

router ospf 1
network 40.1.0.0 0.0.255.255 area 1
network 192.168.37.0 0.0.0.255 area 1
nsf
```

VC Mode for Cell Relay Configuration

CE 1 Configuration

```
!
interface gigabitethernet 0/1/0
no negotiation auto
load-interval 30

interface gigabitethernet 0/1/0
ip address 20.1.1.1 255.255.255.0
!
interface ATM 1/0/4
!
interface ATM 1/0/4.10 point
ip address 50.1.1.1 255.255.255.0
pvc 20/101
encapsulation aal5snap
!
ip route 30.1.1.2 255.255.255.255 50.1.1.2
!
```

CE 2 Configuration

```
interface gigabitethernet 1/0
no negotiation auto
load-interval 30

interface gigabitethernet 1/0
ip address 30.1.1.1 255.255.255.0
interface ATM6/2/1
!
interface ATM 1/0/1.10 point
ip address 50.1.1.2 255.255.255.0
pvc 20/101
encapsulation aal5snap
!
ip route 20.1.1.2 255.255.255.255 50.1.1.1
```

PE 1 Configuration

```
!
interface Loopback0
ip address 192.168.37.3 255.255.255.255
!
interface ATM0/0/0
!

interface ATM 0/0/0.10 point
pvc 20/101 l2transport
encapsulation aal0
xconnect 192.168.37.2 100 encapsulation mpls
!
interface gigabitethernet 0/1/0
ip address 40.1.1.1 255.255.0.0
mpls ip

!
mpls ip
mpls label protocol ldp
```

```
mpls ldp router-id Loopback0 force
mpls ldp graceful-restart

router ospf 1
network 40.1.0.0 0.0.255.255 area 1
network 192.168.37.0 0.0.0.255 area 1
nsf
```

PE 2 Configuration

```
!
interface Loopback0
ip address 192.168.37.2 255.255.255.255
!
interface ATM 0/1/1
!
interface ATM 0/1/1.10 point
pvc 20/101 l2transport
encapsulation aal0
xconnect 192.168.37.3 100 encapsulation mpls

!
interface gigabitethernet 1/0
ip address 40.1.1.2 255.255.0.0
mpls ip
!
mpls ip
mpls label protocol ldp
mpls ldp router-id Loopback0 force
mpls ldp graceful-restart

router ospf 1
network 40.1.0.0 0.0.255.255 area 1
network 192.168.37.0 0.0.0.255 area 1
nsf
```

VP Mode for Cell Relay Configuration

CE 1 Configuration

```
!
interface gigabitethernet 1/0/0
no negotiation auto
load-interval 30

interface gigabitethernet 1/1/0
ip address 20.1.1.1 255.255.255.0
!
interface ATM 1/0/4
!
interface ATM 1/0/4.10 point
ip address 50.1.1.1 255.255.255.0
pvc 20/101
encapsulation aal5snap
!
ip route 30.1.1.2 255.255.255.255 50.1.1.2
```

CE 2 Configuration

```
!
```

```
interface gigabitethernet 1/0
no negotiation auto
load-interval 30

interface gigabitethernet 1/0
ip address 30.1.1.1 255.255.255.0
interface ATM 1/0/1
!
interface ATM 1/0/1.10 point
ip address 50.1.1.2 255.255.255.0
pvc 20/101
encapsulation aal5snap
!
ip route 20.1.1.2 255.255.255.255 50.1.1.1
```

PE 1 Configuration

```
interface Loopback0
ip address 192.168.37.3 255.255.255.255
!
!
interface ATM 0/0/0

interface ATM 0/0/0.50 multipoint
atm pvp 20 l2transport
xconnect 192.168.37.2 100 encapsulation mpls
!
interface gigabitethernet 0/1/0
ip address 40.1.1.1 255.255.0.0
mpls ip

!
mpls ip
mpls label protocol ldp
mpls ldp router-id Loopback0 force
mpls ldp graceful-restart

router ospf 1
network 40.1.0.0 0.0.255.255 area 1
network 192.168.37.0 0.0.0.255 area 1
nsf
```

PE 2 Configuration

```
interface Loopback0
ip address 192.168.37.2 255.255.255.255
!
!
interface ATM 1/0/1

interface ATM 1/0/1.50 multipoint
atm pvp 20 l2transport
xconnect 192.168.37.3 100 encapsulation mpls
!
interface gigabitethernet 1/1
ip address 40.1.1.2 255.255.0.0
mpls ip
!
mpls ip
mpls label protocol ldp
mpls ldp router-id Loopback0 force
```

```
mpls ldp graceful-restart

router ospf 1
network 40.1.0.0 0.0.255.255 area 1
network 192.168.37.0 0.0.0.255 area 1
nsf
```

Configuring ATM AAL5 over MPLS Pseudowire on a Sonet Controller

This section describes how to configure the ATM adaptation layer 5 (AAL5) over Multiprotocol Label Switching (MPLS) pseudowire on a Sonet controller.

To configure ATM AAL5 over MPLS on a SONET controller, use the following commands beginning privileged EXEC mode:

SUMMARY STEPS

1. **configure terminal**
2. **controller sonet** *slot/subslot/port*
3. **framing sdh**
4. Router(config-controller)# **aug mapping au-4**
5. **au-4** *au-4-number* **tug-3** *tug-3-number*
6. **tug-2** *tug-2-number* **e1** *e1-line-number* **atm**
7. **exit**
8. **interface atm** *slot/subslot/port.sts-1/vtg/t1.subpoint* **point-to-point**
9. **pvc** *vpi/vci* **l2transport**
10. **encapsulation aal5**
11. **xconnect** *remote-pe-loopback ip vcid* **encapsulation mpls**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode from the terminal.
Step 2	**controller sonet** *slot/subslot/port* **Example:** `Device(config)# controller sonet 0/1/0`	Enters controller configuration mode to configure the SONET controller.
Step 3	**framing sdh**	Specifies the framing type as Synchronous Digital Hierarchy (SDH).
Step 4	Router(config-controller)# **aug mapping au-4**	Configures the AUG to be derived from AU-4.

	Command or Action	Purpose
Step 5	**au-4** *au-4-number* **tug-3** *tug-3-number* **Example:** `Device(config-controller)# au-4 1 tug-3 1`	Specifies the Administrative Unit type 4 (AU-4) and Tributary Unit group type 3 (TUG-3) numbers.
Step 6	**tug-2** *tug-2-number* **e1** *e1-line-number* **atm** **Example:** `Device(config-ctrlr-tug3)# tug-2 1 e1 1 atm`	Creates an ATM group for the AU-4
Step 7	**exit**	Exits to global configuration mode.
Step 8	**interface atm** *slot/subslot/port.sts-1/vtg/t1.subpoint.* **point-to-point** **Example:** `Device(config)# interface atm 0/0/0.1/1/1/1.2 point-to-point`	Enters subinterface configuration mode pertaining to the specified subinterface and specifies a point-to-point subinterface.
Step 9	**pvc** *vpi/vci* **l2transport** **Example:** `Device(config-subif)# pvc 10/100 l2transport`	Creates an ATM permanent virtual circuit (PVC) and enters Layer 2 transport ATM virtual circuit configuration submode.
Step 10	**encapsulation aal5**	Specifies ATM AAL5 encapsulation for the PVC.
Step 11	**xconnect** *remote-pe-loopback ip vcid* **encapsulation mpls** **Example:** `Device(cfg-if-atm-l2trans-pvc)# xconnect 203.0.113.5 501 encapsulation mpls`	Binds the attachment circuit to a pseudowire VC.

Configuring ATM AAL5 over MPLS Pseudowire on T1 Controller

This section describes how to configure the ATM adaptation layer 5 (AAL5) over Multiprotocol Label Switching (MPLS) pseudowire on a T1 controller.

To configure ATM AAL5 over MPLS on a T1 controller, use the following commands beginning privileged EXEC mode:

SUMMARY STEPS

1. Router# **configure terminal**
2. Router(config)# **controller t1** *slot/subslot/port*
3. Router(config-controller)# **atm**
4. Router(config)# **interface atm** *slot/subslot/port* **point-to-point**
5. Router(config-subif)# **pvc** *vpi/vci* **l2transport**
6. Router(cfg-if-atm-l2trans-pvc)# **encapsulation aal5**
7. Router(cfg-if-atm-l2trans-pvc)# **xconnect** *peer-router-id vcid* **encapsulation mpls**

DETAILED STEPS

	Command or Action	Purpose
Step 1	Router# **configure terminal**	Enters global configuration mode from the terminal.
Step 2	Router(config)# **controller t1** *slot/subslot/port* **Example:** `Router(config)# controller t1 0/1/0`	Enters the controller configuration mode.
Step 3	Router(config-controller)# **atm**	Configures the T1 interface for ATM.
Step 4	Router(config)# **interface atm** *slot/subslot/port* **point-to-point** **Example:** `Router(config)# interface atm 0/1/0.10 point-to-point`	Configures a subinterface and point-to-point as the interface type.
Step 5	Router(config-subif)# **pvc** *vpi/vci* **l2transport** **Example:** `Router(config-subif)# pvc 10/100 l2transport`	Creates an ATM permanent virtual circuit (PVC) and enters Layer 2 transport ATM virtual circuit configuration submode.
Step 6	Router(cfg-if-atm-l2trans-pvc)# **encapsulation aal5**	Specifies ATM AAL5 encapsulation for the PVC.
Step 7	Router(cfg-if-atm-l2trans-pvc)# **xconnect** *peer-router-id vcid* **encapsulation mpls** **Example:** `Router(cfg-if-atm-l2trans-pvc)# xconnect 203.0.113.5 501 encapsulation mpls`	Binds the attachment circuit to a pseudowire VC.

Configuring Service Classes on a PVC

This section describes how to configure different classes of service on a PVC.

To configure the configure different classes of service on a PVC, use the following commands beginning privileged EXEC mode:

SUMMARY STEPS

1. Router# **configure terminal**
2. Router(config)# **controller t1** *slot/subslot/port*
3. Router(config-controller)# **atm**
4. Router(config)# **interface atm** *slot/subslot/port* **point-to-point**
5. Router(config-subif)# **pvc** *vpi/vci* **l2transport**
6. Router(cfg-if-atm-l2trans-pvc)# {**cbr** | **ubr** | **ubr+** | **vbr-nrt** | **vbr-rt**}

- Constant Bit Rate (CBR)—The CBR service class is designed for ATM virtual circuits (VCs) that need a static amount of bandwidth that is continuously available for the duration of the active connection.
- Unspecified Bit Rate (UBR)—This is a service class where the network management makes no Quality of Service (QoS) commitment. It models the best-effort service that the Internet normally provides and is suitable for applications tolerant to delay and does not require real-time responses.
- Unspecified Bit Rate Plus—UBR+ supports a zero committed information rate (CIR) with infinite burst capabilities up to an entire T1. It allows any available network bandwidth to be continuously usable by any data application.
- Variable Bit Rate Non-Real Time VBR-nrt service class is used in order to transmit non-real-time applications that are bursty in nature.
- Variable Bit Rate Real Time—VBR-rt service class is used in order to transmit real-time data that is sensitive to time delays.

DETAILED STEPS

	Command or Action	Purpose
Step 1	Router# **configure terminal**	Enters global configuration mode from the terminal.
Step 2	Router(config)# **controller t1** *slot/subslot/port* **Example:** `Router(config)# controller t1 0/1/0`	Enters the controller configuration mode.
Step 3	Router(config-controller)# **atm**	Configures the T1 interface for ATM.
Step 4	Router(config)# **interface atm** *slot/subslot/port* **point-to-point** **Example:** `Router(config)# interface atm 0/1/0.10 point-to-point`	Configures a subinterface and point-to-point as the interface type.
Step 5	Router(config-subif)# **pvc** *vpi/vci* **l2transport** **Example:** `Router(config-subif)# pvc 10/100 l2transport`	Creates an ATM permanent virtual circuit (PVC) and enters Layer 2 transport ATM virtual circuit configuration submode.
Step 6	Router(cfg-if-atm-l2trans-pvc)# {**cbr** | **ubr** | **ubr+** | **vbr-nrt** | **vbr-rt**} • Constant Bit Rate (CBR)—The CBR service class is designed for ATM virtual circuits (VCs) that need a static amount of bandwidth that is continuously available for the duration of the active connection. • Unspecified Bit Rate (UBR)—This is a service class where the network management makes no Quality of Service (QoS) commitment. It models the best-effort service that the Internet normally provides and is suitable for applications tolerant to delay and does not require real-time responses.	Configures a service class on a PVC. These are the available options:

	Command or Action	Purpose
	• Unspecified Bit Rate Plus—UBR+ supports a zero committed information rate (CIR) with infinite burst capabilities up to an entire T1. It allows any available network bandwidth to be continuously usable by any data application. • Variable Bit Rate Non-Real Time VBR-nrt service class is used in order to transmit non-real-time applications that are bursty in nature. • Variable Bit Rate Real Time—VBR-rt service class is used in order to transmit real-time data that is sensitive to time delays. **Example:** `Router(cfg-if-atm-l2trans-pvc)# cbr`	

Configuring ATM AAL5 L3 Termination on a SONET Controller

This section describes how to configure the ATM AAL5 layer 3 termination on a SONET controller. This allows the use of multiple protocols over the same VC.

To configure the ATM AAL5 layer 3 termination on a SONET controller, use the following commands beginning privileged EXEC mode:

SUMMARY STEPS

1. Router# **configure terminal**
2. Router(config)# **controller sonet** *slot/subslot/port*
3. Router(config-controller)# **framing sdh**
4. Router(config-controller)# **aug mapping au-4**
5. Router(config-controller)# **au-4** *au-4-number* **tug-3** *tug-3-number*
6. Router(config-ctrlr-tug3)# **tug-2** *tug-2-number* **e1** *e1-line-number* **atm**
7. **exit**
8. Do one of the following:
   - Router(config)# **interface atm** *interface-path-id* **point-to-point**
   - Router(config)# **interface atm** *port.port-adapter.subinterface-numberinterface-path-id.subinterface* **point-to-point**
9. Router(config-subif)# **ip address** *ip-address subnet-mask*
10. Router(config-subif)# **pvc** *vpi/vci*
11. Router(cfg-if-atm-vc)# **encapsulation aal5snap**

DETAILED STEPS

	Command or Action	Purpose
Step 1	Router# **configure terminal**	Enters global configuration mode from the terminal.

	Command or Action	Purpose
Step 2	Router(config)# **controller sonet** *slot/subslot/port* **Example:** `Router(config)# controller sonet 0/1/0`	Enters controller configuration mode to configure the SONET controller.
Step 3	Router(config-controller)# **framing sdh**	Specifies the framing type as Synchronous Digital Hierarchy (SDH).
Step 4	Router(config-controller)# **aug mapping au-4**	Configures the AUG to be derived from AU-4.
Step 5	Router(config-controller)# **au-4** *au-4-number* **tug-3** *tug-3-number* **Example:** `Router(config-controller)# au-4 1 tug-3 1`	Specifies the Administrative Unit type 4 (AU-4) and Tributary Unit group type 3 (TUG-3) numbers.
Step 6	Router(config-ctrlr-tug3)# **tug-2** *tug-2-number* **e1** *e1-line-number* **atm** **Example:** `Router(config-ctrlr-tug3)# tug-2 1 e1 1 atm`	Creates an ATM group for the AU-4
Step 7	**exit**	Exits to global configuration mode.

Step 8	Do one of the following:
	• Router(config)# **interface atm** *interface-path-id* **point-to-point**
	• Router(config)# **interface atm** *port.port-adapter.subinterface-number interface-path-id.subinterface* **point-to-point**
	Example:
	`Router(config)# interface atm 0/0/0.1/1/1/1 point-to-point`
	`Router(config)# interface atm 0/0/0.1/1/1/1.2 point-to-point`
		Specifies the ATM interface using the appropriate format of the **interface atm** command. You can configure a port or a subport.

Step 9	Router(config-subif)# **ip address** *ip-address subnet-mask* **Example:** `Router(config-subif)# ip address 203.0.113.2 255.255.255.0`	Configures an IP address to the ATM interface.
Step 10	Router(config-subif)# **pvc** *vpi/vci* **Example:** `pvc 10/100`	Creates an ATM permanent virtual circuit (PVC).
Step 11	Router(cfg-if-atm-vc)# **encapsulation aal5snap**	Specifies ATM AAL5 encapsulation for the PVC.

Configuring ATM AAL5 Layer 3 Termination on a T1 Controller

This section describes how to configure the ATM AAL5 layer 3 termination on a T1 controller. This feature enables the Cisco ASR 903 router to process the ATM packets so that the ATM packets can terminate at the router.

To configure the ATM AAL5 layer 3 termination on a T1 controller, use the following commands beginning privileged EXEC mode:

SUMMARY STEPS

1. Router# **configure terminal**
2. Router(config)# **controller t1** *slot/subslot/port*
3. Router(config-controller)# **atm**
4. exit
5. Do one of the following:
   - Router(config)# **interface atm** *slot/subslot/port.subinterface* **point-to-point**
   - Router(config)# **interface atm** *slot/subslot/port*
6. Router(config-subif)# **ip address** *ip-address subnet-mask*
7. Router(config-subif)# **pvc** *vpi/vci*
8. Router(cfg-if-atm-vc)# **encapsulation aal5snap**

DETAILED STEPS

	Command or Action	Purpose
Step 1	Router# **configure terminal**	Enters global configuration mode from the terminal.
Step 2	Router(config)# **controller t1** *slot/subslot/port* **Example:** `Router(config)# controller t1 0/1/0`	Enters the controller configuration mode and configures the t1 controller.
Step 3	Router(config-controller)# **atm**	Configures the T1 interface for ATM.
Step 4	exit	Exits to global configuration mode.

Step 5	Do one of the following:
	• Router(config)# **interface atm** *slot/subslot/port.subinterface* **point-to-point**
	• Router(config)# **interface atm** *slot/subslot/port*
	Example:
	`Router(config)# interface atm 0/1/0.10 point-to-point`
	`Router(config)# interface atm 0/1/1 point-to-point`
		Specifies the ATM interface using the appropriate format of the **interface atm** command. You can configure a port or a subport.

	Command or Action	Purpose
Step 6	Router(config-subif)# **ip address** *ip-address subnet-mask* **Example:** `ip address 203.0.113.1 255.255.255.0`	Configures an IP address to the ATM interface.
Step 7	Router(config-subif)# **pvc** *vpi/vci* **Example:** `Router(config-subif)# pvc 10/100`	Creates an ATM permanent virtual circuit (PVC).
Step 8	Router(cfg-if-atm-vc)# **encapsulation aal5snap**	Specifies ATM AAL5 encapsulation for the PVC.

Example QoS Exp Marking on ATM Layer 2 Interfaces

This section provides examples for configuring QoS Exp Marking on ATM Layer 2 Interfaces.

Example Configuring QoS Exp Marking on PVC Pseudowire

The following example shows how to configure QoS Exp Marking on PVC Pseudowire.

```
Policy-map mark_exp_5
class class-default
set mpls exp imposition 5
interface atm 0/1/1 point-to-point
pvc 10/100 l2transport
xconnect 10.0.0.1 200 encapsulation mpls
service-policy input mark_exp_5
pvc 20/111 l2transport
xconnect 10.0.0.1 200 encapsulation mpls
service-policy input mark_exp_5
```

Example Configuring QoS Exp Marking on PVP Pseudowire

The following example shows how to configure QoS Exp Marking on PVP Pseudowire.

```
Policy-map mark_exp_5
class class-default
set mpls exp imposition 5
interface ATM0/1/2
atm pvp 10 l2 transport
xonnect 10.0.0.1 400 encapsulation mpls
service-policy input mark_exp_5
```

Example Configuring QoS Exp Marking on N:1 Pseudowire

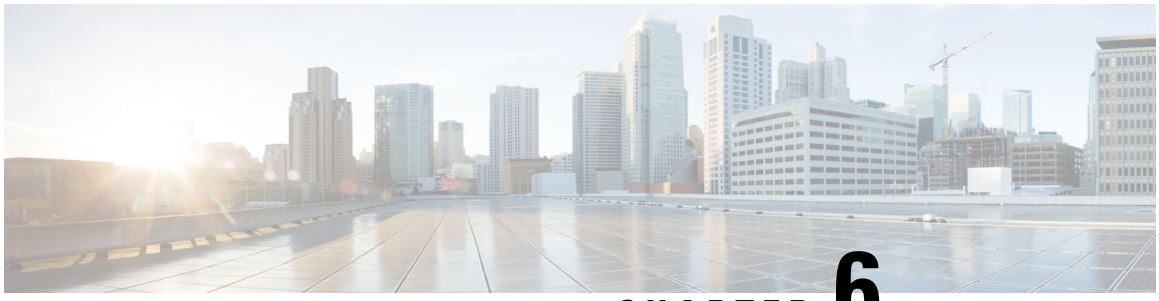
The following example shows how to configure QoS Exp Marking on N:1 Pseudowire.

```
Policy-map mark_exp_5
class class-default
set mpls exp imposition 5
interface atm 0/3/2.1 multipoint
xconnect 11.1.1.1 400 encapsulation mpls
service-policy input mark_exp_5
pvc 10/122
pvc 120/122
```

PE Configuration Example Configuring Cell Packing

The following example shows how to configure Cell Packing.

```
interface ATM0/4/11
no ip address
atm mcpt-timers 51150 51150 51150
no atm enable-ilmi-trap
end
interface ATM0/4/11.1 multipoint
no atm enable-ilmi-trap
cell-packing 28 mcpt-timer 1
xconnect 11.11.11.11 30 encapsulation mpls
pvc 20/10 l2transport
!
pvc 21/11 l2transport
!
pvc 22/12 l2transport
!
pvc 23/13 l2transport
!
pvc 24/14 l2transport
!
pvc 25/15 l2transport
!
pvc 26/16 l2transport
!
pvc 27/17 l2transport
```



CHAPTER 6

Pseudowire Group Switchover Configuration

This chapter provides information about the Pseudowire Group Switchover feature on the Cisco ASR 903 Router.

Prerequisites for Pseudowire Group Switchover

- This feature is supported only by Cisco IOS Release 15.3(3)S or later.
- The remote provider edge (PE) router should be capable of sending group status messages.
- Cisco ASR 903 cannot generate pseudowire group status messages. It can only process the message. To use the pseudowire group switchover feature, the Cisco ASR 903 must be connected with a router that supports the sending of group status messages.

Restrictions for Pseudowire Group Switchover

Cisco ASR 903 supports pseudowire group switchover for Ethernet, Asynchronous Transfer Mode (ATM), and T1/E1 circuit emulation (CEM) pseudowires. However, due to current limitations on Cisco ASR 9000, Ethernet pseudowire switchover in less than one second is not supported.

Pseudowire Group Switchover

Currently, pseudowire switchovers to the backup pseudowires occur one by one from IOS to platform dataplane and can take up to four seconds for 1000 pseudowires. The group switchover feature reduces this switchover time by efficiently grouping status messages in both Label Distribution Protocol (LDP) and internal Inter-Process Communications (IPCs). Using group switchover feature, 1000 pseudowires can be switched to their backup pseudowires in less than one second.

Note The Pseudowire Group Switchover feature is enabled by default and cannot be disabled.

Configuring Predictive Switchover

In a Multi-Chassis Link Aggregation Group (MC-LAG) or multichassis LACP (mLACP) scenario, predictive switchover improves the performance when the remote PE router's standby pseudowire advertises down (standby) state to the local PE router. This scenario is also applicable for automatic protection switching (APS) for CEM and ATM.

Without predictive switchover, the active pseudowire has to wait for the standby pseudowire to be up before it does a switchover. With predictive switchover configured, the active pseudowire immediately switches over to the standby pseudowire as soon as the active pseudowire goes down, even if the remote state of the standby pseudowire is standby.

Depending on the requirement, the predictive switchover can be configured using either of the following methods:

Configuring Predictive Switchover on Global Configuration Mode

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **l2vpn**
4. **redundancy predictive enabled**
5. **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	**l2vpn** **Example:** `Router(config)# l2vpn`	Enters Layer 2 VPN (L2VPN) configuration mode. To return to the default behavior, use the no form of this command.
Step 4	**redundancy predictive enabled** **Example:** `Router(config-l2vpn)# redundancy predictive enabled`	Enables redundancy predictive mode. To disable redundancy predictive mode, use the no form of the command. By default, redundancy predictive mode is disabled.

	Command or Action	Purpose
Step 5	**end** **Example:** `Router(config-l2vpn)# end`	Returns to privileged EXEC mode.

Configuring Predictive Switchover on per Cross Connect basis

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **l2vpn xconnect context context-name**
4. **redundancy predictive {enabled | disabled}**
5. **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	**l2vpn xconnect context context-name** **Example:** `Router(config)# l2vpn xconnect context con1`	Creates a L2VPN cross connect context and enters cross connect configuration mode. context-name—Name of the cross connect context. To remove the connection, use the no form of this command.
Step 4	**redundancy predictive {enabled | disabled}** **Example:** `Router(config-xconnect)# redundancy predictive enabled`	Enables redundancy predictive mode. enabled—enables the predictive mode. disabled—disables the predictive mode.
Step 5	**end** **Example:** `Router(config-xconnect)# end`	Returns to privileged EXEC mode.

Verifying Pseudowire Group Switchover Configurations

You can use various **show** commands to view information specific to pseudowire group switchover configurations.

The following example displays information about Any Transport over MPLS (AToM) virtual circuits (VCs):

```
Router# show l2vpn atom vc destination 2.2.2.2 group remote 100663808

                                      Service
Interface Dest Address    VC ID      Type   Name                       Status
--------- --------------- ---------- ------ ------------------------ ----------
pw100041  2.2.2.2         1000       p2p    AT0/5/1.1/1/1.1:10/1000  UP
```

The following example display status of the pseudowire switching point:

```
Router# show l2vpn atom vc destination 2.2.2.2 group remote 100663808 detail

pseudowire100041 is up, VC status is up PW type: ATM AAL5
  Create time: 01:17:42, last status change time: 00:01:55
    Last label FSM state change time: 01:17:41
  Destination address: 2.2.2.2 VC ID: 1000
    Output interface: Gi0/3/3, imposed label stack {16003}
    Preferred path: not configured
    Default path: active
    Next hop: 11.0.0.2
  Member of xconnect service AT0/5/1.1/1/1.1:10/1000, group right
    Associated member AT0/5/1.1/1/1.1 is up, status is up
    Interworking type is Like2Like
    Service id: 0xb6000015
  Signaling protocol: LDP, peer 2.2.2.2:0 up
    Targeted Hello: 10.1.1.1(LDP Id) -> 2.2.2.2, LDP is UP
    Graceful restart: configured and enabled
    Non stop routing: not configured and not enabled
    PWid FEC (128), VC ID: 1000
    Status TLV support (local/remote)         : enabled/supported
      LDP route watch                         : enabled
      Label/status state machine              : established, LruRru
      Local dataplane status received         : No fault
      BFD dataplane status received           : Not sent
      BFD peer monitor status received        : No fault
      Status received from access circuit     : No fault
      Status sent to access circuit           : No fault
      Status received from pseudowire i/f     : No fault
      Status sent to network peer             : No fault
      Status received from network peer       : No fault
      Adjacency status of remote peer         : No fault
  Sequencing: receive disabled, send disabled
  Bindings
    Parameter    Local                          Remote
    ------------ ------------------------------ ------------------------------
    Label        514                            16003
    Group ID     0                              100663808
    Interface                                   ATM0_1_0_0.1
    MTU          4470                           4470
    Control word on (configured: autosense)     on
    PW type      ATM AAL5                       ATM AAL5
    VCCV CV type 0x02                           0x02
                   LSPV [2]                       LSPV [2]
    VCCV CC type 0x02                           0x07
```

```
                RA [2]                          CW [1], RA [2], TTL [3]
  Status TLV   enabled                         supported
SSO Descriptor: 2.2.2.2/1000, local label: 514
Dataplane:
  SSM segment/switch IDs: 4114/4096 (used), PWID: 41
Rx Counters
  24 input transit packets, 1872 bytes
  0 drops, 0 seq err
Tx Counters
  27611 output transit packets, 5466978 bytes
  0 drops
```

The following example lists the active/standby segment pairs associated with each peer IP address and group identifier:

```
Router# show ssm group

Active                  Standby
IP Address          Group ID     Segment/Switch          Segment/Switch
=============================================================================
2.2.2.2           100663808     7384593/7224772         7380496/7228869
```

The following example displays the number of active/standby segment pairs associated with each peer IP address and group identifier :

```
Router# show ssm group 2.1.1.2 6 summary

IP Address          Group ID     Group Members
=============================================
2.2.2.2           100663808              900
```

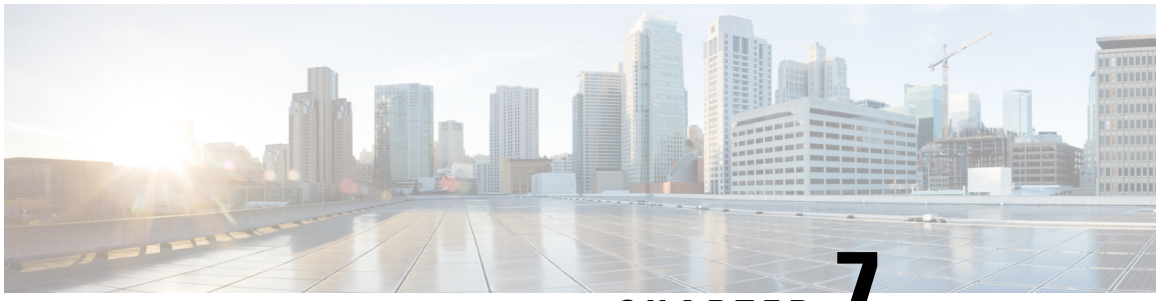
The following example displays the number of pseudowires programmed in hardware with grouping:

```
Router# show platform hardware pp active pw eompls group brief

Brief L2VPN EoMPLS Pseudo Wire Group Info

IP address            Group ID         Count
                                      ------------------------------------------------------
0x02020202            100663808        900
```

Troubleshooting the Pseudowire Group Switchover Configuration

Caution We suggest you do not use the debug command without TAC supervision.

Use the **debug platform software atom brief** command to get details on Add Group, Delete From Group, and Group Switchovers.



CHAPTER 7

Configuring Pseudowire Group Message Generation

Note Pseudowire Group Message Generation is *not* supported on the Cisco ASR 900 RSP3 module.

This chapter provides information about configuring the pseudowire (PW) group message generation feature on Cisco routers.

• Pseudowire Group Message Generation, on page 93

Pseudowire Group Message Generation

The Pseudowire Group Message Generation feature assigns the pseudowire group ID for a group of pseudowires and sends wildcard status notifications or label withdrawal messages for a group.

Prerequisites for Pseudowire Group Message Generation

- The remote provider edge (PE) router must be capable of receiving group status messages.
- Label Distribution Protocol (LDP) must be implemented on the network.

Restrictions for Pseudowire Group Message Generation

The Pseudowire Group Message Generation feature is supported on Cisco IOS XE Release 3.16 and later releases.

- This feature is supported on Cisco Routers on the following attachment circuits:
  - Ethernet VLAN
  - Asynchronous Transfer Mode (ATM)
  - Circuit Emulation over MPLS (CEM)
- Pseudowire group ID is unique and is assigned automatically.

- This feature can only be configured globally rather than for each xconnect.
- Hot Standby Pseudowire (HSPW) has high convergence for Cisco RSP3 Module.

Information About Pseudowire Group Message Generation

The pseudowires associated with a given attachment circuit parent (e.g. physical or port channel) interface are grouped together by assigning a group ID. The group ID is assigned based on port index or virtual tunnel index of the interface. When a fault occurs in a group of pseudowires, a single status message is sent to the remote PE router for that particular group ID. When the status message is received by the remote PE router, it can switch the entire group to the designated backup pseudowires, instead of switching an individual pseudowire, thus reducing switchover time.

The Pseudowire Group Message Generation feature thus enhances recovery performance and scalability by reducing switchover time.

Note The Pseudowire Group Message Generation feature is disabled by default.

Multisegment Pseudowire

An L2VPN multisegment pseudowire (MS-PW) is a set of two or more PW segments that function as a single PW. When a MS-PW is configured, the switching provider edge router (S-PE) assigns Local group IDs to each pseudowire. This group ID is then sent to the terminating provider edge routers (T-PEs). Pseudowire group status messages received from a T-PE are then converted into group status messages for another T-PE by using the locally assigned group ID to prevent replication of group IDs.

Configuring Pseudowire Group Message Generation

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **l2vpn**
4. **pseudowire group status**
5. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.

	Command or Action	Purpose
Step 3	**l2vpn** **Example:** `Device(config)# l2vpn`	Enters l2vpn configuration mode.
Step 4	**pseudowire group status** **Example:** `Device(config-l2vpn)# pseudowire group status`	Sends pseudowire group status messages.
Step 5	**end** **Example:** `Device(config-l2vpn)# end`	Exits l2vpn configuration mode and returns to privileged EXEC mode.

Example for Configuring Pseudowire Group Message

The following example shows how to configure a pseudowire group message:

```
PE1:

Router# show run interface GigabitEthernet0/3/5
Building configuration...

Current configuration: 1623 bytes
!
interface GigabitEthernet0/3/5
 mtu 1504
 no ip address
 carrier-delay msec 0
 negotiation auto
 service instance 100 ethernet
  encapsulation dot1q 100
  xconnect 2.2.2.2 1000 encapsulation mpls
   backup peer 3.3.3.3 1000
   backup delay 0 40

PE2:

Router# show run | section l2vpn
l2vpn
logging pseudowire status
pseudowire group status
```

Verifying a Pseudowire Group Message Configuration

You can use **show** commands to view information about a pseudowire group message configuration.

The following example displays the information about local pseudowire groups and the parent interface state the last time when the pseudowire status was sent:

```
Device# show l2vpn atom group local


Peer Address     Group ID    Status
```

```
-------------   ----------  ---------
10.1.1.1             5          UP
```

The following example displays the count of the number of LDP messages sent and received:

```
Device# show l2vpn atom statistics ldp

Load for five secs: 0%/0%; one minute: 0%; five minutes: 0%
Time source is hardware calendar, *07:36:32.858 PST Wed Dec 10 2014

LDP Message Type          Sent          Received
------------------     -----------     ----------
Label Mapping              10             10
Label Request               0              0
Label Release               0              0
Label Withdraw              0              0
Group Withdraw              0              0
VC Notification            55             20
Group Notification          0              1
```