Configuring Pseudowire

Note Pseudowire configuration is *not* supported on the Cisco ASR 900 RSP3 module.

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.

	Command or Action	Purpose
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.
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.

	Command or Action	Purpose
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.

	Command or Action	Purpose
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 1.1.1.1 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 1.1.1.1 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 1.1.1.1.
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 1.1.1.1 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 1.1.1.1 40 encapsulation mpls	Creates a pseudowire on an ATM interface. This example creates a pseudowire to the remote peer 1.1.1.1.
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.
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 1.1.1.1 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.

	Command or Action	Purpose
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.
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.

	Command or Action	Purpose
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. • 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**	Configures a service class on a PVC. These are the available options:

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 1.1.1.1 200 encapsulation mpls
service-policy input mark_exp_5
pvc 20/111 l2transport
xconnect 1.1.1.1 200 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 1.1.1.1 400 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
```