

Providing Protocol Support for Broadband Access Aggregation of PPP over ATM Sessions

PPP over ATM enables a high-capacity central site router with an ATM interface to terminate multiple remote Point-to-Point Protocol (PPP) connections. PPP over ATM provides security validation per user, IP address pooling, and service selection capability.

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Prerequisites for Providing Protocol Support for Broadband Access Aggregation of PPP over ATM Sessions

Perform the preparation tasks in the "Preparing for Broadband Access Aggregation" module.

Restrictions for Providing Protocol Support for Broadband Access Aggregation of PPP over ATM Sessions

PPP over ATM cannot be configured on IETF-compliant Logical Link Control (LLC) encapsulated PPP over ATM.

Information About Providing Protocol Support for Broadband Access Aggregation of PPP over ATM Sessions

Virtual Access Interface

When you configure PPP over ATM, a logical interface known as a *virtual access interface* associates each PPP connection with an ATM virtual circuit (VC). You can create this logical interface by configuring an ATM permanent virtual circuit (PVC) or switched virtual circuit (SVC). This configuration encapsulates each PPP connection in a separate PVC or SVC, thus allowing each PPP connection to terminate at the ATM interface of a device as if received from a typical PPP serial interface.

After you have configured the device for PPP over ATM, the PPP subsystem starts and the device attempts to send a PPP configuration request to the remote peer. If the peer does not respond, the router periodically goes into a listen state and waits for a configuration request from the peer.

Before you create the ATM VC, we recommend that you create and configure a virtual template as described in the "Preparing for Broadband Access Aggregation" module. When the VC is created, the virtual access interface for each VC obtains the configuration from a virtual interface template (virtual template) .

The virtual access interface is associated with the VC after the completion of the LCP negotiation. When the PPP session goes down, the virtual access interface is no longer associated with the VC and is returned to the pool of free virtual-access interfaces.

If you set a keepalive timer of the virtual template on the interface, the virtual access interface uses the PPP echo mechanism to verify the existence of the remote peer.

The following types of PPP over ATM connections are supported:

- IETF-compliant Multiplex (MUX) encapsulated PPP over ATM
- IETF-compliant LLC encapsulated PPP over ATM

How to Provide Protocol Support for Broadband Access Aggregation of PPP over ATM Sessions

Configuring IETF-Compliant MUX Encapsulated PPP over ATM on Point-to-Point Subinterface

Internet Engineering Task Force (IETF)-compliant multiplexer (MUX) encapsulated PPP over ATM, also known as *null encapsulation* , allows you to configure PPP over ATM using a VC multiplexed encapsulation mode. This feature complies with IETF RFC 2364 entitled PPP over AAL5.

You can configure ATM PVCs for IETF-compliant MUX encapsulated PPP over ATM on either point-to-point or multipoint subinterfaces.

Perform this task to configure IETF-compliant MUX Encapsulated PPP over ATM point-to-point subinterface.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface atm** *number.subinterface-number* **point-to-point**
4. Do one of the following:
   - **pvc** [*name*] *vpi* / *vci*
   -
   - **range** [*range-name*] **pvc** *start-vpi* / *start-vci end-vpi* / *end-vci*
5. **encapsulation aal5mux ppp virtual-template** *number*
6. Do one of the following:
   - **end**

DETAILED STEPS

Procedure

	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** *number.subinterface-number* **point-to-point** **Example:** `Device(config)# interface atm 1.0 point-to-point`	Specifies the ATM point-to-point subinterface using the appropriate form of the **interface atm**command[1] and enters subinterface configuration mode.

Step 4	Do one of the following:
	• **pvc** [*name*] *vpi* / *vci*
	•
	• **range** [*range-name*] **pvc** *start-vpi* / *start-vci end-vpi* / *end-vci*
	Example:
	`Device(config-subif)# pvc cisco 0/5`
	Example:
	`or`
		Configures the PVC or a range of PVCs and enters ATM virtual circuit subinterface mode or ATM range subinterface configuration mode.

	Command or Action	Purpose
	Example: `Device(config-subif)# range range1 pvc 1/200 1/299`	

Step 5	**encapsulation aal5mux ppp virtual-template** *number*
	Example:
	`Device(config-subif-atm-vc)# encapsulation aal5mux ppp virtual-template 3`
	Example:
	`or`
	Example:
	`Device(config-subif-atm-range)# encapsulation aal5mux ppp virtual-template 3`
		Configures VC multiplexed encapsulation on a PVC or PVC range.

Step 6	Do one of the following:
	• **end**
	Example:
	`Device(config-subif-atm-vc)# end`
	Example:
	`or`
	Example:
	`Device(config-subif-atm-range)# end`
		Exits ATM virtual circuit range subinterface configuration mode.
		or
		Exits ATM range subinterface configuration mode.

Configuring IETF-Compliant MUX Encapsulated PPP over ATM on a Multipoint Subinterface

Multiple PVCs on multipoint subinterfaces significantly increase the maximum number of PPP-over-ATM sessions running on a device. You can configure IETF-compliant MUX encapsulated PPP over ATM on a single ATM PVC or an ATM PVC range.

Perform this task to configure IETF-compliant MUX Encapsulated PPP over ATM on a multipoint subinterface.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface atm** *number.subinterface-number* **multipoint**
4. Do one of the following:
   - **pvc** [*name*] *vpi* / *vci*

-
- **range** [*range-name*] **pvc** *start-vpi* / *start-vci end-vpi* / *end-vci*

5. **encapsulation aal5mux ppp virtual-template** *number*
6. Do one of the following:
   - **end**

DETAILED STEPS

Procedure

	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** *number.subinterface-number* **multipoint** **Example:** `Device(config)# interface atm 1/0/0.4 multipoint`	Specifies the ATM multipoint subinterface using the appropriate form of the **interface atm**command and enters subinterface configuration mode.

Step 4	Do one of the following:
	• **pvc** [*name*] *vpi* / *vci*
	•
	• **range** [*range-name*] **pvc** *start-vpi* / *start-vci end-vpi* / *end-vci*
	Example:
	`Device(config-subif)# pvc cisco 0/5`
	Example:
	`or`
	Example:
	`Device(config-subif)# range range1 pvc 1/200 1/299`
		Configures the PVC or a range of PVCs and enters ATM virtual circuit subinterface mode or ATM range subinterface configuration mode.

Step 5	**encapsulation aal5mux ppp virtual-template** *number* **Example:**	Configures VC multiplexed encapsulation on a PVC or PVC range.

	Command or Action	Purpose

	`Device(config-subif-atm-vc)# encapsulation aal5mux ppp virtual-template 3`
	Example:
	or
	Example:
	`Device(config-subif-atm-range)# encapsulation aal5mux ppp virtual-template 3`	

Step 6	Do one of the following:
	• **end**
	Example:
	`Device(config-subif-atm-vc)# end`
	Example:
	Example:
	`Device(config-subif-atm-range)# end`
		Exits ATM virtual circuit subinterface configuration mode.
		or
		Exits ATM range subinterface configuration mode.

Configuring IETF-Compliant LLC Encapsulated PPP over ATM on a Point-to-point Subinterface

IETF-compliant LLC encapsulated PPP over ATM allows you to configure PPP over ATM with LLC encapsulation. It accommodates Frame Relay-to-ATM service interworking (Frame Relay Forum standard FRF.8). There is no equivalent VC multiplexed encapsulation mode for Frame Relay; therefore, LLC encapsulation is required for Frame Relay-to-ATM networking. This version of PPP over ATM also enables you to carry multiprotocol traffic. For example, a VC will carry both PPP and IPX traffic.

The figure below shows Frame Relay-to-ATM interworking.

Figure 1: Frame Relay-to-ATM Interworking



You can configure ATM PVCs for IETF-compliant LLC encapsulated PPP over ATM on either point-to-point or multipoint subinterfaces. Multiple PVCs on multipoint subinterfaces significantly increase the maximum number of PPP-over-ATM sessions running on a router.

Perform this task to configure IETF-compliant LLC encapsulated PPP over ATM PVC or range of PVCs on a point-to-point interface.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface atm** *number.subinterface-number* **point-to-point**
4. Do one of the following:
   - **pvc** [*name*] *vpi* / *vci*
   -
   - **range** [*range-name*] **pvc** *start-vpi* / *start-vci end-vpi* / *end-vci*
5. **encapsulation aal15snap**
6. **protocol ppp virtual-template** *number*
7. Do one of the following:
   - **end**

DETAILED STEPS

Procedure

	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** *number.subinterface-number* **point-to-point** **Example:** `Router(config)# interface atm 6.200 point-to-point`	Specifies the ATM point-to-point or multipoint subinterface using the appropriate form of the **interface atm** command[2] and enters subinterface configuration mode.
Step 4	Do one of the following: • **pvc** [*name*] *vpi* / *vci* • • **range** [*range-name*] **pvc** *start-vpi* / *start-vci end-vpi* / *end-vci* **Example:** `Router(config-subif)# pvc cisco 0/5` **Example:**	Configures the PVC or a range of PVCs and enters ATM virtual circuit subinterface mode or ATM range subinterface configuration mode.

	Command or Action	Purpose
	or **Example:** `Router(config-subif)# range range1 pvc 1/200 1/299`	

Step 5	**encapsulation aal15snap**
	Example:
	`Router(config-subif-atm-vc)# encapsulation aal15snap`
	Example:
	or
	Example:
	`Router(config-subif-atm-range)# encapsulation aal15snap`
		Configures LLC SNAP encapsulation on the PVC or a range of PVCs.[3]

Step 6	**protocol ppp virtual-template** *number*
	Example:
	`Router(config-subif-atm-vc)# protocol ppp virtual-template 2`
	Example:
	or
	Example:
	`Router(config-subif-atm-range)# protocol ppp virtual-template 2`
		Configures IETF PPP over ATM LLC encapsulation on the PVC or a range of PVCs.

Step 7	Do one of the following:
	• **end**
	Example:
	`Router(config-subif-atm-vc)# end`
	Example:
	or
	Example:
	`Router(config-subif-atm-range)# end`
		Exits ATM virtual circuit subinterface configuration mode.
		or
		Exits ATM range subinterface configuration mode.

Configuring IETF-Compliant LLC Encapsulated PPP over ATM on a Multipoint Subinterface

Multiple PVCs on multipoint subinterfaces significantly increase the maximum number of PPP-over-ATM sessions running on a Device.

Perform this task to configure IETF-compliant LLC encapsulated PPP over ATM PVC or a range of PVCs on a multipoint subinterface.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface atm** *number.subinterface-number* **multipoint**
4. Do one of the following:
   - **pvc** [*name*] *vpi* / *vci*
   -
   - **range** [*range-name*] **pvc** *start-vpi* / *start-vci end-vpi* / *end-vci*
5. **encapsulation aal5mux ppp virtual-template** *number*
6. **protocol ppp virtual-template** *number*
7. Do one of the following:
   - **end**

DETAILED STEPS

Procedure

	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** *number.subinterface-number* **multipoint** **Example:** `Device(config)# interface atm 1/0/0.4 multipoint`	Specifies the ATM multipoint subinterface using the appropriate form of the **interface atm**command[4] and enters subinterface configuration mode.
Step 4	Do one of the following: • **pvc** [*name*] *vpi* / *vci*	Configures the PVC or a range of PVCs and enters ATM virtual circuit subinterface mode or ATM range subinterface configuration mode.

	Command or Action	Purpose

	•
	• **range** [*range-name*] **pvc** *start-vpi* / *start-vci end-vpi* / *end-vci*
	Example:
	`Device(config-subif)# pvc cisco 0/5`
	Example:
	`or`
	Example:
	`Device(config-subif)# range range1 pvc 1/200 1/299`	

Step 5	**encapsulation aal5mux ppp virtual-template** *number*
	Example:
	`Device(config-subif-atm-vc)# encapsulation aal5mux ppp virtual-template 3`
	Example:
	`or`
	Example:
	`Device(config-subif-atm-range)# encapsulation aal5mux ppp virtual-template 3`
		Configures VC multiplexed encapsulation on a PVC or PVC range.

Step 6	**protocol ppp virtual-template** *number*
	Example:
	`Device(config-subif-atm-vc)# protocol ppp virtual-template 2`
	Example:
	`or`
	Example:
	`Device(config-subif-atm-range)# protocol ppp virtual-template 2`
		Configures IETF PPP over ATM LLC encapsulation on the PVC or a range of PVCs.

Step 7	Do one of the following: • **end** **Example:** `Device(config-subif-atm-vc)# end` **Example:**	Exits ATM virtual circuit subinterface configuration mode. or Exits ATM range subinterface configuration mode.

	Command or Action	Purpose
	Example: `Device(config-subif-atm-range)# end`	

What to do next

You can also configure IETF-compliant LLC encapsulated PPP over ATM in a VC class and apply this VC class to an ATM VC, subinterface, or interface. For information about configuring a VC class, see the "Configuring VC Classes" section in the Configuring ATM module.

Configuration Examples for PPP over ATM

IETF-Compliant MUX Encapsulated PPP over ATM Configuration

This section provides the following examples for configuring IETF-compliant PPP over ATM:

Example: ETF-Compliant PPP over ATM with Different Traffic-Shaping Parameters

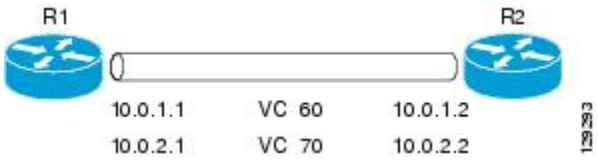
PVCs with different PPP-over-ATM traffic-shaping parameters can be configured on the same subinterface. In the following example, three PVCs are configured for PPP over ATM on subinterface ATM 2/0.1. PVC 0/60 is configured with IETF-compliant PPP over ATM encapsulation. Its traffic-shaping parameter is an unspecified bit rate with peak cell rate at 500 kb/s. PVC 0/70 is also configured with IETF-compliant PPP over ATM encapsulation, but its traffic-shaping parameter is nonreal-time variable bit rate, with peak cell rate at 1 Mb/s, sustainable cell rate at 500 kb/s, and burst cell size of 64 cells.

```
interface atm 2/0.1 multipoint
 pvc 0/60
  encapsulation aal5mux ppp virtual-template 3
   ubr 500
  exit
pvc 0/70
 encapsulation aal5mux ppp virtual-template 3
 vbr-nrt 1000 500 64
  exit
```

Example: Two Routers with Back-to-Back PVCs

The figure below illustrates an ATM interface with two PPP sessions over two PVC session connections. The sample commands following the figure establish the back-to-back router configuration.

Figure 2: Two Routers with Back-to-Back PVCs



R1 Configuration

```
interface atm 2/0
atm clock internal
pvc 0/60
encapsulation aal5mux ppp virtual-template 1
ubr 90
exit
pvc 0/70
encapsulation aal5mux ppp virtual-template 2
vbr-nrt 90 50 1024
exit
interface virtual-template 1
ip address 10.0.1.1 255.255.255.0
interface virtual-template 2
ip address 10.0.2.1 255.255.255.0
exit
```

R2 Configuration

```
interface atm 2/0.1 multipoint
pvc 0/60
encapsulation aal5mux ppp virtual-template 1
ubr 90
exit
pvc 0/70
encapsulation aal5mux ppp virtual-template 2
vbr-nrt 90 50 1024
exit
exit
interface virtual-template 1
ip address 10.0.1.2 255.255.255.0
exit
interface virtual-template 2
ip address 10.0.2.2 255.255.255.0
```

Example: Multiplexed Encapsulation Using VC Class

In the following example, PVC 0/60 is configured on subinterface ATM 2/0.1 with a VC class attached to it. By rule of inheritance, PVC 0/60 runs with IETF-compliant PPP over ATM encapsulation using the configuration from interface virtual-template 1. Its parameter is an unspecified bit rate with peak cell at 90 kb/s.

```
interface atm 2/0/0.1
pvc 0/60
class-vc pvc-ppp
exit
exit
vc-class atm pvc-ppp
encapsulation aal5mux ppp virtual-template 1
ubr 90
exit
```

IETF-Compliant LLC Encapsulated PPP over ATM Configuration

This section provides the following examples for configuring IETF-compliant LLC encapsulated PPP over ATM:

Example: Configuring IETF-Compliant PPP over ATM LLC Encapsulation

This example shows how to configure IETF PPP over ATM LLC encapsulation in the VC class called ppp-default. The VC class specifies virtual template 1 from which to spawn PPP interfaces, SNAP encapsulation (the default), and a UBR class traffic type at 256 kb/s. When the VC class ppp-default is configured on interface 0.1, PVC 0/70 inherits these properties. PVC 0/80 overrides virtual template 1 in the VC class and uses virtual template 2 instead. PVC 0/90 also overrides virtual template 1 and uses virtual template 3 instead. In addition, PVC 0/90 uses a VC multiplexed encapsulation and a UBR class traffic type at 500 kb/s.

```
interface atm 2/0/0.1 multipoint
class-int ppp-default
!
pvc 0/70
exit
!
pvc 0/80
protocol ppp virtual-template 2
exit
!
pvc 0/90
encapsulation aal5mux ppp virtual-template 3
ubr 500
exit
exit
!
vc-class atm ppp-default
protocol ppp virtual-template 1
ubr 256
exit
```

Example: Overriding a Virtual Template for IETF-Compliant PPP over ATM

This example illustrates how to use inheritance to override a virtual template configuration for muxppp encapsulation options. For PVC 5/505 the encapsulation option at that level is ciscoppp virtual template 1, as specified in the VC class called muxppp, the **protocol ppp virtual-template 2** command overrides only the virtual-template configuration.

```
interface atm 2/0/0.1
class-int muxppp
!
pvc 5/505
protocol ppp virtual-template 2
exit
!
muxppp
encapsulation aal5mux ppp virtual-template 1
exit
```

Example: Disabling IETF-Compliant PPP over ATM LLC Encapsulation on a Specific VC

This example shows how to limit the configuration of a particular LLC encapsulated protocol to a particular VC. First, we see that the VC class called ppp is configured with IETF PPP over ATM with LLC encapsulation and virtual template 1. This VC class is then applied to ATM interface 1/0/0. By configuring SNAP encapsulation by itself on PVC 0/32, you disable IETF PPP over ATM with LLC encapsulation on this particular PVC; PVC 0/32 will only carry IP.

```
interface atm 1/0/0
```

```
class-int ppp
exit
!
interface atm 1/0/0.100 point-to-point
description IP only VC
ip address 10.1.1.1 255.255.255.0
pvc 0/32
encapsulation aal5snap
exit
exit
!
vc-class atm ppp
encapsulation aal5snap
protocol ppp virtual-template 1
exit
```

Additional References

Related Documents

Related Topic	Document Title
Cisco IOS commands	
Broadband and DSL commands	Cisco IOS Broadband and DSL Command Reference
Broadband access aggregation preparation tasks	Preparing for Broadband Access Aggregation
Configuring ATM	Configuring ATM

Standards/RFCs

Standards	Title
Frame Relay Forum standard FRF.8	*Frame Relay to ATM Internetworking*
RFC 2364	*PPP over AAL5*

Technical Assistance

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

Feature Information for Providing Protocol Support for Broadband Access Aggregation of PPP over ATM Sessions

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

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

Table 1: Feature Information for Providing Protocol Support for Broadband Access Aggregation of PPP over ATM Sessions

Feature Name	Releases	Feature Configuration Information
PPP over ATM	Cisco IOS XE Release 3.3S Cisco IOS Release XE 3.14S	PPP over ATM provides support for the termination of multiple PPP connections on an ATM interface of a router. In Cisco IOS XE Release 3.3S, this feature was introduced on the Cisco ASR 1000 Series Aggregation Services Routers. In Cisco IOS XE Release 3.14S, support for this feature was added on the Cisco 4451-X Integrated Services Router. The following commands were introduced or modified: **encapsulation aal5mux ppp virtual-template** , **interface atm, protocol ppp virtual-template, pvc, range.**