

Providing Connectivity Using ATM Routed Bridge Encapsulation over PVCs

The Providing Connectivity Using ATM Routed Bridge Encapsulation over PVCs feature provides the functionality of bridged ATM interface support to ATM switched virtual circuits (SVCs). Unlike permanent virtual circuits (PVCs), SVCs must be triggered by ongoing traffic and can be brought down when idle for some time. The SVCs are triggered, if down, and the traffic is passed on to the SVCs belonging to bridged ATM interface.

ATM routed bridge encapsulation (RBE) is used to route IP over bridged RFC 1483 Ethernet traffic from a stub-bridged LAN.

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Prerequisites for Providing Connectivity Using ATM Routed Bridge Encapsulation over PVCs

- When ATM SVCs are used, support for a form of bridging, such as integrated routing and bridging, is required.
- Before configuring connectivity from a remote bridged Ethernet network to a routed network using ATM routed bridge encapsulation, you must understand the concepts in the Understanding Broadband Access Aggregation module.

Restrictions for Providing Connectivity Using ATM Routed Bridge Encapsulation over PVCs

- Unlike PVCs, SVCs must be triggered by ongoing traffic and might be brought down after they have been idle for some time. The Bridged 1483 Encapsulated Traffic over ATM SVCs feature allows for the SVC to be triggered if down, and to pass the traffic on to the SVCs belonging to the bridged ATM interface.
- ATM RBE does not support MAC-layer access lists; only IP access lists are supported.

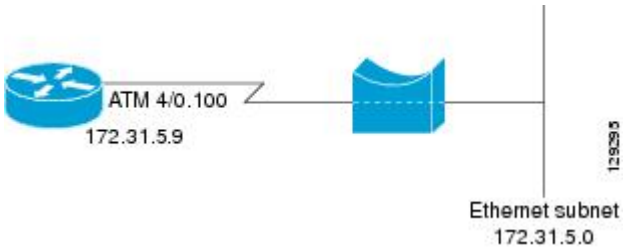
Information About Providing Connectivity Using ATM Routed Bridge Encapsulation over PVCs

Overview on Bridged 1483 Encapsulated Traffic over ATM SVCs

ATM RBE is used to route IP over bridged RFC 1483 Ethernet traffic from a stub-bridged LAN.

The figure below shows an ATM subinterface on a headend router that is configured to function in ATM routed-bridge encapsulation mode. This configuration is useful when a remote bridged Ethernet network device needs connectivity to a routed network via a device bridging from an Ethernet LAN to an ATM RFC 1483 bridged encapsulation.

Figure 1: ATM Routed Bridge Encapsulation



Because PVCs are statically configured along the entire path between the end systems, it would not be suitable to route bridged encapsulated traffic over them when the user wants to configure the virtual circuits (VCs) dynamically and tear down the VCs when there is no traffic.

ATM RBE Subinterface Grouping by PVC Range

You can configure ATM routed bridge encapsulation using an ATM PVC range rather than individual PVCs. When you configure a PVC range for routed bridge encapsulation, a point-to-point subinterface is created for each PVC in the range. The number of PVCs in a range can be calculated using the following formula:

number of PVCs = (end-vpi - start-vpi + 1) x (end-vci - start-vci +1)

Subinterface numbering begins with the subinterface on which the PVC range is configured and increases sequentially through the range.

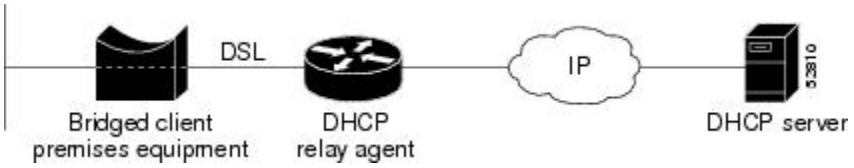
Note You cannot explicitly configure the individual point-to-point subinterfaces created by the PVC range on a point-to-point subinterface. All the point-to-point subinterfaces in the range share the same configuration as the subinterface on which the PVC range is configured.

DHCP Option 82 Support for RBE

The DHCP relay agent information option (option 82) enables a Dynamic Host Configuration Protocol (DHCP) relay agent to include information about itself when forwarding client-originated DHCP packets to a DHCP server. The DHCP server can use this information to implement IP address or other parameter-assignment policies.

The DHCP Option 82 Support for RBE feature provides support for the DHCP relay agent information option when ATM RBE is used. The figure below shows a typical network topology in which ATM RBE and DHCP are used. The aggregation router that is using ATM RBE is also serving as the DHCP relay agent.

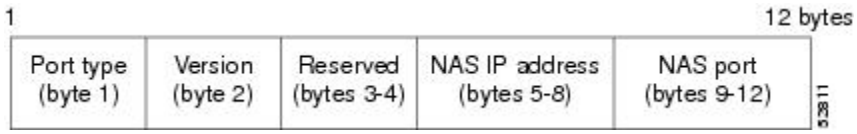
Figure 2: Network Topology Using ATM RBE and DHCP



This feature communicates information to the DHCP server using a suboption of the DHCP relay agent information option called *agent remote ID* . The information sent in the agent remote ID includes an IP address identifying the relay agent and information about the ATM interface and the PVC over which the DHCP request came in. The DHCP server can use this information to make IP address assignments and security policy decisions.

The figure below shows the format of the agent remote ID suboption.

Figure 3: Format of the Agent Remote ID Suboption



The table below describes the agent remote ID suboption fields displayed in the figure above.

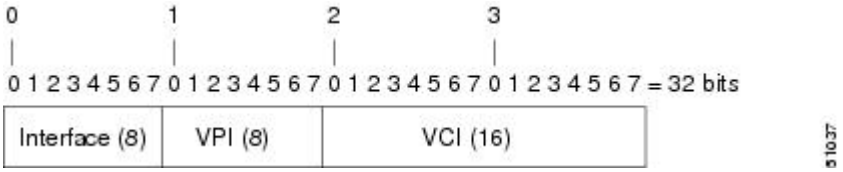
Table 1: Agent Remote ID Suboption Field Descriptions

Field	Description
Port Type	Port type. The value 0x01 indicates RBE. (1 byte)
Version	Option 82 version. The value 0x01 specifies the RBE version of Option 82 (1 byte).
Reserved	RBE reserved (2 bytes).
NAS IP Address	One of the interfaces on the DHCP relay agent. The **rbe nasip** command can be used to specify which IP address will be used. (4 bytes)

Field	Description
NAS Port	RBE-enabled virtual circuit on which the DHCP request has come in. See the figure below for the format of this field. (4 bytes)

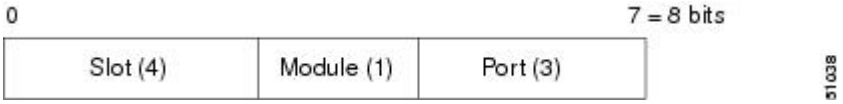
The figure below shows the format of the network access server (NAS) port field in the agent remote ID suboption.

Figure 4: Format of the NAS Port Field



The figure below shows the format of the interface field. If there is no module, the value of the module bit is 0.

Figure 5: Format of the Interface Field



DHCP Lease Limit per ATM RBE Unnumbered Interface

The DHCP lease limit per ATM RBE Unnumbered Interface feature is enabled on a Cisco IOS DHCP relay agent connected to clients through unnumbered interfaces. The relay agent keeps information about the DHCP leases offered to the clients per subinterface. When a DHCPACK message is forwarded to the client, the relay agent increments the number of leases offered to clients on that subinterface. If a new DHCP client tries to obtain an IP address and the number of leases has already reached the configured lease limit, DHCP messages from the client will be dropped and will not be forwarded to the DHCP server.

If this feature is enabled on the Cisco IOS DHCP server directly connected to clients through unnumbered interfaces, the server allocates addresses and increments the number of leases per subinterface. If a new client tries to obtain an IP address, the server will not offer an IP address if the number of leases on the subinterface has already reached the configured lease limit.

Benefits of Providing Connectivity Using ATM Routed Bridge Encapsulation

Bridged IP packets received on an ATM interface configured in routed-bridge mode are routed via the IP header. Such interfaces take advantage of the characteristics of a stub LAN topology commonly used for digital subscriber line (DSL) access and offer increased performance and flexibility over integrated routing and bridging (IRB).

Another benefit of ATM RBE is that it reduces the security risk associated with normal bridging or IRB by reducing the size of the nonsecured network. By using a single VC allocated to a subnet (which could be as small as a single IP address), ATM RBE uses an IP address in the subnet to limit the "trust environment" to the premises of a single customer.

ATM RBE supports Cisco Express Forwarding (CEF), fast switching, and process switching.

The DHCP Option 82 Support for RBE feature enables those service providers to use DHCP to assign IP addresses and DHCP option 82 to implement security and IP address assignment policies.

The DHCP Lease Limit per ATM RBE Unnumbered Interface feature allows an Internet service provider (ISP) to globally limit the number of leases available to clients per household or connection.

How to Configure ATM Routed Bridge Encapsulation over PVCs

Configuring ATM Routed Bridge Encapsulation Using PVCs

Perform the following task to configure ATM RBE using PVCs. Only the specified network layer (IP) is routed. Any remaining protocols can be passed on to bridging or other protocols. In this manner, ATM RBE can be used to route IP, while other protocols (such as IPX) are bridged normally.

or

show ip cache verbose

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface atm** *slot* / **0** . *subinterface-number* **point-to-point**
4. Do one of the following:
   - **pvc** *vpi* /*vci*
   -
   - **range** [*range-name*] **pvc** *start-vpi* / *start-vci end-vpi* / *end-vci*
5. **exit**
6. **ip address** *ip-address mask* [**secondary**]
7. **end**
8. Do one of the following:
   - **show arp**
   - or
   - **show ip cache verbose**

DETAILED STEPS

Procedure

	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	**interface atm** *slot* **/ 0 .** *subinterface-number* **point-to-point** **Example:** `Router(config)# interface atm 5/0.5 point-to-point`	Specifies an ATM point-to-point subinterface and enters subinterface mode.

Step 4	Do one of the following:
	• **pvc** *vpi* /*vci*
	•
	• **range** [*range-name*] **pvc** *start-vpi* / *start-vci end-vpi* / *end-vci*
	Example:
	`Router(config-subif)# pvc 0/32`
	Example:
	`Router(config-subif)# range range1 pvc 1/200 1/299`
		Configures a PVC to carry the routed bridge traffic and enters ATM VC class configuration mode.
		Configures a range of PVCs to carry the routed bridge traffic and enters ATM PVC range configuration mode.

Step 5	**exit** **Example:** `Router(config-if-atm-vc)# exit`	Exits to subinterface configuration mode.
Step 6	**ip address** *ip-address mask* [**secondary**] **Example:** `Router(config-subif)# ip address 209.165.200.224 255.255.255.0`	Provides an IP address on the same subnetwork as the remote network.
Step 7	**end** **Example:** `Router(config-subif)# end`	Exits to privileged EXEC mode.
Step 8	Do one of the following: • **show arp** • or • **show ip cache verbose** **Example:** `Router# show arp`	(Optional) Displays ATM RBE configuration information.

	Command or Action	Purpose
	Example: `Router# show ip cache verbose`	

Examples

To confirm that ATM RBE is enabled, use the **show arp** command and the **show ip cache verbose** command in privileged EXEC mode:

```
Router# show arp

Protocol  Address          Age (min)  Hardware Addr   Type   Interface
Internet  209.165.201.51           6   0001.c9f2.a81d  ARPA   Ethernet3/1
Internet  209.165.201.49           -   0060.0939.bb55  ARPA   Ethernet3/1
Internet 209.165.202.128          30   0010.0ba6.2020  ARPA   Ethernet3/0
Internet 209.165.201.52            6   00e0.1e8d.3f90  ARPA   ATM1/0.4
Internet 209.165.201.53            5   0007.144f.5d20  ARPA   ATM1/0.2
Internet 209.165.202.129           -   0060.0939.bb54  ARPA   Ethernet3/0
Internet 209.165.201.125          30   00b0.c2e9.bc55  ARPA   Ethernet3/1#
Router# show ip cache verbose
IP routing cache 3 entries, 572 bytes
   9 adds, 6 invalidates, 0 refcounts
Minimum invalidation interval 2 seconds, maximum interval 5 seconds,
   quiet interval 3 seconds, threshold 0 requests
Invalidation rate 0 in last second, 0 in last 3 seconds
Last full cache invalidation occurred 00:30:34 ago
Prefix/Length       Age       Interface  Next Hop
209.165.201.51/32-24 00:30:10  Ethernet3/1 10.1.0.51 14  0001C9F2A81D00600939 BB550800
209.165.202.129/32-24 00:00:04 ATM1/0.2  10.8.100.50 28
00010000AAAA030080C2000700000007144F5D2000600939 BB1C0800
209.165.201.125/32-24 00:06:09 ATM1/0.4  10.8.101.35 28
00020000AAAA030080C20007000000E01E8D3F9000600939 BB1C0800
```

Configuring DHCP Option 82 for RBE

Perform this task to configure the DHCP Option 82 Support for RBE feature.

Before you begin

DHCP option 82 support must be configured on the DHCP relay agent using the **ip dhcp relay information option** command before you can use the DHCP Option 82 Support for RBE feature.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip dhcp relay information option**
4. **rbe nasip** *source-interface*
5. **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	**ip dhcp relay information option** **Example:** `Router(config)# ip dhcp relay information option`	Enables the DHCP option 82 support on relay agent. • Enabling the DHCP option 82 support allows the system to insert the DHCP relay agent information option in forwarded BOOT REQUEST messages to a Cisco IOS DHCP server.
Step 4	**rbe nasip** *source-interface* **Example:** `Router(config)# rbe nasip loopback0`	Specifies the IP address of an interface on the DHCP relay agent that will be sent to the DHCP server via the Agent Remote ID suboption.
Step 5	**end** **Example:** `Router(config)# end`	Exits global configuration mode and enters privileged configuration mode.

Configuring the DHCP Lease Limit

Perform this task to limit the number of DHCP leases allowed on ATM RBE unnumbered or serial unnumbered interfaces.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip dhcp limit lease per interface** *lease-limit*
4. **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	**ip dhcp limit lease per interface** *lease-limit* **Example:** `Router(config)# ip dhcp limit lease per interface 2`	Limits the number of leases offered to DHCP clients behind an ATM RBE unnumbered or serial unnumbered interface.
Step 4	**end** **Example:** `Router(config)# end`	Exits global configuration mode and returns to privileged EXEC mode.

Troubleshooting the DHCP Lease Limit

Perform this task to troubleshoot the DHCP lease limit.

SUMMARY STEPS

1. **enable**
2. **debug ip dhcp server packet**
3. **debug ip dhcp server events**

DETAILED STEPS

Procedure

	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	**debug ip dhcp server packet** **Example:** `Router# debug ip dhcp server packet`	(Optional) Decodes DHCP receptions and transmissions.
Step 3	**debug ip dhcp server events** **Example:** `Router(config)# debug ip dhcp server events`	(Optional) Displays server events.

Configuration Examples for Providing Connectivity Using ATM Routed Bridge Encapsulation

The following examples show various ways to provide connectivity from a remote bridged network to a routed network using ATM RBE.

Example Configuring ATM RBE on PVCs

The following example shows a typical ATM routed bridge encapsulation configuration:

```
enable
 configure terminal
 interface atm 4/0.100 point-to-point
  ip address 209.165.200.225 255.255.255.224
   pvc 0/32
    end
```

Example Configuring ATM RBE on an Unnumbered Interface

The following example uses a static route to point to an unnumbered interface:

```
 enable
  configure terminal
  interface loopback 0
  ip address 209.165.200.226 255.255.255.224
  interface atm 4/0.100 point-to-point
   ip unnumbered loopback 0
   pvc 0/32
    atm route-bridge ip
    exit
  ip route 209.165.200.228 255.255.255.224 atm 4/0.100
  end
```

Example Concurrent Bridging and ATM RBE

The following example shows concurrent use of ATM RBE with normal bridging. IP datagrams are route-bridged, and other protocols (such as IPX or AppleTalk) are bridged.

```
bridge 1 protocol ieee
interface atm 4/0.100 point-to-point
 ip address 209.165.200.225 255.255.255.224
 pvc 0/32
 bridge-group 1
 atm route-bridge ip
```

Example DHCP Option 82 for RBE Configuration

In the following example, DHCP option 82 support is enabled on the DHCP relay agent using the **ip dhcp relay information option** command. The **rbe nasip** command configures the router to forward the IP address for Loopback0 to the DHCP server.

```
ip dhcp-server 209.165.200.225
!
ip dhcp relay information option
!
interface Loopback0
 ip address 209.165.201.0 255.255.255.248
!
interface atm 4/0
 no ip address
!
interface atm 4/0.1 point-to-point
 ip unnumbered Loopback0
 ip helper-address 209.165.201.3
 atm route-bridged ip
 pvc 88/800
  encapsulation aal5snap
!
!
interface Ethernet5/1
 ip address 209.165.201.4 255.255.255.248
!
router eigrp 100
 network 209.165.201.0
 network 209.165.200.0
!
rbe nasip Loopback0
```

For the configuration example, the value (in hexadecimal) of the agent remote ID suboption would be 010100000B01018140580320. The table below shows the value of each field within the agent remote ID suboption.

Table 2: Agent Remote ID Suboption Field Values

Agent Remote ID Suboption Field	Value
Port Type	0x01
Version	0x01
Reserved	undefined
NAS IP Address	0x0B010181 (hexadecimal value of 11.1.1.129)

Agent Remote ID Suboption Field	Value
NAS Port • Interface (slot/module/port) • VPI • VCI	• 0x40 (The slot/module/port values are 01 00/0/000.) • 0x58 (hexadecimal value of 88) • 0x320 (hexadecimal value of 800)

Example DHCP Lease Limit

In the following example, if more than three clients try to obtain an IP address from interface ATM4/0.1, the DHCPDISCOVER packets will not be forwarded to the DHCP server. If the DHCP server resides on the same router, DHCP will not reply to more than three clients.

```
ip dhcp limit lease per interface 3
!
interface loopback0
 ip address 209.165.201.3 255.255.255.248
!
interface atm 4/0.1
 no ip address
!
interface atm 4/0.1 point-to-point
 ip helper-address 172.16.1.2
 ip unnumbered loopback0
 atm route-bridged ip
  pvc 88/800
  encapsulation aal5snap
```

Additional References

Related Documents

Related Topic	Document Title
Cisco IOS commands	
Broadband Access Aggregation and DSL commands	*Cisco IOS Broadband Access Aggregation and DSL Command Reference*
Broadband access aggregation concepts	Understanding Broadband Access Aggregation
Preparing for broadband access aggregation task	Preparing for Broadband Access Aggregation
DHCP commands	*Cisco IOS IP Addressing Services Command Reference*
DHCP configuration tasks	"Configuring the Cisco IOS DHCP Server" module in the *Cisco IOS IP Addressing Services Configuration Guide*

Standards

Standards	Title
None	--

MIBs

MIBs	MIBs Link
None	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

RFCs	Title
None	--

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/cisco/web/support/index.html

Feature Information for Providing Connectivity Using ATM Routed Bridge Encapsulation

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 3: Feature Information for Providing Connectivity Using ATM Routed Bridge Encapsulation

Feature Name	Releases	Feature Information
Bridged 1483 Encapsulated Traffic over ATM SVCs	12.4(15)T 12.2(33)SRE	The Bridged 1483 Encapsulated Traffic over ATM SVCs feature provides support for bridged 1483 encapsulated packets to trigger ATM SVC and also support for sending this traffic on triggered ATM SVCs.
DHCP Option 82 Support for Routed Bridge Encapsulation	15.1(1)S 12.2(2)T	This feature provides support for the DHCP relay agent information option when ATM RBE is used. The following command was introduced:**rbe nasip**
DHCP Lease Limit per ATM RBE Unnumbered Interface	12.3(2)T	This feature limits the number of DHCP leases per subinterface offered to DHCP clients connected from an ATM RBE unnumbered interface or serial unnumbered interface of the DHCP server or DHCP relay agent. The following command was introduced:**ip dhcp limit lease per interface**