



Routed Bridge Encapsulation with ATM Virtual Circuit Bundles

First Published: October 31, 2006

Last Updated: November 20, 2009

The Routed Bridge Encapsulation with ATM Virtual Circuit Bundles feature enables routed bridge encapsulation (RBE) over ATM permanent virtual circuit (PVC) bundles. This feature supports PVC bundle member selection based on the quality of service (QoS) group or on the type of service (ToS) or Multiprotocol Label Switching (MPLS) Experimental (EXP) bit in each packet over RBE interfaces. The PVC bundles carry RBE traffic configured on ATM point-to-point subinterfaces.

This feature also supports PVC bundle functionality for ATM adaptation layer 5 (AAL5) multiplexer (MUX) or Logical Link Control (LLC)/Subnetwork Access Protocol (SNAP) encapsulations and ATM PVC bundle scalability.

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the [“Feature Information for Routed Bridge Encapsulation with ATM Virtual Circuit Bundles” section on page 12](#).

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

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Restrictions for Routed Bridge Encapsulation with ATM Virtual Circuit Bundles

The following restrictions apply to the Routed Bridge Encapsulation with ATM Virtual Circuit Bundles feature:

- RBE over switched virtual circuit (SVC) bundles is not supported.
- SVC bundle member selection based on QoS groups is not supported.
- Fast switching is not supported (only Cisco Express Forwarding switching and process switching are supported).
- PVC bundle member selection based on QoS groups does not support distributed platforms.
- PVC bundle member selection based on QoS groups does not support bumping, protection, or PVC bundle incompleteness detection.

PVC bundles are supported under the following conditions (numbers are maximum per interface and per router):

- 1000 PVC bundles with AAL5 LLC/SNAP encapsulation, and each PVC bundle with four PVC bundle members
- 800 PVC bundles with two members each and with AAL5 LLC/SNAP encapsulation, and interfaces with 4000 PVCs overall (including PVC bundle members)

Information About Routed Bridge Encapsulation with ATM Virtual Circuit Bundles

To configure the Routed Bridge Encapsulation with ATM Virtual Circuit Bundles feature, you should understand the following concepts:

- [Benefits of Routed Bridge Encapsulation with ATM Virtual Circuit Bundles, page 2](#)
- [Memory Impact of Routed Bridge Encapsulation with ATM Virtual Circuit Bundles, page 3](#)
- [Performance Impact of Routed Bridge Encapsulation with ATM Virtual Circuit Bundles, page 3](#)

Benefits of Routed Bridge Encapsulation with ATM Virtual Circuit Bundles

If the Routed Bridge Encapsulation with ATM Virtual Circuit Bundles feature is not configured, you can make the PVC bundle member selection based on ToS bit settings (for IP packets) or EXP bit settings (for MPLS packets). With the Routed Bridge Encapsulation with ATM Virtual Circuit Bundles feature configured, you can make the PVC bundle member selection based on the QoS group value associated

with the packet on the ingress before route selection, or on the egress after selecting the adjacency. The packet's pak_type header is marked with the QoS group to use, based on the generic match criterion provided by the modular QoS (MQC) command-line interface (CLI).

The Routed Bridge Encapsulation with ATM Virtual Circuit Bundles feature gives you the flexibility to choose PVC bundle members based on various criteria. You can define any classification criterion for the traffic, mark the packets matching that criterion with the QoS group, and send them over a specific PVC bundle member to assign the appropriate quality of service to the corresponding class of traffic.

Memory Impact of Routed Bridge Encapsulation with ATM Virtual Circuit Bundles

The additional memory required for configuring the Routed Bridge Encapsulation with ATM Virtual Circuit Bundles feature does not exceed 50 bytes per PVC bundle.

Performance Impact of Routed Bridge Encapsulation with ATM Virtual Circuit Bundles

The Routed Bridge Encapsulation with ATM Virtual Circuit Bundles feature impacts forwarding path performance when PVC bundles are configured with QoS groups. This impact results because, during forwarding, QoS groups must be mapped to the appropriate PVC bundle member index in the array of adjacencies associated with the PVC bundle adjacency.

This feature does not significantly increase CPU usage when traffic at line rates is sent over the PVC bundle (regardless of the selection criterion used for PVC bundle member selection).

How to Configure Routed Bridge Encapsulation with ATM Virtual Circuit Bundles

This section contains the following tasks:

- [Specifying the Method for Selecting PVC Bundle Members, page 3](#) (required)
- [Configuring the QoS Group-Based Method for Selection of PVC Bundle Members, page 5](#) (optional)
- [Configuring Explicit Inverse ARP PVC Selection for QoS Group-Based PVC Bundle Member Selection, page 6](#) (required)
- [Verifying Routed Bridge Encapsulation with ATM Virtual Circuit Bundles, page 8](#) (optional)

Specifying the Method for Selecting PVC Bundle Members

Perform this task to specify the method of selection of PVC bundle members. You can specify one of two selection methods:

- QoS group—Use the QoS group value associated with each packet for selection of PVC bundle members.

- ToS or EXP—Use ToS bit settings of each packet (for IP packets) or EXP bit settings of each packet (for MPLS packets) for selection of PVC bundle members.

The selection methods are mutually exclusive. This means that when the selection method based on QoS groups is specified on any PVC bundle member, no other selection method is allowed on the same PVC bundle. Similarly, if the selection method based on ToS or EXP is specified on any PVC bundle member, no other selection method is allowed on the same PVC bundle.

Restrictions

- You can change the selection method from QoS groups to ToS or EXP only if no PVC bundle member has QoS groups or Inverse Address Resolution Protocol (InverseARP) configured.
- You can change the selection method from ToS or EXP to QoS groups only if no PVC bundle member has precedence, protection, or bumping configured.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface atm slot/port**
4. **bundle bundle-name**
5. **selection-method { qos-group | tos-exp }**
6. **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	interface atm slot/port Example: Router(config)# interface atm 2/0	Specifies the ATM interface type and enters interface configuration mode. To determine the correct form of the interface atm command, see your ATM network module, port adapter, or router documentation.
Step 4	bundle bundle-name Example: Router(config-if)# bundle bundle-test	Creates a PVC bundle or modifies an existing PVC bundle and enters ATM bundle configuration mode.

	Command or Action	Purpose
Step 5	selection-method { qos-group tos-exp } Example: Router(config-if-atm-bundle)# selection-method qos-group	Specifies the method for selection of PVC bundle members.
Step 6	end Example: Router(config-if-atm-member)# end	Ends the configuration session and returns to privileged EXEC mode.

Configuring the QoS Group-Based Method for Selection of PVC Bundle Members

Perform this task to configure the method for selection of PVC bundle members that is based on QoS groups.

Prerequisites

You must associate a QoS group or groups with a PVC bundle member. You can specify a QoS group, a range of QoS groups, or any combination of QoS groups and ranges of QoS groups.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface atm** *slot/port*
4. **bundle** *bundle-name*
5. **selection-method qos-group**
6. **pvc** *vpil/vci*
7. **qos-group** *qos-groups*
8. **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.

	Command or Action	Purpose
Step 3	interface atm slot/port Example: Router(config)# interface atm 2/0	Specifies the ATM interface type and enters interface configuration mode. To determine the correct form of the interface atm command, see your ATM network module, port adapter, or router documentation.
Step 4	bundle bundle-name Example: Router(config-subif)# bundle bundle-test	Creates a PVC bundle or modifies an existing PVC bundle and enters ATM bundle configuration mode.
Step 5	selection-method qos-group Example: Router(config-if-atm-bundle)# selection-method qos-group	Specifies the method for selection of PVC bundle members based on QoS group.
Step 6	pvc vpi/vci Example: Router(config-if-atm-bundle)# pvc 1/32	Creates an ATM PVC and enters ATM bundle-member configuration mode.
Step 7	qos-group qos-groups Example: Router(config-if-atm-member)# qos-group 1	Associates a QoS group or groups with the PVC bundle member.
Step 8	end Example: Router(config-if-atm-member)# end	Ends the configuration session and returns to privileged EXEC mode.

Configuring Explicit Inverse ARP PVC Selection for QoS Group-Based PVC Bundle Member Selection

Perform this task to configure explicit Inverse ARP for a PVC bundle member.

This procedure is optional and provides backward compatibility with existing PVC bundles, in which an Inverse ARP request is sent or expected to be received on the PVC bundle member with precedence 6. If a PVC bundle with selection based on QoS group is connected to an existing PVC bundle, you must follow this procedure to allow Inverse ARP to function. If you do not follow this procedure, Inverse ARP is sent over any of the available PVC bundle members.

Restrictions

You can enable Inverse ARP for a PVC bundle member only when using the QoS groups method for selecting PVC bundle members.

SUMMARY STEPS

1. **enable**

2. **configure terminal**
3. **interface atm** *slot/port*
4. **bundle** *bundle-name*
5. **selection-method qos-group**
6. **pvc** *vpi/vci*
7. **qos-group** *qos-groups*
8. **inarp-vc**
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	interface atm <i>slot/port</i> Example: Router(config)# interface atm 2/0	Specifies the ATM interface type and enters interface configuration mode. To determine the correct form of the interface atm command, see your ATM network module, port adapter, or router documentation.
Step 4	bundle <i>bundle-name</i> Example: Router(config-if)# bundle bundle-test	Creates a bundle or modifies an existing bundle and enters ATM bundle configuration mode.
Step 5	selection-method qos-group Example: Router(config-if-atm-bundle)# selection-method qos-group	Specifies the method for selection of PVC bundle members based on QoS group.
Step 6	pvc <i>vpi/vci</i> Example: Router(config-if-atm-bundle)# pvc 1/32	Creates an ATM PVC and enters ATM bundle member configuration mode.
Step 7	qos-group <i>qos-groups</i> Example: Router(config-if-atm-member)# qos-group 1	Associates a QoS group or groups with the PVC bundle member.

	Command or Action	Purpose
Step 8	inarp-vc Example: Router(config-if-atm-member)# inarp-vc	Enables Inverse ARP for the PVC bundle member.
Step 9	end Example: Router(config-if-atm-member)# end	Ends the configuration session and returns to privileged EXEC mode.

Verifying Routed Bridge Encapsulation with ATM Virtual Circuit Bundles

Perform this task to verify configuration of the Routed Bridge Encapsulation with ATM Virtual Circuit Bundles feature:

SUMMARY STEPS

1. **enable**
2. **show atm vc**
3. **show interfaces**
4. **show interfaces virtual-access**

DETAILED STEPS

	Command or Action	Purpose
Step 1	enable Example: Router> enable	Enters privileged EXEC mode. • Enter your password if prompted.
Step 2	show atm vc Example: Router# show atm vc	Displays all ATM PVCs and SVCs and their traffic information.
Step 3	show interfaces Example: Router# show interfaces	Displays interleaving statistics. • Interleaving data is displayed only if interleaving occurs.
Step 4	show interfaces virtual-access Example: Router# show interfaces virtual-access	Displays multilink bundle information.

Configuration Examples for Routed Bridge Encapsulation with ATM Virtual Circuit Bundles

This section provides the following configuration examples:

- [Specifying the Method for Selecting PVC Bundle Members: Example, page 9](#)
- [Configuring the QoS Group-Based Method for Selection of PVC Bundle Members: Example, page 9](#)
- [Configuring Explicit Inverse ARP PVC Selection for QoS Group-Based PVC Bundle Member Selection: Example, page 9](#)

Specifying the Method for Selecting PVC Bundle Members: Example

The following example shows how to specify the method for selecting PVC bundle members:

```
interface atm 2/0
 bundle cisco
  selection-method qos-group
end
```

Configuring the QoS Group-Based Method for Selection of PVC Bundle Members: Example

The following example shows how to configure the QoS group-based method for selection of PVC bundle members:

```
interface atm 2/0
 bundle cisco
  selection-method qos-group
  pvc 35/56
  qos-group 1
end
```

Configuring Explicit Inverse ARP PVC Selection for QoS Group-Based PVC Bundle Member Selection: Example

The following example shows how to configure explicit Inverse ARP PVC selection for QoS group-based PVC bundle member selection:

```
interface atm 2/0
 bundle cisco
  selection-method qos-group
  pvc 1/32
  qos-group 1
  inarp-vc
end
```

Additional References

The following sections provide references related to the Routed Bridge Encapsulation with ATM Virtual Circuit Bundles feature.

Related Documents

Related Topic	Document Title
Broadband access aggregation concepts	<i>Understanding Broadband Access Aggregation</i>
Preparing for broadband access aggregation tasks	<i>Preparing for Broadband Access Aggregation</i>
Broadband access aggregation and DSL commands: complete command syntax, command mode, defaults, usage guidelines, and examples	<i>Cisco IOS Broadband Access Aggregation and DSL Command Reference</i>
Cisco IOS commands	<i>Cisco IOS Master Commands List, All Releases</i>

Standards

Standard	Title
None	—

MIBs

MIB	MIBs Link
None	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

RFCs

RFC	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 Routed Bridge Encapsulation with ATM Virtual Circuit Bundles

Table 1 lists the release history for this feature.

For information on a feature in this technology that is not documented here, see the “[Configuring Broadband Access Aggregation Features Roadmap](#).”

Not all commands may be available in your Cisco IOS software release. For details on when support for specific commands was introduced, see the command reference documents.

Use Cisco Feature Navigator to find information about platform support and software image support. Cisco Feature Navigator enables you to determine which Cisco IOS and Catalyst OS software images support a specific software release, feature set, or platform. To access Cisco Feature Navigator, go to <http://www.cisco.com/go/cfn>. An account on Cisco.com is not required.



Note

Table 1 lists only the Cisco IOS software release that introduced support for a given feature in a given Cisco IOS software release train. Unless noted otherwise, subsequent releases of that Cisco IOS software release train also support that feature.

Table 1 Feature Information for Routed Bridge Encapsulation with ATM Virtual Circuit Bundles

Feature Name	Releases	Feature Information
Routed Bridge Encapsulation with ATM Virtual Circuit Bundles	12.2(31)SB2 12.2(33)SRE 12.4(4)T	This feature enables RBE over ATM PVC bundles. This feature supports PVC bundle member selection based on the QoS group or on the ToS or MPLS EXP bit in each packet over RBE interfaces. The following command was introduced: selection-method.

Glossary

ARP—Address Resolution Protocol. Internet protocol used to map an IP address to a MAC address. Defined in RFC 826.

ATM—Asynchronous Transfer Mode. The international standard for cell relay in which multiple service types (such as voice, video, or data) are conveyed in fixed-length (53-byte) cells. Fixed-length cells allow cell processing to occur in hardware, thereby reducing transit delays. ATM is designed to take advantage of high-speed transmission media, such as E3, SONET, and T3.

bundle—A logical grouping of one or more physical interfaces using the formats and procedures of multilink Frame Relay. A bundle emulates a physical interface to the Frame Relay data link layer. The bundle is also referred to as the *MFR interface*.

Cisco Express Forwarding—Layer 3 IP switching technology that optimizes network performance and scalability for networks with large and dynamic traffic patterns.

fast switching—Cisco feature in which a route cache expedites packet switching through a router.

Inverse ARP—Inverse Address Resolution Protocol (ARP). Method of building dynamic routes in a network. Allows an access server to discover the network address of a device associated with a virtual circuit.

MPLS—Multiprotocol Label Switching. Switching method that forwards IP traffic using a label. This label instructs the routers and the switches in the network where to forward the packets based on preestablished IP routing information.

MQC—modular QoS command-line interface (CLI). A CLI structure that lets you create traffic policies and attach them to interfaces. A traffic policy contains a traffic class and one or more QoS features. A traffic class is used to classify traffic, and the QoS features in the traffic policy determine how to treat the classified traffic.

PVC—permanent virtual circuit (or connection). Virtual circuit that is permanently established. PVCs save bandwidth associated with circuit establishment and teardown in situations where certain virtual circuits must exist all the time. In ATM terminology, this is called a permanent virtual connection.

QoS—quality of service. Measure of performance for a transmission system that reflects its transmission quality and service availability.

RBE—routed bridge encapsulation. Process by which a stub-bridged segment is terminated on a point-to-point routed interface. Specifically, the router is routing on an IEEE 802.3 or Ethernet header carried over a point-to-point protocol, such as PPP, RFC 1483 ATM, or RFC 1490 Frame Relay.

SVC—switched virtual circuit. Virtual circuit that is dynamically established on demand and is torn down when transmission is complete. SVCs are used in situations where data transmission is sporadic. Called a switched virtual connection in ATM terminology.

ToS—type of service byte. Second byte in the IP header that indicates the desired quality of service for a specific datagram.

VC—virtual circuit. Logical circuit created to ensure reliable communication between two network devices. A VC is defined by a VPI/VCI pair and can be either permanent or switched.

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