Configuring Circuits

SYSTEM ADMINISTRATOR GUIDE

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Contents

1 Overview

This document describes how to configure, monitor, and administer permanent virtual circuits (PVCs) on ports and aggregated link-group PVCs. Use of circuit-groups is also described.

This document applies to both the Ericsson SmartEdge® and SM family routers. However, the software that applies to the SM family of systems is a subset of the SmartEdge OS; some of the functionality described in this document may not apply to SM family routers.

For information specific to the SM family chassis, including line cards, refer to the SM family chassis documentation.

For specific information about the differences between the SmartEdge and SM family routers, refer to the Technical Product Description *SM Family of Systems* (part number 5/221 02-CRA 119 1170/1) in the **`Product Overview`** folder of this Customer Product Information library.

The SmartEdge router supports the following types of circuits and circuit-related features:

- 802.1Q permanent virtual circuits (PVCs)
- Asynchronous Transfer Mode (ATM) PVCs
- Frame Relay PVCs
- Clientless IP service selection (CLIPS) PVCs
- Point-to-Point (PPP)-encapsulated circuits
- Link groups of circuits

Note: Unless otherwise noted, the SmartEdge 100 router supports all commands described in this document.

Circuits are logical paths through a port, channel, or tunnel. This section provides overviews of PVCs on Ethernet, ATM, and Frame Relay networks:

Note: When IP Version 6 (IPv6) addresses are not referenced or explicitly specified, the term IP address can refer generally to IP Version 4 (IPv4) addresses, IPv6 addresses, or IP addressing. When IPv6 addresses are referenced or explicitly specified, the term IP address refers only to IPv4 addresses. For a description of IPv6 addressing and the types of IPv6 addresses, see RFC 3513, *Internet Protocol Version 6 (IPv6) Addressing Architecture*.

1.1 802.1Q PVCs

A VLAN is a separate, administratively defined, subgroup of a bridged LAN. Bridged LANs and 802.1Q encapsulation are described in the *802.1Q IEEE Standard for Local and Metropolitan Area Networks: Virtual Bridged Local Area Networks* specification, which defines an architecture and bridging protocols for the partitioning of a bridged LAN into VLANs.

In the SmartEdge router, an 802.1Q PVC that connects an 802.1Q VLAN to the SmartEdge router can be created on any 10/100 Fast Ethernet (FE), Gigabit Ethernet, or 10 Gigabit Ethernet port.

Note: The 802.1Q features do not apply to the Ethernet management port on the controller card.

The SmartEdge router supports 802.1Q encapsulation on Ethernet ports. When an 802.1Q frame is received on an 802.1Q PVC, the 802.1Q header is stripped from the packet. The Ethernet packet is then routed by the system. When an outbound packet is forwarded to an 802.1Q PVC, the SmartEdge router adds the appropriate 802.1Q header to the packet.

The types of 802.1Q PVCs and 802.1Q tunnels are discussed in the following sections:

1.1.1 On-Demand, CCOD, and Static 802.1Q PVCs

Two types of 802.1Q PVCs are supported—static and on-demand. A static PVC is created in main memory when it is configured, and is always considered active, even when there is no traffic on it. An on-demand PVC is also created when it is configured, but it becomes active only when user traffic is detected on it.

The process by which on-demand PVCs are created is called circuit creation on demand (CCOD).

On-demand PVCs have two modes—dormant (or listening) and active. When you configure a single on-demand PVC, or a range of on-demand PVCs, the dormant version of each PVC is created in listening mode; it does not occupy main memory.

When user traffic is detected on a dormant PVC, the PVC is created in active mode in main memory. When the traffic ceases (there are no subscriber sessions connected on it), the PVC is said to be inactive. After a configurable time interval, the inactive PVC is deleted from main memory and the dormant version is again in listening mode. In this way, on-demand PVCs conserve main memory.

You can assign a profile and specify the encapsulation for a range of on-demand PVCs when you configure them, or you can specify the authentication, authorization, and accounting (AAA) and RADIUS features to provide the profile and encapsulation.

An 802.1Q PVC can be configured as a tunnel, with static, on-demand, or both types of 802.1Q PVCs configured within it. Each 802.1Q PVC within the tunnel has an outer VLAN tag value, which is the tunnel's VLAN tag value, and a unique inner VLAN tag value.

1.1.2 802.1Q Tunnels

Four types of 802.1Q tunnels are supported; they are identified from their 802.1Q headers: 8100, 88a8, 9100, and 9200. You can also specify a user-defined type. You can configure one or more tunnels on each port.

Because 802.1Q PVCs can carry multiple types of packets, IP over Ethernet (IPoE), Point-to-Point Protocol over Ethernet (PPPoE), and IPv6 over Ethernet (IPv6oE), the operating system supports the creation of child circuits to segregate PPPoE and IPv6oE packets. You can terminate these child circuits or cross-connect them just as you can terminate or cross-connect the 802.1Q PVCs on which you have configured them.

1.1.3 Aggregated 802.1Q PVCs and 802.1Q Tunnels in Link Groups

You can create aggregated 802.1Q PVCs and tunnels in access link groups. See the *IEEE 802.3ad Link Groups for FE and GE Ports* section in *Configuring Link Aggregation* for details.

1.1.4 Circuit Groups

Circuit groups allow you to group arbitrary PVCs or other circuits such as subscriber sessions for collective metering, policing, and scheduling. You can group PVCs—for example, to represent a business entity—and apply class-aware and circuit-level rate limits to the group. In this case, the traffic on all of the member circuits is collectively limited to any metering, policing, and scheduling rates configured on the circuit group.

Circuit group membership is available for 802.1Q PVCs, 802.1Q tunnels, or a mix of these circuit types. Circuit group membership is also available for subscriber circuits.

Circuit group members can have child circuits configured under them. The following apply to circuit group membership:

- Circuit-group membership may be configured for 802.1Q tunnels with PVC children. Similarly, if an 802.1Q tunnel encapsulated PVC has been configured as belonging to a circuit group, child PVCs may be configured with that outer VLAN or (PVC) ID.

- Circuit-group membership may be configured for 802.1Q PVCs with authentication bindings and maximum sessions configured for a value greater than 1.

- Circuit-group membership may be configured for 802.1Q PVCs with the **`circuit protocol`** command configured.

When a circuit with children is assigned circuit-group membership, those child circuits remain associated with their parent and are subject to QoS inheritance of any QoS policies applied to the circuit group or the member circuit itself. However, if the child circuit is itself assigned circuit-group membership, the QoS inheritance relationship with its parent circuit is broken and the child inherits from its own circuit group.

Counters values reported for the circuit group reflect the aggregate totals of all the members as well as their children.

Subscriber session circuits can be configured as direct members of a circuit group. You can configure the **`circuit-group-member`** command in the subscriber record, subscriber profile, or subscriber default configuration modes. In addition, a corresponding VSA (210, Circuit_Group_Member) is provided to allow configuration of circuit-group membership through RADIUS. The following apply to a subscriber session member of a circuit group:

- It is no longer subject to QoS policy inheritance from its parent port or PVC and is an equal peer of any PVC.

- If a subscriber session with a Circuit-Group-Membership attribute shares a circuit with its parent PVC due to **`bind authentication maximum 1`** configuration, the PVC parent of the subscriber session also becomes a member of the circuit group. When the subscriber session goes down, the PVC parent is no longer a circuit group member.

For information about the **`circuit-group`**, **`circuit-group-member`**, and **`subscriber`** commands, see *Command List*. For information about VSA 210, see *RADIUS Attributes*.

The SmartEdge router also supports virtual port circuit groups (VPCGs). This circuit group allows you to organize circuits or link groups of ports that support PWFQ and have a line rate greater than 1 Gbps into multiple scheduling domains. For information about VPCGs, see *Virtual Port Circuit Groups*.

A circuit group can belong to another circuit group. For more information about these nested circuit groups, see *Nested Circuit Groups*.

1.1.5 Filtering Traffic on 802.1Q PVCs or Access Link Groups

The SmartEdge router also supports the use of IP access control lists (ACLs) to filter (IPv4) traffic on Ethernet untagged circuits, 802.1Q PVCs, or access link groups. For the procedures to apply an ACL to an Ethernet circuit or VLAN PVC, see *Configuring ACLs* and to apply an ACL to an access link group, see *Configuring Link Aggregation*.

1.2 ATM Profiles, VPs, and PVCs

ATM encapsulation is described in RFC 1483, *Multiprotocol Encapsulation over ATM Adaptation Layer 5.* ATM PVCs can be created on any ATM port.

Using ATM, data flows over PVCs on a virtual path (VP) on an ATM port. These PVCs are identified by a virtual path identifier (VPI) and virtual circuit identifier (VCI). After you have configured an ATM port, you can configure VPs and PVCs. ATM PVCs and shaped VPs are configured using ATM profiles. (A shaped VP is a VP created with the **`atm vp`** command in ATM OC configuration mode.)

Note: A PVC created on a shaped VP is sometimes referred to as a virtual circuit (VC). VC is used in the following descriptions only when it is necessary to distinguish it from a PVC configured on a nonshaped VP; otherwise, PVC is used throughout this document. A shaped VP is also referred to as a VP tunnel; the term VP tunnel is not used in this document.

For ATM PVCs configured on ports on second-generation ATM OC traffic cards, you can also create ATM VC tunnels by attaching a quality of service (QoS) ATM weighted fair queuing (ATMWFQ) policy to an ATM PVC.

An ATMWFQ policy allows you to define either two, four, or eight class of service (CoS) queues of packets on each ATM PVC. Each PVC then acts as a VC tunnel.

You can specify the queuing algorithm for the policy, and for each queue its congestion avoidance parameters, either weighted random early detection (RED) or early packet discard (EPD). For information about attaching QoS policies of any type, see *Configuring Circuits for QoS*.

The types of ATM profiles, ATM traffic management, and the types of ATM circuits are discussed in the following sections:

1.2.1 ATM Profiles

ATM profiles can be either static or dynamic (nonstatic):

- A static profile is one that you cannot modify or delete after you have assigned any ATM VP or PVC to it; to modify or delete a static profile, you must delete every VP and PVC assigned to it or reassign them to a different profile. However, you can assign an unlimited number of VPs and PVCs to a static profile.

- A dynamic (nonstatic) profile is one that you can modify at any time without deleting any VP or PVC assigned to it, subject to the constraints listed in the sections ATM Profiles section and the ATM Configuration Guidelines. You can assign up to 48,000 combined VPs and PVCs to a dynamic profile.

Note: To dynamically assign a static or dynamic profile to an ATM PVC, either by using subscriber-specific RADIUS attributes at the time a subscriber session becomes active or by using the RADIUS Refresh function, you must have enabled the software license for dynamic services.

Every ATM profile has a default traffic class, unspecified bit rate (UBR) without any option, which is assigned to each shaped ATM VP or PVC that references that profile. Other supported traffic classes include constant bit rate (CBR), variable bit rate-real time (VBR-rt), VBR nonreal-time (VBR-nrt), and UBR extended (UBRe).

1.2.2 ATM Traffic Shaping and Scheduling

For ATM VPs and PVCs configured on second-generation ATM OC traffic cards, the SmartEdge router supports multiple modes of traffic shaping and scheduling. These modes are:

- ATM priority

  This mode supports different ATM profiles with different shaping for VPs and the ATM VCs that you configure on them. VPs and VCs are shaped using constant bit rate (CBR), variable bit rate-real time (VBR-rt), VBR nonreal-time (VBR-nrt), or unspecified bit rate (UBR), subject to the restrictions given in the Configuring ATM section.

  It uses these traffic classes to perform VP and VC scheduling; VCs can also be scheduled with an attached QoS ATMWFQ scheduling policy.

  PVCs configured on a nonshaped VP are shaped using any traffic class, including UBR extended (UBRe) and can be scheduled using traffic classes and an attached QoS ATMWFQ scheduling policy.

  Note: ATM priority mode replaces the hierarchical-shaped virtual circuit (HSVC) SAR image that was supported in previous releases. Second-generation ATM OC traffic cards that were configured with the hierarchical shaping command (in card configuration mode) are automatically configured using this command with the **`atm-priority`** keyword.

- IP priority

  This mode supports different profiles with different shaping for VPs and their VCs, but restricts the shaping for VPs to CBR, UBR with the peak cell rate (PCR) option, VBR-rt, and VBR-nrt; VCs are restricted to UBR with the PCR option.

  It uses the IP priorities specified by an attached QoS ATMWFQ policy to perform VP and VC scheduling.

  PVCs configured on a nonshaped VP are shaped using any traffic class except UBRe and can be scheduled using traffic classes and an attached

QoS ATMWFQ scheduling policy. (Configuring PVCs in this mode is not recommended.)

Note: The ATM priority and IP priority modes reduce the number of PVCs that you can configure on a second-generation ATM OC traffic card.

- VC fairness

  This mode supports different profiles with different shaping for shaped VPs and their VCs, but restricts the shaping for VPs to CBR, UBR with the PCR option, VBR-rt, and VBR-nrt; VCs are restricted to UBR without the PCR option.

  It uses traffic classes to perform VP scheduling; VCs are scheduled using weighted round-robin (WRR) scheduling. VCs can also be scheduled with an attached QoS ATMWFQ scheduling policy.

  PVCs configured on a nonshaped VP are shaped and scheduled using any traffic class.

- HSVC fairness

  This mode supports the same functionality as VC fairness. In addition, it also supports the following features: not restricted to UBR without the PCR option; supports up to 8 queues; port rate limiting (scaling a port's bandwidth) and VC fairness under congestion.

1.2.3 On-Demand, CCOD, and Static ATM PVCs

Two types of ATM PVCs are supported—explicitly configured (static) and on-demand. A static PVC is created in main memory when it is configured, and is always considered active, even when there is no traffic on it. An on-demand PVCs is also created when it is configured, but it becomes active only when user traffic is detected on it.

On-demand PVCs have two modes—dormant (or listening) and active. When you configure a single on-demand PVC or a range of on-demand PVCs, the dormant version of each PVC is created in listening mode; it does not occupy main memory.

The process by which on-demand PVCs is created is called circuit creation on demand (CCOD).

When user traffic is detected on a dormant PVC, the PVC is created in active mode in main memory. When the traffic ceases (there are no subscriber sessions connected on it), the PVC is said to be inactive. After a configurable time interval, the inactive PVC is deleted from main memory and the dormant version is again in listening mode. In this way, on-demand PVCs conserve main memory.

You can assign a profile and specify the encapsulation for a range of on-demand PVCs when you configure them, or you can specify that the AAA and RADIUS functions provide the profile and encapsulation type.

The ATM profile that AAA and RADIUS dynamically assign can be either a static or dynamic profile that you have created previously.

Note: To configure ATM VC tunnels or hierarchical shaping, or to enable AAA and RADIUS to assign a profile to an on-demand PVC at the time it becomes active, you must have enabled the software license for that feature.

1.3 Frame Relay Profiles and PVCs

Frame Relay encapsulation is described in RFC 1490, *Multiprotocol Interconnect over Frame Relay* and RFC 2115, *Management Information Base for Frame Relay DTEs Using SMIv2*. You can create Frame Relay PVCs on any Packet over SONET/SDH (POS) port, MFR link group, or DS-0 channel group.

1.4 Terminology

Note: An 802.1Q PVC is also referred to as an *802.1Q virtual LAN (VLAN)*; however, in this document, it is the PVC, not the VLAN, that is being configured.

In the following descriptions, the term *controller card* refers to any version of the Cross-Connect Route Processor (XCRP4) Controller card, including the controller carrier card, unless otherwise noted.

The term *controller carrier card* refers to the controller functions on the circuit board within the SmartEdge 100 chassis. The term I/O carrier card refers to the traffic card functions on the circuit board; these functions are compatible with the similar functions that are implemented on all SmartEdge 400 and SmartEdge 800 traffic cards.

The term *chassis* refers to any SmartEdge router; the term *SmartEdge 800* refers to any version of the SmartEdge 800 chassis; the term *SmartEdge 800s* refers only to the SmartEdge 800s chassis

The term *traffic card* refers to a SmartEdge 100 media interface card (MIC) or an SmartEdge traffic card, unless otherwise noted.

The term *Gigabit Ethernet* refers to any Ethernet traffic card that supports a port speed of 1 Gbps or greater; unless explicitly stated, the speed of any Gigabit Ethernet port is 1 Gbps.

1.5 Related Information

Other documents with related tasks and commands include:

- *Configuring ATM, Ethernet, and POS Ports*
- *Configuring CLIPS*
- *Configuring PPP and PPPoE*
- *Configuring Link Aggregation*
- *Configuring Bridging*
- *Configuring Cross-Connections*

2 Circuit Configuration and Operations

2.1 Configuring 802.1Q PVCs

2.1.1 Configure an 802.1Q Profile

An 802.1Q profile is required to collect bulk statistics or set the priority bits for any 802.1Q PVC that uses the profile. To configure a profile for an 802.1Q PVC, perform the tasks described in Table 1.

Table 1 Configure an 802.1Q Profile

Step	Task	Root Command	Notes
1.	Create an 802.1Q profile, or select an existing one for modification, and access dot1q profile configuration mode.	*dot1q profile*	Enter this command in global configuration mode.
2.	The following commands appear in dot1Q profile configuration mode:		
	Associate a description with the profile.	*description (Dot1Q)*	Enter these commands in dot1q profile configuration mode.
	Apply an existing bulkstats schema profile.	*bulkstats schema*	
	Override the rates specified by QoS policies attached to a subscriber session or 802.1q VLAN with the rates learned from the neighbor peer (DSLAM) through ANCP, PPPoE, or DHCP TR-101 tags.	*access-line rate*	
	Set the PPPoE MRU value.	*ppp mru*	
	Configure the PPPoE Active Discovery Offer (PADO) delay value.	*pppoe pado delay*	
	Propagate QoS classification values	*propagate qos from ethernet*, *propagate qos to ethernet*, *propagate qos transport use-vlan-header*	
	Set the NAS port type.	*radius attribute nas-port-type*	
	Configure reporting speed TX/RX specific values.	*report*	

2.1.2 Configure an 802.1Q PVC

To configure an 802.1Q PVC on any Ethernet port, except the Ethernet management port, perform the tasks described in Table 2.

Table 2 Configure an 802.1Q PVC

Step	Task	Root Command	Notes
1.	Bind the Ethernet port to an existing interface in an existing context.	*bind interface*	Enter this command in port configuration mode to allow untagged traffic on the port.
2.	Specify 802.1Q encapsulation for the Ethernet port.	*encapsulation (Ethernet Port)*	Enter the **`encapsulation`** command with the **`dot1q`** keyword in port configuration mode.
3.	Create one or more 802.1Q PVCs and access dot1q PVC configuration mode.	*dot1q pvc* or *dot1q pvc transport*	Enter this command in port configuration mode. Use the **`on-demand`** keyword to create a range of 802.1Q PVCs that are made active only when needed.(1)
4.	Use Table 3 to set the optional parameters of the 802.Q PVC.		
5.	Bind the 802.1Q PVC with one of the following commands. Unless otherwise stated, enter the following commands in link PVC configuration mode:		
	Create a static binding to an interface.	*bind interface*	This binding applies to single 802.1Q PVCs with IPoE encapsulation (default). Enter this command only if you are not cross-connecting the PVC. You can bind to either an IP interface or a bridged interface. To create bridged 802.1Q PVCs, bind to a bridged interface.
	Create a restricted or unrestricted dynamic binding.	*bind authentication*	This binding applies to single PVCs with PPPoE encapsulation. You must specify the context to create a restricted dynamic binding.
	Create a static binding through a subscriber record to an interface.	*bind subscriber*	This binding applies to single PVCs with: • IPoE encapsulation (default) • PPPoE encapsulation Enter this command only if you are not cross-connecting the PVC.

Table 2 Configure an 802.1Q PVC

Step	Task	Root Command	Notes
	Automatically create static bindings through subscriber records to interfaces.	*bind auto-subscriber*	This binding applies to a range of PVCs created using the **on-demand** keyword and IPoE encapsulation (default). Enter this command only if you are not cross-connecting the PVC.
	Bind the PVC to a bypass for cross-connecting.	*bind bypass*	This binding applies to single PVCs that are not bound to an interface or subscriber record or are created on-demand. Enter this command only if you are cross-connecting the PVC and have no child circuits on it.
6.	If you have created a child circuit, bind the child circuit with one of the following commands. Unless otherwise stated, enter the following command in dot1q child protocol configuration mode:		
	Create a static binding through a subscriber record to an interface	*bind subscriber*	This binding applies only to PPPoE child circuit encapsulation. Enter this command only if you are not cross-connecting the child circuit.
	Create a restricted or unrestricted dynamic binding.	*bind authentication*	This binding applies only to PPPoE child circuit encapsulation. You must specify the context to create a restricted dynamic binding. Enter this command only if you are not cross-connecting the child circuit.
	Bind the PVC to a bypass for cross-connecting.	*bind bypass*	Enter this command only if you are cross-connecting the child circuit.
7.	Disable an 802.1Q PVC (stop operations on it) until you are ready to begin operations on it.	*shutdown (PVC)*	Enter this command in dot1q PVC configuration mode. By default, all circuits are enabled (operational).

(1) You cannot configure overlapping transport ranges (with the exception of the fallback transport range [keyword `any`*]) or overlapping circuit creation-on demand (CCOD) ranges. In addition, overlapping transport and CCOD ranges are not allowed.*

2.1.3 Configure the Optional Parameters of an 802.1Q PVC

To configure the optional parameters of an 802.1Q PVC on any Ethernet port, except the Ethernet management port, perform the tasks described in Table 3. Enter all commands in dot1q PVC configuration mode unless otherwise noted.

Table 3 Configure the Optional Parameters of an 802.1Q PVC

Step	Task	Root Command	Notes
1.	Optional. Configure the access-line ID.	*access-line access-node-id*, *access-line adjust*, *access-line agent-circuit-id*, *access-line rate*,	
2.	Optional. Specify the static MAC addresses.	*bridge mac-entry*	This command applies only when the 802.1Q PVC is bound to a bridged interface. Enter this command for the MAC address of each station known to be on this bridge. The bridge dynamically learns the addresses of other stations as they connect to the bridge.(1)
3.	Optional. Assign a bridge profile.	*bridge profile*	This command applies only to bridged 802.1Q PVCs. Supported only if the bridge is a tributary type. Not supported if the bridge is a trunk type.
4.	Optional. Create a child circuit on a multiprotocol-encapsulated PVC and access dot1q child protocol configuration mode.	*circuit protocol*	Enter this command only if you have encapsulated the PVC using the **multi** keyword in the **dot1q pvc** command.
5.	Create a binding for cross-connecting.	*bind bypass*	Enter this command only if you are cross-connecting the child circuit.
6.	Optional. Specify that the 802.1Q PVC is a member of the specified circuit group.	*circuit-group-memb er*	
7.	Optional. Associate a description with the PVC.	*description (Dot1Q)*	

Table 3 Configure the Optional Parameters of an 802.1Q PVC

Step	Task	Root Command	Notes
8.	Optional. Specify the forward output or policy.	• *forward output (circuit)* • *forward policy out* • *forward policy in*	
9.	Optional. Enable a watchdog timer for 802.1Q PVCs created on demand.	*idle-down*	This command applies only to 802.1Q PVCs created using the **on-demand** keyword.
10.	Optional. Apply an IP ACL filter to the 802.1Q PVCs.	*ip access-group*	
11.	Optional. Associate the IP address of the remote host on the circuit.	*ip host (PVC)*	Perform this task only for a PVC that you intend to bind directly to an interface. You cannot perform this task if you have created the PVC as part of a range of PVCs.
12.	Optional. Enable L2VPN bindings on this PVC.	*l2vpn (ctx-name)*	
13.	Optional. Assign a medium access control (MAC) address to an 802.1Q PVC.	*mac-address (Dot1Q PVC)*	
14.	Optional. Configure the QoS parameters of the 802.1Q PVC.	See the document, *Configuring Circuits for QoS* for use of the **qos** commands.	
15.	Optional. Configure a different rate for a circuit that has a QoS metering, policing, modified deficit round-robin (MDRR), or priority weighted fair queuing (PWFQ) policy attached to it.	*rate circuit*	See *Configuring Rate-Limiting and Class-Limiting*.
16.	Optional. Enable clientless IP service selection (CLIPS).	*service clips (static)*, *service clips dhcp*	
16.	Optional. Assign a spanning-tree profile.	*spanning-tree profile*	This command applies only when bound to a bridged interface.
17.	Disable an 802.1Q PVC (stop operations on it) until you are ready to begin operations on it.	*shutdown (PVC)*	By default, all circuits are enabled (operational).

(1) Not supported when the interface encapsulation is PPPoE or multibind.

2.1.4 Configure an 802.1Q Tunnel and the 802.1Q PVCs Within It

To configure an 802.1Q tunnel and any PVCs within the tunnel on any Ethernet port, except the Ethernet management port, perform the tasks described in Table 4.

Table 4 Configure an 802.1Q PVC Tunnel and the 802.1Q PVCs Within It

Step	Task	Root Command	Notes
1.	Bind the Ethernet port to an existing interface in an existing context.	*bind interface*	Enter this command in port configuration mode to allow untagged traffic on the port.
2.	Specify 802.1Q encapsulation for the Ethernet port.	*encapsulation (Ethernet Port)*	Enter this command with the **`dot1q`** keyword in port configuration mode.
3.	Specify the tunnel type for this port.	*dot1q tunnel*	Enter this command in port configuration mode.
4.	Create an 802.1Q tunnel and access dot1q PVC configuration mode.	*dot1q pvc* or *dot1q pvc transport*	Enter this command in port configuration mode. Specify the encapsulation with the **`1qtunnel`** keyword.
5.	Associate a description with the tunnel (optional).	*description (Dot1Q)*	Enter this command in dot1q PVC configuration mode.
6.	Bind the 802.1Q PVC tunnel.	*bind interface*	Enter this command in dot1q PVC configuration mode.
	- Create a binding for cross-connecting.	*bind bypass*	Enter this command only if you are cross-connecting the tunnel and not the PVCs within it.
7.	Create one or more 802.1Q PVCs within the tunnel and access dot1q PVC configuration mode.	*dot1q pvc* or *dot1q pvc transport*	Enter this command in port configuration mode. Specify the VLAN ID of the tunnel followed by a colon (**`:`**) before you specify the VLAN ID of the PVC. Use the **`on-demand`** keyword to configure a range of PVCs within the tunnel that are created only when needed. (1)(2)
8.	Use Table 3 to set the optional parameters of the 802.Q PVCs.		
9.	Bind the 802.1Q PVC with one of the following commands. Unless otherwise stated, enter the following commands in link PVC configuration mode:		

Table 4 Configure an 802.1Q PVC Tunnel and the 802.1Q PVCs Within It

Step	Task	Root Command	Notes
	- Create a static binding to an interface.	*bind interface*	This binding applies to single 802.1Q PVCs with IPoE encapsulation (default) Enter this command only if you are not cross-connecting the PVC. You can bind to either an IP interface or a bridged interface. To create bridged 802.1Q PVCs, bind to a bridged interface.
	- Create a restricted or unrestricted dynamic binding.	*bind authentication*	This binding applies to single PVCs with PPPoE encapsulation You must specify the context to create a restricted dynamic binding.
	- Create a static binding through a subscriber record to an interface.	*bind subscriber*	This binding applies to single PVCs with: • IPoE encapsulation (default) • PPPoE encapsulation Enter this command only if you are not cross-connecting the PVC.
	- Automatically create static bindings through subscriber records to interfaces.	*bind auto-subscriber*	This binding applies to a range of PVCs created using the **on-demand** keyword and IPoE encapsulation (default) Enter this command only if you are not cross-connecting the PVC.

Table 4 Configure an 802.1Q PVC Tunnel and the 802.1Q PVCs Within It

Step	Task	Root Command	Notes
	- Bind the PVC to a bypass for cross-connecting.	*bind bypass*	This binding applies to single PVCs that are not bound to an interface, subscriber record, or are created on-demand. Enter this command only if you are cross-connecting the PVC and have no child circuits on it.
10.	If you have created a child circuit, bind the child circuit with one of the following commands. Unless otherwise stated, enter the following commands in dot1q child protocol configuration mode:		
	- Create a static binding through a subscriber record to an interface.	*bind subscriber*	This binding applies only to PPPoE child circuit encapsulation. Enter this command only if you are not cross-connecting the child circuit.
	- Create a restricted or unrestricted dynamic binding.	*bind authentication*	This binding applies only to PPPoE child circuit encapsulation. You must specify the context to create a restricted dynamic binding. Enter this command only if you are not cross-connecting the child circuit.
	- Bind the PVC to a bypass for cross-connecting.	*bind bypass*	Enter this command only if you are cross-connecting the child circuit.
11.	Disable an 802.1Q PVC (stop operations on it) until you are ready to begin operations on it.	*shutdown (PVC)*	Enter this command in dot1q PVC configuration mode. By default, all circuits are enabled (operational).

(1) You can create both static and on-demand 802.1Q PVCs within the same 802.1Q tunnel.

(2) You cannot configure overlapping transport ranges (with the exception of the fallback transport range [keyword `any`]) or overlapping circuit creation-on demand (CCOD) ranges. In addition, overlapping transport and CCOD ranges are not allowed.

2.1.5 Create a Circuit Group and Assign Members to It

To create a circuit group and assign members to the group, perform the tasks described in Table 5. It is assumed you have configured 802.1Q PVCs or 802.1Q PVC tunnels (including specifying the use of 802.1Q encapsulation for the Ethernet port) before performing the tasks in Table 5. For details on how to configure 802.1Q PVCs and 802.1Q PVC tunnels, see the Configure an 802.1Q PVC and “Configure an 802.1Q Tunnel and the 802.1Q PVCs Within It sections.

For information on how to create a VPCG, see *Configuring VPCGs*.

Table 5 Configure a Circuit Group and Assign Members to It

Step	Task	Root Command	Notes
1.	Create a circuit group and assign a specified name to it.	*ip arp*	Enter this command in global configuration mode. For an example of how to attach a QoS metering, policing, or scheduling policy to the circuit group, see *Configuring Circuits for QoS*.
2.	Select an Ethernet port in which the members of circuit group are to reside, and access port configuration mode.	*port ethernet*	Enter this command in global configuration mode.
3.	Specify the 802.1Q tunnel or one or more static 802.1Q PVCs which are to be assigned to the specified circuit group and access dot1q PVC configuration mode.	*dot1q pvc* or *dot1q pvc transport*	Enter this command in port configuration mode.
4.	Specify that the 802.1Q tunnel or PVCs being configured are members of the specified circuit group.	*circuit-group-member*	Enter this command in dot1q PVC configuration mode.

2.2 Configuring ATM

This section describes the tasks to configure ATM, specify the card mode for the SAR image, configure an ATM profile, a shaped ATM VP, and an ATM PVC.

2.2.1 ATM Configuration Guidelines

2.2.1.1 ATM Profiles

The following guidelines apply to ATM profiles:

- The ATM profile must exist before you create the VP or PVC.

- Both static and dynamic (nonstatic) profiles can be referenced by an unlimited number of PVCs and VPs.

- You can create multiple static and dynamic profiles.

- To modify a static profile, you must first delete all VPs and PVCs that reference it or reassign them to a different profile.

- Deleting a profile deletes all VPs and PVCs that reference it.

The following guidelines apply to ATM profiles assigned to PVCs:

- Changing an ATM profile can cause traffic disruption to all PVCs that reference that profile, as described in the following statements:

  Caution!

  Risk of data loss. When you change the congestion algorithm or the traffic class for the profile (in ATM profile configuration mode), the system deletes and automatically recreates all ATM PVCs that reference the profile and displays an error message.

  Note: To reduce the risk when making any change to a profile, determine if the change affects service:

  - Create a new ATM profile with the changed configuration parameters.

  - Use the **`atm pvc`** command (or its **`atm pvc explicit`** form) (in ATM OC configuration mode) to assign the new profile to the ATM PVC.

  If the change affects service, a warning message is displayed when you enter the command, and you can cancel or commit the change by using the **`abort`** or **`commit`** command, respectively (in ATM OC configuration mode).

  Changes to traffic class parameters, such as rate, the cell loss priority (CLP) bit, the operations, administration, and maintenance (OAM) mechanism parameters, PVC statistics, congestion avoidance parameters, and bulkstats, do not affect traffic and therefore do not cause the error message to be displayed.

- To assign a different profile to an existing PVC, enter either form of the **`atm pvc`** command with the new profile name and the encapsulation.

Caution!

Risk of data loss. The assignment of the new profile can cause traffic to be interrupted on the affected PVC if the new profile changes the congestion algorithm or the traffic class. To reduce the risk, if the system displays an error message, you can cancel or commit the change by using the **`abort`** or **`commit`** command, respectively (in ATM OC configuration mode).

- After a dynamic (nonstatic) ATM profile is bound to a set of PVCs, you can change profile attributes, such as shaping; the modified attributes are applied to all PVCs referencing the profile, including CCOD PVCs. During modification, all sessions remain active. Modification of a large number of circuits may take up to 10 minutes. The CLI prompt returns after a few seconds; however, subscriber activation can be affected if the activation request arrives immediately after the profile change. For 32,000 PVCs, the delay is approximately 30 seconds and the delay increases proportionally with the number of PVCs configured.

The following guidelines apply to ATM profiles assigned to shaped VPs:

- You cannot create a shaped VP with a profile that specifies the UBRe traffic class, and you cannot change the shaping of a profile to UBRe if that profile has been referenced by a shaped VP.
- If you attempt to change the traffic class for an ATM profile that is assigned to a shaped VP that has VCs configured on it, the system displays an error message and the command fails. You must delete all VCs that are configured on the shaped VP before you change the profile and then recreate them.
- If you attempt to modify an existing shaped VP by assigning a different profile to it and that profile changes the traffic class, the system displays an error message and the command fails. You must delete all VCs configured on the shaped VP before you assign the new profile and then recreate them.
- If you reference an ATM profile that enables the OAM options with the **`oam fault-monitor`**, **`oam manage`**, or **`oam xc`** commands (in ATM profile configuration mode), the OAM options are ignored.

2.2.1.2 ATM and Congestion Avoidance

The following guidelines apply to the congestion avoidance algorithm that you specify for an ATM profile:

- The default congestion avoidance algorithm for an ATM profile (without the **`congestion`** command entered in ATM profile configuration mode) is weighted RED with its default parameters.

- You cannot specify more than one congestion algorithm, either weighted RED or EPD, for an ATM profile; if you specify a second algorithm, the first algorithm is silently replaced.
- The default values for the EPD parameters are not the same as those applied to an ATM profile in previous releases.
- Changing the EPD parameters for an ATM profile that is already assigned to an ATM VP or PVC; does not affect service (traffic is not disrupted) on any ATM traffic card.
- Changing the weighted RED parameters for an ATM profile that is already assigned to an ATM VP or PVC does not affect service (traffic is not disrupted) for the second-generation ATM OC traffic cards.
- Changing the congestion avoidance algorithm from weighted RED to EPD for a profile assigned to an ATM VP or PVC on any ATM traffic card can affect service. For second-generation ATM OC traffic cards, changing the algorithm affects service, but the counters are preserved.
- Changing the congestion avoidance algorithm from EPD to weighted RED for a profile assigned to an ATM VP or PVC on any ATM card can affect service. For second-generation ATM OC traffic cards, changing the algorithm affects service.

2.2.1.3 ATM Modes and Traffic Shaping

Traffic shaping restrictions for second-generation ATM OC traffic cards include the following:

- For any mode, except VC fairness, the traffic class specified in an ATM profile can restrict the number of ATM PVCs that you can configure on a port; for details, see Maximum Number of ATM PVCs and VPs.
- If you configure a PVC and reference a profile that includes UBRe shaping, you cannot attach an ATMWFQ QoS policy to that PVC.
- For the ATM priority mode, the traffic class for a profile that you reference for the shaped VP can be any class, except UBRe; however, any VC configured on that VP must reference a profile with a traffic class that is equal to or less restrictive than that for the VP. Table 6 lists the traffic class combinations for VPs and VCs.

Table 6 Traffic Class Combinations for ATM Priority Mode and HSVC Fairness Mode

VP Traffic Class	Valid VC Traffic Classes
CBR	CBR, VBR-rt, VBR-nrt, UBR with PCR option, UBR
VBR-rt	VBR-rt, VBR-nrt, UBR with PCR option, UBR
VBR-nrt	VBR-nrt, UBR with PCR option, UBR

Table 6 Traffic Class Combinations for ATM Priority Mode and HSVC Fairness Mode

VP Traffic Class	Valid VC Traffic Classes
UBR with PCR option	UBR with PCR option, UBR
UBR	UBR

2.2.1.4 ATM and OAM

The following OAM guidelines apply:

- To enable end-to-end path-level (F4) fault monitoring or OAM management for a shaped VP, you must create an ATM VC with VCI 4 on the VP that you intend to monitor; this VC must reference an ATM profile that includes the **`oam fault-monitor`**, **`oam manage`**, or **`oam xc`** command (in ATM profile configuration mode).

- If you specify the **`oam fault-monitor`** or **`oam manage`** command for an ATM profile that is referenced when creating a shaped VP, the OAM fault monitoring option is ignored.

- The **`oam fault-monitor`** command and the **`oam manage`** command (in ATM profile configuration mode) are mutually exclusive; you cannot specify fault monitoring and enable OAM management on the same ATM profile. However, you can include both the **`oam fault-monitor`** and **`oam xc`** or the **`oam manage`** and the **`oam xc`** commands (in ATM profile configuration mode) in the same profile.

- The **`oam fault-monitor`** and **`oam manage`** commands are operational only for ATM PVCs that are not cross-connected. If you also include an **`oam xc`** command (in ATM profile configuration mode) for this profile, and an ATM PVC that references this profile is cross-connected at a later time, the **`oam fault-monitor`** or **`oam manage`** command in the profile is disabled (ignored), and the **`oam xc`** command is made operational instead.

2.2.1.5 ATM and QoS

The following QoS guidelines apply:

- QoS ATMWFQ policies can be attached to ATM PVCs on second-generation ATM OC traffic cards only.

- If you attach an ATMWFQ QoS policy to the outbound traffic on an ATM PVC on a second-generation ATM OC card and that PVC references a profile with congestion parameters, the policy overrides the weighted RED or EPD parameters specified by the profile.

- Using ATM on-demand PVCs, QoS policies cannot be configured directly on the circuit, but must be configured and applied using the subscriber record referenced in the **`bind auto-subscriber`** command.

For information about creating QoS policies CoS queues, see *Configuring Queuing and Scheduling*.

2.2.1.6 Maximum Number of ATM PVCs and VPs

The maximum combined number of ATM circuits and VPs that the system supports for each ATM port depends on the type of ATM traffic card, the total number of circuits configured on that card, the type and number of traffic classes, the SAR image (mode) that is loaded, the type of QoS policy, the number of CoS queues, and the number of dormant on-demand PVCs that are configured.

The number is also affected by your assignment of VPI and VCI values.

Note: The tables in this section list these limits with no on-demand PVCs configured. For limits on the number of PVCs for configurations with on-demand PVCs configured, consult your local technical representative.

The following guidelines apply to the number of shaped VPs and PVCs that the system supports on a traffic card:

- On any ATM traffic card, each shaped VP is counted as a PVC.
- On any ATM PVC with multiprotocol encapsulation, the parent IP over Ethernet (IPoE) circuit and all configured PPPoE child circuits are counted as PVCs.
- The number of PVCs that you can configure for a traffic class depends on the type of traffic card and its mode. Table 7 lists the PVC limits for each traffic class on second-generation ATM OC traffic cards.

Table 7 PVC Limits on Second-Generation ATM OC Ports

	PVC Limits for Each Traffic Class per Port				
Traffic Card	**ATM Prio rity Mode**	**IP Priori ty Mode**	**VC Fair ness Mode**	**HSVC Fairness Mode**	**Notes**
2-port ATM OC-3c/STM-1c MIC (including low-density version)	8,000	8,000	16,000	Not Applicable	
8-port ATM OC-3c/STM-1c	Not Applicable	Not Applicab le	16,000	16,000	
2-port ATM OC-12c/STM-4c	Not Applicable	Not Applicab le	16,000	16,000	

- In some cases, an ATM PVC references a profile with UBRe shaping:

  - If an ATM PVC of an atm-oc3e-8-port traffic card that references a profile with UBRe shaping, the PVC is counted once; however, for other ATM traffic cards, the PVC is counted twice.

  - For all other ATM traffic cards, if an ATM PVC references a profile with UBRe shaping, that PVC must be counted twice—once as a PVC with UBR shaping and once as a PVC with VBR-nrt shaping. Therefore, the maximum number of PVCs with UBR or VBR-nrt shaping and the number of PVCs with UBRe shaping cannot be greater than the maximum number of PVCs for each traffic class and ATM mode.

- If you are creating a range of on-demand PVCs on a second-generation ATM OC port and you have configured the port in listening mode by using the **`ccod-mode port-listen`** command (in ATM OC configuration mode), you can specify the range of the listening PVCs with the VPI spanning from 0 to 255 and the VCI spanning from 1 to 65,535. Otherwise, the range that you specify must be within the limits for active PVCs; these limits depend upon the type of port, the SAR image for the traffic card, and the traffic class specified by the profile. An error message is displayed if the range that you specify is not supported; see the tables Table 7 that specify PVC limits.

- Regardless of the number of listening PVCs that you create, the number of active PVCs cannot be greater than those specified for each traffic class and SAR image on the type of port on which they are created; see Table 7 that specifies PVC limits for each SAR image.

- The number of PVCs on ports that are configured with an ATMWFQ QoS policy is dependent on the number of CoS queues. You can create two, four, or eight CoS queues; see Table 11 for PVC limits.

  For information about creating QoS policies and CoS queues, see *Configuring Queuing and Scheduling*.

- If you leave large gaps between VCI values, then the number of PVCs that you can create is reduced. Whenever possible, to minimize the affect on the number of PVCs:

  - Assign consecutive values for VCIs in groups of 64 PVCs.

  - Limit the number of PVCs defined per VPI to a multiple of 64.

You can create a maximum of 256 shaped and unshaped VPs on any ATM port (VPIs 0 to 255); Table 8 lists the limits for shaped VPs on each type of ATM card.

Table 8 Shaped VP Limits for ATM Traffic Cards

Traffic Card	Shaped VP Limits
2-port ATM OC-3c/STM-1c	64 per traffic card; 32 per port.
1-port ATM OC-12c/STM-4c	64 per traffic card.

Table 8 Shaped VP Limits for ATM Traffic Cards

Traffic Card	Shaped VP Limits
2-port ATM OC-3c/STM-1c MIC (including low-density version)	Determined by many factors, including the number of PVCs and number of CoS queues created, up to a maximum of 256 shaped VPs on each port.
8-port ATM OC-3c/STM-1c	Determined by many factors, including the number of PVCs and number of CoS queues created, up to a maximum of 256 shaped VPs on each port.
2-port ATM OC-12c/STM-4c	Determined by many factors, including the number of PVCs and number of CoS queues created, up to a maximum of 256 shaped VPs on each port.

Table 9 lists the PVC limits on shaped VPs per type of ATM traffic card.

Table 9 PVC Limits on Shaped VPs for ATM Traffic Cards

Traffic Card	VC Limits for Shaped VPs
2-port ATM OC-3c/STM-1c	256 per shaped VP; 5,715 per traffic card.
1-port ATM OC-12c/STM-4c	256 per shaped VP; 5,715 per traffic card.
2-port ATM OC-3c/STM-1c MIC (including low-density version)	16,000 per shaped VP; 16,000 per traffic card.
8-port ATM OC-3c/STM-1c	16,000 per shaped VP; 32,000 per traffic card.
2-port ATM OC-12c/STM-4c	16,000 per shaped VP; 32,000 per traffic card.

Table 10 lists the circuit and PVC limits when no ATMWFQ policy is attached.

Table 10 PVC Limits for ATM Cards Without ATMWFQ Policy

Card	Mode	Circuit and PVC Limits
2-port ATM OC-3c/STM-1c	Default	8,000 per port; 8,000 per traffic card.
1-port ATM OC-12c/STM-4c	Default	8,000 per port; 8,000 per traffic card.
2-port ATM OC-3c/STM-1c MIC (including low-density version)	VC fairness ATM or IP priority	16,000 per port; 16,000 per traffic card.
8-port ATM OC-3c/STM-1c	VC fairness or HSVC fairness	16,000 per port; 32,000 per traffic card.(1)
2-port ATM OC-12c/STM-4c	VC fairness or HSVC fairness	16,000 per port; 32,000 per traffic card.(1)

(1) The sum of VP bandwidths on a port should not be allowed to exceed the port's physical bandwidth.

Table 11 lists the circuit and PVC limits for ATM traffic cards with ATMWFQ CoS queues.

Table 11 PVC Limits for ATM Traffic Cards with ATMWFQ CoS Queues

Traffic Card	Mode	Circuit and PVC Limits
2-port ATM OC-3c/STM-1c MIC	VC fairness	• 0 or 2 CoS queues: 16,000 per port; 16,000 total per MIC. • 4 CoS queues: 10,000 per port; 10,000 per MIC. • 8 CoS queues: 6,000 per port; 6,000 per MIC.
2-port ATM OC-3c/STM-1c MIC	ATM or IP priority	• 0 or 2 CoS queues: 16,000 per port; 16,000 total per MIC. • 4 CoS queues: 10,000 per port; 10,000 per MIC. • 8 CoS queues: 6,000 per port; 6,000 per MIC.
8-port ATM OC-3c/STM-1c	VC fairness or HSVC fairness	• 0 to 2 CoS queues: 16,000 per port; 32,000 per card.(1) • 4 CoS queues: 16,000 per port; 32,000 per card.(1) • 8 CoS queues: 12,000 per port; 24,000 per card.(1)
2-port ATM OC-12c/STM-4c	VC fairness or HSVC fairness	• 0 to 2 CoS queues: 16,000 per port; 32,000 per card.(1) • 4 CoS queues: 16,000 per port; 32,000 per card.(1) • 8 CoS queues: 12,000 per port; 24,000 per card.(1)

(1) The sum of VP bandwidths on a port should not be allowed to exceed the port's physical bandwidth.

2.2.2 Specify the Card Mode for the SAR Image

You must explicitly specify the card mode for the SAR image of a second-generation ATM OC traffic card on which you want to use ATM priority or IP priority traffic scheduling. On cards that support hsvc-fair mode, this must also be explicitly specified. To specify the card mode for the SAR image, perform the task described in Table 12; enter the command in card configuration mode or MIC configuration mode.

Table 12 Specify the Card Mode for the SAR Image

Task	Root Command	Notes
Specify the card mode.	`atm mode`	This command is available only second-generation ATM OC traffic cards and ATM OC MICs.

2.2.3 Configure an ATM Profile

An ATM profile is required to create ATM PVCs or shaped VPs for ATM PVCs. An ATM profile contains common configuration information that is used by all shaped VPs and ATM PVCs that reference the profile.

Typically, you configure at least one ATM profile for each traffic class that you intend to support on a SmartEdge router. You might also require additional ATM profiles for PVCs with other special requirements, such as counters, or PVCs created on demand.

To configure an ATM profile, perform the tasks described in Table 13.

Table 13 Configure an ATM Profile

Step	Task	Root Command	Notes
1.	Create a new ATM profile, or to select an existing ATM profile for modification, and access ATM profile configuration mode.	*atm profile*	Enter this command global configuration mode.
2.	Specify general attributes for the profile. All attributes are optional:		
	Associate a description with an ATM profile.	*description (ATM, Frame Relay)*	Enter this command in ATM profile configuration mode.
	Report the receive and transmit speeds of the ATM PVC to which this profile is assigned.	*report*	Enter this command in ATM profile configuration mode.
	Set the CLP bit in all cells transmitted over PVCs referencing this ATM profile.	*clpbit*	Enter this command in ATM profile configuration mode.
	Specify the traffic class for this ATM profile.	*shaping*	Enter this command in ATM profile configuration mode. The default value is UBR without the PCR option.
	Enable statistics collection for all PVCs referencing this ATM profile.	*counters (ATM)*	Enter this command in ATM profile configuration mode.

Table 13 Configure an ATM Profile

Step	Task	Root Command	Notes
	Specify the weighted RED or EPD parameters for congestion avoidance.	*congestion*	Enter this command in ATM profile configuration mode.
	Apply an existing bulkstats schema profile to the profile.	*bulkstats schema*	
3.	For non-cross-connected ATM PVCs, enable OAM with one of the following tasks (optional):		
	Enable alarm indication signal (AIS) and remote defect indication (RDI) fault monitoring for any ATM PVC that references this profile and is not cross-connected.	*oam fault-monitor*	Enter this command in ATM profile configuration mode. The default value is disabled.
	Enable the operational state of any ATM PVC that is not cross-connected and that references this profile to be reflected by its AIS and RDI (RDI/AIS) state at the F5 level.	*oam manage*	Enter this command in ATM profile configuration mode. The default value is disabled.
4.	For cross-connected ATM PVCs, enable the OAM cells received on one of the ATM PVCs to be forwarded to and transmitted on the other ATM PVC.	*oam xc*	Enter this command in ATM profile configuration mode. The default value is disabled.

2.2.4 Configure a Shaped ATM VP

When you create an ATM PVC, you must specify a VP for it by using a VPI. An ATM VP can be shaped or nonshaped:

- A shaped VP is created explicitly.

  You create it by using the **`atm vp`** command (in ATM OC configuration mode) and specifying its VPI and an existing ATM profile.

- A nonshaped VP is created implicitly.

  The SmartEdge OS creates it when you configure an ATM PVC and specify a VPI that has not be used to create a shaped VP.

To configure a shaped ATM VP, perform the task described in Table 14; enter this command in ATM OC configuration mode.

Table 14 Configure a Shaped ATM VP

Task	Root Command	Notes
Create or modify a shaped ATM VP.	*atm vp*	Enter this command in ATM OC configuration mode.

2.2.5 Configure an ATM PVC

To configure an ATM PVC, perform the tasks described in Table 15.

Table 15 Configure an ATM PVC

Step	Task	Root Command	Notes
1.	Create or modify one or more ATM PVCs, and access ATM PVC configuration mode with one of the following tasks:		
	Create or modify one or more ATM PVCs.	*atm pvc*	Enter this command in ATM OC configuration mode. Use the **`explicit`** keyword to create a range of static PVCs. Use the **`on-demand`** keyword to configure a range of PVCs that are created only when needed.
	Assign a different profile to an existing ATM PVC.	*atm pvc*	You must specify the encapsulation in addition to the new profile name.
2.	Specify general attributes for the PVC (all attributes are optional):		
	Associate a description with an ATM PVC.	*description (ATM, Frame Relay)*	Enter this command in ATM PVC configuration mode.
	Enable a watchdog timer for PVCs created on demand.	*idle-down*	Enter this command in ATM PVC configuration mode. This command applies only to ATM PVCs created using the **`on-demand`** keyword without multiprotocol encapsulation.

Table 15 Configure an ATM PVC

Step	Task	Root Command	Notes
	Associate the IP address and MAC address of the remote host on the circuit with the ATM PVC.	*ip host (PVC)*	Enter this command in ATM PVC configuration mode. Perform this task only for an ATM PVC that you intend to bind directly to an interface. You cannot perform this task if you have created the PVC as part of a range of PVCs.
3.	Optional. Create a child circuit on a multiprotocol-encapsulated PVC and access ATM child protocol configuration mode.	*circuit protocol*	Enter this command only if you have encapsulated the PVC using the **multi** keyword.
	Create a binding for cross-connecting.	*bind bypass*	Enter this command only if you are cross-connecting the child circuit.
4.	If you do not intend to cross-connect the ATM PVC to another circuit, bind the ATM PVC with one of the following `bind` commands:		
	Create a binding for cross-connecting.	*bind bypass*	Enter this command only if you are cross-connecting the PVC.
	For an ATM PVC with **bridge1483**, **multi**, or **route1483** encapsulation, you have three options:		
	Create a static binding to an interface.	*bind interface*	Enter this command in ATM PVC configuration mode. This option is not supported for on-demand ATM PVCs.
	Create a static binding for a single PVC through a subscriber record to an interface.	*bind subscriber*	Enter this command in ATM PVC configuration mode. This option is supported for a single ATM PVC; an on-demand ATM PVC must be configured with the **aaa** keyword.
	Create static bindings for multiple PVCs through subscriber records.	*bind auto-subscriber*	Enter this command in ATM PVC configuration mode. Perform this option only if you are binding a range of PVCs.
	For an ATM PVC with **ppp** encapsulation, you have four options:		
	Create an unrestricted dynamic binding.	*bind authentication*	Enter this command in ATM PVC configuration mode.

Table 15 Configure an ATM PVC

Step	Task	Root Command	Notes
	Create a restricted dynamic binding.	*bind authentication*	Enter this command in ATM PVC configuration mode. You must specify the context to create a restricted dynamic binding.
	Create a static binding for a single PVC through a subscriber record to an interface.	*bind subscriber*	Enter this command in ATM PVC configuration mode. This option is supported for a single ATM PVC; an on-demand ATM PVC must be configured with the **`aaa`** keyword.
	Create static bindings for multiple PVCs through subscriber records.	*bind auto-subscriber*	Perform this option only if you are binding a range of PVCs.
	For an ATM PVC with **`pppoe`** encapsulation, you have two options:		
	Create an unrestricted dynamic binding.	*bind authentication*	Enter this command in ATM PVC configuration mode.
	Create a restricted dynamic binding.	*bind authentication*	Enter this command in ATM PVC configuration mode. You must specify the context to create a restricted dynamic binding.
5.	If you have created a child circuit and are not intending to cross-connect it to another circuit, bind the child circuit with one of the following `bind` commands:		
	Create a static binding through a subscriber record to an interface.	*bind subscriber*	Enter this command in ATM child protocol configuration mode.
	Create an unrestricted dynamic binding.	*bind authentication*	Enter this command in ATM child protocol configuration mode.
	Create a restricted dynamic binding.	*bind authentication*	Enter this command in ATM child protocol configuration mode. You must specify the context to create a restricted dynamic binding.
6.	Disable an ATM PVC (stop operations on it) until you are ready to begin operations on it.	*shutdown (PVC)*	Enter this command in ATM PVC configuration mode. By default, all circuits are enabled (operational).

2.3 Configuring Frame Relay

Note: You must enter the `encapsulation` command in MFR link group, or port configuration mode with the `frame-relay` keyword before you can enter Frame Relay commands in MFR link group, or port configuration mode.

2.3.1 Configure a Channel or Port for Frame Relay

You can create Frame Relay PVCs on any Packet over SONET/SDH (POS) port, MFR link group, or DS-0 channel group.

The procedure for setting up a POS port is described in the section, *Configuring POS Ports*. In this procedure, use the `encapsulation (POS)` command to set the POS port encapsulation to *frame-relay*. An example of this configuration is found in the section Frame Relay PVC on POS Port.

2.3.2 Configure a Frame Relay Profile

To configure a Frame Relay profile, perform the tasks described in Table 16.

Table 16 Configure a Frame Relay Profile

Step	Task	Root Command	Notes
1.	Create a new Frame Relay profile, or to select an existing Frame Relay profile for modification, and access Frame Relay profile configuration mode.	*frame-relay profile*	Enter this command in global configuration mode.
2.	Apply an existing bulkstats schema profile to a Frame Relay profile.	*bulkstats schema*	

2.3.3 Configure the Interface Type and LMI Parameters

For Frame Relay to operate, you must configure the interface type and the Frame Relay LMI for the port or channel with Frame Relay encapsulation. To configure the interface type and the LMI, perform the tasks described in Table 17. Enter all commands in MFR link group, or port configuration mode.

Table 17 Configure the Interface Type and LMI Parameters

Step	Task	Root Command	Notes
1.	Specify the interface type.	*frame-relay intf-type*	Enter all commands in MFR link group, or port configuration mode.
2.	Specify the interval for the polling verification timer for a DCE interface type.	*frame-relay lmi-t392 dce*	
3.	Specify the Frame Relay LMI type.	*frame-relay lmi-type*	

Table 17 Configure the Interface Type and LMI Parameters

Step	Task	Root Command	Notes
4.	Enable the automatic detection of the LMI type.	*frame-relay auto-detect*	This is the default; use the **no** form to disable automatic detection.
5.	Enable the keepalive function and specify the interval value for a Frame Relay DTE interface.	*frame-relay keepalive*	The keepalive function is enabled by default with a 10-second interval.
6.	Specify the number of keepalive messages sent before the status message request is sent for a Frame Relay DTE interface.	*frame-relay lmi-n391dte*	
7.	Specify the error threshold before LMI is considered to have failed:		
	For a Frame Relay DCE interface.	*frame-relay lmi-n392dce*	
	For a Frame Relay DTE interface.	*frame-relay lmi-n392dte*	
8.	Specify the monitored event count:		
	For a Frame Relay DCE interface.	*frame-relay lmi-n393dce*	
	For a Frame Relay DTE interface.	*frame-relay lmi-n393dte*	

2.3.4 Configure a Frame Relay PVC

You can configure a Frame Relay PVC on a Packet over SONET/SDH (POS) port that is configured with the **encapsulation frame-relay** command, MFR link group, or port configuration mode). To configure a Frame Relay PVC, perform the tasks described in Table 18.

Table 18 Configure a Frame Relay PVC

Step	Task	Root Command	Notes
1.	Create or select a Frame Relay PVC and access Frame Relay PVC configuration mode.	*frame-relay pvc*	Enter this command in MFR link group, or port configuration mode. You must have previously specified Frame Relay encapsulation for this command to be available.

Table 18 Configure a Frame Relay PVC

Step	Task	Root Command	Notes
2.	Associate the IP address of the remote host on the circuit.	*ip host (PVC)*	Enter this command in Frame Relay PVC configuration mode.
3.	Bind the Frame Relay PVC to an existing interface in an existing context.	*bind interface*	Enter this command in Frame Relay PVC configuration mode.
4.	Disable a Frame Relay PVC (stop operations on it) until you are ready to begin operations on it.	*shutdown (PVC)*	By default, all circuits are enabled (operational).

2.4 Circuit Operations

Note: The commands listed in this section are common to all circuit types, except where noted.

To monitor, administer, and troubleshoot any circuit, perform the appropriate task listed in Table 19. Enter the **`clear`** and **`debug`** commands in exec mode; enter the **`show`** commands in any mode.

Table 19 Circuit Operations

Task	Root Command
Clear the circuit counters for one or more circuits in the system.	*clear circuit counters*
Enable the generation of debug messages for one or more circuits in the system.	*debug circuit*
Enable the generation of debug messages that display packets on a circuit in the system.	*debug packet*
Display circuit information for one or more circuits in the system.	*show circuit*
Display general counters and counters specific to the circuit type for one or more circuits in the system.	*show circuit counters*
Display the Ethernet Connectivity Fault Management (CFM) configuration of the system.	*show configuration cfm*
Display configuration commands for a circuit type.	*show configuration (circuits)*
Display a list of circuits for which the generation of debug messages according to the **`debug circuit`** command is enabled.	*show debug circuit*

Note: To display the bindings for circuits and the interfaces to which they are bound, enter the **`show ip interface`** command in any mode.

2.5 802.1Q PVC Operations

To enable the generation of debug messages for 802.1Q events or to display or clear 802.1Q information, perform the appropriate task listed in Table 20. Enter the **clear** and **debug** commands in exec mode; enter the **show** commands in any mode.

Table 20 802.1Q PVC Operations

Task	Root Command
Clear 802.1Q counters.	*clear dot1q counters*
Enable the generation of debug messages for 802.1Q-related events.	*debug dot1q*
Display circuit information for one or more 802.1Q tunnels and PVCs in the system.	*show dot1q pvc transport*
Display counter information for 802.1Q PVCs.	*show dot1q counters*
Display profile information for one or more 802.1Q profiles in the system.	*show dot1q profile*
Display a summary for all 802.1Q tunnels and PVCs.	*show dot1q pvc transport*

2.6 ATM Operations

To enable the generation of debug messages for ATM PVCs or to display or clear ATM information, perform the appropriate task listed in Table 21. Enter the **clear** and **debug** commands in exec mode; enter the **show** commands in any mode.

Table 21 ATM Operations

Task	Root Command
Test ATM PVCs by sending OAM loopback cells.	*ping atm*
Clear traffic counters for one or more ATM PVCs.	*clear atm counters*
Clear one or more ATM PVCs.	*clear atm circuit*
Enable the display of operations, administration, and maintenance (OAM) cells for a specific ATM PVC.	*debug atm oam*
Display cell and SAR packet level counters for configured ATM PVCs.	*show atm counters*
Display ATM profile information for one or all ATM profiles.	*show atm profile*
Display static and on-demand ATM PVCs.	*show atm pvc*
Display on-demand ATM PVCs.	*show atm pvc on-demand*
Display statistics for configured range of on-demand ATM PVCs.	*show atm pvc on-demand range*

Table 21 ATM Operations

Task	Root Command
Display summary information about ATM PVCs and PVCs that are used for OAM.	*show atm summary*
Display summary information about all shaped ATM VPs.	*show atm vp*

2.7 CLIPS Operations

To monitor, administer, and troubleshoot CLIPS circuits, perform the appropriate task listed in Table 22. Enter the **`clear`** and **`debug`** commands in exec mode; enter the **`show`** commands in any mode.

Table 22 CLIPS Operations

Task	Root Command
Clear CLIPS counters.	*clear clips counters*
Enable the generation of CLIPS debug messages.	*debug clips*
Display CLIPS information.	*show clips*
Display CLIPS group information.	*show clips-group*

2.8 Frame Relay Operations

To monitor, administer, and troubleshoot Frame Relay features, perform the tasks described in Table 23. Enter the **`clear`** and **`debug`** commands in exec mode; enter the **`show`** commands in any mode.

Table 23 Frame Relay Operations

Task	Root Command
Clear all Frame Relay counters for one or more Frame Relay PVCs.	*clear frame-relay counters*
Clear Frame Relay LMI statistics and error counters.	*clear frame-relay lmi-counters*
Enable the generation of debug messages for L2VPN-enabled Frame Relay PVCs.	*debug frame-relay l2vpn*
Enable the generation of debug messages for all LMI packet exchanges with a service provider.	*debug frame-relay lmi*
Enable the generation of debug messages for Frame Relay LMI packet messages, except those relating to LMI PVC status.	*debug frame-relay packet*
Display configuration information for configured Frame Relay PVCs.	*show frame-relay*
Display traffic counters for configured Frame Relay PVCs.	*show frame-relay counters*

Table 23 Frame Relay Operations

Task	Root Command
Display Frame Relay LMI configuration information.	*show frame-relay lmi-config*
Display Frame Relay LMI error counters.	*show frame-relay lmi-errors*
Display Frame Relay LMI statistics counters.	*show frame-relay lmi-stats*
Display a list of Frame Relay profiles.	*show frame-relay profile*
Display the state of configured Frame Relay PVCs, according to the specified keyword.	*show frame-relay pvc*

2.9 Link Group Operations

To monitor and troubleshoot link groups, perform the appropriate task listed in Table 24. Enter the **`debug`** commands in exec mode; enter the **`show`** commands in any mode.

Table 24 Link Group Operations

Task	Root Command
Enable the generation of debug messages for link group events.	*debug lg*
Enable the generation of debug messages for MLPPP-related events.	*debug ppp multilink*
Display link groups, circuits, and bindings.	*show link-group*
Display LACP links on subscriber-facing Ethernet ports.	*show lacp actor*
Display the counters for all LACP links on the system.	*show lacp counters*
Display the LACP link group with a given identification number.	*show lacp lg-id*
Display LACP information for a link group with the specified name.	*show lacp lg-name*
Display the partner information for all the LACP circuits or the LACP circuit with a specified circuit handle.	*show lacp partner*
Display the counters for all LACP links on the system.	*show lacp system-id*
Display state and statistics information for one or all MLPPP bundles.	*show ppp multilink*

2.10 PPP and PPPoE Operations

To monitor, administer, and troubleshoot PPP- and PPPoE-encapsulated circuits, perform the appropriate task listed in Table 25. Enter the **`clear`** and **`debug`** commands in exec mode; enter the **`show`** commands in any mode.

Table 25 PPP and PPPoE Operations

Task	Root Command
Clear counters for PPP-encapsulated circuits.	*clear ppp counters*
Clear counters for PPPoE-encapsulated circuits.	*clear pppoe counters*
Enable the generation of debug messages for various PPP events on the system.	*debug ppp*
Enable the generation of debug messages for various PPPoE events on the system.	*debug pppoe*
Display PPP-encapsulated circuit information.	*show ppp*
Display counters for PPP-encapsulated circuits.	*show ppp counters*
Display PPPoE-encapsulated circuit information.	*show pppoe*
Display counters for PPPoE-encapsulated circuits.	*show pppoe counters*

2.11 Circuit-Groups Operations

To monitor, administer, and troubleshoot circuit-groups, perform the appropriate task listed in Table 26. Enter the **show** commands in any mode.

Table 26 Circuit-Groups Operations

Task	Root Command
Display counters for circuit-groups.	*show circuit counters circuit-group*
Show list of the configured circuit groups or display details pertaining to a specified circuit group.	*show circuit-group*
Display configuration commands for a circuit type.	*show configuration (circuits)*

3 Configuration Examples

3.1 802.1Q PVC Examples

This section provides examples of configurations for 802.1Q PVCs, 802.1Q PVC tunnels, and how to create a circuit group and assign members to it.

3.1.1 802.1Q PVCs

The following example binds untagged traffic to an interface, **untagged**, creates two 802.1Q PVCs on an Ethernet port, and binds them to the interfaces, **vlan100** and **vlan200:**

1. First, the interfaces are created in the **local** context:

```
[local]Redback(config)#context local
[local]Redback(config-ctx)#interface untagged
[local]Redback(config-ctx)#ip address 15.1.0.1/24
[local]Redback(config-ctx)#interface vlan100
[local]Redback(config-ctx)#ip address 15.1.1.1/24
[local]Redback(config-ctx)#interface vlan200
[local]Redback(config-ctx)#ip address 15.1.2.1/24
[local]Redback(config-ctx)#exit
```

2. Next, the Ethernet port is configured:

```
[local]Redback(config)#port ethernet 5/1
[local]Redback(config-port)#no shutdown
[local]Redback(config-port)#bind interface untagged local
[local]Redback(config-port)#encapsulation dot1q
```

3. Finally, the 802.1Q PVCs with VLAN tag values **100** and **200** are configured:

```
[local]Redback(config-port)#dot1q pvc 100
[local]Redback(config-dot1q-pvc)#description local vlan
[local]Redback(config-dot1q-pvc)#bind interface vlan100 local
[local]Redback(config-dot1q-pvc)#exit
[local]Redback(config-port)#dot1q pvc 200
[local]Redback(config-dot1q-pvc)#bind interface vlan200 local
[local]Redback(config-dot1q-pvc)#exit
```

3.1.2 802.1Q PVC Tunnel

The following example is similar to the previous one, but creates static and on-demand 802.1Q PVCs in the 802.1Q tunnel:

1. Create the interfaces in the **local** context:

```
[local]Redback(config)#context local
[local]Redback(config-ctx)#interface untagged
[local]Redback(config-ctx)#ip address 15.1.0.1/24
[local]Redback(config-ctx)#interface vlan-tunnel
[local]Redback(config-ctx)#ip address 15.1.4.1/24
[local]Redback(config-ctx)#interface vlan100
[local]Redback(config-ctx)#ip address 15.1.1.1/24
[local]Redback(config-ctx)#interface vlan200
[local]Redback(config-ctx)#ip address 15.1.2.1/24
[local]Redback(config-ctx)#exit
```

2. Configure the Ethernet port:

```
[local]Redback(config)#port ethernet 5/1
[local]Redback(config-port)#no shutdown
[local]Redback(config-port)#bind interface untagged local
[local]Redback(config-port)#encapsulation dot1q
```

3. Create the 802.1Q PVC tunnel:

```
[local]Redback(config-port)#dot1q tunnel 9100
[local]Redback(config-port)#dot1q pvc 50 encapsulation 1qtunnel
[local]Redback(config-dot1q-pvc)#description 802.1Q tunnel
[local]Redback(config-dot1q-pvc)#bind interface vlan-tunnel local
```

4. Create the static and on-demand 802.1Q PVCs within the tunnel. The static PVC has VLAN tag value **100**; the on-demand PVCs have VLAN tag values **1** through **99**:

```
[local]Redback(config-port)#dot1q pvc 50:100
[local]Redback(config-dot1q-pvc)#bind interface vlan100 local
[local]Redback(config-dot1q-pvc)#exit
[local]Redback(config-port)#dot1q pvc on-demand 50:1 through 99 encapsulation pppoe
[local]Redback(config-port)#bind authentication chap
[local]Redback(config-dot1q-pvc)#exit
```

Note: The **`bind interface`** command is not available for on-demand 802.1Q PVCs.

3.1.3 Creating a Circuit Group and Assigning Members to It

The following example shows how to create a homed circuit group (**salesgroup**) and attach a previously configured QoS scheduling policy (**pwfq1_policy**) to this circuit group. This example then shows how to assign 802.1Q PVC tunnels (50 through 60, and 40) as members of the circuit group:

1. Create a homed circuit group and then attach a QoS scheduling policy to it:

```
[local]Redback(config)#circuit-group salesgroup port 12/1
[local]Redback(config-circuit-group)#qos policy queuing pwfq1_policy
[local]Redback(config-ctx)#exit
```

2. Configure the Ethernet port:

```
[local]Redback(config)#port ethernet 12/1
[local]Redback(config-port)#encapsulation dot1q
```

3. Create or access the 802.1Q PVC tunnels and then assign the tunnels as members of the circuit group:

```
[local]Redback(config-port)#dot1q pvc 50 through 60
[local]Redback(config-dot1q-pvc)#circuit-group-member salesgroup
[local]Redback(config-dot1q-pvc)#dot1q pvc 40
[local]Redback(config-dot1q-pvc)#circuit-group-member salesgroup
```

3.2 ATM Examples

This section provides examples of configuring ATM profiles, ATM VPs, ATM, PVCs, and ATM HSVCs.

3.2.1 ATM Profiles

The following example shows the configuration of the following ATM profiles:

- **vbrnrt-basic** provides a profile for ATM PVCs that support VBR-nrt traffic.
- **oam** provides a profile for OAM-managed ATM PVCs.
- **monitor** provides a profile for OAM monitoring of ATM PVCs.
- **cbr1** provides a profile for ATM PVCs and VPs that includes fault and continuity monitoring.
- **ubr1** provides a profile for ATM PVCs that is configured on a shaped VP.

```
[local]Redback(config)#atm profile vbrnrt-basic
[local]Redback(config-atm-profile)#shaping vbr-nrt pcr 100000 cdvt 5000 scr 80000 bt 8000
[local]Redback(config-atm-profile)#exit

[local]Redback(config)#atm profile oam
[local]Redback(config-atm-profile)#shaping ubr
[local]Redback(config-atm-profile)#oam manage end-to-end auto-loopback regular-timeout 45 retry-timeout 4
[local]Redback(config-atm-profile)#counters l2
[local]Redback(config-atm-profile)#exit
[local]Redback(config)#atm profile monitor
[local]Redback(config-atm-profile)#shaping ubr
[local]Redback(config-atm-profile)#oam fault-monitor end-to-end
[local]Redback(config-atm-profile)#counters l2
[local]Redback(config-atm-profile)#exit

[local]Redback(config)#atm profile cbr1
[local]Redback(config-atm-profile)#shaping cbr rate 100000 cdvt 10
[local]Redback(config-atm-profile)#oam fault-monitor end-to-end
[local]Redback(config-atm-profile)#counters l2
[local]Redback(config-atm-profile)#exit

[local]Redback(config)#atm profile ubr1
[local]Redback(config-atm-profile)#shaping ubr
[local]Redback(config-atm-profile)#counters l2
[local]Redback(config-atm-profile)#exit
```

3.2.2 ATM VPs

The following example shows how to create a shaped ATM VP on an ATM OC port:

```
[local]Redback(config)#port atm 4/1
[local]Redback(config-atm-oc)#atm vp 100 profile cbr1
```

3.2.3 ATM PVCs

The following example shows how to create two ATM PVCs, **4** and **110**, on an ATM OC port, using the **oam** and **ubr1** profiles on shaped VP **100**, and binds them to an existing interface **atmpvc** in the **local** context:

```
!Create VCI 4 on VP 100 for OAM cells
[local]Redback(config)#port atm 3/1
[local]Redback(config-atm-oc)#atm pvc 100 4 profile oam encapsulation bridge1483
!Create the PVC that will be managed with OAM
[local]Redback(config-atm-oc)#atm pvc 100 110 profile monitor encapsulation bridge1483
[local]Redback(config-atm-pvc)#description bridged 1483 PVC
[local]Redback(config-atm-pvc)#bind interface atmpvc local
[local]Redback(config-atm-pvc)#exit
```

3.3 Frame Relay Examples

3.3.1 Frame Relay PVC on POS Port

The following example shows the configuration of Frame Relay on a POS port, which is bound to an interface, **fr4-1**, in the **local** context:

```
[local]Redback(config)#port pos 4/1
[local]Redback(config-port)#no shutdown
[local]Redback(config-port)#encapsulation frame-relay
[local]Redback(config-port)#frame-relay lmi-type ansi
[local]Redback(config-port)#frame-relay keepalive 10
[local]Redback(config-port)#frame-relay lmi-n391dte 6
[local]Redback(config-port)#frame-relay lmi-n392dte 3
[local]Redback(config-port)#frame-relay lmi-n393dte 4
[local]Redback(config-port)#frame-relay pvc dlci 16
[local]Redback(config-fr-pvc)#bind interface fr4-1 local
[local]Redback(config-fr-pvc)#exit
```