Cisco ISG Design and Deployment Guide: ATM Aggregation

First Published: March 22, 2006
Last Updated: January 21, 2009

This document uses model networks tested in a Cisco lab to describe how to deploy a service provider broadband-based network using Cisco 7200, 7300, or 10000 routers as a Cisco Intelligent Service Gateway (ISG) and ATM as the aggregation technology. The Cisco ISG software provides a feature set that assists the service provider with provisioning and maintaining broadband networks that have many types of edge devices and many subscribers and services. The Cisco ISG software combines real-time session and flow control with programmable, dynamic policy control to deliver flexible and scalable subscriber session management capabilities. The role of the Cisco ISG software is to execute policies that identify and authenticate subscribers, and to provide access to the services that the subscriber is entitled to access. The role of the Cisco ISG router is deployment at network access control points so subscribers can access services through the software.

ISG Software Feature Sets

Cisco IOS software is packaged in feature sets that are supported on specific platforms. The Cisco ISG software is supported on Cisco 7200, 7300, and 10000 series routers. To get updated information regarding platform support and ISG feature sets, access Cisco Feature Navigator at http://www.cisco.com/go/fn. To access Cisco Feature Navigator, you must have an account on Cisco.com. Qualified users can establish an account on Cisco.com by following the directions at http://www.cisco.com/register. If you have an account but have forgotten or lost your account information, send a blank e-mail to cco-locksmith@cisco.com. An automatic check will verify that your e-mail address is registered with Cisco.com. If the check is successful, account details with a new random password will be e-mailed to you.

Americas Headquarters:
Cisco Systems, Inc., 170 West Tasman Drive, San Jose, CA 95134-1706 USA

Contents

Information About ISG and ATM Aggregation

This section contains the following topics:

ATM Aggregation

The emerging generation of broadband network software and hardware has been designed to help Internet service providers (ISPs) control, manage, and bill subscribers for bandwidth and quality of service (QoS). For more advanced deployments, ISPs have requested dynamic bandwidth and dynamic QoS capabilities based on service types and time with selection via a prearranged service agreement. The Cisco ISG software provides dynamic policies with permissions, services, QoS, and so on, that define the requisite control to enable revenue-generating services.

The result of configuring an ISG is a collection of powerful and dynamic policies that can be applied to the subscriber session. The new policies are a superset of the Service Selection Gateway (SSG) concept of a service. With the ISG software, new subscriber rules allow you to build policies based on conditional events by triggering service actions. Services can be implemented within virtual routing contexts.

The dynamic policy enforcement inherent in the ISG software allows consistent, tailored, and secure user services to be deployed in the network, triggered by a service or by a user—concepts referred to in the ISG software as *push* and *pull*.

The ISG has the ability to initiate and manage sessions consistently, regardless of the access protocol type, network service, or session traffic policies configured. The ISG software provides seamless integration with existing Cisco IOS IP services such as Domain Name System (DNS), QoS, access control lists (also access lists or ACLs), Dynamic Host Configuration Protocol (DHCP), virtual private network (VPN) routing and forwarding (VRF) instances, and Multiprotocol Label Switching (MPLS).

The ISG software also provides enhanced accounting of services for both use and application, and for services such as prepaid, compared to previous service provider feature sets. You will also find distributed conditional debugging that has been enhanced to provide the ability to monitor and debug sessions and services based on identity.

ISG with ATM Aggregation Platform Support

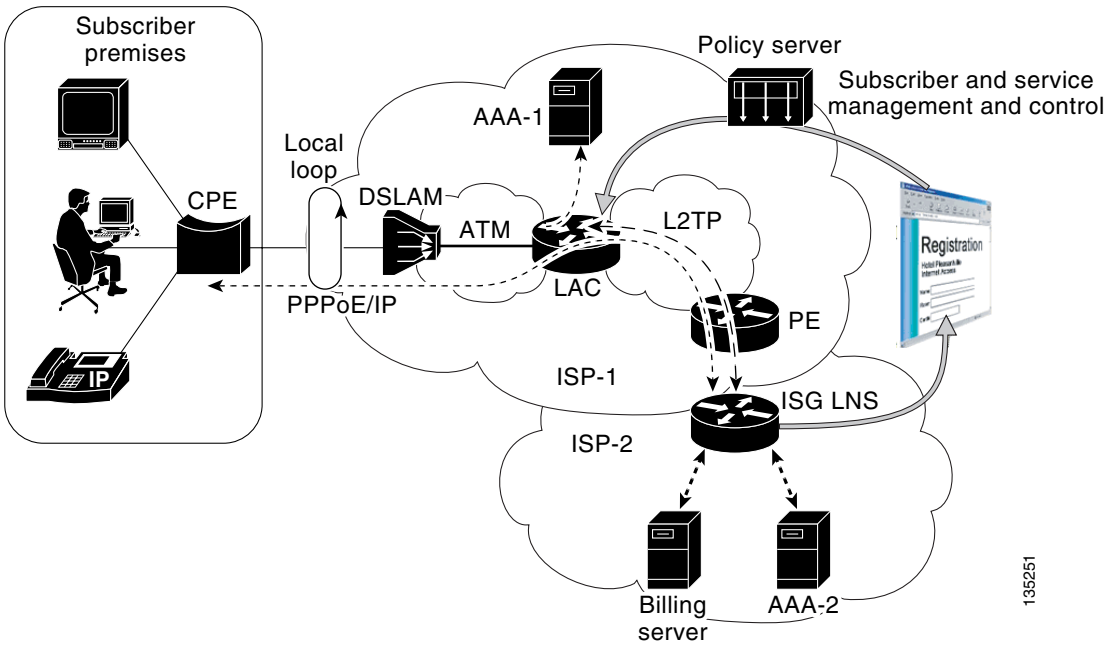
Cisco's broadband aggregation portfolio offers comprehensive solutions for broadband service deployment that provides innovative technologies for simplified operations, revenue-generating network services, comprehensive management, and proven high availability. The aggregation of traffic received from an ATM-based digital subscriber line (DSL) network element is supported in the ISG software by the following Cisco hardware:

- The Cisco 7200 series router with the NPE-G1 network processing engine card, and the stackable, operationally efficient Cisco 7300 series router are compact and mid-ranged, designed for incremental expansion of the service provider network, and targeted for deployment at the network edge. Both routers have a long list of features especially suited for broadband aggregation and the network service provider, and are capable of supporting 8,000 sessions with extended memory configurations.
- The Cisco 10000 series router with the PRE2 performance routing engine card provides carrier-class delivery of over 32,000 simultaneous subscriber sessions.

ISG with ATM Aggregation High-Level Network Topology

Figure 1 shows a typical network topology for the models that will be used in this document.

Figure 1 High-Level ATM Network Topology



Note that some of the models described in this document deploy the ISG as an L2TP network server (LNS), which serves as a connection between the Subscriber Edge Services Manager (SESM) and the first ISG in the network.

The following elements play key roles in the network topology shown in Figure 1:

- CPE—The customer premises equipment (CPE) router is a small router such as the Cisco 800 series router that is used either as a bridge or to initiate PPP over Ethernet (PPPoE) connections from the customer PC to the Layer 2 Tunnel Protocol (L2TP) access concentrator (LAC).
- Local loop—DSL services provide dedicated, point-to-point, public network access over twisted-pair copper wire on the local loop which occurs in the last mile between the service provider's central office and a customer site such as a house or office building. DSL technology uses existing twisted-pair telephone lines to transport high-bandwidth data to service subscribers. DSL delivers high-bandwidth data rates to dispersed locations with relatively small changes to the existing telco infrastructure.
- DSLAM—The Digital Subscriber Line Access Multiplexer (DSLAM) aggregates multiple incoming DSL connections into a single ATM line. It is maintained at a point of presence (POP) separate from the ISP's central network.

Note The configuration of the DSLAM will not be discussed in this document.

- ISG—A Cisco router such as the Cisco 7200, 7300, and 10000 series is configured as an ISG to control subscriber access at the edge of an IP/MPLS network.
- ISG as LAC—In the L2TP deployments in this document, the ISG also serves as a LAC. It is maintained by the ISP as part of its central network. It receives incoming sessions from the DSLAM and forwards them to the appropriate retail ISP by establishing an L2TP tunnel with the LNS. The LAC contacts the ISP's authentication, authorization, and accounting (AAA) server to determine the forwarding information based on the subscriber's domain name.

- ISG as LNS—An LNS is used only in L2TP deployments. The LNS terminates the L2TP tunnel from the LAC and the PPPoE session from the subscriber. It is maintained by the ISP on its central network. The ISG LNS authenticates the user by contacting the AAA server for ISP, and assigns the user a VRF. The ISG LNS also communicates with the AAA server when the user requests additional services.
- ISG as BRAS—A Broadband Remote Access Server (BRAS) is a high-density ISG router that supports thousands of simultaneous active sessions for the widest variety of broadband architectures. BRAS platform enhancements are enabling service providers to generate additional per-subscriber revenue while lowering operating and capital expenditures.
- PE—The provider edge (PE) router maintains VRF information. It is the final endpoint on the ISP's network that terminates the user session. The ISP uses VRF to segment customers easily without having to specify different subnets for different classes of customers.
- DHCP server—A DHCP server can be used to dynamically assign reusable IP addresses to devices in the network. Using a DHCP server can simplify device configuration and network management by centralizing network addressing. In the deployments described in this document, a Cisco CNS Network Registrar (CNR) server is used as the DHCP server.

Note Configuring the Cisco CNR is beyond the scope of this document. For information on configuring the Cisco CNR, see the *Cisco CNS Network Registrar* documentation at the following URL: http://www.cisco.com/en/US/products/sw/netmgtsw/ps1982/index.html

- Policy server —A policy server is the network element that provides the service control that allows for the management and modification of services in real time. The Cisco Subscriber Edge Services Manager (SESM) is a policy server that provides service selection and connection management in broadband and mobile wireless networks. The Cisco SESM provides a web portal to enable users to access services. ISPs can customize the web portal to their needs. (The *Installation and Configuration Guide for the Cisco SESM* is at the following URL: http://www.cisco.com/en/US/docs/net_mgmt/subscriber_edge_services_manager/3.2/administration/guide/captive_portal/cportal.html
- Billing server—The billing server maintains user account information, including the amount of credit remaining for prepaid services. When users initiate services, the ISG contacts the billing server to determine if the user has credit available.
- AAA server—In IP and PPPoE deployments, the network utilizes a single AAA server. The AAA server maintains user authentication information and information about services available to users. When the ISG receives a user's username and password, it forwards it to the AAA server for authentication. When a user activates a service, the ISG contacts the AAA server, which replies with information on the service to the ISG.

The deployments using PPPoE over L2TP described in this document simulate two ISPs working together, but each with their own AAA server. ISP-1 offers wholesale service to other ISPs. ISP-2 contracts with ISP-1 to receive wholesale service, which it then offers to retail customers.

- The AAA server for ISP-1 (known as AAA-1 in the deployment model) maintains forwarding information for the retail ISPs. When queried by the ISG LAC, it sends forwarding information based on the user's domain name.
- The AAA server for ISP-2 (known as AAA-2 in the deployment model) maintains user authentication information as well as information on the services available to users. When the LNS receives a user's username and password, it forwards them to AAA-2 for authentication. When a user activates a service, the LNS contacts AAA-2. AAA-2 then replies with information on the service to the LNS.

Instead of using single AAA servers, ISPs can maintain multiple AAA servers to be used for separate domains or for round-robin load balancing.

Routing Protocols and Traffic Delivery

This section summarizes the routing protocols used in the ISG ATM network, in the following sections:

Routing Protocols

When designing the network, you have three basic choices for how to deliver traffic from the ISG at the wholesale ISP to the retail ISP:

- IP routed—Traffic is IP-routed from the ISG to the retail ISP.
- PPP terminated—The DSLAM delivers traffic to the ISG using PPPoE. The ISG terminates the PPPoE and then IP routes traffic to the retail ISP.
- L2TP tunneled—The DSLAM delivers traffic to the ISG using PPPoE. The ISG then establishes an L2TP tunnel with an LNS at the retail ISP. The LNS terminates the PPPoE, and IP is used to route the traffic in the retail ISP's network. Using an L2TP tunnel offers the advantage that it can support both ATM and Gigabit Ethernet as the aggregation technology.

Traffic Delivery

The network deployed in the ATM-to-ISG LNS aggregation model uses the L2TP tunneled method. In all models, the DSLAM delivers traffic to the first ISG using an ATM permanent virtual circuit (PVC).

The model networks in this document use the following access technologies:

- IP sessions
- PPPoE sessions
- PPPoE over L2TP sessions

DSL deployments described in this document are based on routed ATM (per RFC 2684) and ATM Routed Bridge Encapsulation (RBE).

QoS

Cisco IOS QoS software supports three types of service models: best-effort services, IntServ, and DiffServ. QoS capabilities vary depending on the platform and session types.

On Cisco 7200 and 7300 series routers:

- Policing is available on IP and PPP sessions.
- Shaping is available on PPP sessions.

On the Cisco 10000 router:

- IP sessions are not supported.
- Policing is supported on PPP sessions.
- Shaping is supported at the virtual local area network (VLAN) or ATM PVC level, but not at the session level.

Hierarchical QoS is possible; for example, policing at the session level followed by a policer at the flow level.

It is worth noting that if best-effort user network interfaces (UNIs) reside in the same network as differentiated QoS networks, it is required that even best-effort UNIs re-mark all their traffic to the proper classification.

DHCP

As described in RFC 2131, *Dynamic Host Configuration Protocol*, DHCP provides configuration parameters to Internet hosts. DHCP consists of two components: a protocol for delivering host-specific configuration parameters from a DHCP server to a host, and a mechanism for allocating network addresses to hosts. DHCP is built on a client/server model, where designated DHCP server hosts allocate network addresses and deliver configuration parameters to dynamically configured hosts. By default, Cisco routers running Cisco IOS software include DHCP server and relay agent software.

DHCP supports three mechanisms for IP address allocation:

- Automatic allocation—DHCP assigns a permanent IP address to a client.
- Dynamic allocation—DHCP assigns an IP address to a client for a limited period of time (or until the client explicitly relinquishes the address).
- Manual allocation—The network administrator assigns an IP address to a client, and DHCP is used simply to convey the assigned address to the client.

Automatic DHCP address allocation is typically based on an IP address, whether it be the gateway IP or the incoming interface IP address. In some networks, it is necessary to use additional information to further determine which IP addresses to allocate. Using the relay agent information option (option 82) permits the Cisco IOS relay agent to include additional information about itself when forwarding client-originated DHCP packets to a DHCP server.

IP Sessions

An IP session includes all the traffic that is associated with a single subscriber IP address. If the IP address is not unique to the system, other distinguishing characteristics such as VRF or a MAC address form part of the identity of the session. An ISG can be configured to create IP sessions upon receipt of DHCP messages (packets) and unknown IP source addresses. IP sessions may be hosted for a connected subscriber device (one routing hop from the ISG) or one that is many hops from the gateway.

The following events may be used to signal the start of an IP session:

- DHCPDISCOVER message.

  If the following conditions are met, receipt of a DHCPDISCOVER message will trigger the creation of an IP session:

  - The ISG serves as a DHCP relay or server for new IP address assignments.
  - Subscribers are configured for DHCP.
  - The DHCPDISCOVER message is the first DHCP request received from the subscriber.

- Unrecognized source IP address.

  In the absence of a DHCPDISCOVER message, a new IP session is triggered by the appearance of an IP packet with an unrecognized source IP address.

Because there is no inherent control protocol for IP sessions, the following events can be used to terminate a session:

- DHCPRELEASE message from the host or subscriber, or a lease expiry packet.
- Idle timeout.
- Session timeout.
- Account logoff.

ISG Service Bundles for ATM Deployment Models

Because of the large number of ISG software services available, we have developed a list of services that are representative of what the general market is using. We have grouped the features into *service bundles*. The following service bundles are deployed in the network models used in this document:

- Basic Internet Access Service Bundle, page 8
- Multiservice Service Bundle, page 8
- Triple Play Plus Service Bundle, page 9

Basic Internet Access Service Bundle

The Basic Internet Access service bundle consists of traditional Layer 3 VPN access. Subscribers establish Layer 2 access connections over a Layer 3 VPN technology—in this case, an MPLS VPN. The bandwidth for all users is capped at a static 128 kbps upstream and 256 kbps downstream.

Note The specific bandwidths described in this document are used only as examples. ISPs are free to configure any bandwidth levels that their service requires.

Multiservice Service Bundle

The Multiservice service bundle consists of the following features:

- Layer 3 VPN Access, page 8
- Bandwidth on Demand, page 9
- Prepaid Services, page 9

Layer 3 VPN Access

The default service for subscribers in the Multiservice service bundle is Layer 3 VPN access. All ISPs that deploy ISG software services begin with Layer 3 VPN access. In the ATM-to-ISG LNS aggregation network, access is accomplished using basic DSL connectivity. Subscribers establish Layer 2 access connections over a Layer 3 VPN technology, in this case, using a MPLS VPN. Subscriber bandwidth for basic Layer 3 VPN access is capped at 128 kbps upstream and 256 kbps downstream.

Bandwidth on Demand

Bandwidth on demand enables subscribers to temporarily increase their upstream and downstream bandwidths for either a set duration of time or a set volume of bandwidth. Subscribers first establish basic connectivity with a default cap on bandwidth, and then access a website maintained by the Cisco SESM where subscribers trigger a request for bandwidth on demand. The ISP authorizes the subscriber for the service and bills the subscriber's account. Bandwidth on demand can be either prepaid or post paid. The service remains active until either the subscriber deactivates the service or the subscriber terminates the session.

Prepaid Services

For prepaid services, subscribers pay into their accounts before the service is initiated. When a subscriber activates the service, the billing server charges the subscriber's account either for the time that the service is active or for the amount of bandwidth the subscriber uses. The service remains active until either the subscriber's account is depleted or the subscriber deactivates the service or terminates the session. As an example, for the model 1 scenario in this document, prepaid service will be enabled to pay for bandwidth on demand.

Triple Play Plus Service Bundle

The term *triple play* refers to delivery of three foundation services for broadband networks:

- Basic broadband (Internet) connectivity
- Voice over IP (VoIP)
- Broadcast video for video on demand

The Triple Play Plus service bundle includes gaming and advanced QoS features

When subscribers initiate a session, they are granted basic broadband connectivity. If subscribers wish to activate one of the advanced services (VoIP, video on demand, and gaming), they go the web portal maintained by Cisco SESM and select the service. The advanced services are granted a higher level of QoS than other services to ensure that subscribers can maintain the necessary level of bandwidth for the activity they select.

Note In the deployments described in this document, the advanced services are deployed only for IP sessions; however, the ISG software supports these services on both IP and PPPoE.

The ATM Deployment Models

The following tested networks are presented in this document as models for you to use to deploy your ISG and ATM-based network:

- Model 1: Cisco 7200 and 7300 Routers as ISG with Multiservice Service Bundle over PPPoE, page 10
- Model 2: Cisco 10000 Router as ISG with Multiservice Service Bundle over PPPoE, page 15
- Model 3: Cisco 7200 and 7300 Routers as ISG with Triple Play Plus Service Bundle over IP and PPPoE, page 18
- Model 4: Cisco 7200 and 7300 Routers as ISG LNS with Multiservice Service Bundle, page 23

Model 1: Cisco 7200 and 7300 Routers as ISG with Multiservice Service Bundle over PPPoE

In this deployment, the service provider wants to expand its traditional, static DSL service by deploying the Multiservice service bundle, which consists of bandwidth on demand and prepaid services. When customers activate these services, the network allocates additional bandwidth to them, based on either time or volume of bandwidth. The management of the available minutes will be done via a billing server external to the ISG.

Deployment model 1 offers the following two methods for subscriber authentication:

- Subscribers can be authenticated based on their username on the local AAA server.
- Subscribers can be automatically connected to a service domain based on the domain downloaded from an initial local AAA lookup.

Subscriber authentication takes place within the domain of the ISP by a remote AAA server lookup. The following advanced ISG software services are then available to the user:

- BOD1MVOLUME: 1 Mbps
- BOD1MTIME: 1 Mbps
- BOD2MVOLUME: 2 Mbps

For volume-based service, subscribers are billed according to the amount of bandwidth they use. For time-based service, subscribers are billed according to the length of time the service is active.

Note The specific bandwidths described in this document are used only as examples. ISPs are free to configure any bandwidth levels that their service requires.

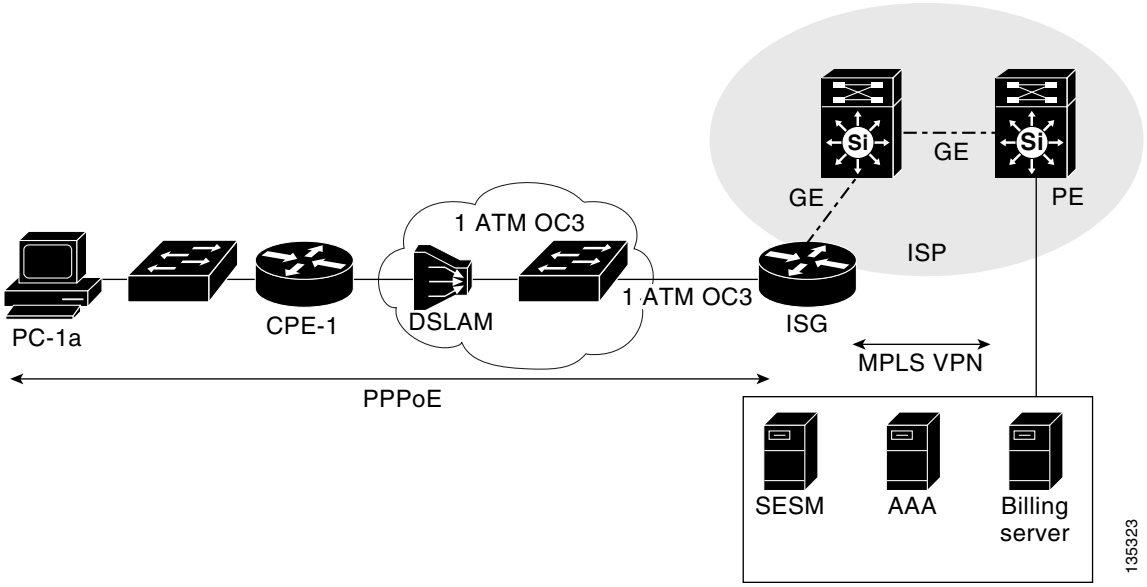
In this deployment, subscribers will not be able to switch from a time-based prepaid service to a volume-based prepaid service or vice versa. Rather, ISPs can offer both time-based and volume-based services, and individual subscribers can access one or the other, but not both. Typically, ISPs will only deploy either time-based or volume-based services for subscribers, but not both simultaneously.

The following sections describe the deployment model that configures a Cisco 7200 router as an ISG with the multiservice service bundle over PPPoE:

Model 1 Network Topology

Figure 2 shows the topology of network model 1.

Figure 2 Model 1 Network Topology



Model 1 Device List

Table 1 lists the devices used in the model 1 test network. Note that a Cisco 7206 or 7301 router can be used as the ISG.

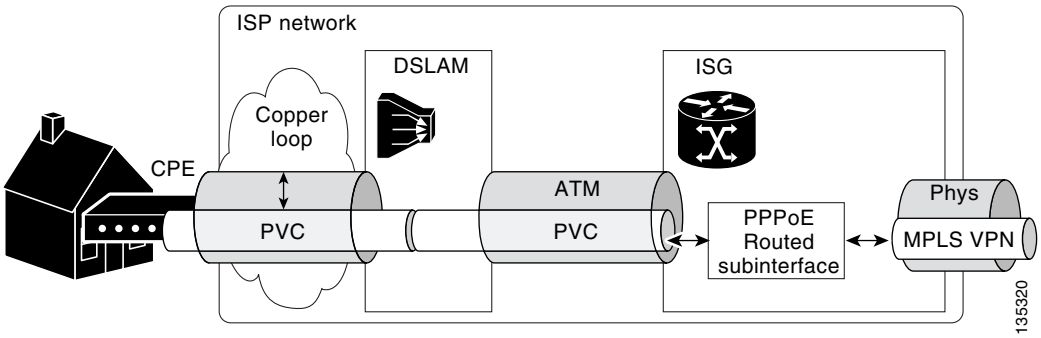
Table 1 Model 1 Device List

Device	Platform
CPE	Cisco 837
ISG	Cisco 7206 or Cisco 7301
PE	Cisco 6509

Model 1 Protocol Flow

Figure 3 shows how traffic is routed across the network.

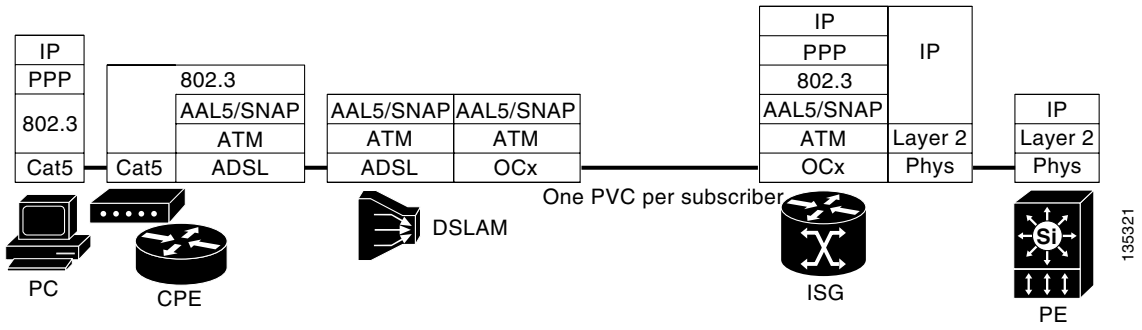
Figure 3 Model 1 Protocol Flow



Model 1 Traffic Flow

Figure 4 shows the protocols that are active at each device in the network.

Figure 4 Model 1 Traffic Flow



Model 1 QoS Strategy

Figure 5 shows all the interfaces in the network where QoS could potentially be configured. Here "Up" refers to the upstream interface between the two devices, and "Dw" refers to the downstream interface. The interfaces shown are the points where QoS is configured for this deployment.

Figure 5 Model 1 QoS Interfaces

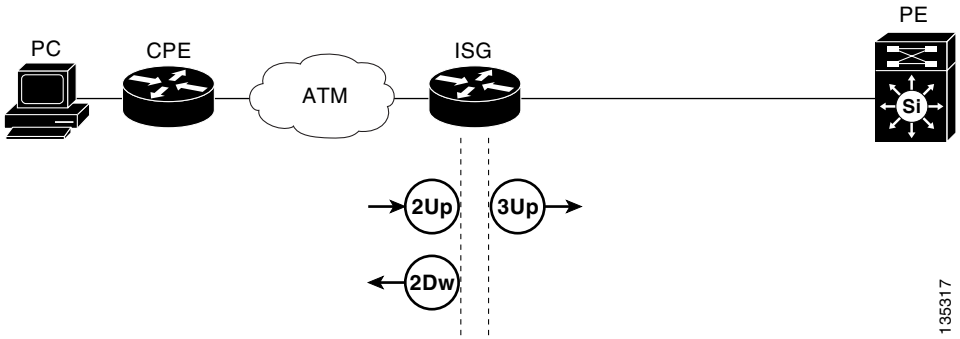


Table 2 describes the QoS strategy that is deployed on each of the interfaces shown in Figure 5.

Table 2 Model 1 QoS Strategy

Interface	Device	Traffic Origin	Traffic Destination	QoS Strategy
2Up	ISG	CPE	ISG	QoS is not configured on this interface; therefore, upstream traffic must be limited by the DSLAM modem train rate.

Table 2 Model 1 QoS Strategy

Interface	Device	Traffic Origin	Traffic Destination	QoS Strategy
2Dw	ISG	ISG	CPE	Dynamic Bandwidth Selection (DBS) is configured to shape downstream traffic by using the **dbs enable maximum** command.
3Up	ISG	ISG	PE	Upstream traffic is marked as the default service, MPLS EXP 0, by the service policy governing the outbound Gigabit Ethernet interface.

Model 1 Call Flows

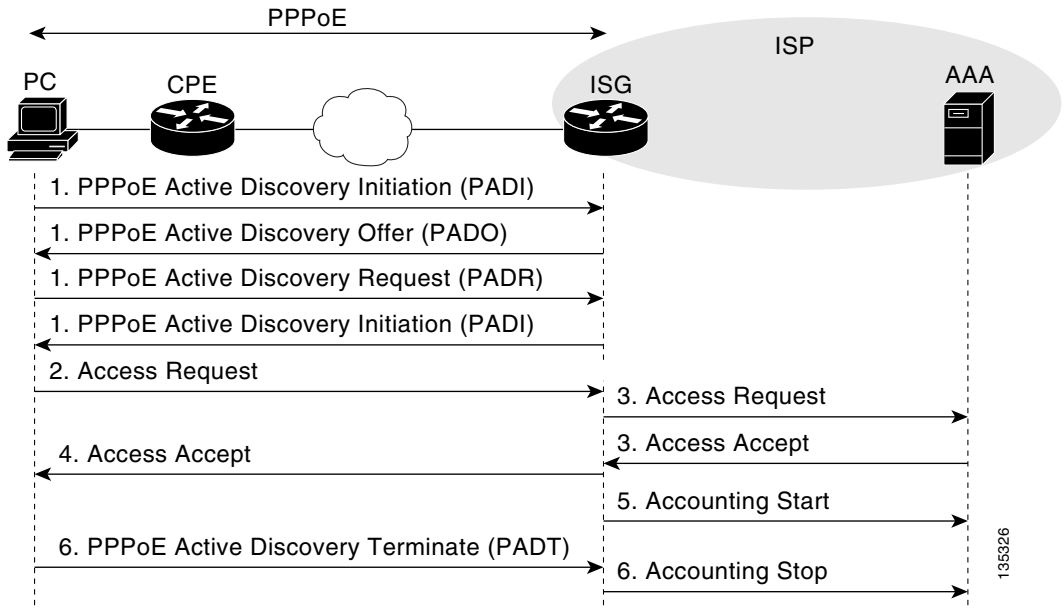
The following call flows describe the operation of the network:

- Basic Layer 3 VPN Access Call Flow for PPPoE Sessions, page 13
- Prepaid Services Call Flow, page 14

Basic Layer 3 VPN Access Call Flow for PPPoE Sessions

Figure 6 shows the call flow process of establishing basic Layer 3 VPN access. Each user session begins with this process before initiating advanced ISG software services.

Figure 6 Layer 3 VPN Access Call Flow for PPPoE Sessions



Following is an explanation of the sequence of events in Figure 6:

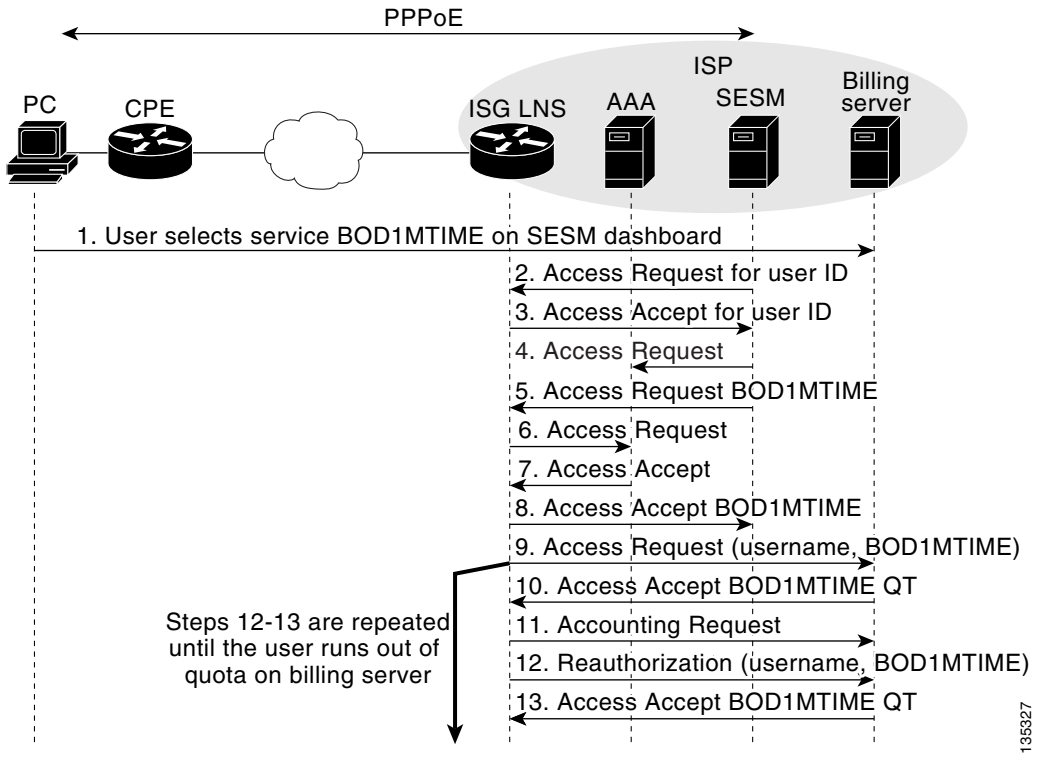
1. The subscriber initiates a PPPoE connection from the PC to the ISG by way of the CPE.
2. The client initiates the session by sending an Access Request message to the ISG.
3. The ISG sends the subscriber information to the AAA server. The AAA server authenticates the user and sends the ISG the appropriate service profile to the ISG.

4. After the user has been successfully authenticated, the ISG sends an Access Accept message to the client.
5. The ISG sends an Accounting Start message to the AAA server.
6. When the subscriber ends the session, the client sends a PPPoE Terminate message to the ISG, and the ISG terminates the session and sends an Accounting Stop message to the AAA server.

Prepaid Services Call Flow

Figure 7 shows the call flow process of establishing prepaid services. In this configuration, a subscriber initiates a service that will be named BOD1MTIME in the configuration.

Figure 7 Prepaid Services Call Flow for PPPoE Sessions



Following is an explanation of the sequence of events in Figure 7:

1. The subscribers selects the BOD1MTIME service on the Cisco SESM web interface dashboard.
2. The Cisco SESM sends an Access Request message to the ISG for the subscriber's information.
3. The ISG replies to the Cisco SESM with an Access Accept message containing the subscriber's information.
4. The Cisco SESM sends an Access Request message to the ISG requesting information about the BOD1MTIME service.
5. The ISG sends an Access Request message to the AAA server requesting information about the BOD1MTIME service.
6. The AAA server replies to the ISG with an Access Accept message containing the traffic class, BOD1MTIME profile, and the prepaid configuration.

7. The ISG sends an Access Accept message to the AAA server containing the details of the BOD1MTIME service.
8. The ISG sends an Access Request message to the billing server, notifying it that the subscriber has initiated the BOD1MTIME service.
9. The billing server replies with an Access Accept message that authorizes the subscriber for a set quota of time.
10. The ISG sends an Accounting Request to the billing server with the subscriber's username and an event time stamp.
11. After the subscriber quota is depleted, the ISG sends a Reauthorization request to renew the quota.
12. The billing server reauthorizes the subscriber and sends a renewed quota to the ISG.

Steps 12 and 13 are repeated until either the subscriber terminates the BOD1MTIME service or the subscriber runs out of quota on the billing server.

Model 2: Cisco 10000 Router as ISG with Multiservice Service Bundle over PPPoE

This deployment scenario is similar to the Multiservice service bundle over PPPoE deployment for model 1, but with the following differences:

- The ISG configuration is performed on a Cisco 10000 router.
- The prepaid service is not configured for bandwidth on demand; instead, these services are paid for using postpaid via per-service accounting.
- Model 2 uses Layer 2 ATM shaping for downstream traffic and the addition of upstream policing.

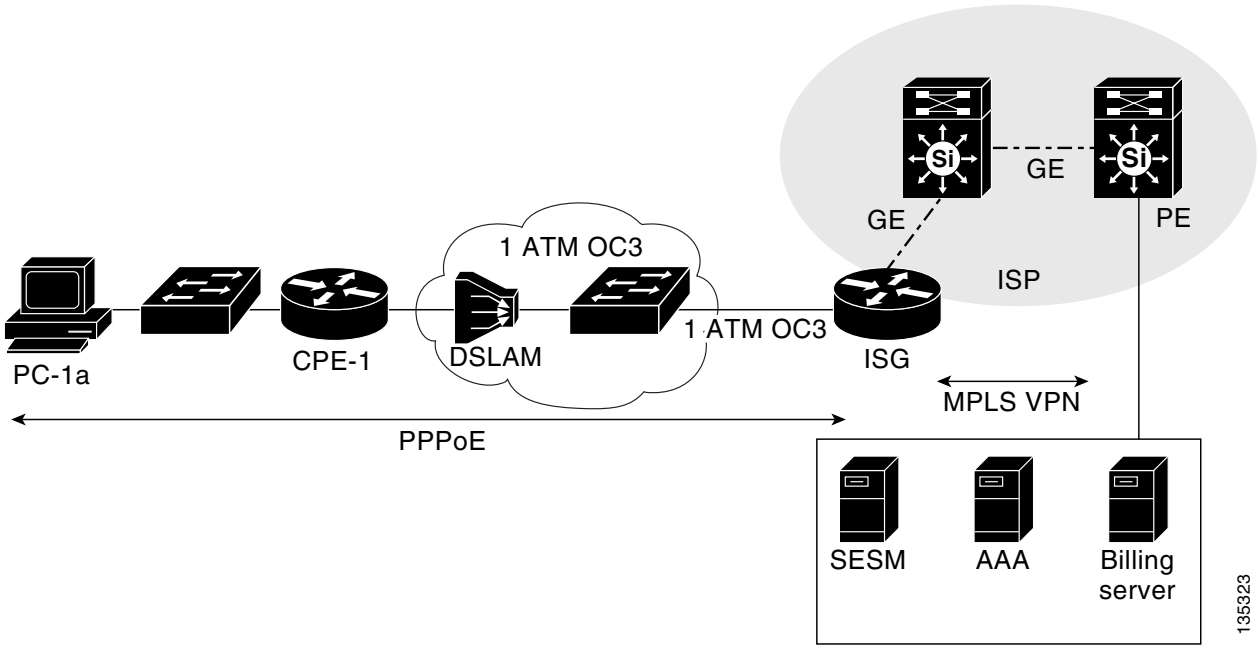
The following sections describe the deployment model that configures a Cisco 10000 router as an ISG with the multiservice service bundle over PPPoE:

- Model 2 Network Topology, page 15
- Model 2 Device List, page 16
- Model 2 Call Flow, page 16

Model 2 Network Topology

Figure 8 shows the network topology of this deployment.

Figure 8 Model 2 Network Topology



Model 2 Device List

Table 3 lists the devices used in the model 2 test network.

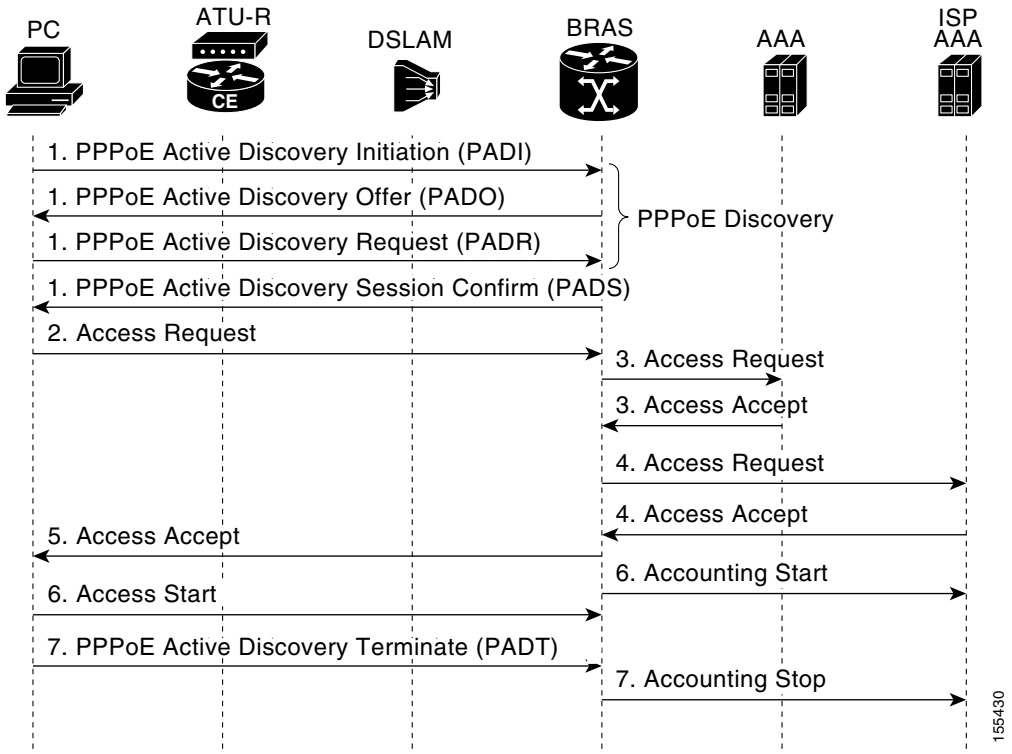
Table 3 Model 2 Device List

Device	Platform
CPE	Cisco 837
ISG	Cisco 10000
PE	Cisco 6509

Model 2 Call Flow

Figure 9 shows the authenticated domain call flow used in this model.

Figure 9 Authenticated Domain Call Flow



Following is an explanation of the sequence of events in Figure 9:

1. The call flow begins with the PPPoE Discovery phase as defined in RFC 2516. The session is initiated when an Access Request message from the client device is received. The Cisco BRAS is configured for auto-domain operation, and the Access Request message is not transparently forwarded to the local AAA server.
2. The BRAS performs a service profile download for the selected auto-domain name using the globally configured service password. When the service profile is received, it is determined that the auto-domain service is a proxy service and that authentication should take place with the remote ISP AAA server. Authentication details are contained in the proxy service profile.
3. The BRAS forwards the Access Request message originally received from the client device to the remote ISP AAA server. If authentication is successful, an Access Accept message is returned to BRAS, which may contain either an explicitly configured IP address or a locally valid IP pool name.
4. Once the auto-domain service has been successfully activated, the BRAS sends an Access Accept message to the client device. If a service domain IP address has already been assigned to the session in the Access-Accept message from the remote ISP AAA server, this IP address is returned to the client device in attribute 8 of the Access Accept message.
5. ISG software accounting starts after the Authentication Success is sent to the client. It is also possible that a Start Accounting message can be sent from the Client; however, this would be used to validate that the customer is actually active (up), and if the customer claims not to be, you can pull down the session. The Accounting Start Request message is sent by the client, and is transparently proxied to the AAA server.
6. When the session is complete, the Client sends a PPPoE Terminate message that causes the BRAS to terminate the session.

Model 3: Cisco 7200 and 7300 Routers as ISG with Triple Play Plus Service Bundle over IP and PPPoE

In network model 3, an ISP offers the Triple Play Plus service bundle, which consists of advanced services designed for gaming subscribers. The services include voice over IP (VoIP), broadcast video, and as prioritized traffic to the ISP's own gaming servers.

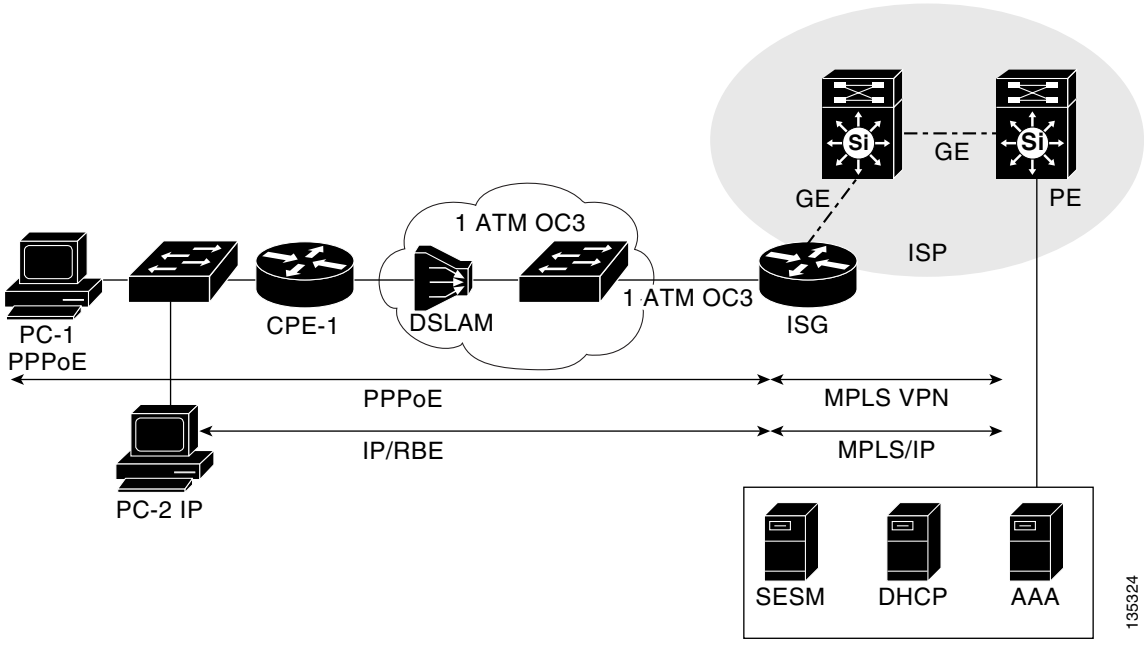
This deployment supports Transparent Autologin (TAL) based on the subscriber's MAC address, which requires that subscriber MAC addresses be configured manually. If MAC address-based authentication fails, subscribers are redirected to the web portal maintained by the Cisco SESM, where they can manually log in.

The following sections describe the deployment model that configures a Cisco 7200 ISG with the Triple Play Plus service bundle over IP and PPPoE:

Model 3 Network Topology

Figure 10 shows the topology of network model 3.

Figure 10 Model 3 Network Topology



Model 3 Device List

Table 4 lists the devices used in the model 3 test network. Note that either a Cisco 7206 or 7301 router can be used as the ISG.

Table 4 Model 3 Device List

Device	Platform
CPE	Cisco 837
ISG	Cisco 7206 or Cisco 7301
PE	Cisco 6509

Model 3 Protocol Flow

Figure 11 shows how traffic is routed across the network.

Figure 11 Model 3 Protocol Flow

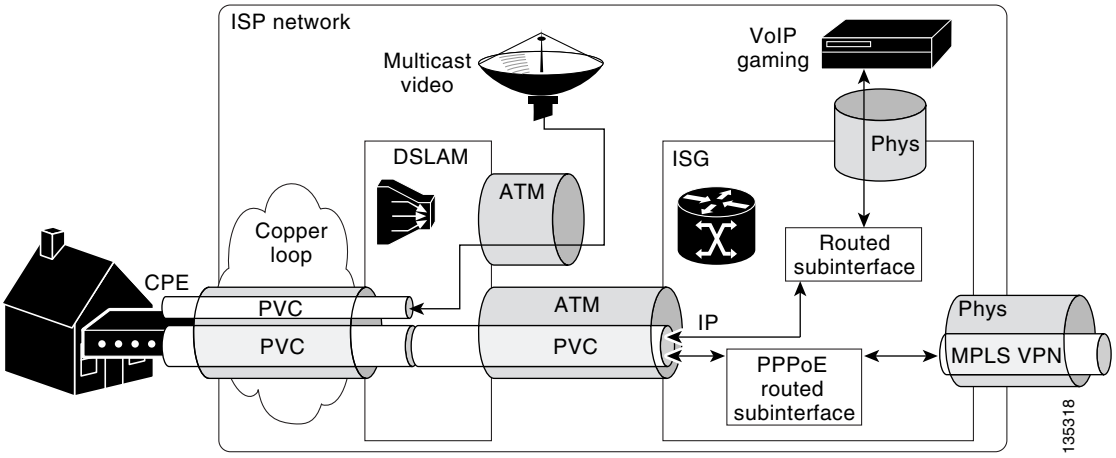
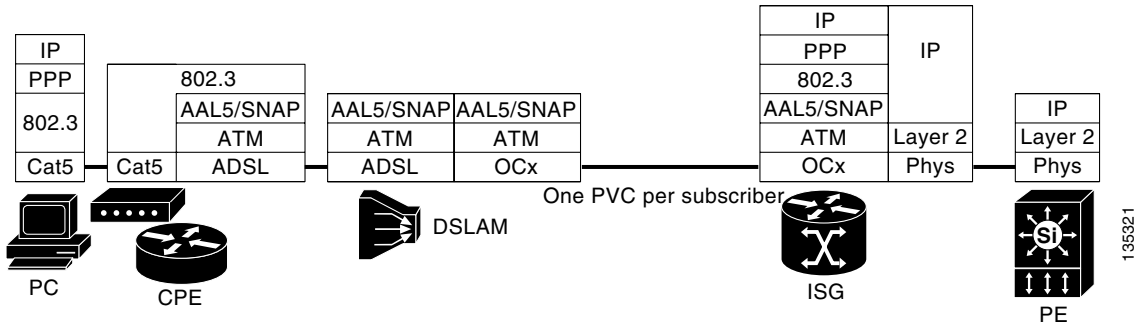


Figure 12 shows the protocols that are active at each device in the network.

Figure 12 Model 3 Protocol Stack



Model 3 QoS Strategy

Figure 13 shows all of the interfaces in the network where QoS could potentially be configured. Here, "Up" refers to the upstream interface between the two devices, and "Dw" refers to the downstream interface. The interfaces shown are the points where QoS is configured for this deployment.

Figure 13 Model 3 QoS Interfaces

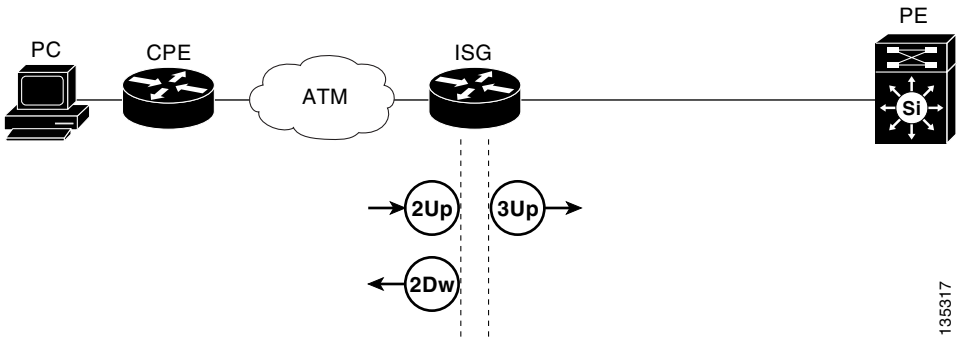


Table 5 describes the QoS strategy that is deployed on each of the interfaces shown in Figure 13.

Table 5 Model 3 QoS Strategy

Interface	Device	Traffic Origin	Traffic Destination	QoS Strategy
2Up	ISG	CPE	ISG	Upstream traffic is policed to an aggregate rate using a parent policy. A child policy then applies Class Based Policing on VoIP, Call Control, and gaming. Differentiated Services Code Point (DSCP) is mapped to the appropriate MPLS Experimental bit.
2Dw	ISG	ISG	CPE	LLQ is applied to VoIP streams, and class-based weighted fair queueing (CBWFQ) is applied to Call Control and gaming.
3Up	ISG	ISG	PE	DSCP is mapped to the appropriate MPLS Experimental bit.

Model 3 Call Flows

The following call flows describe the operation of the model 3 test network:

- Basic Layer 3 VPN Access Call Flow for PPPoE Sessions, page 20
- Basic Layer 3 VPN Access Call Flow for IP Sessions, page 21

Basic Layer 3 VPN Access Call Flow for PPPoE Sessions

For PPPoE sessions, the process of establishing basic Layer 3 VPN access is the same as the process for Model 1. For details of that process, see the "Basic Layer 3 VPN Access Call Flow for PPPoE Sessions" section on page 13.

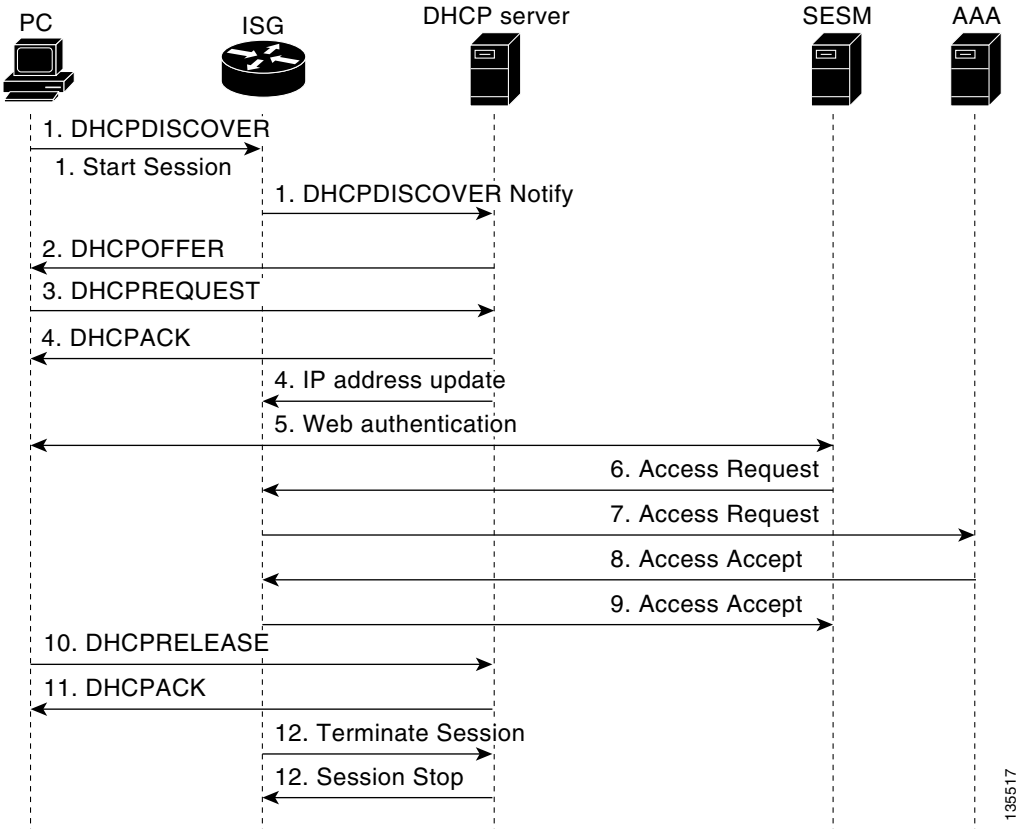
Basic Layer 3 VPN Access Call Flow for IP Sessions

For IP sessions, the ISG architecture supports several methods of authenticating the user, which lead to multiple call flows. The authentication method used depends on whether or not the ISP configures the TAL feature. TAL enables the ISG to authenticate subscribers on the basis of either source IP address or MAC address.

When TAL is not enabled, subscribers are authenticated manually. When subscribers initiate a session, the ISG sends them to the Cisco SESM (using the Layer 4 Redirect feature). Subscribers then enter their usernames and passwords.

Figure 14 shows the call flow process of establishing basic Layer 3 VPN access for IP sessions with non-TAL authentication.

Figure 14 Non-TAL Layer 3 VPN Access Call Flow for IP Sessions



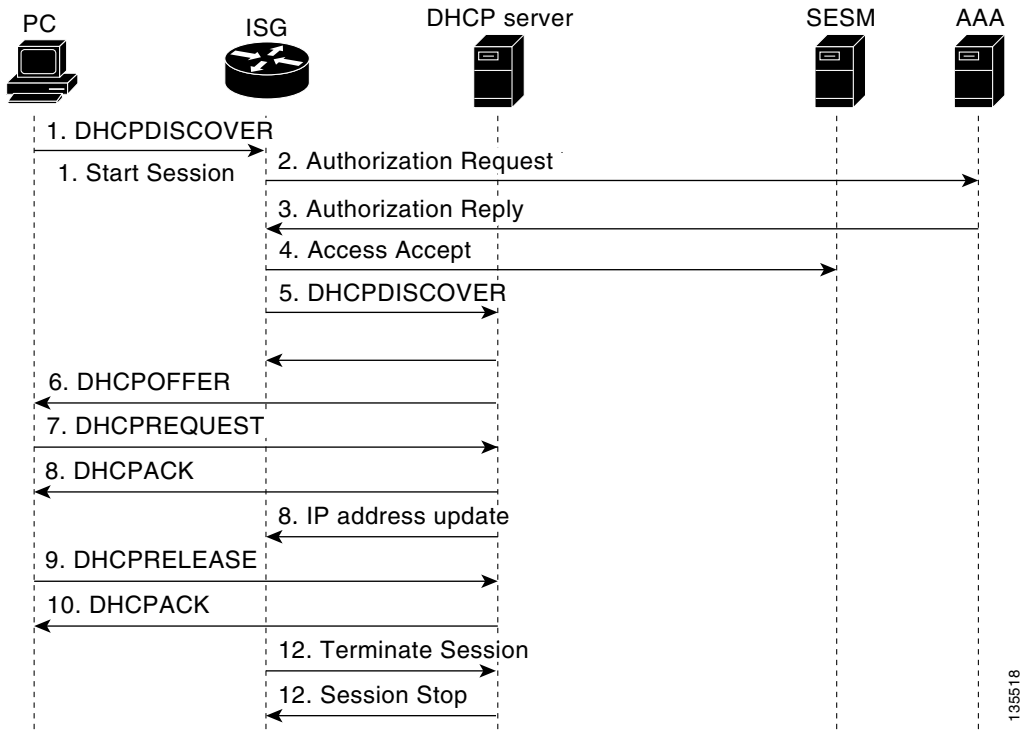
Following is an explanation of the sequence of events in Figure 14:

1. The client sends a DHCPDISCOVER message to the ISG. The ISG then relays this message by sending a DHCPDISCOVER notify message to the DHCP server. The ISG creates the IP session upon receiving the DHCPDISCOVER message from the PC client.
2. The DHCP server sends a DHCPOFFER message to the client.
3. The client sends a DHCPREQUEST message to the DHCP server.
4. The DHCP server assigns the client an IP address and sends it in a DHCPACK message to the client. The DHCP server sends an IP address update message to the ISG to notify it of the IP address allocation.

5. The subscriber's port is now allowed to connect only over HTTP to an IP address for the Cisco SESM. Other HTTP requests are sent to the Cisco SESM by the Layer 4 Redirect feature. The subscriber then enters username and password information.
6. The Cisco SESM sends the username and password to the ISG in an Access Request message.
7. The ISG sends an Access Request message to the AAA server.
8. The AAA server authenticates the subscriber and sends an Access Accept message to the ISG.
9. The ISG sends an Access Accept message to the Cisco SESM, authorizing it to begin service for the subscriber.
10. When the subscriber terminates the session, the client sends a DHCPRELEASE message to the DHCP server.
11. The DHCP server responds with a DHCPACK message.
12. The ISG sends a Terminate Session message to the DHCP server, and the DHCP server confirms that the session is ended by sending a Session Stop message to the ISG.

Figure 15 shows the call flow process of establishing basic Layer 3 VPN access for IP sessions with TAL authentication.

Figure 15 TAL-Based Layer 3 VPN Access Call Flow for IP Sessions



Following is an explanation of the sequence of events in Figure 15:

1. The client sends a DHCPDISCOVER message to the ISG.
2. The ISG sends an Authorization Request to the AAA server.
3. The AAA server performs TAL authentication based on either the clients' IP address or MAC address and sends an Authorization Reply message to the ISG.

4. If the client is successfully authenticated, the ISG sends an Access Accept message to the Cisco SESM. If the client fails TAL authentication, the subscriber will be sent to the Cisco SESM by Layer 4 redirect to manually log in.
5. The ISG relays the DHCPDISCOVER Notify message to the DHCP server. The ISG then creates an IP session.
6. The DHCP server sends a DHCPOFFER message to the client.
7. The client sends a DHCPREQUEST message to the DHCP server.
8. The DHCP server assigns the client an IP address and sends it in a DHCPACK message to the client. The DHCP server sends an IP address update message to the ISG to notify it of the IP address allocation.
9. When the subscriber terminates the session, the client sends a DHCPRELEASE message to the DHCP server.
10. The DHCP server responds with a DHCPACK message.
11. The ISG sends a Terminate Session message to the DHCP server, and the DHCP server confirms that the session is ended by sending a Session Stop message to the ISG.

Model 4: Cisco 7200 and 7300 Routers as ISG LNS with Multiservice Service Bundle

The motivation for deploying this network is an ISP's desire to broaden the flexibility of its DSL deployments beyond traditional, static DSL service. Basic Layer 3 VPN access is established first. The following advanced ISG software services are then deployed:

- Bandwidth on demand—Enables subscribers to temporarily increase their upstream and downstream bandwidths. This increased bandwidth can be charged to the subscriber's account on either a duration or a volume basis.
- Prepaid services—Enables subscribers to purchase short-term DSL access, using either time or volume limits.

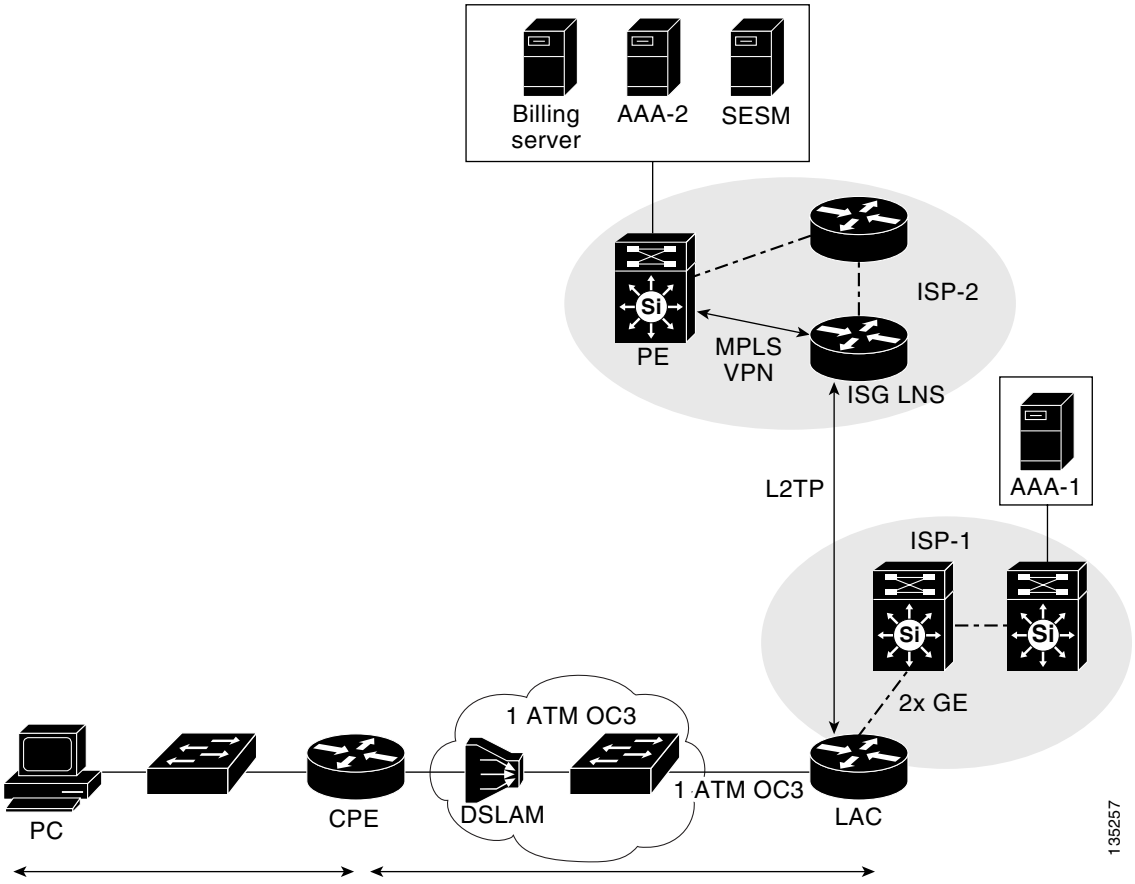
Note In this deployment, subscribers will not be able to switch from a time-based prepaid service to a volume-based prepaid service or vice versa. Subscribers will have access to both time-based and volume-based services. This scenario is presented to describe the full range of ISG software services available. Typically, ISPs will only deploy either time-based or volume-based services for subscribers, but not both simultaneously.

The following sections describe the deployment model that configures a Cisco 7200 as ISG LNS with the Multiservice service bundle:

Model 4 Network Topology

Figure 16 shows the topology of network model 4.

Figure 16 Model 4 Network Topology



Model 4 Device List

Table 6 describes devices used in the model 4 test network. Note that both a Cisco 7206 and 7301 can be used as an ISG LAC and LNS.

Table 6 Model 4 Device List

Device	Platform
CPE	Cisco 837
LAC	Cisco 7206 or Cisco 7301
ISG LNS	Cisco 7206 or Cisco 7301
PE	Cisco 6509

Model 4 Protocol Flow

PPP is tunneled from the LAC to the ISG LNS. At the ISG LNS, the PPP session is terminated, and the encapsulated IP session is routed on through the ISP's network. The identity of the customer is uniquely maintained only by the PPP session. Figure 17 shows how the PPP session is routed across the network.

Figure 17 Model 4 Protocol Flow

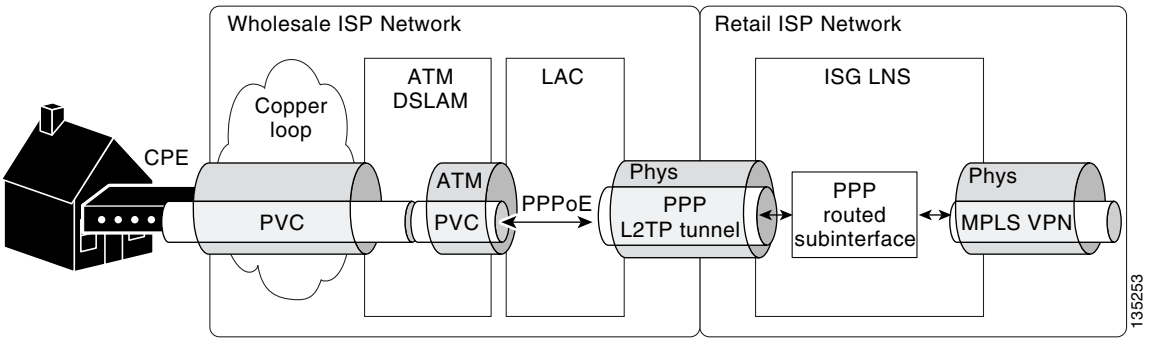
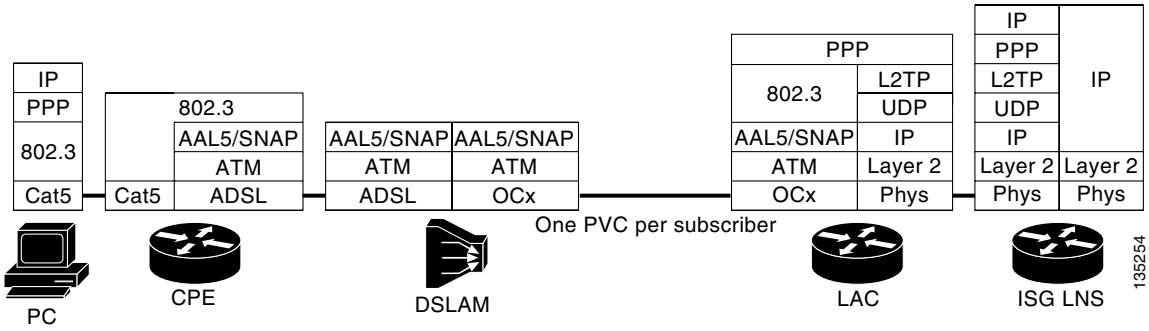


Figure 18 shows the protocols that are active at each device in the network.

Figure 18 Model 4 Protocol Stack



Model 4 QoS Strategy

Figure 19 shows all of the interfaces in the network where QoS could potentially be configured, where "Up" refers to the upstream interface between the two devices, and "Dw" refers to the downstream interface. The interfaces shown are the points where QoS is configured for this deployment.

Figure 19 Model 4 QoS Interfaces

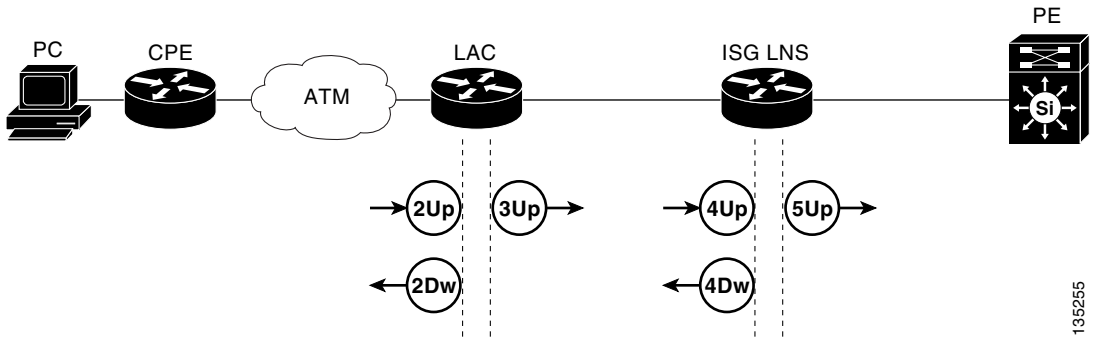


Table 7 describes the QoS strategy that is deployed on each of the interfaces shown in Figure 19.

Table 7 Model 4 QoS Strategy

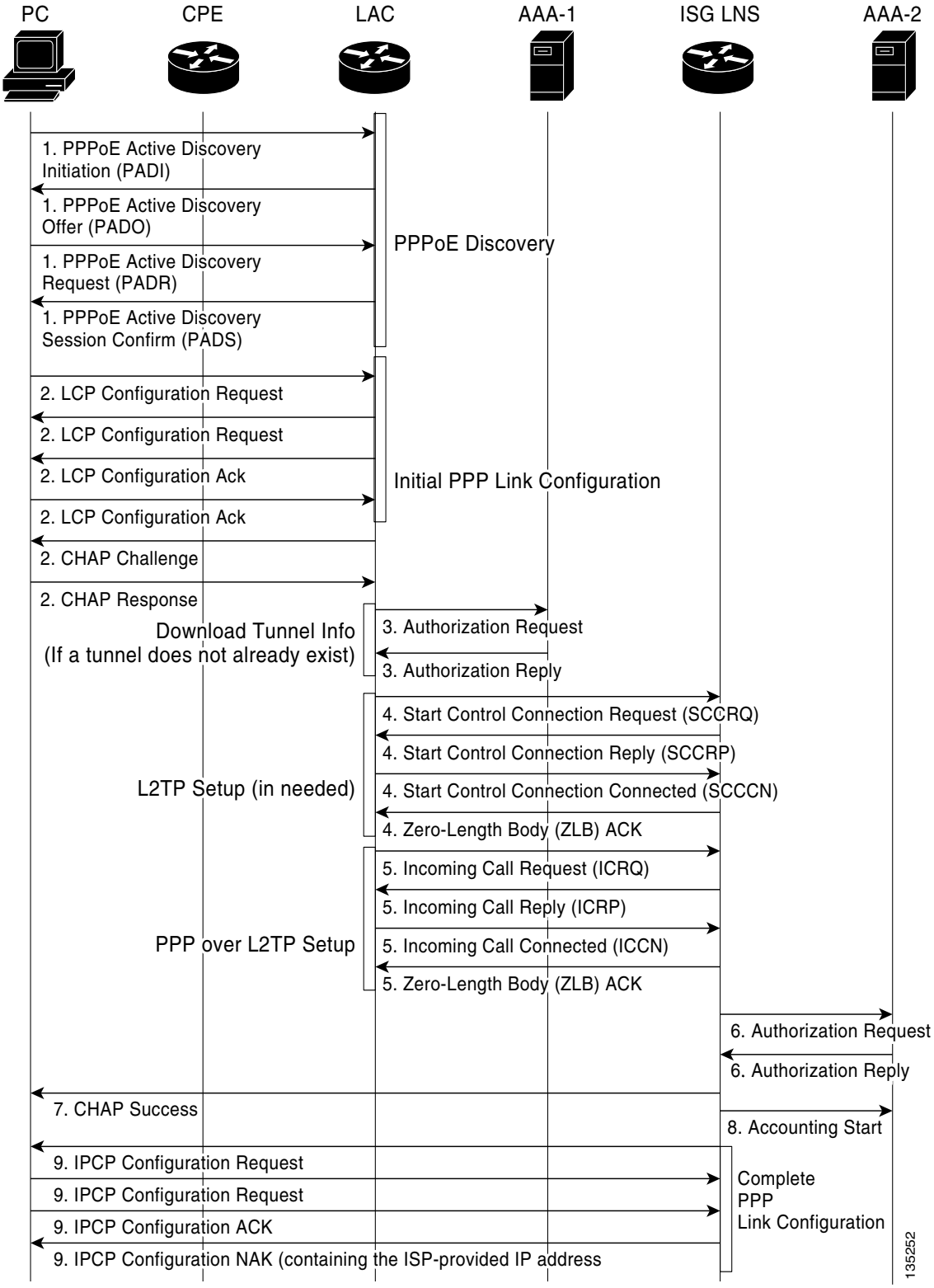
Interface	Device	Traffic Origin	Traffic Destination	QoS Strategy
2Up	LAC	CPE	LAC	Virtual circuit (VC) shaping parameters are defined by a domain profile on AAA-1 using the DBS feature.
2Dw	LAC	LAC	CPE	VC shaping parameters are defined by a domain profile on AAA-1 using the DBS feature.
3Up	LAC	LAC	ISG LNS	All traffic is reclassified as best effort DSCP is set to 0.
4Up	ISG LNS	LAC	ISG LNS	Multiple bandwidth-on-demand services are defined on AAA-2 using the QU attribute.[1]
4Dw	ISG LNS	ISG LNS	LAC	Multiple bandwidth-on-demand services are defined on AAA-2 using the QD attribute.
5Up	ISG LNS	ISG LNS	PE	Upstream traffic is marked as the default service, and the MPLS Experimental bit 0 by the service policy governing the outbound Gigabit Ethernet interface.

1. Attributes are listed in the *Cisco SSG-to-ISG DSL Broadband Migration Guide*.

Basic Layer 3 VPN Access Call Flow

Figure 20 shows the call flow process of establishing basic Layer 3 VPN access. Each subscriber session begins with this process before initiating advanced ISG software services.

Figure 20 Layer 3 VPN Access Call Flow for the Cisco ISG LNS



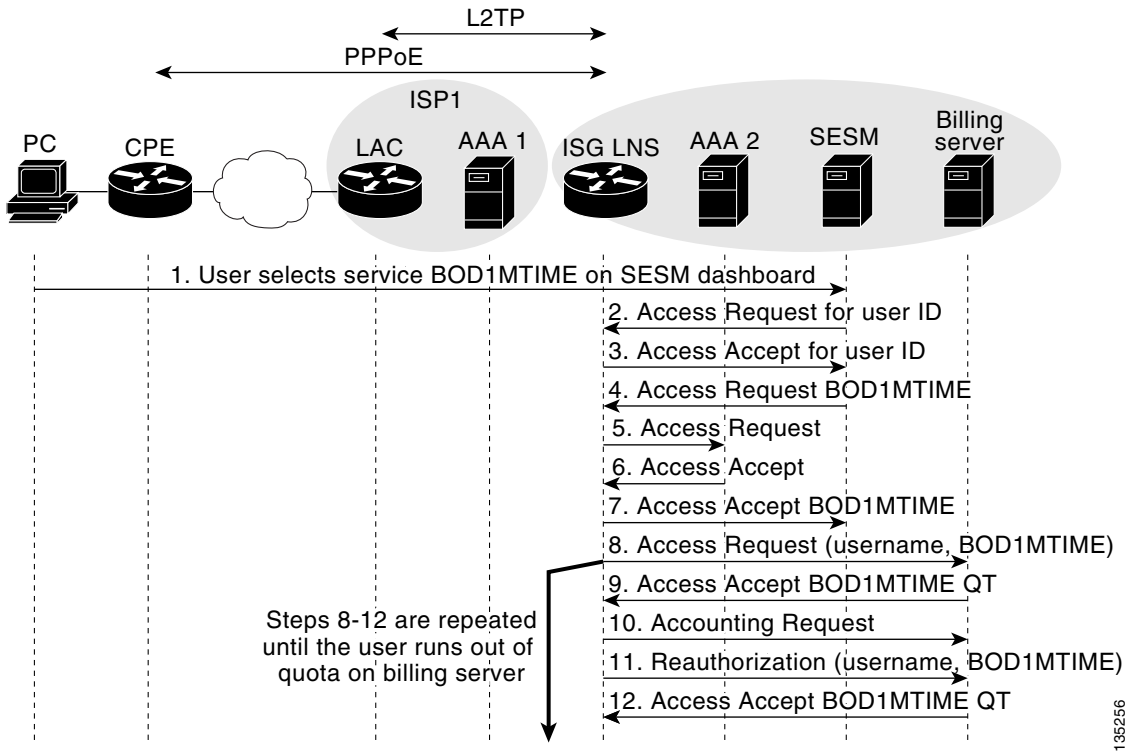
Following is an explanation of the sequence of events in Figure 20:

1. The subscriber initiates a PPPoE connection from the PC to the LAC by way of the CPE.
2. The PC and the LAC establish a PPP connection.
3. The LAC contacts the AAA-1 server to retrieve domain authentication information for L2TP.
4. The LAC establishes an L2TP tunnel with the ISG LNS. This step is necessary only if an L2TP tunnel does not already exist.
5. The LAC forwards the subscriber PPP session and associated information to the ISG LNS.
6. The ISG LNS contacts the AAA-2 server to authenticate the subscriber. Once the subscriber is authenticated, the ISG LNS clones a virtual-access interface from the virtual template.
7. The ISG LNS sends a Challenge Handshake Authentication Protocol (CHAP) response to the subscriber. The IP Control Protocol (IPCP) negotiation is performed, and the route to the ISG LNS is installed. The PPP session now runs between the subscriber and the ISG LNS, while the ISG forwards the PPP traffic over the L2TP tunnel.
8. The ISG LNS sends an Accounting Start message to the AAA-2 server.
9. The subscriber and the ISG LNS use IPCP to negotiate the link details, including the IP address. IPCP is responsible for configuring, enabling, and disabling the IP protocol modules on both ends of the PPP link. IPCP uses the same packet exchange mechanism as the link control protocol (LCP). IPCP packets may not be exchanged until PPP has reached the Network-Layer Protocol phase.

Prepaid Service Call Flow

Figure 21 shows the call flow process that occurs when a subscriber initiates prepaid services.

Figure 21 Prepaid Services Call Flow for the Cisco ISG LNS



Following is an explanation of the sequence of events in Figure 21:

1. The subscriber selects the BOD1MTIME service on the Cisco SESM web page dashboard.
2. The Cisco SESM sends an Access Request message to the ISG LNS for the subscriber's information.
3. The ISG LNS replies to the Cisco SESM with an Access Accept message containing the subscriber's information.
4. The Cisco SESM sends an Access Request message to the ISG LNS requesting information on the BOD1MTIME service.
5. The ISG LNS sends an Access Request message to the AAA-2 server requesting information on the BOD1MTIME service.
6. The AAA-2 server replies to the ISG LNS with an Access Accept message containing the traffic class, the BOD1MTIME profile, and the prepaid configuration.
7. The ISG LNS sends an Access Accept message to the AAA-2 server containing the details of the BOD1MTIME service.
8. The ISG LNS sends an Access Request message to the billing server, notifying it that the subscriber has initiated the BOD1MTIME service.
9. The billing server replies with an Access Accept message that authorizes the subscriber for a set quota of time.
10. The ISG LNS sends an accounting request to the billing server with the subscriber's username and an event time stamp.
11. When the subscriber quota is depleted, the ISG LNS sends a reauthorization request to renew the quota.
12. The billing server reauthorizes the subscriber and sends a renewed quota to the ISG LNS.

Steps 8 through 12 are repeated until either the subscriber terminates the BOD1MTIME service or the subscriber runs out of quota on the billing server.

Prerequisites for Configuration

Before you use the configuration information in this document, you must be familiar with the following topics:

- Basic Configuration Requirements, page 29
- Configuration Passwords, page 30
- Vendor-Specific Attributes, page 30

Basic Configuration Requirements

Before the networks described in this document are deployed, the following baseline network operations must be configured:

- For models 1 and 2, basic PPPoE connection between PC clients and the ISG must be established.
- For model 3, basic IP ATM RBE connectivity must be established between the PC and the ISG.
- For model 4, L2TP must be configured between the ISG LAC and the LNS. The subscriber must also be able to establish a PPPoE connection over the L2TP tunnel to the LNS.

Network administrators should also be familiar with the topics listed in the "Additional References" section on page 95.

Configuration Passwords

As you read through the configurations in this document, you will come across several types of passwords that will be required, such as for the Cisco IOS, for the Cisco Access Registrar (CAR) and AAA RADIUS server, for the billing server, and so on. The configurations in this document use the word "cisco" frequently as a password. You will need to provide unique passwords for each of these areas in your network, and determine some secure method for identifying which passwords are associated with a particular service.

Vendor-Specific Attributes

The configurations in this document use RADIUS vendor-specific attributes. These attributes are described in the following Cisco documentation:

- *RADIUS Attribute-Value Pairs and Dictionary Management*
- *RADIUS Vendor-Proprietary Attributes*
- "RADIUS Service and User Profile Attributes " in the *Cisco SSG-to-ISG DSL Broadband Migration Guide*

Table 8 summarizes the numeric definitions for some more commonly used RADIUS subattributes.

Note The Command-Code string must be converted to hexadecimal in ISGs running Cisco IOS Software Release 12.2(28)SB or earlier software. Also note that the attribute identifier is always 26, and the Cisco vendor identifier is always 9.

Table 8 Commonly Used RADIUS Vendor-Specific Subattributes

Subattribute Name	Attribute ID	Vendor ID	Subattribute ID	Subattribute Data Type
Cisco-AVPair	26	9	1	String
Account-Info	26	9	250	String
Service-Info	26	9	251	String
Command-Code	26	9	252	String
Control-Info	26	9	253	String

Model 1 Configuration: Cisco 7200 and 7300 Routers as ISG with Multiservice Service Bundle over PPPoE

Deployment model 1 was designed for the service provider that wants to expand traditional, static DSL service by deploying bandwidth on demand and prepaid services, which are part of the Multiservice service bundle. When customers activate these services, the network allocates additional bandwidth to them, based on either time or volume of bandwidth. The management of the available minutes is done via a billing server external to the ISG.

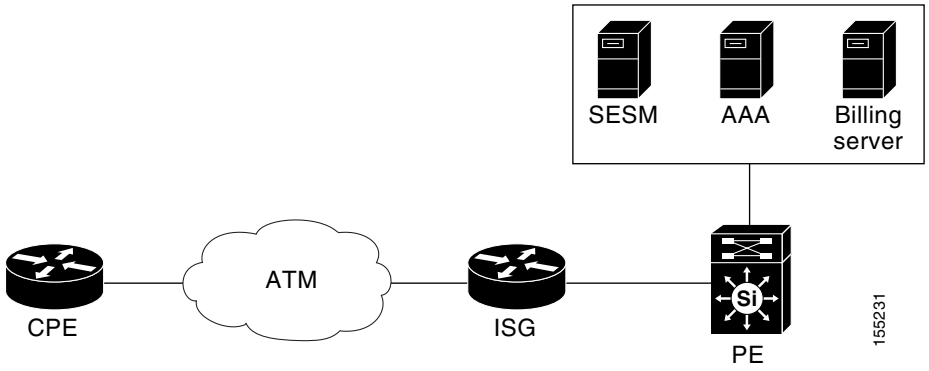
This network involves a single service provider. The DSLAM delivers traffic to the ISG using PPPoE. The ISG terminates PPPoE and routes the IP traffic through the ISP network. Subscriber identities are maintained through PPPoE authentication, and the uniqueness of the DSL line is maintained by a dedicated Layer 2 path to the ISG over an ATM PVC that is cross-connected to the subscriber at the DSLAM.

It is best if services are applied at the ISG. It is possible—but more difficult—to apply services at the DSLAM; however, the services at the DSLAM are not part of the PPP link.

The user's PC initiates a PPPoE session to the ISG across the ATM network. The CPE in this model is configured as a bridge. The ISG then forwards the subscriber session to the PE over an MPLS VPN. The PPPoE user profile pulled from the AAA server contains the VRF name, session-timeout value, idle-timeout, and default services assigned to this subscriber.

Figure 22 shows the basic devices that are configured for this model.

Figure 22 Basic Device Topology for Network Model 1



The following tasks are performed to deploy network model 1:

- Configuring the ISG in Network Model 1, page 31
- Configuring ISG Control Policies for Network Model 1, page 35
- Configuring Profiles for Network Model 1, page 37
- Configuring the CPE Bridge in Network Model 1, page 39
- Configuring the PE in Network Model 1, page 40

Configuring the ISG in Network Model 1

The following configuration tasks are performed on the LNS:

- Configuring AAA and the Connection to the RADIUS Server, page 32
- Configuring PPPoE and the Connections to the CPE and PE, page 33
- Configuring Baseline ISG Subscriber Services, page 34
- Configuring Inbound and Outbound Access Lists, page 34

Configuring AAA and the Connection to the RADIUS Server

In this configuration, connections to the CAR AAA server, the Cisco SESM, and two billing servers are configured. Vendor-specific attribute (VSA) accounting and authentication are enabled, and the loopback interface 0 is used for AAA communications.

```
aaa new-model
!
! Configures the AAA server group for the CAR AAA server.
aaa group server radius CAR_SERVER
 server 10.100.2.36 auth-port 1812 acct-port 1813
!
! Configures the AAA server group for the BILLING_SERVER billing server.
aaa group server radius BILLING_SERVER
 server 10.100.12.89 auth-port 1645 acct-port 1646


! Configures AAA for the CAR AAA server.
aaa authentication login default none
aaa authentication ppp default group CAR_SERVER
! Configures authentication for prepaid customers on the BILLING_SERVER billing server.
aaa authentication ppp PREPAID_AUTHEN_LIST group BILLING_SERVER
aaa authorization network default group CAR_SERVER
! Configures authorization for prepaid customers on the BILLING_SERVER billing server.
aaa authorization network PREPAID_AUTHOR_LIST group BILLING_SERVER
aaa authorization subscriber-service default local group radius
aaa accounting network default start-stop group CAR_SERVER
! Configures accounting for prepaid customers on the BILLING_SERVER billing server.
aaa accounting network PREPAID_ACCNT_LIST start-stop group BILLING_SERVER
! Configures the connection to the Cisco SESM
aaa server radius sesm
 client 10.100.4.38
 key cisco
 port 1812
 message-authenticator ignore
!

! Loopback 0 is used for communicating with AAA, the billing servers, and SESM.
interface Loopback0
 ip address 10.200.1.53 255.255.255.255

! Instructs the router to use loopback 0 to communicate with the AAA RADIUS servers.
ip radius source-interface Loopback0
!
! These RADIUS attributes are required for prepaid services.
radius-server attribute 44 include-in-access-req
radius-server attribute 8 include-in-access-req
radius-server attribute 55 access-request include
radius-server attribute 25 access-request include
! The CAR AAA server.
radius-server host 10.100.1.35 auth-port 1812 acct-port 1813 key cisco
! The BILLING_SERVER billing server.
radius-server host 10.100.12.89 auth-port 1645 acct-port 1646 key cisco
radius-server retransmit 5
radius-server timeout 15
radius-server vsa send accounting
radius-server vsa send authentication
```

Configuring PPPoE and the Connections to the CPE and PE

The ISG is configured to receive PPPoE sessions from the PC client by way of the DSLAM. A PPP local pool and MPLS VRF tables are created for incoming subscribers.

```
no ip dhcp use vrf connected
!
! Globally enables MPLS VRFs for incoming subscribers.
ip vrf VPN10005
 rd 100:5
 route-target export 100:5
 route-target import 100:5!
!
ip cef
!
!
! The BBA group method is used to configure PPPoE.
bba-group pppoe BBA_LM_ATM5
 virtual-template 8
 sessions per-vc limit 1
!
! This virtual circuit (VC) class is applied to the ATM PVC.
vc-class atm VC_LM_ATM8
! Associates the VC class with the above bba-group.
  protocol pppoe group BBA_LM_ATM8
! Enables dynamic bandwidth selection.
  dbs enable maximum
  encapsulation aal5snap
!

! Gigabit Ethernet interface 0/3 points to the PE.
interface GigabitEthernet0/3
 ip address 10.40.1.53 255.255.255.0
! The PBHK feature is enabled on this interface.
 ip portbundle outside
 load-interval 30
 duplex full
 speed 1000
 media-type gbic
 negotiation auto
 mpls mtu 1522
 mpls ip
 service-policy output QOS_OUT_MPLS_UPLINK
 ip rsvp bandwidth 100000
!
! ATM interface 1/0.105 points to the CPE.
interface ATM1/0.105 point-to-point
 description Deployment Model 3
 atm pppatm passive
 no atm enable-ilmi-trap
 pvc 105/45
! The VC class is associated with the PVC.
  class-vc VC_LM_ATM8
! This can be changed to restrict PPPoE sessions on the PVC.
  pppoe max-sessions 1
!
! PPPoE subscribers use this virtual template.
interface Virtual-Template8
 description LM ATM8 PTA Subscriber
 no ip address
 no peer default ip address
 no keepalive
 ppp timeout authentication 100
```

```
 ppp timeout aaa
 load-interval 30
 ppp mtu adaptive
 ppp authentication chap
 service-policy control RULE_PTA_TIME_LM_ATM8
!
! IP Pool that is assigned to PPPoE subscribers.
ip local pool cpe3_pool-53-VPN10005 192.168.3.210 192.168.3.250

! Loopback interface for PPPoE user
interface Loopback5
 ip vrf forwarding VPN10005
 ip address 192.168.3.1 255.255.255.255
```

Configuring Baseline ISG Subscriber Services

Basic ISG subscriber services are configured, including Layer 4 redirect to the Cisco SESM and the Port-Bundle Host Key (PBHK) feature. When the PBHK feature is enabled, TCP packets from subscribers are mapped to a local IP address for the ISG gateway and a range of ports. This mapping allows the portal to identify the ISG gateway from which the session originated.

```
! Configures the connection to the Cisco SESM for Layer 4 Redirect functionality.
redirect server-group SESM_SERVER_GROUP
 server ip 10.100.4.38 port 8080

! Enables port bundle host key (PBHK) access to the Cisco SESM. Each loopback interface
! can support up to 4031 bundles. If additional capacity is required, configure additional
! loopback interfaces.
ip portbundle
 match access-list 135
! The Loopback 0 interface is used to communicate with the Cisco SESM.
 source Loopback0
!
!
! This command is enabled by default. It sets the number of rules that are displayed
! in the show subscriber session detail command.
subscriber policy recording rules limit 64
```

Configuring Inbound and Outbound Access Lists

Basic access lists are configured to govern subscribers' Internet access, and an access list is created for the PBHK feature.

Note To prevent revealing actual network addresses, the following configurations use IP addresses made up of letters instead of numbers.

```
! This access list is referenced in the AAA service profiles. It governs incoming
! Internet traffic. The Internet access lists should prevent subscribers from accessing
! the Cisco SESM and other management devices to help prevent denial-of-service attacks.
!
ip access-list extended INTERNET_IN_ACL
 deny   ip any 2XZ.0.0.0 0.255.255.255
 deny   ip any XJ.0.0.0 0.255.255.255
 deny   ip any XH.0.0.0 0.255.255.255
 deny   ip any XK.0.0.0 0.255.255.255
 deny   ip any XL.0.0.0 0.255.255.255
 deny   ip any XM.0.0.0 0.255.255.255
 deny   ip any XN.0.0.0 0.255.255.255
```

```
 deny   ip any XP.0.0.0 0.255.255.255
 deny   ip any XQ.0.0.0 0.255.255.255
 deny   ip any XR.0.0.0 0.255.255.255
 deny   ip any 10.200.0.0 0.0.255.255
 permit ip any any
!
! This access list is called out in the AAA subscriber profile. It governs outgoing
! Internet traffic. The Internet access lists should prevent subscribers from accessing
! the Cisco SESM and other management devices to help prevent denial-of-service attacks.
!
ip access-list extended INTERNET_OUT_ACL
 deny   ip 2XZ.0.0.0 0.255.255.255 any
 deny   ip 10.200.0.0 0.0.255.255 any
 deny   ip XJ.0.0.0 0.255.255.255 any
 deny   ip XH.0.0.0 0.255.255.255 any
 deny   ip XK.0.0.0 0.255.255.255 any
 deny   ip XL.0.0.0 0.255.255.255 any
 deny   ip XM.0.0.0 0.255.255.255 any
 deny   ip XN.0.0.0 0.255.255.255 any
 deny   ip XP.0.0.0 0.255.255.255 any
 deny   ip XQ.0.0.0 0.255.255.255 any
 deny   ip XR.0.0.0 0.255.255.255 any
 permit ip any any
!
! The following access lists are used in the ip portbundle command configuration above.
! They only permit traffic to the Cisco SESM.
access-list 135 permit ip any host 10.100.4.38
access-list 135 deny ip any any

! The following access lists are used for L4REDIRECT SERVICES
ip access-list extended L4REDIRECT_IN_ACL
 permit ip any any
ip access-list extended L4REDIRECT_OUT_ACL
 permit ip 10.100.0.0 0.0.255.255 any
 deny ip any any
```

Configuring ISG Control Policies for Network Model 1

The following configuration tasks are performed on the ISG to enable the time-based prepaid advanced ISG subscriber services (although volume-based prepaid services could also have been configured):

- Configuring the Global Prepaid Services Configuration, page 35
- Configuring the BOD1MTIME Service, page 36
- Configuring the BOD2MTIME Service, page 37

Configuring the Global Prepaid Services Configuration

The global attributes of the prepaid services are configured for each of the two billing servers.

```
! This is the global configuration for the PREPAID_CONFIG prepaid billing server.
subscriber feature prepaid PREPAID_CONFIG
   threshold time 20 seconds
! Specifies the size of the threshold the ISG requests from the billing server. The
! threshold is an increment of the user's quota. When the threshold  (in this case 1000
! bytes) is exhausted, the ISG requests another 1000 bytes from the subscriber's account.
! This continues until the subscriber terminates the session or the subscriber's account
! is depleted.
   threshold volume 1000 bytes
   interim-interval 3 minutes
```

```
! References the authorization list in the above AAA configuration.
   method-list author PREPAID_AUTHOR_LIST
! References the accounting list in the above AAA configuration.
   method-list accounting PREPAID_ACCNT_LIST
! This is the prepaid password that is configured on the billing servers.
   password cisco
```

Note If you configure only default values for a prepaid service, the configuration will not appear in **show running-config** command output, but the configuration will be active.

```
! This is the global configuration for the default prepaid service.
subscriber feature prepaid default
   threshold time 20 seconds
! The quota size for this service is set at 200 bytes.
   threshold volume 200 bytes
   interim-interval 3 minutes
   method-list author default
   method-list accounting default
   password cisco
!
! This command is enabled by default. It sets the number of rules that are displayed in
! the show subscriber session detail command.
subscriber policy recording rules limit 64
subscriber authorization enable

! Creates the policy map that is used for time based service.
policy-map type control RULE_PTA_TIME_LM_ATM8
! When a session is initiated, PBHK is applied and the subscriber is redirected to the
! Cisco SESM to select a service.
 class type control always event session-start
  1 service-policy type service name PBHK_SERVICE
  2 service-policy type service name L4REDIRECT_SERVICE
!
! The quota-depleted event is triggered when either a prepaid threshold is not configured,
! or if the quota is depleted before the billing server replenishes the quota.
 class type control always event quota-depleted
! Specifies that traffic won't be dropped when the quota is depleted.
  1 set-param drop-traffic FALSE
!
! The credit-exhausted event is triggered when the subscriber's account is empty.
 class type control always event credit-exhausted
! Redirects subscriber's whose accounts are depleted to the Cisco SESM.
  1 service-policy type service name L4REDIRECT_SERVICE
!
```

Note The specific bandwidths described in this document are used only as examples. ISPs are free to configure any bandwidth levels that their service requires.

Configuring the BOD1MTIME Service

For each of the additional services to be configured, a control class map is configured to define matching conditions used by the policy map to trigger events that start and stop the service.

```
! This control class map defines the BOD1MTIME_CLASS service.
class-map type control match-all BOD1MTIME_CLASS
 match service-name BOD1MTIME
!
```

```
! When subscribers start the service, the other services are unapplied.
policy-map control RULE_PTA_TIME_LM_ATM8
 class type control BOD1MTIME_CLASS event service-start
  1 service-policy type service unapply name L4REDIRECT_SERVICE
  2 service-policy type service unapply name BOD1MTIME_CLASS
  3 service-policy type service identifier service-name
! When subscribers stop the service, it is unapplied, and Layer 4 redirect is applied to
! redirect the subscriber to the Cisco SESM.
 class type control BOD1MTIME_CLASS event service-stop
  1 service-policy type service unapply identifier service-name
  2 service-policy type service name L4REDIRECT_SERVICE
```

Configuring the BOD2MTIME Service

The same method used for BOD1MTIME is used to configure the BOD2MTIME service.

```
class-map type control match-all BOD2MTIME_CLASS
 match service-name BOD2MTIME
!
policy-map type control RULE_PTA_TIME_LM_ATM8
 class type control BOD2MTIME_CLASS event service-start
  1 service-policy type service unapply name L4REDIRECT_SERVICE
  2 service-policy type service unapply name BOD1MTIME
  3 service-policy type service identifier service-name
!
 class type control BOD2MTIME_CLASS event service-stop
  1 service-policy type service unapply identifier service-name
  2 service-policy type service name L4REDIRECT_SERVICE
```

Configuring Profiles for Network Model 1

The following configuration tasks are performed on the AAA server:

- Configuring the Time-Based ISG Subscriber Services, page 37
- Configuring Layer 4 Redirect, page 38
- Configuring PBHK, page 38
- Configuring User Profiles for Time-Based Customers, page 38

Configuring the Time-Based ISG Subscriber Services

The following profile specifies the details of the BOD1MTIME service. For all of the ISG software services, a priority level must be configured in order for the Layer 4 Redirect feature to work properly. When the subscriber's credit is exhausted, the Layer 4 Redirect feature (BOD1MTIME in this configuration) is added to the subscriber's existing service, but it will not be applied if the priority levels are not configured.

```
[ BOD1MTIME/Attributes ]
! All of the user-selectable services are given the priority level 10.
    Cisco-AVPair = "ip:traffic-class=in access-group name INTERNET_IN_ACL priority 10"
    Cisco-AVPair = "ip:traffic-class=in default drop"
    Cisco-AVPair = "ip:traffic-class=out access-group name INTERNET_OUT_ACL priority 10"
    Cisco-AVPair = "ip:traffic-class=out default drop"
    Cisco-AVPair = subscriber:accounting-list=PREPAID_ACCNT_LIST
    Cisco-AVPair = prepaid-config=PREPAID_CONFIG
    Cisco-AVPair = atm:peak-cell-rate=1024
```

```
    Cisco-AVPair = atm:sustainable-cell-rate=1024
! The I attribute tells the Cisco SESM that the name of this service is
! BOD1MTIME.
    Cisco-SSG-Service-Info = IBOD1MTIME
! The R attribute is required in service profiles for compatibility with SSG,
! to define subscriber services that will be displayed in the SESM web page.
Cisco-SSG-Service-Info = R10.43.1.0;255.255.255.0
```

The following profile specifies the details of the BOD2MTIME service:

```
[ BOD2MTIME/Attributes ]
    Cisco-AVPair = "ip:traffic-class=in access-group name INTERNET_IN_ACL priority 10"
    Cisco-AVPair = "ip:traffic-class=in default drop"
    Cisco-AVPair = "ip:traffic-class=out access-group name INTERNET_OUT_ACL priority 10"
    Cisco-AVPair = "ip:traffic-class=out default drop"
    Cisco-AVPair = subscriber:accounting-list=PREPAID_ACCNT_LIST
    Cisco-AVPair = prepaid-config=PREPAID_CONFIG
    Cisco-AVPair = atm:peak-cell-rate=2048
    Cisco-AVPair = atm:sustainable-cell-rate=2048
    Cisco-SSG-Service-Info = IBOD2MTIME
    Cisco-SSG-Service-Info = R10.43.1.0;255.255.255.0
```

Configuring Layer 4 Redirect

This attribute enables the Layer 4 Redirect feature.

```
[ //localhost/Radius/UserLists/SERVICES/L4REDIRECT_SERVICE/Attributes ]
! The Layer 4 Redirect feature is given the priority level 5, which is a higher priority
! than the user-selectable features. This ensures that subscribers are redirected when
! their accounts are exhausted.
    Cisco-AVPair = "ip:traffic-class=in access-group name IP_REDIRECT_ACL priority 5"
    Cisco-AVPair = "ip:traffic-class=in default drop"
    Cisco-AVPair = "ip:traffic-class=out access-group name IP_REDIRECT_ACL priority 5"
    Cisco-AVPair = "ip:traffic-class=out default drop"
    Cisco-AVPair = "ip:l4redirect=redirect to group SESM_SERVER_GROUP"
    Cisco-SSG-Service-Info = IL4REDIRECT_SERVICE
```

Configuring PBHK

This profile enables the PBHK feature on the AAA server, which enables access to the SESM by way of the PBHK feature.

```
[ //localhost/Radius/UserLists/SERVICES/PBHK_SERVICE/Attributes ]
    Cisco-AVPair = ip:portbundle=enable
! The I attribute tells the Cisco SESM that the name of this service is
! PBHK_SERVICE. Nonsubscriber services such as PBHK are defined only on the ISG itself
! and not displayed in the SESM service selection web page, and so are defined in a
! service profile without the R attribute.
    Cisco-SSG-Service-Info = IPBHK_SERVICE
```

Configuring User Profiles for Time-Based Customers

The following profile configures a user profile for time-based customers:

```
[ //localhost/Radius/UserLists/ie2-C7206-ATM/C72_DM2_3640/Attributes ]
    Cisco-AVpair = ip:vrf-id=VPN10005
    Cisco-AVpair = "ip:ip-unnumbered=loopback 5"
    Cisco-AVpair = ip:addr-pool=cpe3_pool-53-VPN10005
```

```
! The N attribute at the beginning of the two Account-Info scripts specifies that these
! are services that customers can activate. Time-based subscribers are authorized to
! access the BOD1MTIME and BOD2MTTIME services.
    Cisco-SSG-Account-Info = NBOD1MTIME
    Cisco-SSG-Account-Info = NBOD2MTIME
    idle-timeout = 1800
    session-timeout = 18000
```

Configuring the CPE Bridge in Network Model 1

The following bridge configuration establishes basic connectivity across the network and enables the user to establish basic Layer 3 VPN access:

```
no aaa new-model
ip subnet-zero
no ip domain lookup
!
!
ip audit notify log
ip audit po max-events 100
no ftp-server write-enable
!
interface Ethernet0
 no ip address
 bridge-group 1
 hold-queue 100 out
!
interface ATM0
 no ip address
 no atm ilmi-keepalive
 dsl operating-mode auto
!
interface ATM0.5 multipoint
 pvc 5/45
 encapsulation aal5snap
!
bridge-group 1
!
interface FastEthernet1
 no ip address
 duplex auto
 speed auto
!
interface FastEthernet2
 no ip address
 duplex auto
 speed auto
!
interface FastEthernet3
 no ip address
 duplex auto
 speed auto
!
interface FastEthernet4
 no ip address
 duplex auto
 speed auto
!
ip classless
!
```

```
ip http server
no ip http secure-server
!
bridge 1 protocol ieee
```

Configuring the PE in Network Model 1

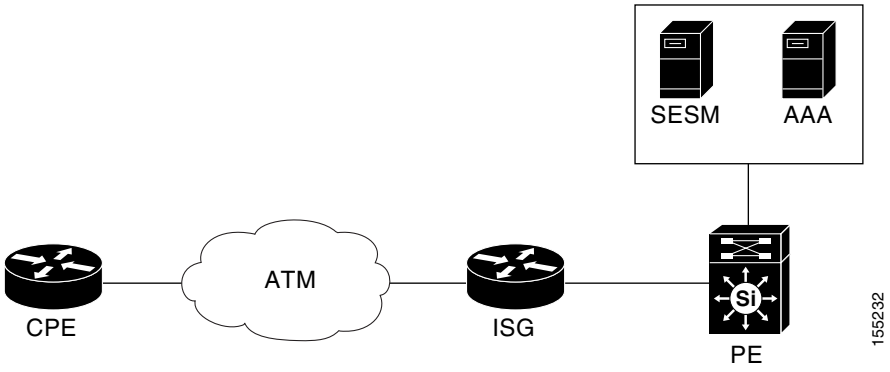
The following basic configuration is required for all of the deployment models. The PE is configured to assign subscribers to a VRF, and then to allow users to access the Cisco SESM.

```
! Configures the VRF to which subscribers are assigned.
ip vrf VPN10005
 rd 100:5
 route-target export 100:5
 route-target import 100:5
!
!
router bgp 100
 no synchronization
 bgp router-id 10.200.1.45
 bgp log-neighbor-changes
 redistribute connected
 redistribute static
 neighbor 10.200.1.41 remote-as 100
 neighbor 10.200.1.41 update-source Loopback0
 no auto-summary
!
!
! Allows VRF routes into the BGP routing table.
 address-family ipv4 vrf VPN10005
 redistribute connected
 redistribute static
 no auto-summary
 no synchronization
 network 10.44.103.0 mask 255.255.255.0
 aggregate-address 10.44.103.0 255.255.255.0 summary-only
 exit-address-family
!
!
! Redistributes a route for subscribers in VRF VPN10005 from the global routing table into
! the VRF routing domain. This route is used for subscribers to access the Cisco SESM.
! This command is only necessary when the PBHK feature is enabled.
ip route vrf VPN10005 10.100.3.34 255.255.255.255 GigabitEthernet3/14 10.100.3.34
```

Model 2 Configuration: Cisco 10000 Router as ISG with Multiservice Service Bundle over PPPoE

Deployment model 2 provides DSL subscribers with bandwidth on demand defined in the multiservice service bundle over PPPoE. In this scenario, the ISP wants to provide a means for the customer to request temporary bandwidth increase. A customer with 512 kbps of network bandwidth downstream, for example, can request a temporary bandwidth increase of up to 2 Mbps. Figure 23 shows the basic devices that are configured for this deployment.

Figure 23 Basic Device Topology for Network Model 2



The following tasks are performed to deploy network model 2:

- Configuring the ISG in Network Model 2, page 41
- Configuring ISG Control Policies for Network Model 2, page 43
- Configuring Profiles for Network Model 2, page 44
- Configuring the CPE Bridge in Network Model 2, page 46
- Configuring the PE in Network Model 2, page 47

Configuring the ISG in Network Model 2

The following tasks are performed to configure the ISG:

- Configuring AAA and the Connection to the RADIUS Server, page 41
- Configuring Baseline ISG Subscriber Services, page 42
- Configuring PPPoE and the Connections to the CPE and PE, page 42

Configuring AAA and the Connection to the RADIUS Server

Following is a basic AAA configuration, including connection to the RADIUS server:

```
aaa new-model
!
!
! Configures the connection to the AAA server and identifies it as CAR_SERVER
aaa group server radius CAR_SERVER
 server 10.100.1.35 auth-port 1812 acct-port 1813
!
aaa group server radius CAR_SERVER_C10K
 server 10.100.100.179 auth-port 1812 acct-port 1813
!
aaa authentication login default none
aaa authentication login IP_AUTHEN_LIST group CAR_SERVER_C10K
aaa authentication ppp default group CAR_SERVER_C10K
aaa authentication ppp PPP_USER_LIST group CAR_SERVER_C10K
aaa authorization network default group CAR_SERVER_C10K
aaa authorization subscriber-service default local group CAR_SERVER_C10K
aaa accounting update periodic 1
aaa accounting network default start-stop group CAR_SERVER_C10K
aaa accounting network CAR_ACCNT_LIST start-stop group CAR_SERVER_C10K
```

```
!
aaa server radius sesm
 client 10.100.3.34
 client 10.100.100.178
 key cisco
 port 1812
 message-authenticator ignore
```

Configuring Baseline ISG Subscriber Services

The following configurations enable PBHK access to the Cisco SESM. Each loopback interface can support up to 4032 bundles. If additional capacity is required, configure additional loopback interfaces.

```
ip portbundle
 source Loopback0
 match access-list 198

! The Loopback 0 interface is used to communicate with the Cisco SESM.
interface Loopback0
 ip address 10.200.1.54 255.255.255.255

! Assigns the port bundle to the uplink interface
interface GigabitEthernet8/0/0
ip portbundle outside

! Configures the access lists for PBHK
access-list 198 permit ip any host 10.100.3.34
access-list 198 deny   ip any any

! Configures the access lists for BOD services
access-list extended INTERNET_IN_ACL
  permit ip any any
ip access-list extended INTERNET_OUT_ACL
  permit ip any any
```

Configuring PPPoE and the Connections to the CPE and PE

The following configuration shows how the broadband bba-group method is used to configure PPPoE. The virtual circuit class is applied to the ATM PVC.

Note To prevent revealing actual network addresses, the following configurations use IP addresses made up of letters instead of numbers.

```
bba-group pppoe BBA_LM_ATM1
 virtual-template 1
!
!
vc-class atm VC_LM_ATM1
! Associates the VC class with the above bba-group.
protocol pppoe group BBA_LM_ATM1
  vbr-nrt 256 128 50
! Enables dynamic bandwidth selection.
  dbs enable maximum
  encapsulation aal5snap
  weight 10

interface ATM1/0/0
```

```
 no ip address
 atm over-subscription-factor 50
 atm pvp 110 10000 cdvt 1400
!
interface ATM1/0/0.53 point-to-point
 pvc 110/53
  class-vc VC_LM_ATM1

! Defines PPPoE IP address pool
ip local pool C10K_POOL X.2.0.1 X.2.0.254

! Defines loopback address for PPPoE subscribers
interface Loopback53
 ip vrf forwarding 10kvpn1
 ip address 10.53.53.1 255.255.255.0
```

Configuring ISG Control Policies for Network Model 2

The following sections provide configurations of control and policy class maps:

- Configuring Control Class Maps, page 43
- Configuring a Control Policy, page 43
- Configuring a Virtual Template Interface and Assigning Control Policy, page 44

Configuring Control Class Maps

Before configuring services, first define each service by creating a control class map. Then configure instructions on how to start and stop the service as class controls. The following configuration shows control class maps for each of the services defined for deployment model 2:

```
class-map type control match-all BOD1M_CLASS_LM1
 match service-name BOD1M_LM1
!
class-map type control match-all BOD2M_CLASS_LM1
 match service-name BOD2M_LM1
!
class-map type control match-all DEFAULT_CLASS_LM1
 match service-name DEFAULT_BW_512
!
```

Configuring a Control Policy

The following configuration shows the control policies that are configured for model 2:

```
policy-map type control RULE_LM_ATM1
 class type control BOD1M_CLASS_LM1 event service-start
  1 service-policy type service unapply name BOD2M_LM1
  2 service-policy type service unapply name DEFAULT_BW_512
  3 service-policy type service identifier service-name
 !
 class type control BOD2M_CLASS_LM1 event service-start
  1 service-policy type service unapply name BOD1M_LM1
  2 service-policy type service unapply name DEFAULT_BW_512
  3 service-policy type service identifier service-name
 !
 class type control DEFAULT_CLASS_LM1 event service-start
```

```
  1 service-policy type service unapply name BOD1M_LM1
  2 service-policy type service unapply name BOD2M_LM1
  3 service-policy type service identifier service-name
 !
 class type control BOD1M_CLASS_LM1 event service-stop
  1 service-policy type service unapply identifier service-name
  2 service-policy type service name DEFAULT_BW_512
 !
 class type control BOD2M_CLASS_LM1 event service-stop
  1 service-policy type service unapply identifier service-name
  2 service-policy type service name DEFAULT_BW_512
!
class type control always event session-start
  1 service-policy type service name PBHK_SERVICE
  2 collect identifier unauthenticated-domain
  3 authorize aaa password lab identifier unauthenticated-domain
```

Configuring a Virtual Template Interface and Assigning Control Policy

The following configuration shows how the ISG control policy map RULE_LM_ATM1 is used to instruct PPP to authenticate on the basis of domain name:

```
interface Virtual-Template1
 no ip address
 no peer default ip address
 no keepalive
! PPP CHAP authentication is used on the virtual template.
 ppp authentication chap
 ppp ipcp address unique
 service-policy type control RULE_LM_ATM1
```

Configuring Profiles for Network Model 2

The following sections provide configurations of domain, user, and service profiles created on a AAA server for deployment model 2:

- Configuring a Domain Profile, page 44
- Configuring PPPoE User Profiles, page 45
- Creating the PBHK Service Profile, page 45
- Configuring the BOD Service Profiles, page 45

Configuring a Domain Profile

The following policies will capture the unauthenticated domain name and authenticate users on the basis of the domain name. The domain profile points to a AAA method list to perform full username authentication.

```
            Name = 10kvpn1
            Attributes/
               Cisco-AVpair = "subscriber:policy-directive=authenticate aaa list
PPP_USER_LIST" CheckItems/
```

Configuring PPPoE User Profiles

The following attributes are used to create the PPPoE RADIUS user profile:

```
Name = ftc101_user1@10kvpn1
Attributes/
    Cisco-AVpair = "ip:ip-unnumbered=loopback 53"
    Cisco-AVpair = ip:addr-pool=C10K_POOL
    Cisco-AVpair = ip:vrf-id=10kvpn1
    Cisco-SSG-Account-Info = ADEFAULT_BW_512
    Cisco-SSG-Account-Info = NDEFAULT_BW_512
    Cisco-SSG-Account-Info = NBOD1M_LM1
    Cisco-SSG-Account-Info = NBOD2M_LM1
    idle-timeout = 1800
    session-timeout = 180000
```

Creating the PBHK Service Profile

The following attributes create the PBHK service profile in the CAR/AAA server:

```
Name = PBHK_SERVICE
Attributes/
    Cisco-AVPair = ip:portbundle=enable
    Cisco-SSG-Service-Info = IPBHK_SERVICE
```

Configuring the BOD Service Profiles

The following attributes create the profile that provides the temporary bandwidth increase for subscribers:

```
        Name = SESM-SERVICES
        Description =
        BOD1M_LM1/
            Name = BOD1M_LM1
            Attributes/
                Cisco-AVPair = "ip:traffic-class=in access-group name INTERNET_IN_ACL
priority 10"
                Cisco-AVPair = "ip:traffic-class=in default drop"
                Cisco-AVPair = "ip:traffic-class=out access-group name INTERNET_OUT_ACL
priority 10"
                Cisco-AVPair = "ip:traffic-class=out default drop"
                Cisco-AVPair = subscriber:accounting-list=CAR_ACCNT_LIST
                Cisco-AVPair = atm:peak-cell-rate=1024
                Cisco-AVPair = atm:sustainable-cell-rate=1024
                Cisco-SSG-Service-Info = IBOD1M_LM1
                Cisco-SSG-Service-Info = QU;512000;256000
                Cisco-SSG-Service-Info = R10.43.1.0;255.255.255.0
            CheckItems/
        BOD2M_LM1/
             Attributes/
                Cisco-AVPair = "ip:traffic-class=in access-group name INTERNET_IN_ACL
priority 10"
                Cisco-AVPair = "ip:traffic-class=in default drop"
                Cisco-AVPair = "ip:traffic-class=out access-group name INTERNET_OUT_ACL
priority 10"
                Cisco-AVPair = "ip:traffic-class=out default drop"
                Cisco-AVPair = subscriber:accounting-list=CAR_ACCNT_LIST
                Cisco-AVPair = atm:peak-cell-rate=2048
                Cisco-AVPair = atm:sustainable-cell-rate=2048
```

```
                Cisco-SSG-Service-Info = IBOD2M_LM1
                Cisco-SSG-Service-Info = QU;1024000;512000
                Cisco-SSG-Service-Info = R10.43.1.0;255.255.255.0
            CheckItems/
        DEFAULT_BW_512/
            Name = DEFAULT_BW_512
            Attributes/
                Cisco-AVPair = "ip:traffic-class=in access-group name INTERNET_IN_ACL
priority 10"
                Cisco-AVPair = "ip:traffic-class=in default drop"
                Cisco-AVPair = "ip:traffic-class=out access-group name INTERNET_OUT_ACL
priority 10"
                Cisco-AVPair = "ip:traffic-class=out default drop"
                Cisco-AVPair = subscriber:accounting-list=CAR_ACCNT_LIST
                Cisco-AVPair = atm:peak-cell-rate=512
                Cisco-AVPair = atm:sustainable-cell-rate=512
                Cisco-SSG-Service-Info = IDEFAULT_BW_512
                Cisco-SSG-Service-Info = QU;512000;256000
                Cisco-SSG-Service-Info = R10.43.1.0;255.255.255.0
            CheckItems/
```

Configuring the CPE Bridge in Network Model 2

Following is the configuration of the CPE bridge:

```
no aaa new-model
ip subnet-zero
no ip domain lookup
!
!
ip audit notify log
ip audit po max-events 100
no ftp-server write-enable

!
interface Ethernet0
 no ip address
 bridge-group 1
 hold-queue 100 out
!
interface ATM0
 no ip address
 no atm ilmi-keepalive
 dsl operating-mode auto
!
interface ATM0.10 multipoint
 pvc 10/53
 encapsulation aal5snap
!
bridge-group 1
!
interface FastEthernet1
 no ip address
 duplex auto
 speed auto
!
interface FastEthernet2
 no ip address
 duplex auto
 speed auto
!
```

```
interface FastEthernet3
 no ip address
 duplex auto
 speed auto
!
interface FastEthernet4
 no ip address
 duplex auto
 speed auto
!
ip classless
!
ip http server
no ip http secure-server
!
bridge 1 protocol ieee
!
```

Configuring the PE in Network Model 2

The PE is configured to assign subscribers to a VRF and to allow subscribers to access the Cisco SESM.

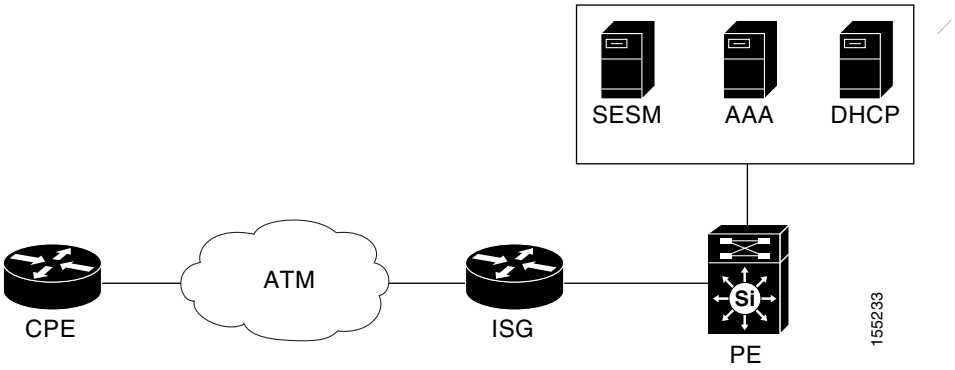
```
ip vrf 10kvpn1
 rd 200:1
 route-target export 200:1
 route-target import 200:1

router bgp 100
 no synchronization
 bgp router-id 10.200.1.45
 bgp log-neighbor-changes
 neighbor 10.200.1.41 remote-as 100
 neighbor 10.200.1.41 update-source
Loopback0
 no auto-summary
!
! Enables BGP VPNv4 neighbors.
 address-family vpnv4
 neighbor 10.200.1.41 activate
 neighbor 10.200.1.41 send-community both
 exit-address-family
!
! Allows VRF routes into the BGP routing table.
 address-family ipv4 vrf 10kvpn1
 redistribute connected
 no auto-summary
 no synchronization
 exit-address-family
!
```

Model 3 Configuration: Cisco 7200 and 7300 Routers as ISG with Triple Play Plus Service Bundle over IP and PPPoE

Deployment model 3 involves a single ISP. In this deployment, two peering IP interfaces are configured between the CPE and the ISG: one for IP connections and one for PPPoE connections. This configuration allows all subscribers to use PPPoE for data traffic, regardless of whether they are subscribing to the basic service or to the triple-play package. This dual-purpose approach eases support and conversion issues and allows the ISP to gradually convert to a full IP routed scheme.

Figure 24 shows the basic devices that are configured for this deployment.

Figure 24 Basic Device Topology for Network Model 3



The following tasks are performed to deploy network model 3:

- Configuring the ISG in Network Model 3, page 48
- Configuring Profiles for Network Model 3, page 54
- Configuring the CPE Bridge in Network Model 3, page 56
- Configuring the PE in Network Model 3, page 57

Configuring the ISG in Network Model 3

The following baseline configuration tasks are performed on the ISG:

- Configuring AAA and the Connection to the RADIUS Server, page 49
- Configuring PPPoE and the Connections to the CPE and PE, page 49
- Configuring Baseline ISG Subscriber Services, page 51
- Configuring Inbound and Outbound Access Lists, page 51
- Configuring QoS for Triple Play Plus, page 52
- Configuring Triple Play Plus Access Lists, page 53

Configuring AAA and the Connection to the RADIUS Server

In this AAA configuration, connections to the CAR AAA server, the Cisco SESM, and two billing servers are configured. VSA accounting and authentication are enabled, and the loopback interface 0 is used for AAA communications.

```
aaa new-model
!
! Configures the AAA server group for the CAR AAA server.
aaa group server radius CAR_SERVER
 server 10.100.2.36 auth-port 1812 acct-port 1813
!

! Configures AAA for the CAR AAA server.
aaa authentication login default none
aaa authentication login IP_AUTHEN_LIST group CAR_SERVER
aaa authentication ppp default group CAR_SERVER
! Configures the connection to the Cisco SESM
aaa server radius sesm
 client 10.100.4.38
 key cisco
 port 1812
 message-authenticator ignore
!

! Loopback 0 is used for communicating with AAA, the billing servers, and SESM.
interface Loopback0
 ip address 10.200.1.53 255.255.255.255

! Instructs the router to use loopback 0 to communicate with the AAA RADIUS servers.
ip radius source-interface Loopback0
!
! The CAR AAA server.
radius-server host 10.100.1.35 auth-port 1812 acct-port 1813 key cisco
radius-server retransmit 5
radius-server timeout 15
radius-server vsa send accounting
radius-server vsa send authentication
```

Configuring PPPoE and the Connections to the CPE and PE

The ISG is configured to receive PPPoE sessions from the CPE by way of the DSLAM, and MPLS VRF tables are created for incoming subscribers.

```
no ip dhcp use vrf connected
!
! Globally enables MPLS VRFs for incoming subscribers.
ip vrf VPN10003
 rd 100:3
 route-target export 100:3
 route-target import 100:3
!
ip cef
!
!

! The BBA group method is used to configure PPPoE.
bba-group pppoe BBA_LM_ATM2
 virtual-template 2
!
! This virtual circuit (VC) class is applied to the ATM PVC.
vc-class atm VC_LM_ATM2
```

```
! Associates the VC class with the above bba-group.
  protocol pppoe group BBA_LM_ATM2
! Enables dynamic bandwidth selection.
  dbs enable maximum
  encapsulation aal5snap
  service-policy control RULE_PTA_LM_ATM2
!

! Gigabit Ethernet interface 0/3 points to the PE.
interface GigabitEthernet0/3
 ip address 10.40.1.53 255.255.255.0
! The PBHK feature is enabled on this interface.
 ip portbundle outside
 load-interval 30
 duplex full
 speed 1000
 media-type gbic
 negotiation auto
 mpls mtu 1522
 mpls ip
 service-policy output QOS_OUT_MPLS_UPLINK
 ip rsvp bandwidth 100000
!
! ATM interface 1/0.103 points to the CPE.
interface ATM1/0.103 point-to-point
 ip unnumbered Loopback3
 ip verify unicast reverse-path
 ip helper-address 10.100.1.37
 no ip redirects
 no ip unreachables
 no ip proxy-arp
 ip subscriber
  initiator dhcp
 atm route-bridged ip
 no atm enable-ilmi-trap
 ntp disable
 pvc 103/43
! The VC class is associated with the PVC.
  class-vc VC_LM_ATM2
 service-policy input QOS_IN_LM_ATM2
 service-policy output QOS_OUT_LM_ATM2
 service-policy control RULE_IP_LM_ATM2
!

! PPPoE subscribers use this virtual template.
interface Virtual-Template2
 description LM ATM2 PTA Subscriber
 no ip address
 no peer default ip address
 no keepalive
 ppp authentication chap
 ppp timeout authentication 100
 ppp timeout aaa
!
! The PPPoE pool that is assigned to subscribers.
ip local pool cpe3_pool-53 192.168.3.2 192.168.3.100
```

Configuring Baseline ISG Subscriber Services

The baseline ISG software services, Layer 4 redirect, ISG software authentication methods, and PBHK are configured. When the PBHK feature is enabled, TCP packets from subscribers are mapped to a local IP address for the ISG gateway and a range of ports. This mapping allows the portal to identify the ISG gateway from which the session originated.

```
! Configures the connection to the Cisco SESM for Layer 4 Redirect functionality.
redirect server-group SESM_SERVER_GROUP
 server ip 10.100.3.34 port 8080
!
! This policy map governs authentication.
policy-map control RULE_IP_LM_ATM2
! Unauthenticated traffic is dropped after the timer expires.
 class control IP_UNAUTH_COND event timed-policy-expiry
  1 service disconnect
!
 class control always event session-start
! PBHK must be applied before authorization, because if subscribers are authorized first,
! ISG software will skip the remaining steps and PBHK won't be applied.
  1 service-policy service name PBHK_SERVICE
! Authorizes subscribers based on their MAC address. If authorization is successful, the
! remaining steps are skipped.
  2 authorize aaa password lab identifier mac-address
! If authorization fails, subscribers are redirected to the Cisco SESM.
  3 service-policy service name L4REDIRECT_SERVICE
! When users are redirected, the IP_UNAUTH_TIMER gives them 5 minutes to manually
! authenticate at the Cisco SESM before the session is dropped.
  4 set-timer IP_UNAUTH_TIMER 5
!
 class control always event account-logon
! Authorization is performed based on the IP_AUTHEN_LIST.
  1 authenticate aaa list IP_AUTHEN_LIST
! If authorization fails, users are redirected to the Cisco SESM.
  2 service-policy service unapply name L4REDIRECT_SERVICE
!
!
policy-map control RULE_PTA_LM_ATM2
 class control always event session-start
  1 service-policy service name PBHK_SERVICE
!
!
! Enables port bundle host key (PBHK) access to the Cisco SESM. Each loopback interface
! can support up to 4031 bundles. If additional capacity is required, configure additional
! loopback interfaces.
ip portbundle
 match access-list 135
! The Loopback 0 interface is used to communicate with the Cisco SESM.
 source Loopback0
!
! This class map specifies that a timer is initiated for unauthenticated sessions. If the
! subscriber does not authenticate before the timer expires, the session is dropped.
class-map control match-all IP_UNAUTH_COND
 match timer IP_UNAUTH_TIMER
 match authen-status unauthenticated
```

Configuring Inbound and Outbound Access Lists

Basic access lists are configured to govern subscribers' Internet access, and an access list is created for the PBHK feature.

Note To prevent revealing actual network addresses, the following configurations use IP addresses made up of letters instead of numbers.

```
! This access list is referenced in the AAA subscriber profile. It governs incoming
! Internet traffic. The Internet access lists should prevent subscribers from accessing
! the Cisco SESM and other management devices to help prevent denial-of-service attacks.
!
ip access-list extended Internet-in-acl
 deny   ip any 2XZ.0.0.0 0.255.255.255
 deny   ip any XJ.0.0.0 0.255.255.255
 deny   ip any XH.0.0.0 0.255.255.255
 deny   ip any XK.0.0.0 0.255.255.255
 deny   ip any XL.0.0.0 0.255.255.255
 deny   ip any XM.0.0.0 0.255.255.255
 deny   ip any XN.0.0.0 0.255.255.255
 deny   ip any XP.0.0.0 0.255.255.255
 deny   ip any XQ.0.0.0 0.255.255.255
 deny   ip any XR.0.0.0 0.255.255.255
 deny   ip any 10.200.0.0 0.0.255.255
 permit ip any any
!
! The following access list is called out in the AAA subscriber profile. It
! governs outgoing Internet traffic. The Internet access lists should prevent
! subscribers from accessing the Cisco SESM and other management devices to
! help prevent denial-of-service attacks.
!
ip access-list extended Internet-out-acl
 deny   ip 2XZ.0.0.0 0.255.255.255 any
 deny   ip 10.200.0.0 0.0.255.255 any
 deny   ip XJ.0.0.0 0.255.255.255 any
 deny   ip XH.0.0.0 0.255.255.255 any
 deny   ip XK.0.0.0 0.255.255.255 any
 deny   ip XL.0.0.0 0.255.255.255 any
 deny   ip XM.0.0.0 0.255.255.255 any
 deny   ip XN.0.0.0 0.255.255.255 any
 deny   ip XP.0.0.0 0.255.255.255 any
 deny   ip XQ.0.0.0 0.255.255.255 any
 deny   ip XR.0.0.0 0.255.255.255 any
 permit ip any any
!
! This access list is used in the ip portbundle configuration above.
access-list 135 permit ip any host 10.100.4.38
access-list 135 deny ip any any
```

Configuring QoS for Triple Play Plus

The Triple Play Plus service bundle is configured by specifying different levels of QoS for each of the user-selectable services. Three DSCP levels are configured: gaming, call control, and voice. The video-on-demand service uses the same DSCP as the voice service. Policy maps are then used to apply this QoS configuration to the inbound and outbound interfaces.

```
! These class maps specify the various DSCP levels.
class-map match-any QOS_GROUP_CALL_CONTROL
  match qos-group 2
class-map match-any GAMING
  match ip dscp af21
class-map match-any QOS_GROUP_GAMING
  match qos-group 3
class-map match-any CALL_CONTROL
```

```
  match ip dscp cs3
class-map match-any QOS_GROUP_VOICE
  match qos-group 1
class-map match-any VOICE
  match ip dscp ef
!

!
! This policy map governs QoS for the outbound interface to the CPE.
policy-map QOS_OUT_LM_ATM2
  class VOICE
    priority 128
  class CALL_CONTROL
    bandwidth percent 5
  class GAMING
    bandwidth percent 20

! This policy map governs QoS for the outbound interface to the PE.
policy-map QOS_OUT_MPLS_UPLINK
  class QOS_GROUP_VOICE
   set mpls experimental topmost 5
  class QOS_GROUP_CALL_CONTROL
   set mpls experimental topmost 3
  class QOS_GROUP_GAMING
   set mpls experimental topmost 2
  class class-default
   set mpls experimental topmost 0

! This policy map governs QoS for the inbound interface from the CPE.
policy-map QOS_IN_LM_ATM2
  class VOICE
! Caps bandwidth for VoIP and VoD traffic at 128 kbps.
   police cir 128000
     exceed-action drop
   set qos-group 1
  class CALL_CONTROL
! Caps bandwidth for call control traffic at 12.5 kbps.
   police cir 12500
     exceed-action drop
   set qos-group 2
  class GAMING
! Caps bandwidth for gaming traffic at 75 kbps.
   police cir 75000
     exceed-action drop
   set qos-group 3

! This policy map governs QoS for the default service.
policy-map QOS_IN_LM_ATM2_256K
  class class-default
! Caps bandwidth for basic connectivity traffic at 256 kbps.
   police cir 256000
     exceed-action drop
   set qos-group 1
   service-policy QOS_IN_LM_ATM2
```

Configuring Triple Play Plus Access Lists

The following access lists govern the access of subscribers who have activated the various services:

```
! The gaming access lists allow gaming subscribers to access only the gaming server.
ip access-list extended GAMING_IN_ACL
 permit ip any 10.47.0.0 0.0.255.255
 deny   ip any any
```

```
ip access-list extended GAMING_OUT_ACL
 permit ip 10.47.0.0 0.0.255.255 any
 deny   ip any any
! The opengarden access lists govern the access of users who have not activated an
! advanced service.
ip access-list extended OPENGARDEN_IN_ACL
 permit ip any 10.100.0.0 0.0.255.255
 permit ip any 10.48.0.0 0.0.255.255
 permit ip any 192.168.3.0 0.0.0.255
ip access-list extended OPENGARDEN_OUT_ACL
 permit ip 10.100.0.0 0.0.255.255 any
 permit ip 10.48.0.0 0.0.255.255 any
 permit ip 192.168.3.0 0.0.0.255 any
ip access-list extended SESM-in-acl
 permit ip any host 10.100.3.34
 deny   ip any any
ip access-list extended SESM-out-acl
 permit ip host 10.100.3.34 any
 deny   ip any any
! The VoD access lists allow VoD subscribers to access only the VoD server.
ip access-list extended VOD_IN_ACL
 permit ip any 10.46.0.0 0.0.255.255
 deny   ip any any
ip access-list extended VOD_OUT_ACL
 permit ip 10.46.0.0 0.0.255.255 any
 deny   ip any any
! The VoIP access lists allow VoIP subscribers to access only the VoD server.
ip access-list extended VOIP_IN_ACL
 permit ip any 10.45.0.0 0.0.255.255
 deny   ip any any
ip access-list extended VOIP_OUT_ACL
 permit ip 10.45.0.0 0.0.255.255 any
 deny   ip any any
```

Configuring Profiles for Network Model 3

The following configuration tasks are performed on the AAA server:

- Configuring Layer 4 Redirect, page 54
- Configuring PBHK, page 55
- Configuring Service Profiles, page 55
- Configuring User Profiles, page 56

Configuring Layer 4 Redirect

This attribute enables the Layer 4 Redirect feature.

```
[ //localhost/Radius/UserLists/SERVICES/L4REDIRECT_SERVICE/Attributes ]
! The Layer 4 Redirect feature is given the priority level 5, which is a higher priority
! than the user-selectable features. This ensures that subscribers are redirected when
! their accounts are exhausted.
    Cisco-AVPair = "ip:traffic-class=in access-group name IP_REDIRECT_ACL priority 5"
    Cisco-AVPair = "ip:traffic-class=in default drop"
    Cisco-AVPair = "ip:traffic-class=out access-group name IP_REDIRECT_ACL priority 5"
    Cisco-AVPair = "ip:traffic-class=out default drop"
    Cisco-AVPair = "ip:l4redirect=redirect to group SESM_SERVER_GROUP"
    Cisco-SSG-Service-Info = IL4REDIRECT_SERVICE
```

Configuring PBHK

This profile enables the PBHK feature on the AAA server, which enables access to the SESM by way of the PBHK feature.

```
[ //localhost/Radius/UserLists/SERVICES/PBHK_SERVICE/Attributes ]
    Cisco-AVPair = ip:portbundle=enable
! The I attribute tells the Cisco SESM that the name of this service is named
! "PBHK_SERVICE". Nonsubscriber services such as PBHK are defined only on the ISG itself
! and not displayed in the SESM service selection web page, and so are defined in a
! service profile without the R attribute.
    Cisco-SSG-Service-Info = IPBHK_SERVICE
```

Configuring Service Profiles

The following service profile enables the GAMING_SERVICE service:

```
[ //localhost/Radius/UserLists/SERVICES/GAMING_SERVICE/Attributes ]
    Cisco-AVPair = "ip:traffic-class=in access-group name GAMING_IN_ACL"
    Cisco-AVPair = "ip:traffic-class=in default drop"
    Cisco-AVPair = "ip:traffic-class=out access-group name GAMING_OUT_ACL"
    Cisco-AVPair = "ip:traffic-class=out default drop"
! The "I" in the attribute tells the Cisco SESM that the name of this service is
! "IGAMING_SERVICE".
    Cisco-SSG-Service-Info = IGAMING_SERVICE
! The R attribute is required in service profiles for compatibility with SSG,
! to define subscriber services that will be displayed in the SESM web page.
Cisco-SSG-Service-Info = R10.43.1.0;255.255.255.0
```

The following service profile enables the OPENGARDEN_SERVICE service. The term *Open garden* is from an SSG feature that provides default service and basic Internet access.

```
[ //localhost/Radius/UserLists/SERVICES/OPENGARDEN_SERVICE/Attributes ]
    Cisco-AVPair = "ip:traffic-class=in access-group name OPENGARDEN_IN_ACL"
    Cisco-AVPair = "ip:traffic-class=in default drop"
    Cisco-AVPair = "ip:traffic-class=out access-group name OPENGARDEN_OUT_ACL"
    Cisco-AVPair = "ip:traffic-class=out default drop"
    Cisco-SSG-Service-Info = IOPENGARDEN_SERVICE
```

The following service profile enables the VOIP_SERVICE service:

```
[ //localhost/Radius/UserLists/SERVICES/VOIP_SERVICE/Attributes ]
    Cisco-AVPair = "ip:traffic-class=in access-group name VOIP_IN_ACL"
    Cisco-AVPair = "ip:traffic-class=in default drop"
    Cisco-AVPair = "ip:traffic-class=out access-group name VOIP_OUT_ACL"
    Cisco-AVPair = "ip:traffic-class=out default drop"
    Cisco-SSG-Service-Info = IVOIP_SERVICE
    Cisco-SSG-Service-Info = R10.43.1.0;255.255.255.0
```

The following service profile enables the VOD_SERVICE service:

```
[ //localhost/Radius/UserLists/SERVICES/VOD_SERVICE/Attributes ]
    Cisco-AVPair = "ip:traffic-class=in access-group name VOD_IN_ACL"
    Cisco-AVPair = "ip:traffic-class=in default drop"
    Cisco-AVPair = "ip:traffic-class=out access-group name VOD_OUT_ACL"
    Cisco-AVPair = "ip:traffic-class=out default drop"
    Cisco-SSG-Service-Info = IVOD_SERVICE
    Cisco-SSG-Service-Info = R10.43.1.0;255.255.255.0
```

The following service profile enables the INTERNET_SERVICE service. Subscribers select this service to return to the default service, basic Internet access.

```
[ //localhost/Radius/UserLists/SERVICES/INTERNET_SERVICE/Attributes ]
    Cisco-AVPair = ip:inacl=Internet-in-acl
    Cisco-AVPair = ip:outacl=Internet-out-acl
    Cisco-SSG-Service-Info = IINTERNET_SERVICE
    Cisco-SSG-Service-Info = R10.43.1.0;255.255.255.0
```

Configuring User Profiles

The following user profile is for IP sessions that use MAC address-based TAL:

```
[ //localhost/Radius/UserLists/ie2-C7206-ATM/0000.1001.1014/Attributes ]
    Cisco-SSG-Account-Info = AOPENGARDEN_SERVICE
    Cisco-SSG-Account-Info = AVOIP_SERVICE
    Cisco-SSG-Account-Info = AVOD_SERVICE
    Cisco-SSG-Account-Info = AGAMING_SERVICE
```

The following user profile is for PPPoE users:

```
[ //localhost/Radius/UserLists/ie2-C7206-ATM/C72_DM3_1188/Attributes ]
    Cisco-AVpair = ip:vrf-id=VPN_C72_DM3_2038
    Cisco-AVpair = "ip:ip-unnumbered=loopback 2001"
    Cisco-AVpair = ip:addr-pool=C72_DM3_2001
    Cisco-SSG-Account-Info = AINTERNET_SERVICE
```

Configuring the CPE Bridge in Network Model 3

The following configuration establishes basic connectivity across the network and enables the user to establish basic Layer 3 VPN access:

```
no aaa new-model
ip subnet-zero
no ip domain lookup
!
!
ip audit notify log
ip audit po max-events 100
no ftp-server write-enable
!
interface Ethernet0
 no ip address
 bridge-group 1
 hold-queue 100 out
!
interface ATM0
 no ip address
 no atm ilmi-keepalive
 dsl operating-mode auto
!
interface ATM0.5 multipoint
 pvc 5/43
 encapsulation aal5snap
!
bridge-group 1
!
interface FastEthernet1
 no ip address
 duplex auto
 speed auto
!
interface FastEthernet2
 no ip address
```

```
 duplex auto
 speed auto
!
interface FastEthernet3
 no ip address
 duplex auto
 speed auto
!
interface FastEthernet4
 no ip address
 duplex auto
 speed auto
!
ip classless
!
ip http server
no ip http secure-server
!
bridge 1 protocol ieee
```

Configuring the PE in Network Model 3

The following basic configuration is required for all deployment models. The PE is configured to assign subscribers to a VRF and to allow users to access the Cisco SESM.

```
! Configures the VRF to which subscribers are assigned.
ip vrf VPN10003
 rd 100:3
 route-target export 100:3
 route-target import 100:3
!
!
router bgp 100
 no synchronization
 bgp router-id 10.200.1.45
 bgp log-neighbor-changes
 redistribute connected
 redistribute static
 neighbor 10.200.1.41 remote-as 100
 neighbor 10.200.1.41 update-source Loopback0
 no auto-summary
!
!
! Allows VRF routes into the BGP routing table.
 address-family ipv4 vrf VPN10003
 redistribute connected
 redistribute static
 no auto-summary
 no synchronization
 network 10.44.103.0 mask 255.255.255.0
 aggregate-address 10.44.103.0 255.255.255.0 summary-only
 exit-address-family
!
!
! Redistributes a route for subscribers in VRF VPN10003 from the global routing table into
! the VRF routing domain. This route is used for subscribers to access the Cisco SESM.
! This command is only necessary when the PBHK feature is enabled.
ip route vrf VPN10003 10.100.3.34 255.255.255.255 GigabitEthernet3/14 10.100.3.34
```

Model 4 Configuration: Cisco 7200 and 7300 Routers as ISG LNS with Service Bundle

Network model 4 uses the Cisco 7206 or 7301 routers as ISGs, ATM as the aggregation technology, and L2TP tunnels to securely deliver traffic across the Internet.

The model 4 network involves two ISPs:

- ISP-1 offers wholesale service to other ISPs.
- ISP-2 contracts with ISP-1 to receive wholesale service, which it then offers to retail customers.

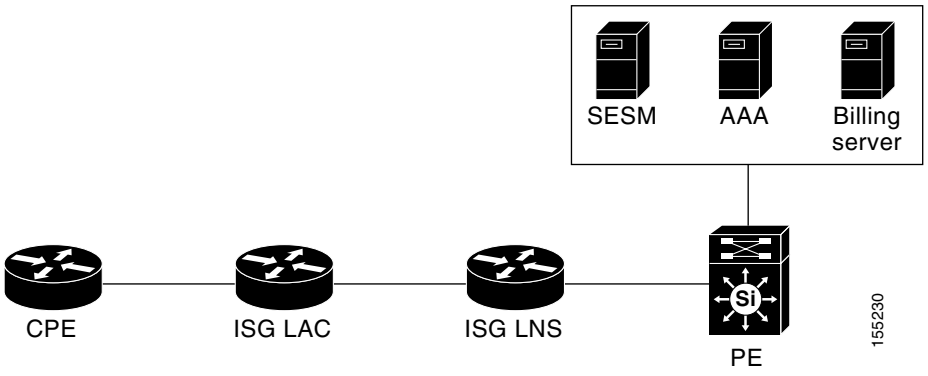
For this scenario, the subscriber's PC connects to the CPE, which initiates a PPPoE session to the LAC (maintained by ISP-1) across either an ATM or a DSL network. The LAC then establishes an L2TP tunnel with the ISG LNS (maintained by ISP-2) and forwards the PPPoE session to the LNS. The LNS assigns the subscriber a VRF and assigns the subscriber the default service, which is a capped bandwidth of 256 kbps. The following advanced ISG software services are then available to the subscriber:

- BOD1MVOLUME—1 Mbps downstream, 256 kbps upstream
- BOD2MVOLUME—2 Mpbs downstream, 512 kbps upstream

For volume-based service, subscribers are billed according to the amount of bandwidth they use.

Figure 25 shows the basic devices that are configured for this deployment.

Figure 25 Basic Device Topology for Network Model 4



The following tasks are performed to deploy model 4. The configurations establish basic connectivity across the network and enables the subscriber to establish basic Layer 3 VPN access.

- Configuring the ISG as LNS in Network Model 4, page 59
- Configuring the ISG as LAC in Network Model 4, page 62
- Configuring User Profiles for ISP-1, page 64
- Configuring User Profiles for ISP-2, page 65
- Configuring Service Profiles for Network Model 4, page 68
- Configuring the CPE in Network Model 4, page 70
- Configuring the PE in Network Model 4, page 72

Configuring the ISG as LNS in Network Model 4

The following baseline configuration tasks are performed on the ISG LNS:

Configuring AAA and the Connection to the RADIUS Server

In the following AAA configuration, connections to the AAA server, the Cisco SESM, and two billing servers are configured. VSA accounting and authentication are enabled, and the loopback interface 0 is used for AAA communications.

```
aaa new-model
!
! Configures the AAA server group for the CAR AAA server.
aaa group server radius CAR_SERVER
 server 10.100.2.36 auth-port 1812 acct-port 1813
!
! Configures the AAA server group for the BILLING_SERVER billing server.
aaa group server radius BILLING_SERVER
 server 10.100.6.88 auth-port 1645 acct-port 1646
!

! Configures AAA for the CAR AAA server.
aaa authentication login default none
aaa authentication login IP_AUTHEN_LIST group CAR_SERVER
aaa authentication ppp default group CAR_SERVER
! The following commands configure authentication, authorization, and accounting for the
! CAR AAA server and the two billing servers.
aaa authentication ppp PREPAID_AUTHEN_LIST group BILLING_SERVER
aaa authorization network default group CAR_SERVER
aaa authorization network PREPAID_AUTHOR_LIST group BILLING_SERVER
aaa authorization subscriber-service default local group radius
aaa accounting network default start-stop group CAR_SERVER
aaa accounting network PREPAID_ACCNT_LIST start-stop group BILLING_SERVER
! Configures the connection to the Cisco SESM
aaa server radius sesm
 client 10.100.4.38
 key cisco
 port 1812
 message-authenticator ignore
!

! Loopback 0 is used for communicating with AAA, the billing servers, and SESM.
interface Loopback0
 ip address 10.200.1.55 255.255.255.255
 ip router isis Remote_ISP

! Instructs the router to use loopback 0 to communicate with the AAA RADIUS servers.
ip radius source-interface Loopback0
!
! These RADIUS attributes are required for prepaid services.
radius-server attribute 44 include-in-access-req
radius-server attribute 8 include-in-access-req
radius-server attribute 55 include-in-acct-req
radius-server attribute 55 access-request include
```

```
radius-server attribute 25 access-request include
! The CAR AAA server.
radius-server host 10.100.2.36 auth-port 1812 acct-port 1813 key Cisco
! The BILLING_SERVER billing server.
radius-server host 10.100.6.88 auth-port 1645 acct-port 1646 key Cisco
```

Configuring PPPoE and the Connection to the LAC

In the following configuration, a virtual private dialup network (VPDN) is configured to receive L2TP tunnels from the LAC over which the PPPoE sessions are sent. A DHCP pool and MPLS VRF tables are created for incoming subscribers.

Note To prevent revealing actual network addresses, the following configurations use IP addresses made up of letters instead of numbers.

```
no ip dhcp use vrf connected
!
! Globally enables MPLS VRFs for incoming subscribers.
ip vrf VPN11006
 rd 200:6
 route-target export 200:6
 route-target import 200:6
!
!
ip cef
!
vpdn enable
vpdn ip udp ignore checksum
!
! VPDN group 1 terminates PPPoE clients that come in from the LAC over L2TP tunnels.
vpdn-group 1
 accept-dialin
  protocol l2tp
  virtual-template 5
 terminate-from hostname sp_lac
 local name sp_lns
 l2tp tunnel password 0 lab
!
!
interface Loopback1
 ip vrf forwarding VPN11006
 ip address 100.6.6.6 255.255.255.255
!

! Gigabit Ethernet interface 0/3 points to the ISG LNS.
interface GigabitEthernet0/3
 ip address XL.22.1.55 255.255.255.0
! The PBHK feature is enabled on this interface.
 ip portbundle outside
 ip flow ingress
 ip router isis Remote_ISP
 load-interval 30
 duplex full
 speed 1000
 media-type gbic
 negotiation auto
 mpls mtu 1522
 mpls label protocol ldp
 mpls ip
```

```
 no keepalive
!

! PPPoE subscribers terminated from L2TP tunnels use this virtual template.
interface Virtual-Template5
 no ip address
 load-interval 30
 no peer default ip address
 no keepalive
 ppp mtu adaptive
 ppp authentication chap
! Applies this policy map to PPPoE subscribers.
 service-policy type control RULE_PPP_VOLUME_LM_ATM5
!
! The DHCP pool that is assigned to subscribers.
ip local pool cpe6_pool-53 192.168.6.2 192.168.6.254
!
```

Configuring Baseline ISG Subscriber Services

Basic ISG subscriber services are configured, including Layer 4 redirect to the Cisco SESM and the PBHK feature. When the PBHK feature is enabled, TCP packets from subscribers are mapped to a local IP address for the ISG gateway and a range of ports. This mapping allows the portal to identify the ISG gateway from which the session originated. Also, the default service, BOD256K_CLASS is configured, limiting subscribers' bandwidth to 256 kbps.

```
! Configures the connection to the Cisco SESM for Layer 4 Redirect functionality.
redirect server-group SESM-Server
 server ip 10.100.4.38 port 8080
!
!
! Creates the class map BOD256K_CLASS, which is the default service applied to all
! subscribers.
class-map type control match-any BOD256K_CLASS
 match service-name BOD256K
!
 class type control BOD256K_CLASS event service-start
  1 service-policy type service identifier service-name
!

! Applies PBHK to all subscribers so they can access the Cisco SESM.
 class type control always event session-start
  1 service local
  2 service-policy type service name PBHK_SERVICE
!
! If both the quota from the billing server and idle time equal zero, the connection is
! dropped.
 class type control always event quota-depleted
  1 set-param drop-traffic FALSE
!
! If the quota from the billing server equals zero, but the idle time is greater than
! zero, Layer 4 redirect is activated.
 class type control always event credit-exhausted
  1 service-policy type service name L4REDIRECT_SERVICE
!

! Enables port bundle host key (PBHK) access to the Cisco SESM.
ip portbundle
 match access-list 110
! The Loopback 0 interface is used to communicate with the Cisco SESM.
 source Loopback0
```

Configuring Inbound and Outbound Access Lists

Basic access lists are configured to govern subscribers' Internet access, and an access list is created for the PBHK feature.

Note To prevent revealing actual network addresses, the following configurations use IP addresses made up of letters instead of numbers.

```
! This access list is referenced in the AAA subscriber profile. It governs incoming
! Internet traffic.
ip access-list extended Internet-in-acl
 deny   ip any 2XZ.0.0.0 0.255.255.255
 deny   ip any XJ.0.0.0 0.255.255.255
 deny   ip any XH.0.0.0 0.255.255.255
 deny   ip any XK.0.0.0 0.255.255.255
 deny   ip any XL.0.0.0 0.255.255.255
 deny   ip any XM.0.0.0 0.255.255.255
 deny   ip any XN.0.0.0 0.255.255.255
 deny   ip any XP.0.0.0 0.255.255.255
 deny   ip any XQ.0.0.0 0.255.255.255
 deny   ip any 10.200.0.0 0.0.255.255
 permit ip any any
! This access list is called out in the AAA subscriber profile. It governs outgoing
! Internet traffic.
ip access-list extended Internet-out-acl
 deny   ip 2XZ.0.0.0 0.255.255.255 any
 deny   ip 10.200.0.0 0.0.255.255 any
 deny   ip XJ.0.0.0 0.255.255.255 any
 deny   ip XH.0.0.0 0.255.255.255 any
 deny   ip XK.0.0.0 0.255.255.255 any
 deny   ip XL.0.0.0 0.255.255.255 any
 deny   ip XM.0.0.0 0.255.255.255 any
 deny   ip XN.0.0.0 0.255.255.255 any
 deny   ip XP.0.0.0 0.255.255.255 any
 deny   ip XQ.0.0.0 0.255.255.255 any
 permit ip any any
!
access-list 101 permit ip any any
! This access list is used in the ip portbundle configuration above.
access-list 110 permit ip any any
access-list 111 deny   tcp any host 10.100.4.38 eq www
access-list 111 deny   tcp any host 10.100.4.38 eq 8080
access-list 111 permit tcp any any eq www
```

Configuring the ISG as LAC in Network Model 4

The following baseline configuration tasks are performed on the LAC:

- Configuring AAA and the Connection to the RADIUS Server, page 62
- Configuring the Connection to the ISG LNS and PPPoE, page 63

Configuring AAA and the Connection to the RADIUS Server

A basic AAA configuration is entered, and the connection to the RADIUS server is configured, including VSA accounting and authentication.

```
aaa new-model
!
aaa authentication login default none
! setup RADIUS server for authentication
aaa authentication ppp default group radius local
aaa authorization network default group radius local
aaa accounting network default start-stop group radius
!
!
aaa session-id common
!
interface Loopback0
 ip address 10.200.1.49 255.255.255.255
!

! Use Loopback 0 to communicate with radius server
ip radius source-interface Loopback0
!
!
radius-server host 10.100.1.35 auth-port 1812 acct-port 1813 key Cisco
radius-server vsa send accounting
radius-server vsa send authentication
```

Configuring the Connection to the ISG LNS and PPPoE

The connection to the ISG LNS is configured. The LAC uses VPDN to initiate L2TP tunnels to the ISG LNS, which are used to carry the subscriber PPPoE sessions. An ISG software control policy map is used to instruct L2TP to authenticate on the basis of the domain name, and a BBA group is used to configure PPPoE.

```
no ip dhcp use vrf connected
!

subscriber policy recording rules limit 64
subscriber access pppoe pre-authorize nas-port-id default
subscriber authorization enable

! Enables VPDN globally, which is used for PPPoE.
vpdn enable
vpdn ip udp ignore checksum
vpdn search-order domain
!
no mpls traffic-eng auto-bw timers frequency 0
call rsvp-sync
!
!
!
! This control policy map instructs L2TP to authenticate based on domain name.
policy-map type control RULE_L2TP_LM_ATM5
 class type control always event session-start
  1 collect identifier unauthenticated-domain
  2 authorize identifier unauthenticated-domain
!
!
! The BBA group method is used to configure PPPoE (alternatively, the vpdn-group
! method could be used).
bba-group pppoe BBA_LM_ATM5
 virtual-template 5
 sessions auto cleanup
!
! This virtual circuit (VC) class is applied to the ATM PVC.
```

```
vc-class atm VC_LM_ATM5
! Associates the VC class with the above bba-group.
  protocol pppoe group BBA_LM_ATM5
! Enables dynamic bandwidth selection.
  dbs enable maximum
  encapsulation aal5snap
! Applies the L2TP rule above to the VC class.
  service-policy type control RULE_L2TP_LM_ATM5
!
! Interface Gigabit Ethernet 0/3 points to the LNS.
interface GigabitEthernet0/3
 ip address 172.31.1.49 255.255.255.0
! The port bundle host key (PBHK) feature is enabled on the interface.
 ip portbundle outside
 ip flow ingress
 load-interval 30
 duplex full
 speed 1000
 media-type gbic
 negotiation auto
!
!
interface ATM2/0.101 point-to-point
 ip flow ingress
 no atm enable-ilmi-trap
 pvc 106/46
! The VC class is associated with the PVC.
  class-vc VC_LM_ATM5
! This can be changed to restrict PPPoE sessions on the PVC.
  pppoe max-sessions 1
!
!
! The PPP CHAP configuration is entered on the virtual template.
interface Virtual-Template5
 no ip address
 no peer default ip address
 no keepalive
 ppp authentication chap
 ppp timeout aaa
```

Configuring User Profiles for ISP-1

The following baseline configuration tasks are performed on the AAA server for ISP-1:

- Configuring the Connection to the LAC, page 64
- Configuring L2TP Forwarding from the LAC to the ISG LNS, page 65

Configuring the Connection to the LAC

This profile allows the LAC router access to the AAA CAR server. The IP address 10.200.1.49 is the address of the loopback interface on the LAC.

```
--> cd ie2-c7206-ge

[ //localhost/Radius/Clients/ie2-C7206-GE ]
    Name = ie2-C7206-GE
    Description =
    IPAddress = 10.200.1.49
    SharedSecret = cisco
    Type = NAS
```

```
    Vendor =
    IncomingScript~ =
    OutgoingScript~ =
    EnablePOD = FALSE
```

Configuring L2TP Forwarding from the LAC to the ISG LNS

This profile and the corresponding attributes instruct the LAC to establish an L2TP tunnel to the ISG LNS, based on the "@isp.com" portion of the username. The IP address 10.200.1.55 is the address of the loopback interface on the ISG LNS.

```
--> cd isp.com

[ //localhost/Radius/UserLists/SESMServices/isp.com ]
    Name = isp.com
    Description =
    Password = <encrypted>
    Enabled = TRUE
    Group~ =
    BaseProfile~ =
    AuthenticationScript~ =
    AuthorizationScript~ =
    UserDefined1 =
    AllowNullPassword = FALSE
    Attributes/
    CheckItems/

--> ls attributes/

[ Attributes ]
    Cisco-AVpair = vpdn:tunnel-id=sp_lac
    Cisco-AVpair = vpdn:l2tp-tunnel-password=lab
    Cisco-AVpair = vpdn:tunnel-type=l2tp
    Cisco-AVpair = vpdn:ip-addresses=10.200.1.55
    Cisco-AVpair = atm:peak-cell-rate=3000
    Cisco-AVpair = atm:sustainable-cell-rate=3000
    idle-timeout = 86400
```

Configuring User Profiles for ISP-2

The following baseline configuration tasks are performed on the AAA server for ISP-2:

- Configuring the Connection to the ISG LNS, page 65
- Configuring the Connection to the Cisco SESM, page 66
- Configuring User Profiles, page 66
- Configuring Layer 4 Redirect, page 67
- Configuring PBHK, page 67
- Configuring the Subscriber's Default PPP Profile, page 67

Configuring the Connection to the ISG LNS

This profile allows the ISG LNS to have access to the AAA CAR server.

```
--> cd ie2-c7206-lns

[ //localhost/Radius/Clients/ie2-C7206-LNS ]
```

```
    Name = ie2-C7206-LNS
    Description =
    IPAddress = 10.200.1.55
    SharedSecret = cisco
    Type = NAS
    Vendor =
    IncomingScript~ =
    OutgoingScript~ =
    EnablePOD = FALSE
```

Configuring the Connection to the Cisco SESM

This profile connects the AAA CAR server to the Cisco SESM.

```
--> cd ie2-sesm-1b

[ //localhost/Radius/Clients/ie2-SESM-1b ]
    Name = ie2-SESM-1b
    Description =
    IPAddress = 10.100.4.38
    SharedSecret = cisco
    Type = NAS
    Vendor =
    IncomingScript~ =
    OutgoingScript~ =
    EnablePOD = FALSE
```

Configuring User Profiles

This profile and the following attributes specify the ISG subscriber services that are allowed:

```
--> cd cpe6_1@isp.com

[ //localhost/Radius/UserLists/SESMSubscribers/cpe6_1@isp.com ]
! Specifies the username that the CPE uses.
    Name = cpe6_1@isp.com
    Description =
! This password must match the one configured on the CPE.
    Password = <encrypted>
    Enabled = TRUE
    Group~ =
! Specifies the name of the PPP profile.
    BaseProfile~ = Default-PPP-Users
    AuthenticationScript~ =
    AuthorizationScript~ =
    UserDefined1 =
    AllowNullPassword = FALSE
    Attributes/
    CheckItems/

--> ls attributes/

[ Attributes ]
! Assigns subscribers to vrf VPN11006.
    Cisco-AVpair = "lcp:interface-config=ip vrf forwarding VPN11006"
    Cisco-AVpair = "lcp:interface-config=ip unnumbered loopback 1"
! Assigns an address to this DHCP pool on the LNS.
    Cisco-AVpair = ip:addr-pool=cpe6_pool-53
! The A in front of BOD256K designates autologin, which means that the default service
! is BOD256k.
    Cisco-SSG-Account-Info = ABOD256K
```

```
    Cisco-SSG-Account-Info = NBOD256K
! Specifies the other services that the subscriber is allowed to access.
    Cisco-SSG-Account-Info = NBOD1MVOLUME
    Cisco-SSG-Account-Info = NBOD2MVOLUME
! Specifies the total session timeout value (optional).
    Session-Timeout = 86400
```

This profile and the following attributes configure the default service, BOD256K:

```
--> cd bod256k

[ //localhost/Radius/UserLists/SESMServices/BOD256K ]
! This service is not a prepaid service because there is no "prepaid-config" line.
    Name = BOD256K

[ Attributes ]
    Cisco-AVPair = "ip:traffic-class=in access-group name  Internet-in-acl"
    Cisco-AVPair = "ip:traffic-class=in default drop"
    Cisco-AVPair = "ip:traffic-class=out access-group name Internet-out-acl"
    Cisco-AVPair = "ip:traffic-class=out default drop"
    Cisco-SSG-Service-Info = IBOD256K
    Cisco-SSG-Service-Info = QU;128000;8000;8000;D;256000;16000;16000
    Cisco-SSG-Service-Info = R10.43.1.0;255.255.255.0
```

Configuring Layer 4 Redirect

This attribute enables the Layer 4 Redirect feature.

```
[ Attributes ]
! Instructs Layer 4 redirect to send traffic to ACL 111 on the ISG LNS.
    Cisco-AVPair = "ip:l4redirect=redirect list 111 to group SESM-Server duration 30
frequency 180"
```

Configuring PBHK

This profile and the following attribute enable access to the SESM using the PBHK feature:

```
--> cd pbhk_service

[ //localhost/Radius/UserLists/SESMServices/PBHK_SERVICE ]
    Name = PBHK_SERVICE

[ Attributes ]
    Cisco-AVPair = ip:portbundle=enable
```

Configuring the Subscriber's Default PPP Profile

This profile and the following attributes configure the PPP profile that is used in the subscriber's base profile:

```
--> cd default-ppP-users/

[ //localhost/Radius/Profiles/default-PPP-users ]
    Name = default-PPP-users
    Description =
    Attributes/

--> ls attributes/

[ Attributes ]
    Ascend-Idle-Limit = 1800
```

```
    Framed-MTU = 1500
    Framed-Protocol = PPP
    Framed-Routing = None
! Configures the length of the idle timeout on PPP sessions, after which the session is
! dropped.
    Idle-timeout = 180
    Service-Type = Framed
```

Configuring Service Profiles for Network Model 4

The following tasks are performed to enable the advanced ISG subscriber services:

- ISG Subscriber Services Configuration, page 68
- AAA Server Service Configuration for ISP-2, page 69

ISG Subscriber Services Configuration

The following configuration tasks are performed on the ISG LNS to enable the advanced ISG subscriber services:

- Configuring the Global Prepaid Services Configuration, page 68
- Configuring Control Class Maps for Model 4, page 68
- Configuring Control Policy for Model 4, page 69

Configuring the Global Prepaid Services Configuration

The global attributes of the prepaid services are configured for each of the two billing servers.

```
! This is the global configuration for the PREPAID_CONFIG prepaid billing server.
subscriber feature prepaid PREPAID_CONFIG
   threshold time 10 seconds
   threshold volume 1000 bytes
   interim-interval 3 minutes
! References the authorization list in the above AAA configuration.
   method-list author PREPAID_AUTHOR_LIST
! References the accounting list in the above AAA configuration.
   method-list accounting PREPAID_ACCNT_LIST
! This is the prepaid password that is configured on the billing servers.
   password prepaidcisco

!
subscriber policy recording rules limit 64
```

Configuring Control Class Maps for Model 4

Following are configurations for the control class maps:

```
class-map type control match-any BOD256K_CLASS
match service-name BOD256K
!
class-map type control match-all BOD2MVOLUME_CLASS
 match service-name BOD2MVOLUME
!
class-map type control match-all BOD1MVOLUME_CLASS
 match service-name BOD1MVOLUME
!
```

Configuring Control Policy for Model 4

Following are configurations for the control policies:

```
policy-map type control RULE_PPP_VOLUME_LM_ATM5
 class type control BOD256K_CLASS event service-start
  1 service-policy type service unapply name BOD1MVOLUME
  2 service-policy type service unapply name BOD2MVOLUME
  3 service-policy type service identifier service-name
!
 class type control BOD1MVOLUME_CLASS event service-start
  1 service-policy type service unapply name BOD256K
  2 service-policy type service unapply name BOD2MVOLUME_LM5
  3 service-policy type service identifier service-name
 !
 class type control BOD2MVOLUME_CLASS event service-start
  1 service-policy type service unapply name BOD256K
  2 service-policy type service unapply name BOD1MVOLUME_LM5
  3 service-policy type service identifier service-name
 !
 class type control BOD2MVOLUME_CLASS event service-stop
  1 service-policy type service unapply identifier service-name
  2 service-policy type service name BOD256K
 !
 class type control BOD1MVOLUME_CLASS event service-stop
  1 service-policy type service unapply identifier service-name
  2 service-policy type service name BOD256K
 !
 class type control always event session-start
  1 service-policy type service name PBHK_SERVICE
  2 service-policy type service name L4REDIRECT_SERVICE
 !
 class type control always event quota-depleted
  1 set-param drop-traffic FALSE
 !
 class type control always event credit-exhausted
  1 service-policy type service name L4REDIRECT_SERVICE
 !
```

AAA Server Service Configuration for ISP-2

The following configuration tasks are performed on the AAA server for ISP-2 to enable the advanced ISG subscriber services:

- Configuring the BOD1MVOLUME Service, page 69
- Configuring the BOD2MVOLUME Service, page 70
- Configuring Layer 4 Redirect upon Depletion of Quotas Run, page 70

Configuring the BOD1MVOLUME Service

The following profile and attributes configure the BOD1MVOLUME service:

```
--> cd bod1mvolUME/

[ //localhost/Radius/UserLists/SESMServices/BOD1MVOLUME ]
    Name = BOD1MVOLUME

[ Attributes ]
    Cisco-AVPair = "ip:traffic-class=in access-group name  Internet-in-acl"
    Cisco-AVPair = "ip:traffic-class=in default drop"
    Cisco-AVPair = "ip:traffic-class=out access-group name Internet-out-acl"
```

```
    Cisco-AVPair = "ip:traffic-class=out default drop"
    Cisco-AVPair = prepaid-config=PREPAID_CONFIG
    Cisco-SSG-Service-Info = IBOD1MVOLUME
    Cisco-SSG-Service-Info = QU;256000;16000;16000;D;1000000;64000;64000
    Cisco-SSG-Service-Info = R10.43.1.0;255.255.255.0
```

Configuring the BOD2MVOLUME Service

The following profile and attributes configure the BOD2MVOLUME service:

```
    Name = BOD2MVOLUME

[ Attributes ]
    Cisco-AVPair = "ip:traffic-class=in access-group name  Internet-in-acl"
    Cisco-AVPair = "ip:traffic-class=in default drop"
    Cisco-AVPair = "ip:traffic-class=out access-group name Internet-out-acl"
    Cisco-AVPair = "ip:traffic-class=out default drop"
    Cisco-AVPair = prepaid-config=PREPAID_CONFIG
    Cisco-SSG-Service-Info = IBOD2MVOLUME
    Cisco-SSG-Service-Info = QU;512000;32000;32000;D;2000000;128000;128000
    Cisco-SSG-Service-Info = R10.43.1.0;255.255.255.0
```

Configuring Layer 4 Redirect upon Depletion of Quotas Run

The following profile enables Layer 4 redirect when the subscriber's quota or funds from the billing server are exhausted:

```
[ //localhost/Radius/UserLists/SESMServices/L4REDIRECT_SERVICE ]
    Name = L4REDIRECT_SERVICE

[ Attributes ]
    Cisco-AVPair = "ip:traffic-class=in access-group name IP_REDIRECT_ACL priority 5"
    Cisco-AVPair = "ip:traffic-class=in default drop"
    Cisco-AVPair = "ip:traffic-class=out access-group name IP_REDIRECT_ACL priority 5"
    Cisco-AVPair = "ip:traffic-class=out default drop"
    Cisco-AVPair = "ip:l4redirect=redirect to group SESM_SERVER_GROUP"
    Cisco-SSG-Service-Info = IL4REDIRECT_SERVICE
```

Configuring the CPE in Network Model 4

The following baseline configuration tasks are performed on the CPE:

- Configuring the Ethernet Interface and DHCP, page 70
- Configuring the Outbound Interface, page 71
- Configuring the Dialer Interface and NAT, page 71

Configuring the Ethernet Interface and DHCP

In the following configuration, interface Ethernet 0 is configured to connect to the subscriber PC, and DHCP is enabled for incoming sessions:

```
interface Ethernet0
 ip address 10.10.10.1 255.255.255.0
 ip nat inside
 load-interval 30
 no cdp enable
 hold-queue 100 out
```

```
!

ip dhcp excluded-address 10.10.10.1
!
! DHCP configuration for interface Ethernet 0 subscribers
ip dhcp pool CLIENT
   import all
   network 10.10.10.0 255.255.255.0
   default-router 10.10.10.1
   lease 0 2
```

Configuring the Outbound Interface

In the following configuration, ATM interface 0.6 is configured as a PVC. This is the outbound interface from the CPE to the DSLAM.

```
interface ATM0.6 point-to-point
! This is the PVC which is going to the ATM DSLAM
  pvc 6/46
  encapsulation aal5snap
! This associates the PVC with dialer 1
  pppoe-client dial-pool-number 1
```

Configuring the Dialer Interface and NAT

In the following configuration, dialer interface 1 is configured to receive incoming connections from the subscriber. CHAP is used for the CPE's username and password, and Network Address Translation (NAT) is enabled for outbound traffic.

```
interface Dialer1
 ip address negotiated
 ip nat outside
! using PPP
 encapsulation ppp
 ip route-cache flow
 dialer pool 1
 no cdp enable
!The username and password are set for CHAP
 ppp chap hostname cpe6_1@isp.com
 ppp chap password 7 060A0E23
!
! Enables subscribers on the inside of E0 to access outside using NAT
ip nat inside source list 1 interface Dialer1 overload
!
ip classless
! set the default gateway out the dialer 1 interface
ip route 0.0.0.0 0.0.0.0 Dialer1

!
! allow E0 subscribers to be NAT translated
access-list 1 permit 10.10.10.0 0.0.0.255
! refers to ACL 1
dialer-list 1 protocol ip permit
no cdp run
```

Configuring the PE in Network Model 4

The PE is configured to assign subscribers to a VRF and to allow subscribers to access the Cisco SESM.

```
! The VRF that subscribers are assigned to.
ip vrf VPN11006
 rd 200:6
 route-target export 200:6
 route-target import 200:6
!
!
router bgp 200
 no synchronization
 bgp router-id 10.200.1.43
 bgp log-neighbor-changes
 network 10.100.2.0 mask 255.255.255.0
 network 10.200.1.43 mask 255.255.255.255
 network 10.31.1.0 mask 255.255.255.0
 network 10.83.1.0 mask 255.255.255.0
 network 10.85.1.0 mask 255.255.255.0
 network 10.86.1.0 mask 255.255.255.0
 network 10.87.1.0 mask 255.255.255.0
 network 10.88.1.0 mask 255.255.255.0
 neighbor 10.200.1.47 remote-as 200
 neighbor 10.200.1.47 ebgp-multihop 10
 neighbor 10.200.1.47 update-source Loopback0
 no auto-summary
!
! Enables BGP VPNv4 neighbors
 address-family vpnv4
 neighbor 10.200.1.47 activate
 neighbor 10.200.1.47 send-community extended
 exit-address-family
!
!
! Allows VRF routes into the BGP routing table.
 address-family ipv4 vrf VPN11006
 redistribute connected
 redistribute static
 no auto-summary
 no synchronization
 exit-address-family
!
!
! Creates an IP route for subscribers in VRF VPN11006 to access the Cisco SESM.
ip route vrf VPN11006 10.100.4.38 255.255.255.255 Vlan6 10.100.4.38
```

Configuration Verification

The following sections describe how to verify configurations for the model deployments:

The commands described in these sections can be used on Cisco 7200, 7300, and 10000 series routers.

ISG Configuration Information Verification

Use the **show subscriber policy condition** command to show the number of times each policy has been executed.

```
ie2-C7206-ATM# show subscriber policy condition

Class-map                     Action                          Exec Hit Miss Comp
---------                     ------                          ---- --- ---- ----
match-any TAL_STATIC_DM3      match identifier source-ip-addr36131   036131    0
match-any TAL_STATIC_DM3      match identifier source-ip-addr3613128932 719928932
match-all IP_UNAUTH_COND      match identifier timer IP_UNAUT1662416624    0    0
match-all IP_UNAUTH_COND      match identifier authen-status 1662454261119811198
match-any TAL_STATIC_DM4      match identifier source-ip-addr23502   023502    0
match-any TAL_STATIC_DM4      match identifier source-ip-addr2350222902  60022902
match-all BOD2MVOLUME_CLASS_L match identifier service-name B    0   0    0    0
match-all BOD1MVOLUME_CLASS_L match identifier service-name B    0   0    0    0
match-all BOD2MTIME_CLASS_DM2 match identifier service-name B    1   0    1    1
match-all BOD1MTIME_CLASS_DM2 match identifier service-name B4632546325    0    0

Key:
  "Exec" - The number of times this line was executed
  "Hit"  - The number of times this line evaluated to TRUE
  "Miss" - The number of times this line evaluated to FALSE
  "Comp" - The number of times this line completed the execution of its
           condition without a need to continue on to the end
```

Use the **clear subscriber policy conditions** command to clear the statistics of subscriber policy changes.

```
ie2-C7206-ATM# clear subscriber policy conditions
ie2-C7206-ATM#
ie2-C7206-ATM# show subscriber policy conditions

Class-map                     Action                          Exec Hit Miss Comp
---------                     ------                          ---- --- ---- ----
match-any TAL_STATIC_DM3      match identifier source-ip-addr    0   0    0    0
match-any TAL_STATIC_DM3      match identifier source-ip-addr    0   0    0    0
match-all IP_UNAUTH_COND      match identifier timer IP_UNAUT    0   0    0    0
match-all IP_UNAUTH_COND      match identifier authen-status     0   0    0    0
match-any TAL_STATIC_DM4      match identifier source-ip-addr    0   0    0    0
match-any TAL_STATIC_DM4      match identifier source-ip-addr    0   0    0    02
match-all BOD2MVOLUME_CLASS_L match identifier service-name B    0   0    0    0
match-all BOD1MVOLUME_CLASS_L match identifier service-name B    0   0    0    0
match-all BOD2MTIME_CLASS_DM2 match identifier service-name B    1   0    1    1
match-all BOD1MTIME_CLASS_DM2 match identifier service-name B    0   0    0    0

Key:
  "Exec" - The number of times this line was executed
  "Hit"  - The number of times this line evaluated to TRUE
  "Miss" - The number of times this line evaluated to FALSE
  "Comp" - The number of times this line completed the execution of its
           condition without a need to continue on to the end
```

Use the **show subscriber service** command to list details of all of the services configured on the ISG.

```
ie2-C7206-ATM# show subscriber service

  Service "PBHK_SERVICE":
    Version 1:
      SVM ID               : 47000002
      Locked by            : SVM-Feature-Info       [196]
```

```
    Locked by             : SVM-Printer           [1]
    Locked by             : PM-Service            [3626]
    Locked by             : PM-Info               [3626]
    Locked by             : FM-Bind               [3430]
    Profile               : 21E3C738
      Profile name: PBHK_SERVICE, 3628 references
        portbundle          "enable"
        ssg-service-info    "IPBHK_SERVICE"
    Feature               : Portbundle Hostkey
        Feature IDB type      : Sub-if or not required

  Service "GAMING_SERVICE":
    Version 1:
      SVM ID              : 5E000003
      Child ID            : FB000007
      Locked by           : SVM-Feature-Info      [4]
      Locked by           : SVM-Printer           [1]
      Locked by           : PM-Service            [722]
      Locked by           : PM-Info               [722]
      Locked by           : FM-Bind               [718]
      Locked by           : TC-Child              [1]
      Locked by           : Accounting-Feature    [718]
      Profile             : 21E3AE18
        Profile name: GAMING_SERVICE, 1440 references
          idletime            1800 (0x708)
          traffic-class       "in access-group name GAMING_IN_ACL priority 10"
          traffic-class       "in default drop"
          traffic-class       "out access-group name GAMING_OUT_ACL priority 10"
          traffic-class       "out default drop"
          accounting-list     "CAR_ACCNT_LIST"
          ssg-service-info    "IGAMING_SERVICE"
          ssg-service-info    "R10.43.1.0;255.255.255.0"
      Feature             : TC
          Feature IDB type      : Sub-if or not required
          Feature Data          : 28 bytes:
                                : 000000 00 00 FB 00 00 07 00 00  ........
                                : 000008 00 0A 01 00 00 00 21 D2  ......!.
                                : 000010 F4 F8 00 00 00 0A 01 00  ........
                                : 000018 00 00 64 BD              ..d.
```

Note Portbundle Hostkey and Traffic class cannot be configured under the same policy group.

```
Version 1:
        SVM ID              : FB000007
        Parent ID           : 5E000003
        Locked by           : SVM-Printer           [1]
        Locked by           : FM-Bind               [719]
        Locked by           : TC-Parent             [1]
        Feature             : Idle Timeout
          Feature IDB type      : Sub-if or not required
          Feature Data          : 8 bytes:
                                : 000000 00 00 00 1B 77 40 01 01  ....w@..
        Feature             : Accounting
          Feature IDB type      : Sub-if or not required
          Feature Data          : 24 bytes:
                                : 000000 00 00 5E 00 00 03 64 BE  ..^...d.
                                : 000008 03 B0 00 00 00 0F 00 00  ........
                                : 000010 00 01 00 00 00 00 00 00  ........

  Service "VOD_SERVICE":
    Version 1:
      SVM ID              : AB000004
```

```
    Child ID              : 41000008
    Locked by             : SVM-Feature-Info       [4]
    Locked by             : SVM-Printer            [1]
    Locked by             : PM-Service             [720]
    Locked by             : PM-Info                [720]
    Locked by             : FM-Bind                [716]
    Locked by             : TC-Child               [1]
    Locked by             : Accounting-Feature     [716]
    Profile               : 21E3AD58
      Profile name: VOD_SERVICE, 1442 references
        idletime             1800 (0x708)
        traffic-class        "in access-group name VOD_IN_ACL priority 10"
        traffic-class        "in default drop"
        traffic-class        "out access-group name VOD_OUT_ACL priority 10"
        traffic-class        "out default drop"
        accounting-list      "CAR_ACCNT_LIST"
        ssg-service-info     "IVOD_SERVICE"
        ssg-service-info     "R10.43.1.0;255.255.255.0"
    Feature               : TC
        Feature IDB type      : Sub-if or not required
        Feature Data          : 28 bytes:
                              : 000000 00 00 41 00 00 08 00 00  ..a.....
                              : 000008 00 0A 01 00 00 00 53 18  ......s.
                              : 000010 C0 28 00 00 00 0A 01 00  .(......
                              : 000018 00 00 53 19              ..s.
    Version 1:
      SVM ID                : 41000008
      Parent ID             : AB000004
      Locked by             : SVM-Printer            [1]
      Locked by             : FM-Bind                [716]
      Locked by             : TC-Parent              [1]
      Feature               : Idle Timeout
        Feature IDB type      : Sub-if or not required
        Feature Data          : 8 bytes:
                              : 000000 00 00 00 1B 77 40 01 01  ....w@..
      Feature               : Accounting
        Feature IDB type      : Sub-if or not required
        Feature Data          : 24 bytes:
                              : 000000 00 00 AB 00 00 04 52 30  ......r0
                              : 000008 4C B8 00 00 00 0F 00 00  l.......
                              : 000010 00 01 00 00 00 00 00 00  ........
Service "VOIP_SERVICE":
  Version 1:
    SVM ID                : 39000005
    Child ID              : E2000009
    Locked by             : SVM-Feature-Info       [4]
    Locked by             : SVM-Printer            [1]
    Locked by             : PM-Service             [719]
    Locked by             : PM-Info                [719]
    Locked by             : FM-Bind                [715]
    Locked by             : TC-Child               [1]
    Locked by             : Accounting-Feature     [716]
    Profile               : 21E3AD38
      Profile name: VOIP_SERVICE, 1440 references
        idletime             1800 (0x708)
        traffic-class        "in access-group name VOIP_IN_ACL priority 10"
        traffic-class        "in default drop"
        traffic-class        "out access-group name VOIP_OUT_ACL priority 10"
        traffic-class        "out default drop"
        accounting-list      "CAR_ACCNT_LIST"
        ssg-service-info     "IVOIP_SERVICE"
        ssg-service-info     "R10.43.1.0;255.255.255.0"
    Feature               : TC
        Feature IDB type      : Sub-if or not required
```

```
        Feature Data          : 28 bytes:
                              : 000000 00 00 E2 00 00 09 00 00  ........
                              : 000008 00 0A 01 00 00 00 23 2C  ......#,
                              : 000010 33 B0 00 00 00 0A 01 00  3.......
                              : 000018 00 00 52 0C              ..r.
      Version 1:
        SVM ID                : E2000009
        Parent ID             : 39000005
        Locked by             : SVM-Feature-Info       [3]
        Locked by             : SVM-Printer            [1]
        Locked by             : FM-Bind                [716]
        Locked by             : SM-SIP-Apply           [3]
        Locked by             : TC-Parent              [1]
        Feature               : Idle Timeout
          Feature IDB type      : Sub-if or not required
          Feature Data          : 8 bytes:
                                : 000000 00 00 00 1B 77 40 01 01  ....w@..
        Feature               : Accounting
          Feature IDB type      : Sub-if or not required
          Feature Data          : 24 bytes:
                                : 000000 00 00 39 00 00 05 51 12  ..9...q.
                                : 000008 60 F0 00 00 00 0F 00 00  `.......
                                : 000010 00 01 00 00 00 00 00 00  ........

Service "OPENGARDEN_SERVICE":
  Version 1:
    SVM ID                : 77000006
    Child ID              : E300000A
    Locked by             : SVM-Feature-Info       [5]
    Locked by             : SVM-Printer            [1]
    Locked by             : PM-Service             [722]
    Locked by             : PM-Info                [722]
    Locked by             : FM-Bind                [717]
    Locked by             : TC-Child               [1]
    Profile               : 21E3AD18
      Profile name: OPENGARDEN_SERVICE, 1446 references
        traffic-class        "in access-group name OPENGARDEN_IN_ACL"
        traffic-class        "in default drop"
        traffic-class        "out access-group name OPENGARDEN_OUT_ACL"
        traffic-class        "out default drop"
        ssg-service-info     "IOPENGARDEN_SERVICE"
    Feature               : TC
        Feature IDB type      : Sub-if or not required
        Feature Data          : 28 bytes:
                              : 000000 00 00 E3 00 00 0A 00 00  ........
                              : 000008 00 00 01 00 00 00 51 0F  ......q.
                              : 000010 28 C0 00 00 00 00 01 00  (.......
                              : 000018 00 00 51 12              ..q.
    Version 1:
      SVM ID                : E300000A
      Parent ID             : 77000006
      Locked by             : SVM-Feature-Info       [3]
      Locked by             : SVM-Printer            [1]
      Locked by             : FM-Bind                [717]
      Locked by             : SM-SIP-Apply           [3]
      Locked by             : TC-Parent              [1]

Service "L4REDIRECT_SERVICE":
  Version 1:
    SVM ID                : AC000030
    Child ID              : 6D000031
    Locked by             : SVM-Printer            [1]
    Locked by             : PM-Service             [267]
    Locked by             : PM-Info                [2707]
```

```
    Locked by             : FM-Bind               [268]
    Locked by             : TC-Child              [1]
    Profile               : 242C1A08
      Profile name: L4REDIRECT_SERVICE, 5149 references
        traffic-class        "in access-group name IP_REDIRECT_ACL priority 5"
        traffic-class        "in default drop"
        traffic-class        "out access-group name IP_REDIRECT_ACL priority 5"
        traffic-class        "out default drop"
        l4redirect           "redirect to group SESM_SERVER_GROUP"
        ssg-service-info     "IL4REDIRECT_SERVICE"
    Feature               : TC
        Feature IDB type      : Sub-if or not required
        Feature Data          : 28 bytes:
                              : 000000 00 00 6D 00 00 31 00 00  ..m..1..
                              : 000008 00 05 01 00 00 00 53 B8  ......s.
                              : 000010 CF C0 00 00 00 05 01 00  ........
                              : 000018 00 00 24 19              ..$.
    Version 1:
      SVM ID              : 6D000031
      Parent ID           : AC000030
      Locked by           : SVM-Printer           [1]
      Locked by           : FM-Bind               [267]
      Locked by           : TC-Parent             [1]
      Feature             : L4 Redirect
        Feature IDB type      : Sub-if or not required
        Feature Data          : 20 bytes:
                              : 000000 00 00 64 72 B7 F8 64 72  ..dr..dr
                              : 000008 B7 F8 00 00 00 01 00 00  ........
                              : 000010 00 00 00 00              ....

Service "BOD1MTIME_DM2":
  Version 1:
    SVM ID                : 19000053
    Child ID              : 13000054
    Locked by             : SVM-Printer           [1]
    Locked by             : PM-Service            [2440]
    Locked by             : PM-Info               [2440]
    Locked by             : FM-Bind               [2440]
    Locked by             : TC-Child              [1]
    Locked by             : Accounting-Feature    [2440]
    Profile               : 242C1A48
      Profile name: BOD1MTIME_DM2, 4882 references
        traffic-class        "in access-group name INTERNET_IN_ACL priority 10"
        traffic-class        "in default drop"
        traffic-class        "out access-group name INTERNET_OUT_ACL priority 10"
        traffic-class        "out default drop"
        accounting-list      "PREPAID_ACCNT_LIST"
        peak-cell-rate       1024 (0x400)
        sustainable-cell-rat 1024 (0x400)
        ssg-service-info     "IBOD1MTIME_DM2"
        ssg-service-info     "R10.43.1.0;255.255.255.0"
    Feature               : TC
        Feature IDB type      : Sub-if or not required
        Feature Data          : 28 bytes:
                              : 000000 00 00 13 00 00 54 00 00  .....t..
                              : 000008 00 0A 01 00 00 00 56 B7  ......v.
                              : 000010 49 80 00 00 00 0A 01 00  i.......
                              : 000018 00 00 24 62              ..$b
        SIP                   : Info 23E85AB8 access: PPPoE info: PPPoE
    Version 1:
      SVM ID              : 13000054
      Parent ID           : 19000053
      Locked by           : SVM-Printer           [1]
      Locked by           : FM-Bind               [2440]
```

```
      Locked by             : TC-Parent              [1]
      Feature               : Accounting
        Feature IDB type      : Sub-if or not required
        Feature Data          : 24 bytes:
                              : 000000 00 00 19 00 00 53 24 70  .....s$p
                              : 000008 61 68 00 00 00 0F 00 00  ah......
                              : 000010 00 01 00 00 00 00 00 00  ........

  Service "INTERNET_SERVICE":
    Version 1:
      SVM ID                : EE000055
      Locked by             : SVM-Printer            [1]
      Locked by             : PM-Service             [200]
      Locked by             : PM-Info                [200]
      Locked by             : FM-Bind                [200]
      Profile               : 21E3AC78
        Profile name: INTERNET_SERVICE, 402 references
          inacl               "INTERNET_IN_ACL"
          outacl              "INTERNET_OUT_ACL"
          ssg-service-info    "IINTERNET_SERVICE"
          ssg-service-info    "R10.43.1.0;255.255.255.0"
      Feature               : Per-User ACL
          Feature IDB type      : Sub-if or not required
          Feature Data          : 52 bytes:
                                : 000000 00 00 26 0C 07 A6 00 00  ..&.....
                                : 000008 00 00 00 00 00 00 F6 01  ........
                                : 000010 07 B3 00 00 00 00 00 00  ........
                                : 000018 00 00 00 00 00 01 00 00  ........
                                : 000020 00 00 00 00 00 00 00 00  ........
                                : 000028 00 01 00 00 00 00 00 00  ........
                                : 000030 00 00 00 00              ....
```

Use the **show subscriber policy rule** command to show all rules that are configured on the ISG and the number of times they have been executed.

```
ie2-C7206-ATM# show subscriber policy rule

Rule: internal-rule-acct-logon
  Class-map:  always event account-logon
    Action: 1 authenticate aaa list default
    Executed0

Rule: RULE_L2TP_LM_ATM7
  Class-map:  always event session-start
    Action: 1 collect identifier unauthenticated-domain
    Executed0
    Action: 2 authorize identifier unauthenticated-domain
    Executed0

Rule: RULE_L2TP_LM_ATM3
  Class-map:  always event session-start
    Action: 1 collect identifier unauthenticated-domain
    Executed0
    Action: 2 authorize identifier unauthenticated-domain
    Executed0

Rule: RULE_IP_LM_ATM2
  Class-map:  IP_UNAUTH_COND event timed-policy-expiry
    Action: 1 service disconnect
    Executed5388
  Class-map:  TAL_STATIC_DM3 event session-start
    Action: 1 service-policy type service name PBHK_SERVICE
    Executed29007
    Action: 2 authorize identifier source-ip-address
```

```
    Executed28662
    Action: 3 service-policy type service name L4REDIRECT_SERVICE
    Executed5588
    Action: 4 set-timer IP_UNAUTH_TIMER 5
    Executed5588
  Class-map:  always event session-start
    Action: 1 service-policy type service name PBHK_SERVICE
    Executed7199
    Action: 2 authorize identifier mac-address
    Executed6004
    Action: 3 service-policy type service name L4REDIRECT_SERVICE
    Executed5999
    Action: 4 set-timer IP_UNAUTH_TIMER 5
    Executed5999
  Class-map:  always event account-logon
    Action: 1 authenticate aaa list IP_AUTHEN_LIST
    Executed0
    Action: 2 service-policy type service unapply name L4REDIRECT_SERVICE
    Executed0

Rule: RULE_PTA_LM_ATM2
  Class-map:  always event session-start
    Action: 1 service-policy type service name PBHK_SERVICE
    Executed0

Rule: RULE_IP_LM_ATM7
  Class-map:  TAL_STATIC_DM4 event session-start
    Action: 1 service-policy type service name PBHK_SERVICE
    Executed22957
    Action: 2 authorize identifier source-ip-address
    Executed22902
    Action: 3 service-policy type service name L4REDIRECT_SERVICE
    Executed37
    Action: 4 set-timer IP_UNAUTH_TIMER 5
    Executed37
  Class-map:  IP_UNAUTH_COND event timed-policy-expiry
    Action: 1 service disconnect
    Executed38
  Class-map:  always event session-start
    Action: 1 service-policy type service name PBHK_SERVICE
    Executed600
    Action: 2 authorize identifier mac-address
    Executed200
    Action: 3 service-policy type service name L4REDIRECT_SERVICE
    Executed1
    Action: 4 set-timer IP_UNAUTH_TIMER 5
    Executed1
  Class-map:  always event account-logon
    Action: 1 authenticate aaa list IP_AUTHEN_LIST
    Executed0
    Action: 2 service-policy type service unapply name L4REDIRECT_SERVICE
    Executed0

Rule: RULE_PTA_TIME_LM_ATM8
  Class-map:  BOD1MTIME_CLASS_DM2 event service-start
    Action: 1 service-policy type service unapply name L4REDIRECT_SERVICE
    Executed47256
    Action: 2 service-policy type service unapply name BOD2MTIME_DM2
    Executed47256
    Action: 3 service-policy type service identifier service-name
    Executed47256
  Class-map:  BOD2MTIME_CLASS_DM2 event service-start
    Action: 1 service-policy type service unapply name L4REDIRECT_SERVICE
    Executed0
```

```
    Action: 2 service-policy type service unapply name BOD1MTIME_DM2
    Executed0
    Action: 3 service-policy type service identifier service-name
    Executed0
  Class-map:  BOD2MTIME_CLASS_DM2 event service-stop
    Action: 1 service-policy type service unapply identifier service-name
    Executed0
    Action: 2 service-policy type service name L4REDIRECT_SERVICE
    Executed0
  Class-map:  BOD1MTIME_CLASS_DM2 event service-stop
    Action: 1 service-policy type service unapply identifier service-name
    Executed1
    Action: 2 service-policy type service name L4REDIRECT_SERVICE
    Executed1
  Class-map:  always event session-start
    Action: 1 service-policy type service name PBHK_SERVICE
    Executed49636
    Action: 2 service-policy type service name L4REDIRECT_SERVICE
    Executed48636
  Class-map:  always event quota-depleted
    Action: 1 set-param drop-traffic FALSE
    Executed0
  Class-map:  always event credit-exhausted
    Action: 1 service-policy type service name L4REDIRECT_SERVICE
    Executed0
  Class-map:  always event internal-event-cre-t-exp
    Action: 1 service-policy type service unapply name L4REDIRECT_SERVICE
    Executed0

Rule: RULE_PTA_VOLUME_LM_ATM8
  Class-map:  BOD1MVOLUME_CLASS_DM2 event service-start
    Action: 1 service-policy type service unapply name L4REDIRECT_SERVICE
    Executed0
    Action: 2 service-policy type service unapply name BOD2MVOLUME_DM2
    Executed0
    Action: 3 service-policy type service identifier service-name
    Executed0
  Class-map:  BOD2MVOLUME_CLASS_DM2 event service-start
    Action: 1 service-policy type service unapply name L4REDIRECT_SERVICE
    Executed0
    Action: 2 service-policy type service unapply name BOD1MVOLUME_DM2
    Executed0
    Action: 3 service-policy type service identifier service-name
    Executed0
  Class-map:  BOD2MVOLUME_CLASS_DM2 event service-stop
    Action: 1 service-policy type service unapply identifier service-name
    Executed0
    Action: 2 service-policy type service name L4REDIRECT_SERVICE
    Executed0
  Class-map:  BOD1MVOLUME_CLASS_DM2 event service-stop
    Action: 1 service-policy type service unapply identifier service-name
    Executed0
    Action: 2 service-policy type service name L4REDIRECT_SERVICE
    Executed0
  Class-map:  always event session-start
    Action: 1 service-policy type service name PBHK_SERVICE
    Executed0
    Action: 2 service-policy type service name L4REDIRECT_SERVICE
    Executed0
  Class-map:  always event quota-depleted
    Action: 1 set-param drop-traffic FALSE
    Executed0
  Class-map:  always event credit-exhausted
    Action: 1 service-policy type service name L4REDIRECT_SERVICE
```

```
    Executed0
  Class-map:  always event internal-event-cre-t-exp
    Action: 1 service-policy type service unapply name L4REDIRECT_SERVICE
    Executed0

Key:
  "Exec" - The number of times this rule action line was executed
```

Basic ISG Operation Verification

Use the **show subscriber statistics** command to show a summary of the number of active sessions and a brief history of session activity.

```
ie2-C7206-ATM# show subscriber statistics

Current Subscriber Statistics:

Number of sessions currently up: 3227
Number of sessions currently pending: 193
Number of sessions currently authenticated: 3101
Number of sessions currently unauthenticated: 0
Highest number of sessions ever up at one time: 3760
Mean up-time duration of sessions: 00:05:12
Total number of sessions up so far: 105408
Mean call rate per minute: 484, per hour: 35200
Number of sessions failed to come up: 3401
Access type based session count:
PPPoE sessions = 2640
Traffic-Class sessions = 4594
IP sessions = 780
```

Use the **show subscriber session** command to show basic information for all active subscribers.

```
ie2-C7206-LNS# show subscriber session

Current Subscriber Information: Total sessions 3370

Uniq ID Interface  State         Service      Identifier           Up-time
! This is the VID for the subscriber
4910    Vi2.2122   authen        Local Term   C72_DM2_3021         00:03:41
! This is the VID for the subscriber's traffic classes
1748    Traffic-Cl unauthen      Ltm Internal                      00:04:27
10709   Traffic-Cl unauthen      Ltm Internal                      00:04:23
6514    Vi2.78     authen        Local Term   C72_DM2_1078         00:04:55
5650    Traffic-Cl unauthen      Ltm Internal C72_DM2_1446         00:04:46
3771    Traffic-Cl unauthen      Ltm Internal                      00:01:01
2601    Vi2.1558   authen        Local Term   C72_DM2_2097         00:04:12
3508    Traffic-Cl unauthen      Ltm Internal                      00:01:16
9767    Traffic-Cl unauthen      Ltm Internal C72_DM2_1390         00:04:48
```

Use the **show ip route vrf** command to show routing table information for the VPN11006 VRF. In the following output, there is one active subscriber session.

Note To prevent revealing actual network addresses, the following configurations use IP addresses made up of letters instead of numbers.

```
ie2-C7206-LNS# show ip route vrf VPN11006
```

```
Routing Table: VPN11006
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

     XR.0.0.0/24 is subnetted, 1 subnets
B       XR.1.206.0 [200/0] via 10.200.1.43, 4d19h
     1XT.0.0.0/32 is subnetted, 1 subnets
C       1XT.6.6.6 is directly connected, Loopback1
     192.168.6.0/32 is subnetted, 1 subnets
! This shows that the subscriber is connected and part of vrf VPN11006
C       192.168.6.2 is directly connected, Virtual-Access3
     2XW.6.6.0/32 is subnetted, 1 subnets
B       2XW.6.6.6 [200/0] via 10.200.1.56, 4d19h
     10.0.0.0/32 is subnetted, 1 subnets
B       10.100.4.38 [200/0] via 10.200.1.43, 4d19h
```

Subscriber Service Verification

Use the **show subscriber session username** command to show detailed information for the subscriber with the username c72_DM2_1078.

The following output shows a subscriber with the BOD1MTIME_DM2 service:

```
ie2-C7206-ATM# show subscriber session username C72_DM2_1078

Unique Session ID: 6514
Identifier: C72_DM2_1078
SIP subscriber access type(s): PPPoE/PPP
Current SIP options: Req Fwding/Req Fwded
Session Up-time: 00:06:17, Last Changed: 00:06:17
AAA unique ID: 102346
Interface: Virtual-Access2.78

Policy information:
  Context 25559F94: Handle 310104C8
  Authentication status: authen
  Active services associated with session:
! Indicates the services that the subscriber is using.
    name "BOD1MTIME_DM2"
    name "PBHK_SERVICE", applied outwith active session
  Rules, actions and conditions executed:
    subscriber rule-map RULE_PTA_TIME_LM_ATM8
      condition always event session-start
        1 service-policy type service name PBHK_SERVICE
        2 service-policy type service name L4REDIRECT_SERVICE
    subscriber rule-map RULE_PTA_TIME_LM_ATM8
      condition BOD1MTIME_CLASS_DM2 event service-start
        subscriber condition-map match-all BOD1MTIME_CLASS_DM2
          match identifier service-name BOD1MTIME_DM2 [TRUE]
    subscriber rule-map RULE_PTA_TIME_LM_ATM8
      condition BOD1MTIME_CLASS_DM2 event service-start
        1 service-policy type service unapply name L4REDIRECT_SERVICE
        2 service-policy type service unapply name BOD2MTIME_DM2
        3 service-policy type service identifier service-name
```

```
Session inbound features:
 Feature: PPP Idle Timeout
  Timeout value is 1800
  Idle time is 00:06:25
 Feature: Layer 4 Redirect
  Rule table is empty
Traffic classes:
  Traffic class session ID: 3947
   ACL Name: INTERNET_IN_ACL, Packets = 0, Bytes = 0
 Default traffic is dropped
 Unmatched Packets (dropped) = 0, Re-classified packets (redirected) = 0
! Portbound Hostkey information for the subscriber.
 Feature: Portbundle Hostkey
 Portbundle IP = 10.200.1.53     Bundle Number = 1229

Session outbound features:
 Feature: PPP Idle Timeout
  Timeout value is 1800
  Idle time is 00:06:25
Traffic classes:
  Traffic class session ID: 3947
! Identifies the ACL that restricts inbound traffic. The ACL is configured on the ISG,
! and it is applied to the subscriber based on the subscriber profile on the AAA server.
   ACL Name: INTERNET_OUT_ACL, Packets = 0, Bytes = 0
 Default traffic is dropped
 Unmatched Packets (dropped) = 0, Re-classified packets (redirected) = 0

Non-datapath features:
 Feature: Session Timeout
  Timeout value is 18000 seconds
! Indicates the amount of time remaining before the session times out.
  Time remaining is 04:53:33
 Feature: IP Config
  Peer IP Address: 0.0.0.0 (F/F)
  Address Pool: C72_DM2_8003 (F)
  Unnumbered Intf: Lo8001
Configuration sources associated with this session:
! Indicates how long the BOD1MTIME_DM2 service has been active.
Service: BOD1MTIME_DM2, Active Time = 00:06:26
  AAA Service ID = 1441613880
Service: PBHK_SERVICE, Active Time = 00:06:27
Interface: Virtual-Template8, Active Time = 00:06:27
```

Use the **show subscriber session username C72_DM2_1078 detail** to show additional details about the subscriber's session.

```
ie2-C7206-ATM# show subscriber session username C72_DM2_1078 detail

Unique Session ID: 6514
Identifier: C72_DM2_1078
SIP subscriber access type(s): PPPoE/PPP
Current SIP options: Req Fwding/Req Fwded
Session Up-time: 00:06:32, Last Changed: 00:06:32
AAA unique ID: 102346
Interface: Virtual-Access2.78

Policy information:
  Context 25559F94: Handle 310104C8
  Authentication status: authen
  Downloaded User profile, excluding services:
    service-type          2 [Framed]
    Framed-Protocol       1 [PPP]
```

```
    routing              False
    Framed-MTU           1500 (0x5DC)
    timeout              18000 (0x4650)
    idletime             1800 (0x708)
! The A attribute configures auto-login, which indicates that BOD1MTIME_DM2 is the default
! service.
    ssg-account-info     "ABOD1MTIME_DM2"
! The N indicates that the subscriber is allowed access the BOD2MTIME_DM2 service based
! on the subscriber's AAA profile.
    ssg-account-info     "NBOD2MTIME_DM2"
    idletime             1800 (0x708)
    vrf-id               "VPN_C72_DM2_1003"
    ip-unnumbered        "loopback 8001"
    addr-pool            "C72_DM2_8003"
  Downloaded User profile, including services:
    portbundle           "enable"
    service-type         2 [Framed]
    Framed-Protocol      1 [PPP]
    routing              False
    Framed-MTU           1500 (0x5DC)
    timeout              18000 (0x4650)
    idletime             1800 (0x708)
    ssg-account-info     "ABOD1MTIME_DM2"
    ssg-account-info     "NBOD2MTIME_DM2"
    idletime             1800 (0x708)
    vrf-id               "VPN_C72_DM2_1003"
    ip-unnumbered        "loopback 8001"
    addr-pool            "C72_DM2_8003"
    traffic-class        "in access-group name INTERNET_IN_ACL priority 10"
    traffic-class        "in default drop"
    traffic-class        "out access-group name INTERNET_OUT_ACL priority 10"
    traffic-class        "out default drop"
    accounting-list      "PREPAID_ACCNT_LIST"
    peak-cell-rate       1024 (0x400)
    sustainable-cell-rat 1024 (0x400)
    ssg-service-info     "IBOD1MTIME_DM2"
    ssg-service-info     "R10.43.1.0;255.255.255.0"
  Config history for session (recent to oldest):
    Access-type: Web-service-logon Client: SM
     Policy event: Process Config (Service)
      Profile name: BOD1MTIME_DM2, 4882 references
        traffic-class        "in access-group name INTERNET_IN_ACL priority 10"
        traffic-class        "in default drop"
        traffic-class        "out access-group name INTERNET_OUT_ACL priority 10"
        traffic-class        "out default drop"
        accounting-list      "PREPAID_ACCNT_LIST"
        peak-cell-rate       1024 (0x400)
        sustainable-cell-rat 1024 (0x400)
        ssg-service-info     "IBOD1MTIME_DM2"
        ssg-service-info     "R10.43.1.0;255.255.255.0"
    Access-type: Max Client: SM
! Describers the Layer 4 Redirect service, which is not currently applied.
     Policy event: Process Config (Unapplied) (Service)
      Profile name: L4REDIRECT_SERVICE, 5082 references
        traffic-class        "in access-group name IP_REDIRECT_ACL priority 5"
        traffic-class        "in default drop"
        traffic-class        "out access-group name IP_REDIRECT_ACL priority 5"
        traffic-class        "out default drop"
        l4redirect           "redirect to group SESM_SERVER_GROUP"
        ssg-service-info     "IL4REDIRECT_SERVICE"
    Access-type: PPP Client: SM
     Policy event: Process Config
      Profile name: apply-config-only, 28 references
        service-type         2 [Framed]
```

```
        Framed-Protocol      1 [PPP]
        routing              False
        Framed-MTU           1500 (0x5DC)
        timeout              18000 (0x4650)
        idletime             1800 (0x708)
        ssg-account-info     "ABOD1MTIME_DM2"
        ssg-account-info     "NBOD2MTIME_DM2"
        idletime             1800 (0x708)
        vrf-id               "VPN_C72_DM2_1003"
        ip-unnumbered        "loopback 8001"
        addr-pool            "C72_DM2_8003"
    Access-type: PPPoE Client: SM
     Policy event: Service Selection Request (Service)
      Profile name: L4REDIRECT_SERVICE, 5082 references
        traffic-class        "in access-group name IP_REDIRECT_ACL priority 5"
        traffic-class        "in default drop"
        traffic-class        "out access-group name IP_REDIRECT_ACL priority 5"
        traffic-class        "out default drop"
        l4redirect           "redirect to group SESM_SERVER_GROUP"
        ssg-service-info     "IL4REDIRECT_SERVICE"
    Access-type: PPPoE Client: SM
     Policy event: Service Selection Request (Service)
      Profile name: PBHK_SERVICE, 3379 references
        portbundle           "enable"
        ssg-service-info     "IPBHK_SERVICE"
  Active services associated with session:
    name "BOD1MTIME_DM2"
    name "PBHK_SERVICE", applied outwith active session
  Rules, actions and conditions executed:
    subscriber rule-map RULE_PTA_TIME_LM_ATM8
      condition always event session-start
        1 service-policy type service name PBHK_SERVICE
        2 service-policy type service name L4REDIRECT_SERVICE
    subscriber rule-map RULE_PTA_TIME_LM_ATM8
      condition BOD1MTIME_CLASS_DM2 event service-start
        subscriber condition-map match-all BOD1MTIME_CLASS_DM2
! Services that are active are identified as "TRUE."
          match identifier service-name BOD1MTIME_DM2 [TRUE]
    subscriber rule-map RULE_PTA_TIME_LM_ATM8
      condition BOD1MTIME_CLASS_DM2 event service-start
        1 service-policy type service unapply name L4REDIRECT_SERVICE
        2 service-policy type service unapply name BOD2MTIME_DM2
        3 service-policy type service identifier service-name

Session inbound features:
 Feature: PPP Idle Timeout
  Timeout value is 1800
  Idle time is 00:06:35
 Feature: Layer 4 Redirect
  Rule table is empty
Traffic classes:
  Traffic class session ID: 3947
! Identifies the ACL that restricts inbound traffic. The ACL is configured on the ISG LNS,
! and it is applied to the subscriber based on the subscriber profile on the AAA server.
   ACL Name: INTERNET-IN-ACL, Packets = 0, Bytes = 0
 Default traffic is dropped
 Unmatched Packets (dropped) = 0, Re-classified packets (redirected) = 0

 Feature: Portbundle Hostkey
! Identifies the PBHK IP address and the bundle number. This information can be used to
! troubleshoot PBHK with the show ip portbundle command.
 Portbundle IP = 10.200.1.53     Bundle Number = 1229

Session outbound features:
```

```
 Feature: PPP Idle Timeout
  Timeout value is 1800
  Idle time is 00:06:35
Traffic classes:
  Traffic class session ID: 3947
   ACL Name: INTERNET_OUT_ACL, Packets = 0, Bytes = 0
 Default traffic is dropped
 Unmatched Packets (dropped) = 0, Re-classified packets (redirected) = 0

Non-datapath features:
 Feature: Session Timeout
  Timeout value is 18000 seconds
  Time remaining is 04:53:23
 Feature: IP Config
  Peer IP Address: 0.0.0.0 (F/F)
  Address Pool: C72_DM2_8003 (F)
  Unnumbered Intf: Lo8001
Configuration sources associated with this session:
Service: BOD1MTIME_DM2, Active Time = 00:06:35
  AAA Service ID = 1441613880
Service: PBHK_SERVICE, Active Time = 00:06:36
Interface: Virtual-Template8, Active Time = 00:06:36
```

Basic LNS Verification

Use the **show subscriber session** command to show basic information for all active subscribers. In the following output, there is one active subscriber session:

```
ie2-C7206-LNS# show subscriber session

Current Subscriber Information: Total sessions 1

Uniq ID Interface  State         Service      Identifier           Up-time
! This is the VID for the subscriber
520     Vi3        authen        Local Term   cpe6_1@isp.com       00:12:03
! This is the VID for the subscriber's traffic class
521     Traffic-Cl unauthen      Ltm Internal                      00:12:03
```

Use the **show ip route vrf VPN11006** command to show routing table information for the VRF.

Note To prevent revealing actual network addresses, the following configurations use IP addresses made up of letters instead of numbers.

In the following output, there is one active subscriber session:

```
ie2-C7206-LNS# show ip route vrf VPN11006

Routing Table: VPN11006
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

     XR.0.0.0/24 is subnetted, 1 subnets
```

```
B       XR.1.206.0 [200/0] via 10.200.1.43, 4d19h
     1XT.0.0.0/32 is subnetted, 1 subnets
C       1XT.6.6.6 is directly connected, Loopback1
     192.168.6.0/32 is subnetted, 1 subnets
! This shows that the subscriber is connected and part of vrf VPN11006
C       192.168.6.2 is directly connected, Virtual-Access3
     2XW.6.6.0/32 is subnetted, 1 subnets
B       2XW.6.6.6 [200/0] via 10.200.1.56, 4d19h
     10.0.0.0/32 is subnetted, 1 subnets
B       10.100.4.38 [200/0] via 10.200.1.43, 4d19h
ie2-C7206-LNS#
```

Verification of Default BOD256K Service

Use the **show subscriber session uid 520** command to show detailed information for the subscriber with UID 520.

The following output is for a subscriber with the default BOD256K service:

```
ie2-C7206-LNS# show subscriber session uid 520

Unique Session ID: 520
Identifier: cpe6_1@isp.com
SIP subscriber access type(s): VPDN/PPP
Current SIP options: Req Fwding/Req Fwded
Session Up-time: 00:12:10, Last Changed: 00:12:10
AAA unique ID: 472
Interface: Virtual-Access3

Policy information:
  Context 212C1F2C: Handle 41000819
  Authentication status: authen
  User profile, excluding services:
    service-type          2 [Framed]
    Framed-Protocol       1 [PPP]
    routing               False
    Framed-MTU            1500 (0x5DC)
    timeout               86400 (0x15180)
    idletime              180 (0xB4)
! The A attribute configures auto-login, which indicates that BOD256K
! is the default service.
    ssg-account-info      "ABOD256K"
! The N indicates that the subscriber is allowed access to these services based on the
! user's AAA profile.
    ssg-account-info      "NBOD256K"
    ssg-account-info      "NBOD1MTIME"
    ssg-account-info      "NBOD2MTIME"
    ssg-account-info      "NBOD1MVOLUME"
    ssg-account-info      "NBOD2MVOLUME"
    idletime              1800 (0x708)
    interface-config      "ip"
    interface-config      "ip"
    addr-pool             "cpe6_pool-53"
! Indicates the current active services.
  Active services associated with session:
    name "BOD256K"
! PBHK was applied when the session was started, as configured in the policy-map.
    name "PBHK_SERVICE", applied outwith active session
! Because BOD256K is not a prepaid service, prepaid is not active.
  Prepaid context: not present
  Rules, actions and conditions executed:
    subscriber rule-map RULE_PPP_ATM5
      condition always event session-start
```

```
          1 service-policy type service service PBHK_SERVICE
      subscriber rule-map RULE_PPP_ATM5
        condition BOD1MTIME_CLASS event service-start
          subscriber condition-map match-any BOD1MTIME_CLASS
            match identifier service-name BOD1MTIME [FALSE]
      subscriber rule-map RULE_PPP_ATM5
        condition BOD2MTIME_CLASS event service-start
          subscriber condition-map match-any BOD2MTIME_CLASS
            match identifier service-name BOD2MTIME [FALSE]
      subscriber rule-map RULE_PPP_ATM5
        condition BOD256K_CLASS event service-start
          subscriber condition-map match-any BOD256K_CLASS
            match identifier service-name BOD256K [FALSE]
      subscriber rule-map RULE_PPP_ATM5
        condition BOD1MVOLUME_CLASS event service-start
          subscriber condition-map match-any BOD1MVOLUME_CLASS
            match identifier service-name BOD1MVOLUME [FALSE]
      subscriber rule-map RULE_PPP_ATM5
        condition BOD2MVOLUME_CLASS event service-start
          subscriber condition-map match-any BOD2MVOLUME_CLASS
            match identifier service-name BOD2MVOLUME [FALSE]
      subscriber rule-map RULE_PPP_ATM5
        condition BOD1MTIME_CLASS event service-start
          subscriber condition-map match-any BOD1MTIME_CLASS
            match identifier service-name BOD1MTIME [FALSE]
      subscriber rule-map RULE_PPP_ATM5
        condition BOD2MTIME_CLASS event service-start
          subscriber condition-map match-any BOD2MTIME_CLASS
            match identifier service-name BOD2MTIME [FALSE]
      subscriber rule-map RULE_PPP_ATM5
        condition BOD256K_CLASS event service-start
          subscriber condition-map match-any BOD256K_CLASS
! Services that are active are identified as "TRUE."
            match identifier service-name BOD256K [TRUE]
      subscriber rule-map RULE_PPP_ATM5
        condition BOD256K_CLASS event service-start
          1 service-policy service unapply service BOD1MTIME
          2 service-policy service unapply service BOD2MTIME
          3 service-policy service unapply service BOD1MVOLUME
          4 service-policy service unapply service BOD2MVOLUME
          5 service-policy service identifier service-name

Session inbound features:
Traffic classes:
  Traffic class session ID: 521
! Identifies the ACL that restricts inbound traffic. The ACL is configured on the ISG LNS,
! and it is applied to the subscriber based on the subscriber profile on the AAA server.
   ACL Name: Internet-in-acl, Packets = 4, Bytes = 368
 Default traffic is dropped
 Unmatched Packets (dropped) = 0, Re-classified packets (redirected) = 0

 Feature: Portbundle Hostkey
! Identifies the PBHK IP address and the bundle number. This information can be used to
! troubleshoot PBHK with the show ip portbundle command.
 Portbundle IP = 10.200.1.55     Bundle Number = 761

Session outbound features:
 Feature: PPP Idle Timeout
  Timeout value is 1800
! The current elapsed idle time.
  Idle time is 00:12:11
Traffic classes:
  Traffic class session ID: 521
   ACL Name: Internet-out-acl, Packets = 0, Bytes = 0
```

```
 Default traffic is dropped
 Unmatched Packets (dropped) = 0, Re-classified packets (redirected) = 0

Non-datapath features:
 Feature: Interface-Config

 Feature: Session Timeout
  Timeout value is 86400 seconds
  Time remaining is 23:47:48
 Feature: IP Config
  Address Pool: cpe6_pool-53
  Unnumbered Intf: [None]
Configuration sources associated with this session:
Service: BOD256K, Active Time = 00:12:11
Service: PBHK_SERVICE, Active Time = 00:12:11
Interface: Virtual-Template5, Active Time = 00:12:11
```

Use the **show subscriber session** command with a session identifier to show detailed information for the subscriber with UID 521. The following output is for a subscriber with the default BOD256K service:

```
ie2-C7206-LNS# show subscriber session uid 521

Unique Session ID: 521
Identifier:
SIP subscriber access type(s): Traffic-Class
Current SIP options: None
Session Up-time: 00:12:14, Last Changed: 00:12:14
AAA unique ID: 0

Policy information:
  Context 212C1B18: Handle 5A00081C
  Authentication status: unauthen
  Prepaid context: not present


Session inbound features:
Feature: Policing
! Identifies the upstream policing rates for the BOD256K service. These rates are defined
! on the AAA server in the BOD256K service profile.
 Upstream Params:
Average rate = 128000, Normal burst = 8000, Excess burst = 8000
Config level = Service

Session outbound features:
Feature: Policing
! Identifies the downstream policing rates for the BOD256K service. These rates are
! defined on the AAA server in the BOD256K service profile.
 Dnstream Params:
Average rate = 256000, Normal burst = 16000, Excess burst = 16000
Config level = Service

Configuration sources associated with this session:
Service: BOD256K, Active Time = 00:12:14
```

show Command Output for BOD1MTIME Service

The following examples provide reports for subscribers who have activated the BOD1MTIME service:

```
ie2-C7206-LNS# show subscriber session
```

```
Current Subscriber Information: Total sessions 1

Uniq ID Interface  State          Service      Identifier           Up-time
520     Vi3        authen         Local Term   cpe6_1@isp.com       00:14:17
522     Traffic-Cl unauthen       Ltm Internal cpe6_1@isp.com       00:00:11

ie2-C7206-LNS# show subscriber session uid 520

Unique Session ID: 520
Identifier: cpe6_1@isp.com
SIP subscriber access type(s): VPDN/PPP
Current SIP options: Req Fwding/Req Fwded
Session Up-time: 00:14:29, Last Changed: 00:00:23
AAA unique ID: 472
Interface: Virtual-Access3

Policy information:
  Context 212C1F2C: Handle 41000819
  Authentication status: authen
  User profile, excluding services:
    service-type          2 [Framed]
    Framed-Protocol       1 [PPP]
    routing               False
    Framed-MTU            1500 (0x5DC)
    timeout               86400 (0x15180)
    idletime              180 (0xB4)
    ssg-account-info      "ABOD256K"
    ssg-account-info      "NBOD256K"
    ssg-account-info      "NBOD1MTIME"
    ssg-account-info      "NBOD2MTIME"
    ssg-account-info      "NBOD1MVOLUME"
    ssg-account-info      "NBOD2MVOLUME"
    idletime              1800 (0x708)
    interface-config      "ip"
    interface-config      "ip"
    addr-pool             "cpe6_pool-53"
  Active services associated with session:
! Indicates that the BOD1MTIME service is active.
    name "BOD1MTIME"
    name "PBHK_SERVICE", applied outwith active session
  Prepaid context: not present

  Rules, actions and conditions executed:
    subscriber rule-map RULE_PPP_ATM5
      condition always event session-start
        1 service-policy service service PBHK_SERVICE
    subscriber rule-map RULE_PPP_ATM5
      condition BOD1MTIME_CLASS event service-start
        subscriber condition-map match-any BOD1MTIME_CLASS
          match identifier service-name BOD1MTIME [FALSE]
    subscriber rule-map RULE_PPP_ATM5
      condition BOD2MTIME_CLASS event service-start
        subscriber condition-map match-any BOD2MTIME_CLASS
          match identifier service-name BOD2MTIME [FALSE]
    subscriber rule-map RULE_PPP_ATM5
      condition BOD256K_CLASS event service-start
        subscriber condition-map match-any BOD256K_CLASS
          match identifier service-name BOD256K [FALSE]
    subscriber rule-map RULE_PPP_ATM5
      condition BOD1MVOLUME_CLASS event service-start
        subscriber condition-map match-any BOD1MVOLUME_CLASS
          match identifier service-name BOD1MVOLUME [FALSE]
    subscriber rule-map RULE_PPP_ATM5
      condition BOD2MVOLUME_CLASS event service-start
```

```
        subscriber condition-map match-any BOD2MVOLUME_CLASS
          match identifier service-name BOD2MVOLUME [FALSE]
      subscriber rule-map RULE_PPP_ATM5
        condition BOD1MTIME_CLASS event service-start
          subscriber condition-map match-any BOD1MTIME_CLASS
            match identifier service-name BOD1MTIME [FALSE]
      subscriber rule-map RULE_PPP_ATM5
        condition BOD2MTIME_CLASS event service-start
          subscriber condition-map match-any BOD2MTIME_CLASS
            match identifier service-name BOD2MTIME [FALSE]
      subscriber rule-map RULE_PPP_ATM5
        condition BOD256K_CLASS event service-start
          subscriber condition-map match-any BOD256K_CLASS
            match identifier service-name BOD256K [TRUE]
      subscriber rule-map RULE_PPP_ATM5
        condition BOD256K_CLASS event service-start
          1 service-policy service unapply service BOD1MTIME
          2 service-policy service unapply service BOD2MTIME
          3 service-policy service unapply service BOD1MVOLUME
          4 service-policy service unapply service BOD2MVOLUME
          5 service-policy service identifier service-name
      subscriber rule-map RULE_PPP_ATM5
        condition BOD1MTIME_CLASS event service-start
          subscriber condition-map match-any BOD1MTIME_CLASS
            match identifier service-name BOD1MTIME [FALSE]
      subscriber rule-map RULE_PPP_ATM5
        condition BOD2MTIME_CLASS event service-start
          subscriber condition-map match-any BOD2MTIME_CLASS
            match identifier service-name BOD2MTIME [FALSE]
      subscriber rule-map RULE_PPP_ATM5
        condition BOD256K_CLASS event service-start
          subscriber condition-map match-any BOD256K_CLASS
            match identifier service-name BOD256K [TRUE]
      subscriber rule-map RULE_PPP_ATM5
        condition BOD256K_CLASS event service-start
          1 service-policy service unapply service BOD1MTIME
          2 service-policy service unapply service BOD2MTIME
          3 service-policy service unapply service BOD1MVOLUME
          4 service-policy service unapply service BOD2MVOLUME
          5 service-policy service identifier service-name
      subscriber rule-map RULE_PPP_ATM5
        condition BOD1MTIME_CLASS event service-start
          subscriber condition-map match-any BOD1MTIME_CLASS
! Indicates that the BOD1MTIME service is active.
            match identifier service-name BOD1MTIME [TRUE]
      subscriber rule-map RULE_PPP_ATM5
        condition BOD1MTIME_CLASS event service-start
          1 service-policy service unapply service BOD256K
          2 service-policy service unapply service BoD2MTIME
          3 service-policy service unapply service BOD1MVOLUME
          4 service-policy service unapply service BOD2MVOLUME
          5 service-policy service identifier service-name

Session inbound features:
Traffic classes:
  Traffic class session ID: 522
   ACL Name: Internet-in-acl, Packets = 17, Bytes = 1157
 Default traffic is dropped
 Unmatched Packets (dropped) = 0, Re-classified packets (redirected) = 0

 Feature: Portbundle Hostkey
 Portbundle IP = 10.200.1.55     Bundle Number = 761

Session outbound features:
```

```
 Feature: PPP Idle Timeout
  Timeout value is 1800
  Idle time is 00:00:24
Traffic classes:
  Traffic class session ID: 522
   ACL Name: Internet-out-acl, Packets = 26, Bytes = 28894
 Default traffic is dropped
 Unmatched Packets (dropped) = 0, Re-classified packets (redirected) = 0

Non-datapath features:
 Feature: Interface-Config

 Feature: Session Timeout
  Timeout value is 86400 seconds
  Time remaining is 23:45:28
 Feature: IP Config
  Address Pool: cpe6_pool-53
  Unnumbered Intf: [None]
Configuration sources associated with this session:
Service: BOD1MTIME, Active Time = 00:00:25
Service: PBHK_SERVICE, Active Time = 00:14:31
Interface: Virtual-Template5, Active Time = 00:14:31

ie2-C7206-LNS# show subscriber session uid 522

Unique Session ID: 522
Identifier: cpe6_1@isp.com
SIP subscriber access type(s): Traffic-Class
Current SIP options: None
Session Up-time: 00:00:27, Last Changed: 00:00:21
AAA unique ID: 0

Policy information:
  Context 212C1C74: Handle 40000821
  Authentication status: unauthen
! Indicates that prepaid is now active to PREPAID_CONFIG.
  Prepaid context: PREPAID_CONFIG
    threshold time 10 seconds
    threshold volume 1000 bytes
    method-list author PREPAID_AUTHOR_LIST
    method-list accounting PREPAID_ACCNT_LIST
    password prepaidcisco
    Interim 3
    State PREPAID_FEATURE_RUNNING
    Flow idle ? NO
    Acct start sent ? YES

Session inbound features:
Feature: Policing
 Upstream Params:
! Identifies the upstream policing rates for the BOD1MTIME service.
Average rate = 256000, Normal burst = 16000, Excess burst = 16000
Config level = Service

 Feature: Prepaid Volume Monitor
   Threshold:4294967295 - Quota:4294967295
   Usage(since last update):0 - Total:0
   Current states: Start
Session outbound features:
Feature: Policing
 Dnstream Params:
! Identifies the downstream policing rates for the BOD1MTIME service.
Average rate = 1000000, Normal burst = 64000, Excess burst = 64000
```

```
Config level = Service

 Feature: Prepaid Volume Monitor
   Threshold:4294967295 - Quota:4294967295
   Usage(since last update):0 - Total:0
   Current states: Start
Non-datapath features:
! Shows the time statistics for the prepaid services.
 Feature: Time Monitor
   Threshold: 90 (seconds) - Quota: 100 (seconds)
   Session time: 21 (seconds)
Configuration sources associated with this session:
Service: BOD1MTIME, Active Time = 00:00:27
```

show Command Output for History of Service Changes

Use the **show subscriber policy conditions** command as shown in the following examples to show the history of subscriber service changes:

```
ie2-C7206-LNS# show subscriber policy conditions

Class-map                    Action                          Exec Hit Miss Comp
---------                    ------                          ---- --- ---- ----
match-any BOD2MVOLUME_CLASS  match identifier service-name B  256   7  249    7
match-any BOD1MVOLUME_CLASS  match identifier service-name B  257   9  248    9
match-any BOD2MTIME_CLASS    match identifier service-name B  534   4  530    4
match-any BOD256K_CLASS      match identifier service-name B  505 259  246  259
match-any BOD1MTIME_CLASS    match identifier service-name B  548  37  511   37

Key:
  "Exec" - The number of times this line was executed
  "Hit"  - The number of times this line evaluated to TRUE
  "Miss" - The number of times this line evaluated to FALSE
  "Comp" - The number of times this line completed the execution of its
           condition without a need to continue on to the end


ie2-C7206-LNS# show subscriber policy profile

Current policy profile DB contents are:
  Profile name: PBHK_SERVICE, 4 references
    portbundle           "enable"
  Profile name: apply-config-only, 3 references
    service-type         2 [Framed]
    Framed-Protocol      1 [PPP]
    routing              False
    Framed-MTU           1500 (0x5DC)
    timeout              86400 (0x15180)
    idletime             180 (0xB4)
    ssg-account-info     "ABOD256K"
    ssg-account-info     "NBOD256K"
    ssg-account-info     "NBOD1MTIME"
    ssg-account-info     "NBOD2MTIME"
    ssg-account-info     "NBOD1MVOLUME"
    ssg-account-info     "NBOD2MVOLUME"
    idletime             1800 (0x708)
    interface-config     "ip"
    interface-config     "ip"
    addr-pool            "cpe6_pool-53"
  Profile name: BOD256K, 4 references
    traffic-class        "in access-group name  Internet-in-acl"
    traffic-class        "in default drop"
```

```
    traffic-class        "out access-group name Internet-out-acl"
    traffic-class        "out default drop"
    ssg-service-info     "IBOD256K"
    ssg-service-info     "QU;128000;8000;8000;D;256000;16000;16000"
    ssg-service-info     "R10.43.1.0;255.255.255.0"
    policy-handle        1509951516 (0x5A00081C)
  Profile name: BOD1MTIME, 5 references
    traffic-class        "in access-group name  Internet-in-acl"
    traffic-class        "in default drop"
    traffic-class        "out access-group name Internet-out-acl"
    traffic-class        "out default drop"
    ssg-service-info     "IBOD1MTIME"
    ssg-service-info     "QU;256000;16000;16000;D;1000000;64000;64000"
    ssg-service-info     "R10.43.1.0;255.255.255.0"
    policy-handle        1073743905 (0x40000821)
  Profile name: BOD1MTIME, 3 references
    traffic-class        "in access-group name  Internet-in-acl"
    traffic-class        "in default drop"
    traffic-class        "out access-group name Internet-out-acl"
    traffic-class        "out default drop"
    ssg-service-info     "IBOD1MTIME"
    ssg-service-info     "QU;256000;16000;16000;D;1000000;64000;64000"
    ssg-service-info     "R10.43.1.0;255.255.255.0"
    policy-handle        889194527 (0x3500081F)
-----------------------------------------------------------
 Entries in Profile dB subscribers for exact match
-----------------------------------------------------------
No entries found in Profile dB
```

```
ie2-C7206-LNS# show subscriber policy rules

Rule          Class-map                     Action                          Exec
----          ---------                     ------                          ----
internal-rule always event account-logon    1 authenticate aaa list default    0
RULE_PPP_ATM5 BOD1MTIME_CLASS event service 1 service-policy service unapply  21
RULE_PPP_ATM5 BOD1MTIME_CLASS event service 2 service-policy service unapply  21
RULE_PPP_ATM5 BOD1MTIME_CLASS event service 3 service-policy service unapply  21
RULE_PPP_ATM5 BOD1MTIME_CLASS event service 4 service-policy service unapply  21
RULE_PPP_ATM5 BOD1MTIME_CLASS event service 5 service-policy service identif  21
RULE_PPP_ATM5 BOD2MTIME_CLASS event service 1 service-policy service unapply   3
RULE_PPP_ATM5 BOD2MTIME_CLASS event service 2 service-policy service unapply   3
RULE_PPP_ATM5 BOD2MTIME_CLASS event service 3 service-policy service unapply   3
RULE_PPP_ATM5 BOD2MTIME_CLASS event service 4 service-policy service unapply   3
RULE_PPP_ATM5 BOD2MTIME_CLASS event service 5 service-policy service identif   3
RULE_PPP_ATM5 BOD256K_CLASS event service-s 1 service-policy service unapply 259
RULE_PPP_ATM5 BOD256K_CLASS event service-s 2 service-policy service unapply 259
RULE_PPP_ATM5 BOD256K_CLASS event service-s 3 service-policy service unapply 259
RULE_PPP_ATM5 BOD256K_CLASS event service-s 4 service-policy service unapply 259
RULE_PPP_ATM5 BOD256K_CLASS event service-s 5 service-policy service identif 259
RULE_PPP_ATM5 BOD1MVOLUME_CLASS event servi 1 service-policy service unapply   5
RULE_PPP_ATM5 BOD1MVOLUME_CLASS event servi 2 service-policy service unapply   5
RULE_PPP_ATM5 BOD1MVOLUME_CLASS event servi 3 service-policy service unapply   5
RULE_PPP_ATM5 BOD1MVOLUME_CLASS event servi 4 service-policy service unapply   5
RULE_PPP_ATM5 BOD1MVOLUME_CLASS event servi 5 service-policy service identif   5
RULE_PPP_ATM5 BOD2MVOLUME_CLASS event servi 1 service-policy service unapply   4
RULE_PPP_ATM5 BOD2MVOLUME_CLASS event servi 2 service-policy service unapply   4
RULE_PPP_ATM5 BOD2MVOLUME_CLASS event servi 3 service-policy service unapply   4
RULE_PPP_ATM5 BOD2MVOLUME_CLASS event servi 4 service-policy service unapply   4
RULE_PPP_ATM5 BOD2MVOLUME_CLASS event servi 5 service-policy service identif   4
RULE_PPP_ATM5 BOD2MTIME_CLASS event service 1 service-policy service unapply   1
RULE_PPP_ATM5 BOD2MTIME_CLASS event service 2 service-policy service service   1
RULE_PPP_ATM5 BOD1MTIME_CLASS event service 1 service-policy service unapply  16
```

```
RULE_PPP_ATM5 BOD1MTIME_CLASS event service 2 service-policy service service  16
RULE_PPP_ATM5 BOD2MVOLUME_CLASS event servi 1 service-policy service unapply   3
RULE_PPP_ATM5 BOD2MVOLUME_CLASS event servi 2 service-policy service service   3
RULE_PPP_ATM5 BOD1MVOLUME_CLASS event servi 1 service-policy service unapply   4
RULE_PPP_ATM5 BOD1MVOLUME_CLASS event servi 2 service-policy service service   4
RULE_PPP_ATM5 always event session-start    1 service-policy service service 233
RULE_PPP_ATM5 always event quota-depleted   1 set-param drop-traffic FALSE     0
RULE_PPP_ATM5 always event credit-exhausted 1 service-policy service service   0
RULE_PPP_ATM5 always event internal-event-c 1 service-policy service unapply   0

Key:
  "Exec" - The number of times this rule action line was executed
```

Clearing Statistics

Use the **clear subscriber policy conditions** command to clear the statistics of subscriber policy changes.

```
ie2-C7206-LNS# clear subscriber policy conditions
ie2-C7206-LNS#
ie2-C7206-LNS# show subscriber policy conditions

Class-map                    Action                          Exec Hit Miss Comp
---------                    ------                          ---- --- ---- ----
match-any BOD2MVOLUME_CLASS  match identifier service-name B    0   0    0    0
match-any BOD1MVOLUME_CLASS  match identifier service-name B    0   0    0    0
match-any BOD2MTIME_CLASS    match identifier service-name B    0   0    0    0
match-any BOD256K_CLASS      match identifier service-name B    0   0    0    0
match-any BOD1MTIME_CLASS    match identifier service-name B    0   0    0    0

Key:
  "Exec" - The number of times this line was executed
  "Hit"  - The number of times this line evaluated to TRUE
  "Miss" - The number of times this line evaluated to FALSE
  "Comp" - The number of times this line completed the execution of its
           condition without a need to continue on to the end
```

Additional References

The following sections provide references related to configuring the ISG in an ATM-based broadband network:

Related Documents

Related Topic	Document Title
Broadband and DSL configuration	*Cisco IOS Broadband and DSL Configuration Guide*, Release 12.4
CAR configuration procedure	*Cisco CNS Access Registrar Installation and Configuration Guide*, 3.5
CNR configuration procedure	*Cisco CNS Network Registrar User's Guide*, 6.2
ISG software configuration	*Cisco IOS Intelligent Service Gateway Configuration Guide*
L2TP VPDN for dialin and dialout configuration	*Cisco IOS VPDN Configuration Guide*, Release 12.4
QoS configuration	*Cisco IOS Quality of Service Solutions Configuration Guide*, Release 12.4

Related Topic	Document Title
RADIUS attributes	*RADIUS Attribute-Value Pairs and Dictionary Management* *RADIUS Vendor-Proprietary Attributes* "RADIUS Service and User Profile Attributes" in the *Cisco SSG-to-ISG DSL Broadband Migration Guide*
Virtual template interface configuration	"Configuring Virtual Template Interfaces" in the *Cisco IOS Dial Technologies Configuration Guide*, Release 12.4

Standards

Standard	Title
ANSI T1.105-1988	*Synchronous Transmission of Optical Digital Signals*—SONET standard for optical telecommunications transport, approved as an international ANSI standard in 1988, that defines OC-1, OC-2, OC-3, and so on, optical carrier digital signals.
AAL5/SNAP	ATM adaptation layer 5—AAL5 is one of four AALs recommended by the ITU-T. Subnetwork Access Protocol—SNAP specifies a standard method of encapsulating IP datagrams and ARP messages on IEEE networks.

RFCs

RFC	Title
RFC 1541	*Dynamic Host Configuration Protocol*
RFC 1661	*The Point-to-Point Protocol (PPP)*
RFC 1994	*Challenge Handshake Authentication Protocol (CHAP)*
RFC 2516	*A Method for Transmitting PPP Over Ethernet (PPPoE)*
RFC 2684	*Multiprotocol Encapsulation over ATM Adaptation Layer 5*

Technical Assistance

Description	Link
The Cisco Technical Support and Documentation website contains thousands of pages of searchable technical content, including links to products, technologies, solutions, technical tips, and tools. Registered Cisco.com users can log in from this page to access even more content.	http://www.cisco.com/techsupport

Glossary

AAA—Authentication, authorization, and accounting

AAL5/SNAP—ATM adaptation Layer 5/Subnetwork Access Protocol

ACL—Access control list or access list

ATU-R—ADSL Transmission Unit—remote

BRAS—Broadband Remote Access Server

CAR—Cisco Access Registrar

CHAP—Challenge Handshake Authentication Protocol

CNR—CNS Network Registrar

CPE—customer premises equipment

DBS—Dynamic Bandwidth Selection

DHCP—Dynamic Host Configuration Protocol

DNS—Domain Name System

DSCP—Differentiated Services Code Point

DSL—Digital subscriber line

DSLAM—Digital Subscriber Line Access Multiplexer

IPCP—IP Control Protocol

ISG—Intelligent Service Gateway

ISP—Internet service provider

L2TP—Layer 2 Tunnel Protocol

LAC—L2TP access concentrator

LCP—Link control protocol28

LNS—L2TP network server

MAC—Media Access Control

MPLS—Multiprotocol Label Switching

NAT—Network Address Translation

OC—optical carrier

PBHK—Port-Bundle Host Key

PE—provider edge

PPPoE—PPP over Ethernet

PVC—permanent virtual circuit

QoS—quality of service

RBE—Routed Bridge Encapsulation

SESM—Subscriber Edge Services Manager

SSG—Service Selection Gateway

TAL—Transparent Autologin

UNI—user network interface

VoIP—Voice over IP

VPDN—virtual private dialup network

VPN—Virtual Private Network

VRF—VPN routing and forwarding instances

VSA—vendor-specific attribute

Note See *Internetworking Terms and Acronyms* for terms not included in this glossary.