Subscriber Management

This chapter provides information about various types of subscriber sessions, namely IPoE and PPPoE, and IP addressing by DHCP. Also, on how the point-point frames are tunnelled across the network using the Layer 2 Tunneling Protocol.

- Subscriber Session Overview, on page 1
- IPoE Session, on page 1
- PPP over Ethernet (PPPoE), on page 3

Subscriber Session Overview

To enable subscribers to access the network resources, the network has to establish a session with the subscriber. A subscriber session represents the logical connection between the customer premise equipment (CPE) and the network resource. Each session establishment comprises the following phases:

- Establishing a connection—in this phase CPE finds the cnBNG with which to communicate.
- Authenticating and authorizing the subscriber—in this phase, cnBNG authenticates the subscribers and authorizes them to use the network. This phase is performed with the help of the RADIUS server.
- Giving the subscriber an identity—in this phase, the subscriber is assigned an identity, the IP address.
- Monitoring the session—in this phase, cnBNG ascertains that the session is up and running.

The subscriber sessions are established over the subscriber interfaces, which are virtual interfaces. It's possible to create only one interface for each subscriber session. A port can contain multiple VLANs, each of which can support multiple subscribers. cnBNG creates subscriber interfaces for each kind of session. These interfaces are named based on the parent interface, such as bundle-ether 2.100.pppoe312. The subscribers on bundle interfaces (or bundle-VLANs) allow redundancy and are managed on the cnBNG route processor (RP).

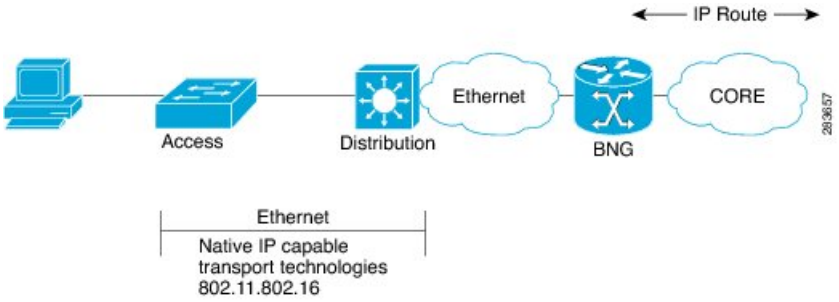
There are two mechanisms to establish a subscriber session, namely, IPoE Session and PPP over Ethernet (PPPoE).

IPoE Session

In an Internet over Ethernet (IPoE) subscriber session, subscribers run IPv4 or IPv6 on the CPE device and connect to the cnBNG through a Layer-2 aggregation. IP subscriber sessions that connect through a Layer-2

aggregation network are called L2-connected. IPoE subscriber sessions are always terminated on cnBNG and then routed into the service provider network. IPoE relies on DHCP to assign the IP address.

Figure 1: IPoE Session



cnBNG supports both DHCP v4 and DHCP v6 subscriber sessions.

Limitations

The following are the limitations:

- L3 routed subscribers are not supported.
- Geo redundancy or subscriber redundancy is not supported.
- Line card or physical port termination-based subscribers are not supported.

Configuration Example

```
Router#configure
Router(config)#interface Bundle-Ether1.1
Router(config-subif)#ipv4 point-to-point
Router(config-subif)#ipv4 unnumbered Loopback1
Router(config-subif)#ipv6 enable
Router(config-subif)#encapsulation dot1q 1
Router(config-subif)#ipsubscriber
Router(config-cnbng-nal-ipsub)#ipv4 l2-connected
Router(config-cnbng-nal-ipsub-l2conn)#initiator dhcp
Router(config-cnbng-nal-ipsub-l2conn)#exit
Router(config-cnbng-nal-ipsub)#ipv6 l2-connected
Router(config-cnbng-nal-ipsub-ipv6-l2conn)#initiator dhcp
Router(config-cnbng-nal-ipsub-ipv6-l2conn)#commit
```

Running Configuration

```
Router#show running-config interface be1.1
interface Bundle-Ether1.1
 ipv4 point-to-point
 ipv4 unnumbered Loopback1
 ipv6 enable
 encapsulation dot1q 1
 ipsubscriber
  ipv4 l2-connected
   initiator dhcp
  !
  ipv6 l2-connected
   initiator dhcp
```

!
!

PPP over Ethernet (PPPoE)

The Point-to-Point Protocol (PPP) is used for communications between two nodes, like a client and a server. The PPP provides a standard method for transporting multiprotocol datagrams over point-to-point links. It defines an encapsulation scheme, a link layer control protocol (LCP), and a set of network control protocols (NCPs) for different network protocols that can be transmitted over the PPP link.

One of the methods to establish PPP connection is by the use of PPPoE. In a PPPoE session, the PPP protocol runs between the CPE and cnBNG. The Home Gateway (which is part of the CPE) adds a PPP header (encapsulation) that is terminated at the cnBNG.

PPPoE Discovery

The PPPoE discovery-stage protocol consists of basic packet exchange between the subscriber and server (cnBNG). The following is the list of the various PPPoE Active Discovery (PAD) messages:

- PPPoE Active Discovery Initiation (PADI)—The CPE broadcasts to initiate the process to discover cnBNG.
- PPPoE Active Discovery Offer (PADO)—The cnBNG responds with an offer.
- PPPoE Active Discovery Request (PADR)—The CPE requests to establish a connection.
- PPPoE Active Discovery Session confirmation (PADS)—cnBNG accepts the request and responds by assigning a session identifier (Session-ID).
- PPPoE Active Discovery Termination (PADT)—Either CPE or cnBNG terminates the session.

PPoE Sessions

The PPPoE sessions are of the following types:

- PPPoE PPP Terminated sessions Terminated (PTA)
- PPPoE L2TP Access Concentrator Sessions (LAC)
- L2TP Network Server Sessions (LNS)

Majority of the digital subscriber line (DSL) broadband deployments use Point-to-Point Protocol over Ethernet (PPPoE) sessions to provide subscriber services. These sessions terminate the Point-to-Point Protocol (PPP) link and provide all the features, service, and billing on the same node. These sessions are called PPP Terminated (PTA) sessions. See PPPoE PPP Terminated and Aggregation Sessions (PPPoE-PTA), on page 4.

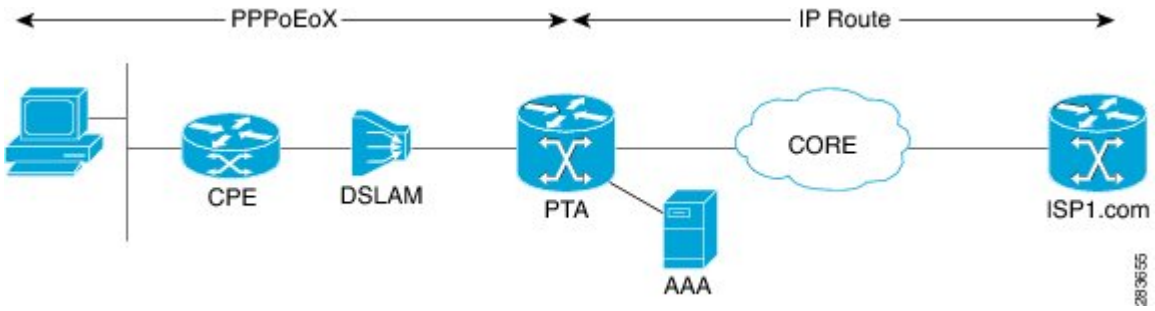
There are some wireline subscriber deployments in the wholesale retail model where ISPs work with others to provide the access and core services separately. In such cases, the subscribers are tunneled between wholesale and retail ISPs using the Layer 2 Tunneling Protocol (L2TP), a client-server protocol. See L2TP Access Concentrator Sessions (LAC), on page 5 and L2TP Network Server Sessions (LNS), on page 9.

Note For the functioning of PPP PTA and PPP LAC session, the RADIUS server must be set up to authenticate and forward sessions as necessary. There's no local authentication available on cnBNG.

PPPoE PPP Terminated and Aggregation Sessions (PPPoE-PTA)

In a PPPoE-PPP Termination and Aggregation (PTA) session, the PPP encapsulation is terminated on cnBNG. After it's terminated, cNBNG routes the traffic to the service provider using IP routing. A typical PTA session is depicted in this figure.

Figure 2: PPPoE-PTA Session



PPPoE session configuration information is contained in PPPoE profiles. After a profile is defined, it's assigned to an access interface. Multiple PPPoE profiles can be created and assigned to multiple interfaces. A global PPPoE profile can also be created; the global profile serves as the default profile for any interface that has not been assigned a specific PPPoE profile.

The PPP PTA session is typically used in the Network Service Provider (retail) model where the same service operator provides the broadband connection to the subscriber and also manages the network services.

Limitations

The following are the limitations:

- L3 routed subscribers are not supported.
- Geo redundancy or subscriber redundancy is not supported.
- Line card or physical port termination-based subscribers aren't supported.

Configure PPPoE-PTA Session

The following section describes the steps to configure PPPoE-PTA sessions:

- Configure the access-interface
- Enable PPPoE

Configuration Example

```
Router#configure
Router(config)#interface Bundle-Ether1.1
Router(config-subif)#ipv4 point-to-point
Router(config-subif)#ipv4 unnumbered Loopback1
Router(config-subif)#ipv6 enable
Router(config-subif)#encapsulation dot1q 1

/* Enable PPPoE */
```

```
Router(config-subif)#pppoe enable
Router(config-subif)#commit
```

Running Configuration

```
Router#show running-config interface be1.1
interface Bundle-Ether1.1
 ipv4 point-to-point
 ipv4 unnumbered Loopback1
 ipv6 enable
 encapsulation dot1q 1

 pppoe enable
!
```

L2TP Access Concentrator Sessions (LAC)

Table 1: Feature History Table

Feature Name	Release Information	Feature Description
Enable LAC on Cloud Native BNG	Release 7.4.2	This feature enables the cloud native BNG user plane to become an L2TP access concentrator (LAC), allowing you to tunnel point-to-point frames between the remote system or LAC client and an LNS located at a wholesaler. This functionality provides highly flexible deployments options to suit different customer use-cases and needs. To enable this feature, use the **l2tp enable** command.

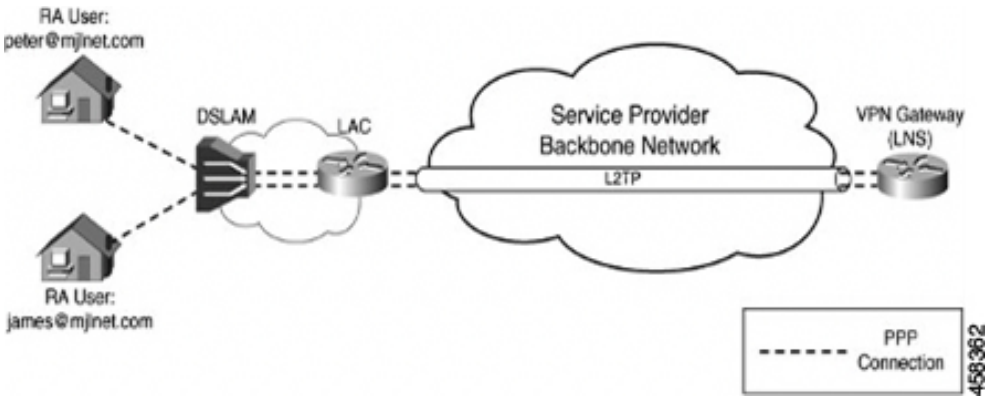
L2TP encapsulates and tunnels the PPP Layer 2 frames through a Layer 3 network. With L2TP, you can have a layer 2 connection to an access concentrator. The concentrator then tunnels individual PPP frames to the Network Access Server (NAS). This allows the processing of PPP packets on different devices. L2TP can be used to make all multilink channels terminate at a single NAS. Thus-allowing multilink operation even when the calls are spread across distinct physical NASs.

In cnBNG, L2TP uses the following two components to perform the hand-off task of the subscriber traffic to the Internet service provider (ISP).

- L2TP Access Concentrator (LAC)—The L2TP enables subscribers to dial into the LAC, which extends the PPP session to the LNS. cnBNG provides LAC.
- L2TP Network Server (LNS)—The L2TP extends PPP sessions over an arbitrary network to a remote network server that is, the LNS. The ISP provides LNS.

The following image depicts the overall topology of LAC and LNS:

Figure 3: Topology of LAC and LNS



The remote user initiates a PPP connection across the cloud to a LAC. The LAC acts as a client and then tunnels the PPP connection across the Internet to an LNS that acts as a server.

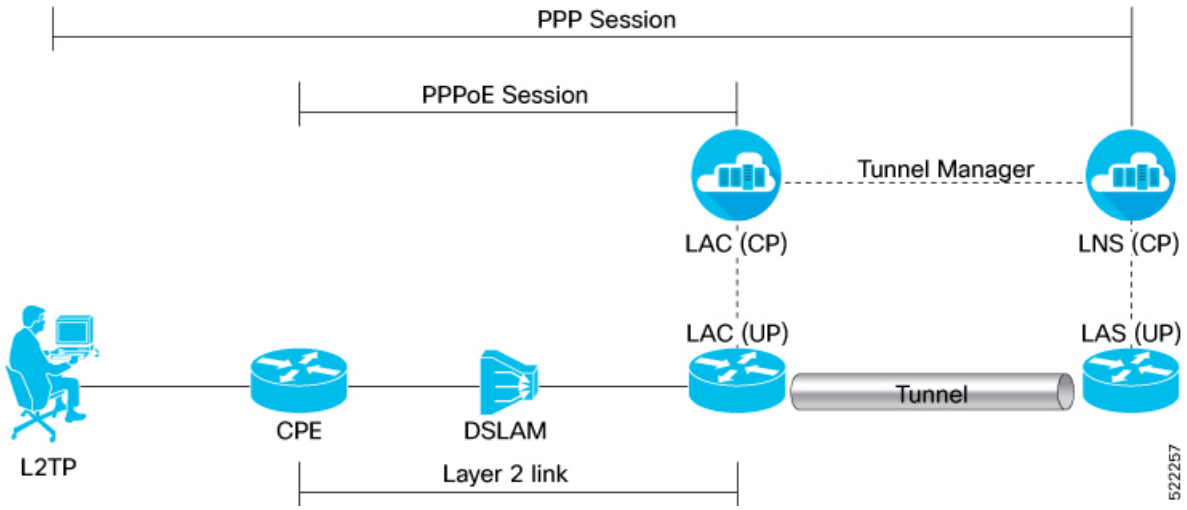
L2TP utilizes two types of messages, control messages and data messages. Control messages are used in the establishment, maintenance, and clearing of tunnels and calls. Data messages are used to encapsulate PPP frames over the tunnel.

```
+--------------------+
| PPP Frames         |
+--------------------+    +-----------------------+
| L2TP Data Messages|    | L2TP Control Messages |
+--------------------+    +-----------------------+
| L2TP Data Channel |    | L2TP Control Channel  |
| (unreliable)      |    | (reliable)            |
+-------------------------------------------------+
|      Packet Transport (UDP, FR, ATM)     |
+-------------------------------------------------+
```

PPP frames are passed over an unreliable data channel that is encapsulated first by an L2TP header. Then a Packet Transport such as UDP. Control messages are sent over a reliable L2TP Control Channel, which transmits packets in-band over the same Packet Transport.

During a PPP LAC session, the PPPoE encapsulation terminates on cnBNG; however, the PPP packets travel beyond cnBNG to LNS through the L2TP tunnel. A typical LAC session is depicted in the following figure.

Figure 4: LAC Session



Both LAC and LNS sessions use L2TP protocol for negotiation and creation of L2TP sessions.

For more information on the LAC high-level work flow, see the *L2TP Subscriber Management* chapter in the *Cloud Native BNG Control Plane Configuration Guide*.

The PPP LAC session is used in the wholesaler model, where the network service provider is a separate entity from the local access network provider. In this kind of setup, the access network provider owns the LAC and the network service provider owns the LNS.

- Network service provider performs access authentication, manage and provide IP addresses to subscribers, and are responsible for overall service.
- The access network prover is responsible for providing the last-mile digital connectivity to the customer, and for passing on the subscriber traffic to the service provider.

Limitations for LAC Sessions

The following are the limitations for the LAC sessions:

- Tunnel specific statistics are not supported.
- LAC and LNS cannot coexist on the same node.
- IPv6 L2TP tunnel is not supported.
- L2TP tunnel keep alive or hello packet offload is not supported.
- Setting of type of service is not supported.
- Multicast group is not supported.
- L2TP packet segmentation or reassemble is not supported.
- The following features aren’t supported:
  - Access Control List (ACL)

- Quality of Service (QoS)
- Policy-based Routing (PBR)
- Unicast Reverse Path Forwarding (uRPF)
- ICMP unreachable

Configure LAC Sessions

This section describes how to configure the LAC session on the cnBNG user plane.

- Enable L2TP
- Establish PPPoE connection

Configuration Example

Enable L2TP:

```
Router#configure
Router(config)#cnbng-nal location 0/1/CPU0

Router(config-cnbng-nal-local)#hostidentifier RTR1

Router(config-cnbng-nal-local)#up-server ipv4 192.0.2.1 gtp-port 15002 pfcp-port 15003
vrf default
Router(config-cnbng-nal-local)#cp-server primary ipv4 198.51.100.1

Router(config-cnbng-nal-local)#enable-test-server

Router(config-cnbng-nal-local)#disconnect-history file-logging-enable

Router(config-cnbng-nal-local)#cp-association retry-count 5

Router(config-cnbng-nal-local)#l2tp enable

Router(config-cnbng-nal-local)#l2tp-tcp-mss-adjust 1400
```

Establish PPPoE connection:

```
Router(config-cnbng-nal-local)#interface Bundle-Ether1.1

Router(config-subif)#ipv4 address 192.11.1.1 255.255.255.0

Router(config-subif)#ipv6 enable

Router(config-subif)#encapsulation dot1q 1

Router(config-subif)#ppoe enable
Router(config-subif)#commit
Router(config-subif)#exit
Router(config)#exit
```

Running Configuration

```
Router#show running-config

cnbng-nal location preconfigure 0/1/CPU0
 l2tp-tcp-mss-adjust 1400
 hostidentifier RTR1
 up-server ipv4 192.0.2.1 gtp-port 15002 pfcp-port 15003 vrf default
 cp-server primary ipv4 198.51.100.1
 disconnect-history file-logging-enable
 cp-association retry-count 5
 l2tp enable
 enable-test-server
!
interface Bundle-Ether1
!
interface Bundle-Ether1.1
 ipv4 address 192.11.1.1 255.255.255.0
 ipv6 enable
 encapsulation dot1q 1
 pppoe enable
!
```

L2TP Network Server Sessions (LNS)

Table 2: Feature History Table

Feature Name	Release Information	Feature Description
Enable LNS on Cloud Native BNG	Release 7.4.2	This feature enables cloud native BNG (cnBNG) to act as an L2TP Network Server (LNS) located at the wholesaler and allows you to terminate the tunnel or the subscriber sessions initiated by the LAC client. The cnBNG LNS solution offers control and user plane separation (CUPS) and cloud-native advantages for next-generation subscriber services in operator networks where subscribers connect directly to a retailer. To enable this feature, use the **lns enable** command.

L2TP Network Server (LNS) resides at one end of an L2TP tunnel and acts as a peer to the LAC. An LNS acts like an L2TP server that terminates the incoming tunnel from the L2TP LAC. An LNS is the logical termination point of the PPP session that is being tunneled from the client by the LAC.

LNS sessions are similar to PTA sessions in the overall functionality. Instead of the PPPoE protocol, here the First-Sign-Of-Life (FSOL) packets are the L2TP Incoming-Call-Request (ICRQ) messages.

For more information on the LNS high-level workflow, see the *L2TP Subscriber Management* chapter in the *Cloud Native BNG Control Plane Configuration Guide*.

Limitations for LNS Sessions

The following are the limitations for the LNS sessions:

- IPv6 L2TP tunnel is not supported.
- L2TP tunnel keep alive or hello packet offload is not supported.
- Tunnel statistics are not supported.
- Termination on non bundle-ether is not supported (for example, PWHE, physical interface).
- Termination of the VLAN interface is not supported.
- Supports parent interface only and not subinterface.
- L2TP packet segmentation or reassemble is not supported.
- Parent interface SVLAN policy must be different for other interfaces on the chassis.
- The following features are not supported:
  - Unicast Reverse Path Forwarding (uRPF)
  - Lawful Intercept (LI)

Configure LNS Sessions

This section describes how to configure the LNS session on the cnBNG user plane.

Configuration Example

To enable L2TP:

```
Router#configure
Router(config)#cnbng-nal location 0/0/CPU0
Router(config-cnbng-nal-local)#hostidentifier RTR1
Router(config-cnbng-nal-local)#up-server ipv4 192.0.2.1 gtp-port 15002 pfcp-port 15003
vrf default
Router(config-cnbng-nal-local)#cp-server primary ipv4 198.51.100.1
Router(config-cnbng-nal-local)#enable-test-server
Router(config-cnbng-nal-local)#disconnect-history file-logging-enable
Router(config-cnbng-nal-local)#cp-association retry-count 5
Router(config-cnbng-nal-local)#l2tp enable << Enble L2TP
Router(config-cnbng-nal-local)#commit
Router(config-cnbng-nal-local)#exit
Router(config)#
```

To establish the LNS session:

```
Router(config)#interface bundle-ether 1.1
Router(config-subif)#service-policy output SVLAN subscriber-parent subscriber-group
resourceid 4 << To allow maximum capacicty on the linecard
Router(config-subif)#ipv4 address 192.5.1.1 255.255.255.0
Router(config-subif)#ipv6 enable
```

```
Router(config-subif)#lns enable << Establish LNS session
Router(config-subif)#commit
Router(config-subif)#exit
```

Note To allow maximum capacity on the linecard, we recommend you to use the **service-policy output SVLAN subscriber-parent subscriber-group resourceid** command in the main interface.

Running Configuration

```
Router#show running-config

cnbng-nal location preconfigure 0/0/CPU0
 hostidentifier RTR1
 up-server ipv4 192.0.2.1 gtp-port 15002 pfcp-port 15003 vrf default
 cp-server primary ipv4 198.51.100.1
 disconnect-history file-logging-enable
 cp-association retry-count 5
 l2tp enable
 enable-test-server
!
interface Bundle-Ether1.1
 service-policy output SVLAN subscriber-parent subscriber-group resourceid 4
 ipv4 address 192.11.1.1 255.255.255.0
 ipv6 enable
 lns enable
!
```