



Configuring Cloud Native BNG User Plane and Key Features

This chapter describes the configuration procedures to achieve the cnBNG user plane functionality on Cisco ASR 9000 Series Routers.

For details on cnBNG user plane commands, see the *Cloud Native BNG Command Reference for Cisco ASR 9000 Series Routers*.

- [Configure cnBNG User Plane, on page 1](#)
- [Verify cnBNG User Plane Configuration, on page 17](#)

Configure cnBNG User Plane

Before you begin:

You must follow these guidelines for configuring cnBNG user plane:

- You must perform a complete reimage followed by a reboot of the router if you are switching between physical BNG to cnBNG, or the other way around.
- Ensure that the cnBNG package is installed and activated on the user plane. See the *Installing Cloud Native BNG User Plane Packages* chapter for detailed procedure.
- The system does not support the removal of configurations while active sessions are present. You must delete all active sessions and dissociate the CP-UP connection prior to any configuration change or commit replace procedure.

Configuration Procedure

You must perform the following tasks for the UP to spawn the NAL process, to establish connection with the CP, and to provision the subscriber requests.

Configure Basic User Plane Settings

The basic user plane configuration for cnBNG involves these high-level tasks:

- Configuring the server endpoints of CP to which UP can send PFCP or GTP-U messages to enable cnBNG on the router.
- Configuring a loopback interface for each VRF.
- Configuring a route tag for subscriber summary routes.
- Configuring the access-interface to enable IPoE and PPPoE subscribers.

The cnBNG endpoint configurations on the UP are delivered to the cnBNG SPA component for initiating connection with the CP.

Configuration Procedure

This section describes the steps for the basic user plane configuration, which include certain mandatory and optional configurations.

Mandatory Configurations:

- Specifying a unique name for the UP-server instance.
- Specifying the details of the UP server (such as IP address, GTP port, and PFCP port) to which the CP can send PFCP or GTP-U messages.
- Specifying the details of CP server to which the UP can send PFCP or GTP-U messages.
- Specifying the retry count for CP-UP association.
- Enabling secondary address programming.
- Specifying a name for the auto-loopback VRF.
- Configuring a loopback interface to associate with the above VRF.
- Specifying a primary address for the loopback interface.

Optional Configuration:

- Configuring a route summary tag for the routes to add in the routing table

Configuration Example

Configuration example with IPv4 transport.

```
Router#configure
Router(config)#cnbng-nal location 0/RSP0/CPU0
Router(config-cnbng-nal-local)#hostidentifier asr9k-1
Router(config-cnbng-nal-local)#cp-server primary ipv4 198.51.100.1
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)#secondary-address-update-enable
Router(config-cnbng-nal-local)#cp-association retry-count 10
Router(config-cnbng-nal-local)#auto-loopback vrf test
Router(config-cnbng-nal-local-auto-loopback-vrf)#interface Loopback2
Router(config-cnbng-nal-local-auto-loopback-vrf-int)#primary-address 127.0.0.1
Router(config-cnbng-nal-local-auto-loopback-vrf-int)#exit
Router(config-cnbng-nal-local-auto-loopback-vrf)#exit
/* Auto-loopback configuration for default VRF */
Router(config-cnbng-nal-local)#auto-loopback vrf default
```

```
Router(config-cnbng-nal-local-auto-loopback-vrf)#interface Loopback1
Router(config-cnbng-nal-local-auto-loopback-vrf-int)#primary-address 10.0.0.1
Router(config-cnbng-nal-local-auto-loopback-vrf-int)#exit
Router(config-cnbng-nal-local-auto-loopback-vrf)#exit
Router(config-cnbng-nal-local)#route-summary tag 4
Router(config-cnbng-nal-local)#commit
```

Configuration example with IPv6 transport.

Starting from Release 24.3.1, we support IPv6 transport for the interface between cnBNG and user plane.

```
Router#configure
Router(config)#cnbng-nal location 0/RSP0/CPU0
Router(config-cnbng-nal-local)#hostidentifier asr9k-1
Router(config-cnbng-nal-local)#cp-server primary ipv6 1::2
Router(config-cnbng-nal-local)#up-server ipv6 1:1
Router(config-cnbng-nal-local)#secondary-address-update-enable
Router(config-cnbng-nal-local)#cp-association retry-count 10
Router(config-cnbng-nal-local)#auto-loopback vrf test
Router(config-cnbng-nal-local-auto-loopback-vrf)#interface Loopback2
Router(config-cnbng-nal-local-auto-loopback-vrf-int)#primary-address 1::3
Router(config-cnbng-nal-local-auto-loopback-vrf-int)#exit
Router(config-cnbng-nal-local-auto-loopback-vrf)#exit

/* Auto-loopback configuration for default VRF */
Router(config-cnbng-nal-local)#auto-loopback vrf default
Router(config-cnbng-nal-local-auto-loopback-vrf)#interface Loopback1
Router(config-cnbng-nal-local-auto-loopback-vrf-int)#primary-address 1::4
Router(config-cnbng-nal-local-auto-loopback-vrf-int)#exit
Router(config-cnbng-nal-local-auto-loopback-vrf)#exit
Router(config-cnbng-nal-local)#route-summary tag 4
Router(config-cnbng-nal-local)#commit
```

Running Configuration

```
Router#show running-config cnbng-nal location 0/RSP0/CPU0
cnbng-nal location 0/RSP0/CPU0
  hostidentifier asr9k-1
  up-server ipv4 192.0.2.1 vrf default
  gtp-port 15002
  pfcf-port 15003
  cp-server primary ipv4 198.51.100.1
  secondary-address-update-enable
  cp-association retry-count 10
  auto-loopback vrf test
    interface Loopback2
      primary-address 127.0.0.1
    !
  !
  auto-loopback vrf default
    interface Loopback1
      primary-address 10.0.0.1
    !
  !
  route-summary tag 4
  !
```

Running configuration for IPv6 Transport

```

Router#show running-config cnbng-nal location 0/RSP0/CPU0
cnbng-nal location 0/RSP0/CPU0
  hostidentifier asr9k-1
  up-server ipv6 1::1 vrf default
  gtp-port 15002
  pfcp-port 15003
  cp-server primary ipv4 1::2
  secondary-address-update-enable
  cp-association retry-count 10
  auto-loopback vrf test
    interface Loopback2
      primary-address 1::3
    !
  !
  auto-loopback vrf default
    interface Loopback1
      primary-address 1::4
    !
  !
  route-summary tag 4
  !

```

Configure Access-Interface

This section describes how to configure the access-interface and to enable PPPoE on the cnBNG user plane.

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)#exit
Router(config-cnbng-nal-ipsub)#exit

/* Enable PPPoE */
Router(config-subif)#pppoe enable
Router(config-subif)#commit

```

Running Configuration

```

Router#show running-config interface bel.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
    !
    !
    pppoe enable
    !

```

Configure Loopback Interface

This section describes how to configure the loopback interface for cnBNG user plane.



Note You must not configure any IP address under loopback interface.

Configuration Example

```

Router#configure
Router(config)#interface loopback 2
Router(config-if)#ipv6 enable
Router(config-if)#commit

```

Running Configuration

```

Router#show running-config interface loopback 2
interface Loopback2
    ipv6 enable
    !

```

Enable Multiple Loopback Interfaces for Cloud Native BNG

Table 1: Feature History Table

Feature Name	Release Information	Feature Description
Multiple Loopback Interfaces for Cloud Native BNG	Release 7.6.2	By configuring multiple loopbacks under the same VRF and splitting a large network into smaller chunks, you can increase the number of IP addresses using IP subnet pools, thus improving address allocation and managing network bandwidth efficiently. In earlier releases, Cloud Native BNG supported only a single loopback for a given VRF.

You can configure multiple loopback interfaces under *cnbng-nal* configuration mode for default and non-default VRF.



Note A maximum of 47 loopback interfaces are supported under the *cnbng-nal* configuration mode.

Configuration for default VRF

```
Router#configure
Router(config)#cnbng-nal location 0/rsp0/CPU0
Router(config-cnbng-nal-local)#auto-loopback vrf default
Router(config-cnbng-nal-auto-loopback-vrf)#interface loopback 0
Router(config-cnbng-nal-auto-lb-vrf-int)#primary-address 10.0.0.1
Router(config-cnbng-nal-auto-lb-vrf-int)#exit
Router(config-cnbng-nal-auto-loopback-vrf)#interface loopback 1
Router(config-cnbng-nal-auto-lb-vrf-int)#primary-address 10.0.0.2
Router(config-cnbng-nal-auto-lb-vrf-int)#exit
Router(config-cnbng-nal-auto-loopback-vrf)#interface loopback 2
Router(config-cnbng-nal-auto-lb-vrf-int)#primary-address 10.0.0.3
Router(config-cnbng-nal-auto-lb-vrf-int)#
```

Running Configuration

```
/* Configuration for default VRF */
cnbng-nal location 0/rsp0/CPU0
auto-loopback vrf default
interface loopback 0
    primary-address 10.0.0.1
!
interface loopback 1
    primary-address 10.0.0.2
!
interface loopback 2
    primary-address 10.0.0.3
!
```

Configuration for non-default VRF

```
Router(config)#cnbng-nal location 0/RSP0/CPU0
Router(config-cnbng-nal-local)# hostidentifier cnBNG-SRG1
Router(config-cnbng-nal-local)# up-server ipv4 10.1.1.1 vrf default
Router(config-cnbng-nal-local)# cp-server primary ipv4 201.201.201.65
Router(config-cnbng-nal-local)# auto-loopback vrf vrftwo
Router(config-cnbng-nal-auto-loopback-vrf)# interface Loopback16
Router(config-cnbng-nal-auto-lb-vrf-int)# primary-address 10.0.0.1
Router(config-cnbng-nal-auto-lb-vrf-int)# interface Loopback17
Router(config-cnbng-nal-auto-lb-vrf-int)# primary-address 10.0.0.2
Router(config-cnbng-nal-auto-lb-vrf-int)# interface Loopback18
Router(config-cnbng-nal-auto-lb-vrf-int)# primary-address 10.0.0.3
Router(config-cnbng-nal-auto-lb-vrf-int)#
```

Running Configuration

```
cnbng-nal location 0/RSP0/CPU0
hostidentifier cnBNG-SRG1
up-server ipv4 19.1.1.1 vrf default
cp-server primary ipv4 201.201.201.65
auto-loopback vrf RJIL-VRF-OLT-MGMT
interface Loopback16
    primary-address 1.1.0.1
!
```

```

interface Loopback17
 primary-address 2.1.0.1
!
interface Loopback18
 primary-address 3.1.0.1

```

Verification

```

/* Verification for default VRF */
Router#show cnbng-nal dynamic-routes summary

```

Location: 0/RSP0/CPU0

Counter Name	Value	
V4 OC Entries	64	
V6 OC Entries	0	
V4 Primary Entries	0	
V4 Secondary Entries	64	<<< This the total secondary addresses pushed from CP for each subnet
V4 RIB Entries	64	<<< This is the total number of v4 subnets pushed from CP
V6 RIB Entries	128	<<< This is the total number of v4 subnets pushed from CP
OC replay entry count	96	

The following example shows the details of each route entry:

```

/* Verification for non-default VRF */
Router#show cnbng-nal dynamic-routes afi ipv4

```

Location: 0/RSP0/CPU0

```

Index                : 1
Interface            : Loopback24
VRF                  : vrfone
AFI                  : IPv4
Prefix               : 10.0.0.0/20
Secondary address    : 10.0.0.1
Route tag            : 41
State                : RIB_REQ_COMPLETE
SRG group name       :
Route metric         : 0

```

[Event History]

Event Name	Time Stamp
Route OC request sent	Jun 15 15:29:10.144
Added secon V4 addrs on lb	Jun 15 15:29:10.144
Route update succeed	Jun 15 15:29:10.144
V4 route add success	Jun 15 15:29:10.144

=====

```

Router#show cnbng-nal dynamic-routes afi ipv6

```

Thu Jun 16 08:06:25.312 GMT

Location: 0/RSP0/CPU0

```

Index                : 1
Interface            : Loopback20
VRF                  : vrfone
AFI                  : IPv6

```

Configure Loopback Interface

```

Prefix                : 4001::/52
Secondary address     : NA
Route tag              : 31
State                  : RIB_REQ_COMPLETE
SRG group name         :
Route metric           : 0

```

[Event History]

Event Name	Time Stamp
Added secon V6 addrs on lb	Jun 15 15:29:05.152
Skip V6 rt install (standby)	Jun 15 15:29:05.152
Route update succeed	Jun 15 15:29:05.152

```
/* Verification for non-default VRF */
```

```
Router#nshow cnbng-nal dynamic-routes afi ipv4
Mon Aug 8 05:13:59.576 GMT
```

```
Location: 0/RSP0/CPU0
```

```

Index                : 1
Interface             : Loopback16
VRF                   : vrftwo
AFI                   : IPv4
Prefix                : 10.0.0.0/20
Secondary address     : 10.0.0.1
Route tag              : 32
State                  : RIB_REQ_COMPLETE
SRG group name         : group32
Route metric           : 0

```

[Event History]

Event Name	Time Stamp
Route OC request sent	Aug 4 15:39:24.288
Added secon V4 addrs on lb	Aug 4 15:39:24.288
Route update succeed	Aug 4 15:39:24.416
V4 route add success	Aug 4 15:39:24.416

```

Index                : 2
Interface             : Loopback17
VRF                   : vrftwo
AFI                   : IPv4
Prefix                : 10.0.0.0/20
Secondary address     : 10.0.0.1
Route tag              : 32
State                  : RIB_REQ_COMPLETE
SRG group name         : group32
Route metric           : 0

```

[Event History]

Event Name	Time Stamp
Route OC request sent	Aug 4 15:39:26.976
Added secon V4 addrs on lb	Aug 4 15:39:26.976
Route update succeed	Aug 4 15:39:26.976
V4 route add success	Aug 4 15:39:26.976

=====

Configure DHCP

This section describes the steps to configure DHCP for cnBNG BNG user plane.

The basic DHCP configurations include these steps:

- Creating a cnBNG profile
- Assigning the cnBNG profile to access-interfaces

Configuration Example

```
Router(config)#dhcp ipv4
/* Create a cnBNG profile */
Router(config-dhcpv4)#profile cnbng_1 cnbng
Router(config-dhcpv4-cnbng-profile)#exit
/* Assign the cnBNG profile to access-interfaces */
Router(config-dhcpv4)#interface bundle-Ether 1.1 cnbng profile cnbng_1
Router(config-dhcpv4)#interface bundle-Ether 2.1 cnbng profile cnbng_1
Router(config-dhcpv4)#commit
```

Similarly, you can configure the DHCP IPv6 profiles.

Running Configuration

```
Router#show run dhcp ipv4
Wed Oct 14 16:48:56.814 UTC
dhcp ipv4
  profile cnbng_1 cnbng
  !
  interface Bundle-Ether1.1 cnbng profile cnbng_1
  interface Bundle-Ether2.1 cnbng profile cnbng_1
  !
```

```
Router#show run dhcp ipv6
Wed Oct 14 16:49:19.095 UTC
dhcp ipv6
  profile cnbng_1 cnbng
  !
  interface Bundle-Ether1.1 cnbng profile cnbng_1
  interface Bundle-Ether2.1 cnbng profile cnbng_1
  !
```

Configure Subscriber Gateway Address and Subnet Route

Table 2: Feature History Table

Feature Name	Release Information	Feature Description
Disable Notifications for Dynamic Programming of Subscriber Gateway Address	Release 7.4.2	This feature allows you to disable the notifications exchanged internally between software components when the user plane (UP) of a cloud-native BNG (cnBNG) network programs the gateway address for its subscriber. It prevents excessive notifications when many active subscribers are on the UP, thus reducing the overhead on UP resources. The feature introduces the following command: <code>disable-secondary-address-notification</code>

In cnBNG, the IP address management is more dynamic. Hence, the loopback interface for IPoE or PPPoE subscribers isn't provisioned in the user profile of the subscriber with static configuration. cnBNG user plane selects the loopback based on the subnet allocated to a loopback dynamically at cnBNG user plane.



Note For every VRF, one loopback must be present on the UP.

Consider this example,

```
On RSP0:
Tue Jul 28 05:55:13.015 UTC
cnbng-nal location 0/RSP0/CPU0
hostidentifier asr9k-1
up-server ipv4 192.0.2.1 vrf default
cp-server primary ipv4 198.51.100.1
auto-loopback vrf default
  interface Loopback1
    primary-address 10.0.0.1
  !
!
On RSP1:
Tue Jul 28 05:56:13.015 UTC
cnbng-nal location 0/RSP1/CPU0
hostidentifier asr9k-1
up-server ipv4 192.0.2.1 vrf default
cp-server primary ipv4 198.51.100.1
auto-loopback vrf default
  interface Loopback1
    primary-address 10.0.0.1
  !
!
```

In this example, the CP assigns 10.11.12.0/24 as subnet, and 10.11.12.1/32 as gateway address to subscribers under the default VRF. This gateway address serves as the DHCPv4 server address for DHCPv4 OFFER or ACK messages. The *cnbng-nal* process uses Operations Center (OC) to configure this gateway address as secondary IP address on the loopback and route provision APIs to program the entry in the L3 routing table.



Note The system supports a maximum of 32 secondary IP addresses under an interface.

```
Router#show ipv4 interface loopback 1
Tue Jul 28 05:29:58.741 UTC
Loopback1 is Up, ipv4 protocol is Up
Vrf is default (vrfid 0x60000000)
Internet address is 10.0.0.1/32
Secondary address 10.11.12.1/32
```

```
Router#show route vrf all ipv4 subscriber
A 10.11.12.0/24 [1/0] via 0.0.0.0, 00:10:29
```



Note The dynamic programming of the subnet (secondary gateway) under the loopback causes a major churn on the UP if large scale of active subscribers is present on the node. Hence, the secondary address programming is disabled, by default.

Enable Secondary Address Programming

It's mandatory to enable the secondary address programming on cnBNG user plane. To enable that, use the **secondary-address-update enable** command under the *cnbng-nal* configuration mode.

Configuration Example

```
Router#configure
Router(config)#cnbng-nal location 0/RSP0/CPU0
Router(config-cnbng-nal)#secondary-address-update enable
Router(config-cnbng-nal)#commit
```

Running Configuration

```
Router#show running-config cnbng-nal location 0/RSP0/CPU0
cnbng-nal location 0/RSP0/CPU0
secondary-address-update enable
!
```



Note From Release 7.4.2 onwards, you can disable internal notifications on the UP while it programs the secondary address on the loopback interface by configuring the command **disable-secondary-address-notification**.

Disable Notifications for Dynamic Programming of Subscriber Gateway Address

In a cnBNG network, the CP assigns the gateway address for each subscriber. The UP dynamically programs gateway address assigned to each subscriber as a secondary IP address on its loopback interface. During this configuration, UP internally exchanges notification messages between various software components. The more the number of active subscribers on the UP, the more the notifications. To preserve valuable time and resources of the UP, you can disable notifications using the command **disable-secondary-address-notification** in the **cnbng-nal-local** config mode.

Configuration Example

```
Router#configure
Router(config)#cnbng-nal location 0/RSP0/CPU0
Router(config-cnbng-nal-local)#disable-secondary-address-notification
Router(config-cnbng-nal-local)#commit
```

Running Configuration

The following running configuration on cnBNG UP includes basic UP configuration as well:

```
Router#show running-config cnbng-nal location 0/RSP0/CPU0
cnbng-nal location 0/1/CPU0
  hostidentifier RTR1
  auto-loopback vrf test
    interface Loopback1
      primary-address 10.1.1.1
    !
  !
  auto-loopback vrf default
    interface Loopback0
      primary-address 10.30.30.1
    !
  !

  up-server ipv4 10.11.11.1 gtp-port 15002 pfcport 15003 vrf default
  cp-server primary ipv4 10.11.11.2
  enable-test-server
  disconnect-history file-logging-enable
  secondary-address-update enable
  disable-secondary-address-notification
  route-summary tag 111
  cp-association retry-count 5
  !
```

Configure Route Summary

This section describes the steps to configure route summary for the cnBNG user plane.

The NAL handles the following routes:

- Individual subscriber routes
- Summary routes for subscriber pool subnet

The subscriber routes are part of the subscriber provisioning message, which includes:

- WAN IP address (/32 or /128 subnet)
- LAN IP (prefix delegation)

The summary routes are for the subscriber pool subnet which are exported to the core network to download traffic towards the subscriber. On physical BNG, the subscriber pool subnets were configured as static routes and redistributed through BGP or IGP. With cnBNG and auto-loopback selection, these subnets for the subscribers are added dynamically to the loopback. Every time a new subscriber pool subnet is added to the loopback, the same is added to the RIB with the tag that is provided by the CP. If tag is '0', the NAL uses the tag configured under the cnbng-nal. Routes with this tag can be exported to the core using the Routing Protocol for Low-Power and Lossy Networks (RPLs).

To configure route summary, use the **route-summary** command under the cnbng-nal configuration mode.

Configuration Example

```
Router#configure
Router(config)#cnbng-nal location 0/RSP0/CPU0
Router(config-cnbng-nal)#route-summary tag 10
Router(config-cnbng-nal)#commit
```

Running Configuration

```
Router#show running-config cnbng-nal location 0/RSP0/CPU0
cnbng-nal location 0/RSP0/CPU0
  route-summary tag 10
!
```

After the first subnet is installed on NAL, the following routes are added to the system:

```
A 10.11.12.0/24 [1/0] via 0.0.0.0, 0d01h
```

Export Routes to Core Network

This section describes how to export routes to core network as part of enabling cnBNG user plane functionality.

Configuration Example

```
Router#configure
Router(config)#route-policy test-policy-cnbng
Router(config-rpl)#if tag eq 10 then
Router(config-rpl-if)#set community (123:100)
Router(config-rpl-if)#done
Router(config-rpl-if)#endif
Router(config-rpl)#end-policy
Router(config)#commit

Router(config)#router ospf 10
Router(config-ospf)#vrf test-vrf-cnbng
Router(config-ospf-vrf)#redistribute subscriber route-policy test-policy-cnbng
Router(config-ospf-vrf)#commit
```

Running Configuration

```
Router#show running-config route-policy test-policy-cnbg
route-policy test-policy-cnbg

    if tag eq 10 then

        set community (123:100)

    done

endif

end-policy
!
```

```
Router#show running-config router ospf
router ospf 10
vrf test-vrf-cnbg
 redistribute subscriber route-policy test-policy-cnbg
!
```

Configure ARP Scale Mode

This section describes the steps to configure ARP scale mode for the cloud-native BNG user plane.

To disable interface entry creation by ARP for each subscriber interface on the data plane (line cards), you must enable ARP scale mode for the subscriber using the **arp scale-mode-enable** command in subscriber configuration mode.

Configuration Example

```
Router#configure
Router(config)#subscriber
Router(config-subscriber)#arp scale-mode-enable
Router(config-subscriber)#commit
```

Running Configuration

```
Router#show running-config subscriber
Sat Aug 22 06:36:21.422 UTC
subscriber
arp scale-mode-enable
!
```

Configure Cloud Native BNG over Pseudowire Headend

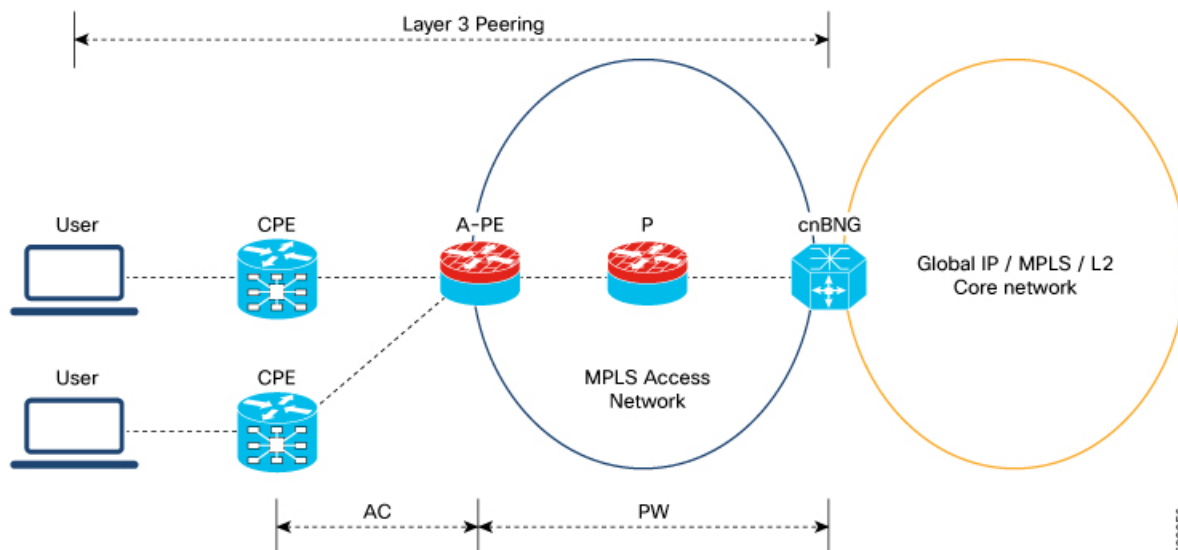
Table 3: Feature History Table

Feature Name	Release Information	Feature Description
Establishing Cloud Native BNG Sessions over Pseudowire Headend (PWHE)	Release 7.4.2	This feature establishes Cloud Native BNG subscriber sessions on PWHE interfaces. PWHE enables an easy and scalable mechanism for tunneling cnBNG traffic into a common IP, MPLS, or L2 network.

Cloud Native BNG provides subscriber support over Pseudowire Headend (PWHE). PWHE provides L3 connectivity to customer edge nodes through a pseudowire connection. PWHE terminates the L2VPN circuits that exist between the access-provide edge (A-PE) nodes, to a virtual interface, and performs routing on the native IP packet. Each virtual interface can use one or more physical interfaces towards the access cloud to reach customer Router through the A-PE nodes.

This figure shows a sample topology for Cloud Native BNG over Pseudowire Headend:

Figure 1: Sample Topology for Cloud Native BNG over Pseudowire Headend:



Restrictions

You can not configure eight ECMP links on the same PE device.

Configuration Example

This section provides the sample configurations for BNG over Pseudowire Headend:

The following is the sample configuration to allow IPOE or PPPOE subscriber to bring up from the PWHE access interface on the cnBNG:

```
Router#configure
```

```

Router(config)#interface PW-Ether100.102
Router(config-subif)#ipv4 unnumbered Loopback100
Router(config-subif)#ipv6 enable
Router(config-subif)#load-interval 30
Router(config-subif)#ipsubscriber
Router(config-cnbnng-nal-ipsub)#ipv4 l2-connected
Router(config-cnbnng-nal-ipsub-l2conn)#initiator dhcp
Router(config-cnbnng-nal-ipsub-l2conn)#exit
Router(config-cnbnng-nal-ipsub)#ipv6 l2-connected
Router(config-cnbnng-nal-ipsub-ipv6-l2conn)#initiator dhcp
Router(config-cnbnng-nal-ipsub-ipv6-l2conn)#exit
Router(config-cnbnng-nal-ipsub)#exit
Router(config-subif)#pppoe enable
Router(config-subif)#encapsulation ambiguous dot1q any second-dot1q 102
Router(config-subif)#commit

```

This example shows the configuration of DHCPv4 on PWHE interfaces:

```

Router#configure
Router(config)#dhcp ipv4
Router(config-dhcpv4)#profile cn4 cnbnng
Router(config-dhcpv4-cnbnng-profile)#exit
Router(config-dhcpv4)#interface PW-Ether100.102 cnbnng profile cn4
Router(config-dhcpv4)#interface PW-Ether100.103 cnbnng profile cn4
Router(config-dhcpv4)#interface PW-Ether100.104 cnbnng profile cn4
Router(config-dhcpv4)#commit

```

This example shows the configuration of DHCPv6 on PWHE interface:

```

Router#configure
Router(config)#dhcp ipv6
Router(config-dhcpv6)#profile cn4 cnbnng
Router(config-dhcpv6-cnbnng-profile)#exit
Router(config-dhcpv6)#interface PW-Ether100.102 cnbnng profile cn6
Router(config-dhcpv6)#interface PW-Ether100.103 cnbnng profile cn6
Router(config-dhcpv6)#commit

```

Running Configuration

The following example displays the running configuration of pw-ether interface.

```

Router#show running-config interface PW-Ether 100.102
Thu Feb  3 11:33:58.450 IST
interface PW-Ether100.102
  ipv4 unnumbered Loopback100
  ipv6 enable
  load-interval 30
  ipsubscriber
  ipv4 l2-connected
    initiator dhcp
  !
  ipv6 l2-connected
    initiator dhcp
  !
  !
  pppoe enable
  encapsulation ambiguous dot1q any second-dot1q 102
  !

```

Configure DHCPv4 on PWHE interface:

```
Router#show run dhcp ipv4
Thu Feb  3 11:55:01.903 IST
dhcp ipv4
  profile cn4 cnbng
!
interface PW-Ether100.102 cnbng profile cn4
interface PW-Ether100.103 cnbng profile cn4
interface PW-Ether100.104 cnbng profile cn4
!
```

Configure DHCPv6 on PWHE interface:

```
Router#show run dhcp ipv6
Thu Feb  3 11:55:07.906 IST
dhcp ipv6
  profile cn6 cnbng
!
interface PW-Ether100.102 cnbng profile cn6
interface PW-Ether100.103 cnbng profile cn6
!
```

Verify cnBNG User Plane Configuration

This section describes the show commands to be executed on the router to verify cloud native BNG user plane configuration.

For details on cnBNG commands, see the *Cloud Native BNG Command Reference for Cisco ASR 9000 Series Routers*.

Verify cnBNG NAL Process Information

You can use the following commands to verify the NAL process information on cnBNG user plane.

- Router#show cnbng-nal process-info location 0/RSP0/CPU0
Mon Aug 3 00:12:42.080 UTC

```
Location: 0/RSP0/CPU0

HA Pre_Init Role      : PRIMARY
HA Role               : PRIMARY
Restart-flag          : FALSE
card_type              : 0
Node-Id               : 0
Disc-Hist File-logging : FALSE
Test-server config-enabled: FALSE

Proc-flags            : 8000FFBF

OT Connection Status: UP
IM Connection Status: UP
IPv4 RIB Connection Status: UP
IPv6 RIB Connection Status: UP
SUBDB Connection Status: UP
```

```

•
Router#show cnbng-nal process-readiness
Mon Aug 3 00:12:00.778 UTC

Location: 0/RSP1/CPU0

NAL resync pending flags:
  Service Resync Pending
  Interface Resync Pending
  IPv4 Route Resync Pending
  IPv6 Route Resync Pending

SIR status: not ready

Location: 0/RSP0/CPU0
NAL resync pending flags:
  NONE

SIR status: ready

•
Router#show processes cnbng_nal
Fri Sep 11 09:22:45.139 UTC
      Job Id: 456
      PID: 1543

Router#show processes memory 1543
Fri Sep 11 09:24:12.398 UTC

```

JID	Text (KB)	Data (KB)	Stack (KB)	Dynamic (KB)	Process
456	992	1700604	200	19999	cnbng_nal

Verify Control Plane Connection Status

You can use the following command to verify the connection status of cnBNG control plane.

```

•
Router#show cnbng-nal cp connection status
Fri Feb 19 11:27:31.178 UTC

Location: 0/RSP0/CPU0

User-Plane configurations:
-----
IP           : 10.105.227.96
GTP Port     : 2152
PFCEP Port   : 8805
VRF          : default

Control-Plane configurations:
-----
PRIMARY IP   : 10.84.102.235
GTP Port     : 2152
PFCEP Port   : 8805

Association retry count: 10

Connection Status: Up

```

```

Connection Status time stamp: Thu Feb 11 12:46:19 2021

Connection Prev Status : Down
Connection Prev Status time stamp: Thu Feb 11 12:44:55 2021

Association status: Active
Association status time stamp: Thu Feb 11 12:46:18 2021

```

Verify Subscriber Information

You can use the following commands to verify subscriber information on the cnBNG user plane.

```

•
Router#show cnbng-nal subscriber access-interface bundle-Ether 1.1
Mon Aug 3 00:04:42.558 UTC
=====
Location: 0/RSP0/CPU0
=====

              Type              PPPoE              IPoE
              ====              =====              ===

Session Counts by State:
    initializing                0                0
    connecting                  0                0
    connected                   0                0
    activated                   0               8000
    idle                        0                0
    disconnecting               0                0
    Total:                      0               8000

Session Counts by Address-Family:
    none                        0                0
    ipv4                       0                0
    ipv6                       0               8000
    dual                        0                0
    Total:                      0               8000

=====
Location: 0/RSP1/CPU0
=====

              Type              PPPoE              IPoE
              ====              =====              ===

Session Counts by State:
    initializing                0                0
    connecting                  0                0
    connected                   0                0
    activated                   0               8000
    idle                        0                0
    disconnecting               0                0
    Total:                      0               8000

Session Counts by Address-Family:
    none                        0                0
    ipv4                       0                0
    ipv6                       0               8000

```

Verify Subscriber Information

```

          dual          0          0
        Total:         0        8000

```

```

Router#show cnbng-nal subscriber all
Fri Sep 11 06:07:52.343 UTC
Codes: CN - Connecting, CD - Connected, AC - Activated,
       ID - Idle, DN - Disconnecting, IN - Initializing

```

CPID(hex) Ifhandle	Interface	State	Mac Address	Subscriber IP Addr / Prefix (Vrf)
1005ca0	BE2.500.ip2149474448	AC	0010.942e.3b00	13.0.92.160 (default) 0x225e60 1:4::5c9f (IANA) 2003:db0:0:5c9e::/64 (IAPD)
10053b2	BE2.500.ip2149466000	AC	0010.942e.3689	13.0.83.175 (default) 0xfdfef0 1:4::53b1 (IANA) 2003:db0:0:53b0::/64 (IAPD)
1004c81	BE2.600.ip2149013936	AC	0010.942e.5230	13.0.76.129 (default) 0x4079a0 1:4::4c80 (IANA) 2003:db0:0:4c7f::/64 (IAPD)
1004aaa	BE2.500.ip2149353232	AC	0010.942e.3205	13.0.74.169 (default) 0x5192e0 1:4::4aa9 (IANA) 2003:db0:0:4aa8::/64 (IAPD)
1004927	BE2.600.ip2149518576	AC	0010.942e.50b1	13.0.73.116 (default) 0x219ba0 1:4::4926 (IANA) 2003:db0:0:4925::/64 (IAPD)
10047e4	BE2.800.ip2149422928	AC	0010.9431.a7c7	13.0.71.228 (default) 0x41ff60 1:4::47e4 (IANA) 2003:db0:0:47e2::/64 (IAPD)
1004777	BE2.600.ip2149520224	AC	0010.942e.5021	13.0.71.115 (default) 0x41420 1:4::4776 (IANA) 2003:db0:0:4775::/64 (IAPD)
1003a6d	BE2.800.ip2149369728	AC	0010.9431.a3a1	13.0.58.105 (default) 0x141360 1:4::3a6d (IANA)

```

2003:db0:0:3a6a::/64 (IAPD)
10038b7 BE2.600.ip2149362240 AC 0010.942e.4bb2 13.0.56.178 (default) 0x259aa0
1:4::38b6 (IANA)
2003:db0:0:38b5::/64 (IAPD)
10028ba BE2.500.ip2149210768 AC 0010.942e.2873 13.0.40.185 (default) 0x129620
1:4::28b9 (IANA)
2003:db0:0:28b8::/64 (IAPD)
100247b BE2.600.ip2149396320 AC 0010.942e.46a3 13.0.36.113 (default) 0x4b8e0
1:4::2471 (IANA)
2003:db0:0:2470::/64 (IAPD)
100207a BE2.500.ip2149356496 AC 0010.942e.2663 13.0.32.117 (default) 0x1a9460
1:4::2079 (IANA)
2003:db0:0:2078::/64 (IAPD)
1001d3f BE2.600.ip2149251360 AC 0010.942e.44d4 13.0.29.61 (default) 0xcc760

```

```

•
Router#show cnbng-nal subscriber all summary
Sun Aug 2 16:26:44.281 UTC
=====
Location: 0/RSP0/CPU0
=====

```

Type	PPPoE	IPoE
====	=====	=====
Session Counts by State:		
initializing	0	0
connecting	0	0
connected	0	0
activated	0	130
idle	0	0
disconnecting	0	0
Total:	0	130
Session Counts by Address-Family:		
none	0	0
ipv4	0	130
ipv6	0	0
dual	0	0
Total:	0	130

```

=====
Location: 0/RSP0/CPU0
=====

```

Type	PPoE	IPoE
====	=====	=====

Session Counts by State:

initializing	0	0
connecting	0	0
connected	226	0
activated	31774	0
idle	0	0
disconnecting	0	0
Total:	32000	0

Session Counts by Address-Family:

none	226	0
ipv4	7774	0
ipv6	0	0
dual	24000	0
Total:	32000	0

• Router#show cnbng-nal subscriber all detail

Mon Aug 3 00:00:14.624 UTC

Location: 0/2/CPU0

=====

Location: 0/RSP1/CPU0

=====

```

Interface: Bundle-Ether1.1.ip2148413040
UPID: 0x800e2e70
CPID: 0x0100918f
PPPOE Session Id: 0x0000
Type: IPoE
IPv4 Address: 0.0.0.0
IPv4 Framed Route:
  Prefix: 0.0.0.0/0
  Next Hop: 0.0.0.0
  Tag: 0
IPv6 IANA Address: 1::345c
IPv6 IAPD Prefix: 2004:cd0:0:188d::/64
CPE link local Address: ::
IPv6 Framed Route:
  Prefix: ::/0
  Next Hop: ::
  Tag: 0
IPv6 State: UP, Sat Jul 25 02:09:55 2020

```

```

Mac Address:          5065.aaab.d864
Inner VLAN ID:        Not Set
Outer VLAN ID:        100
Outer VLAN Cos:       0
Outer VLAN DEI:       1
Created:              Sat Jul 25 02:09:54 2020
State:                Activated
Ifhandle:             0x000b75a0
VRF:                  default
Access-interface:     Bundle-Ether1.1
Attribute List: 0x5556aed3f878
1:  ipv6-enable      len= 4  value= 1(1)
2:  ipv4-unnumbered len= 9  value= Loopback1
3:  strict-rpf       len= 4  value= 1(1)
4:  ipv6-strict-rpf len= 4  value= 1(1)
5:  ipv4-icmp-unreachable len= 4  value= 1(1)
6:  ipv6-unreachable len= 4  value= 1(1)
7:  ipv4-mtu         len= 4  value= 1500(5dc)
8:  ipv6-mtu         len= 4  value= 1500(5dc)
Session Accounting:   enabled
Interim Interval:     1800 secs
Last interim timestamp: Sun Aug 2 23:39:46 2020
Interim fail count:   None
Last interim failed reason: NA
Last stats:
  BytesIn: 0
  BytesOut: 384570
  BytesInGiga: 0
  BytesOutGiga: 0
Feature IDs activated :
  0x800e2e71
  0x800e2e72

```

```

•
Router#show cnbng-nal subscriber type ipoe summary
Mon Aug 3 00:06:15.032 UTC
=====
Location: 0/RSP0/CPU0
=====

              Type                PPPoE                IPoE
              ====                =====                ===

Session Counts by State:
  initializing          0                  0
  connecting            0                  0
  connected             0                  0
  activated             0                 8000
  idle                  0                  0
  disconnecting         0                  0
  Total:                0                 8000

Session Counts by Address-Family:
  none                  0                  0
  ipv4                  0                  0
  ipv6                  0                 8000
  dual                  0                  0
  Total:                0                 8000

=====
Location: 0/RSP1/CPU0
=====

```

```

                Type                PPPoE                IPoE
                ====                =====                ====

Session Counts by State:
    initializing                0                0
    connecting                  0                0
    connected                   0                0
    activated                   0                8000
    idle                        0                0
    disconnecting               0                0
    Total:                      0                8000

```

```

Session Counts by Address-Family:
    none                        0                0
    ipv4                        0                0
    ipv6                        0                8000
    dual                         0                0
    Total:                      0                8000

```

Router#

```

Router#show cnbng-nal subscriber type pppoe summary
Mon Aug  3 00:06:15.032 UTC
=====
Location: 0/RSP0/CPU0
=====

```

```

                Type                PPPoE                IPoE
                ====                =====                ====

Session Counts by State:
    initializing                0                0
    connecting                  0                0
    connected                   0                0
    activated                   31031               0
    idle                        0                0
    disconnecting               0                0
    Total:                      31031               0

```

```

Session Counts by Address-Family:
    none                        0                0
    ipv4                        31031               0
    ipv6                        0                0
    dual                         0                0
    Total:                      31031               0

```

Router#

```

Router#show cnbng-nal subscriber disconnect-history unique
Mon Aug  3 00:07:22.716 UTC

```

Location: 0/RSP1/CPU0

Count	Last Interface	Disconnected Reason	Last Time
			Disconnected
Location: 0/1/CPU0			
Location: 0/RSP0/CPU0			
Count	Last Interface	Disconnected Reason	Last Time
35494	Bundle-Ether1.1.ip2148328848	Disconnect by CP	Sat Jul 25 02:04:55 2020

```

14154    Bundle-Ether1.1.ip2148324096  Disconnect by clear CLI      Sat Jul 25
                                           02:05:48 2020

2777     Bundle-Ether1.1.ip2148194512  Disconnect due to create failure Sat Jul 25
                                           01:38:29 2020

```

```

Router#show cnbng-nal subscriber disconnect-history last location
Mon Aug  3 00:08:42.655 UTC

```

```

Disconnect-reason:      Disconnect by clear CLI
Disconnect-timestamp:   Sat Jul 25 02:05:48 2020
Message Txn ID: 55663
Session Txn ID: 1
Failed at: Sat Jul 25 01:57:03 2020
Feature Mask: 0x0
SVM State: 0
IPSUB flags: 0x600a200
Pending callback: 0x2
Data:

```

```

Interface:              Bundle-Ether1.1.ip2148324096
UPID:                   0x800cd300
CPID:                   0x01007bd8
PPPOE Session Id:      0x0000
Type:                   IPoE
IPv4 Address:           0.0.0.0
IPv4 Framed Route:
  Prefix:               0.0.0.0/0
  Next Hop:             0.0.0.0
  Tag:                  0
IPv6 IANA Address:     1:5::3de5
IPv6 IAPD Prefix:      2004:cd0:0:616::/64
CPE link local Address: ::
IPv6 Framed Route:
  Prefix:               ::/0
  Next Hop:             ::
  Tag:                  0
IPv6 State:            UP, Sat Jul 25 01:57:03 2020
Mac Address:           5065.aaab.cfbb
Inner VLAN ID:         Not Set
Outer VLAN ID:         100
Outer VLAN Cos:        0
Outer VLAN DEI:        1
Created:               Sat Jul 25 02:05:48 2020
State:                 Init
Ifhandle:              0x000323a0
VRF:                   default
Access-interface:      Bundle-Ether1.1
Attribute List: 0x559125764408
1: ipv6-enable         len= 4  value= 1(1)
2: ipv4-unnumbered     len= 9  value= Loopback1
3: strict-rpf          len= 4  value= 1(1)
4: ipv6-strict-rpf     len= 4  value= 1(1)
5: ipv4-icmp-unreachable len= 4  value= 1(1)
6: ipv6-unreachable    len= 4  value= 1(1)
7: ipv4-mtu            len= 4  value= 1500(5dc)
8: ipv6-mtu            len= 4  value= 1500(5dc)
Session Accounting:    enabled
Interim Interval:      1800 secs
Last interim timestamp: Sat Jul 25 02:05:47 2020
Interim fail count:    None
Last interim failed reason: NA

```

Verify Subscriber Information

```

Last stats:
  BytesIn: 0
  BytesOut: 540
  BytesInGiga: 0
  BytesOutGiga: 0
Feature IDs activated :
  0x800cd301
  0x800cd302

```

```

[Event History]
UPID: 0x800cd300

```

Event Name	Time Stamp	S, M
Create	Jul 25 01:57:02.999679	0, 0
New Session Request	Jul 25 01:57:02.999686	0, 0
Interface create	Jul 25 01:57:02.999823	0, 0
SVM create	Jul 25 01:57:03.018268	0, 0
UP Install(req)	Jul 25 01:57:03.018321	0, 0
UP Install(CB)	Jul 25 01:57:03.019220	0, 0
Last Assoc(req)	Jul 25 01:57:03.019232	0, 0
Last Assoc(CB)	Jul 25 01:57:03.020160	0, 1
Produce done(req)	Jul 25 01:57:03.020233	0, 0
IPv4 Caps Up	Jul 25 01:57:03.188034	0, 0
IPv6 Caps Up	Jul 25 01:57:03.233210	0, 0
Init data req	Jul 25 01:57:03.254482	0, 1
Init data cb	Jul 25 01:57:03.369027	0, 1
Client Session up	Jul 25 01:57:03.379152	0, 0
Produce done	Jul 25 01:57:03.977629	0, 0
IPv6 Up	Jul 25 01:57:03.977643	0, 0
Session up notified	Jul 25 01:57:03.977650	0, 0
Stats start	Jul 25 01:57:03.977841	0, 0
Disconnect notified	Jul 25 02:05:47.548202	0, 0
Disconnect ack	Jul 25 02:05:47.550293	0, 0
IPv4 Caps Down	Jul 25 02:05:47.652232	0, 0
IPv6 Caps Down	Jul 25 02:05:47.652333	0, 0
Final stats	Jul 25 02:05:47.753805	0, 0
SVM delete	Jul 25 02:05:47.780713	0, 0
SVM cleanup	Jul 25 02:05:48.283050	0, 0

Help: S - Sticky Event, M - Multiple Occurrence

```

Router#show cnbng-nal subscriber fadb

```

Mon Aug 3 00:03:12.858 UTC

```

Location: 0/RSP1/CPU0
=====

```

```

UPID:          0x800ec810
Service-ID: 0x04000003  Service-Name: JHV_VOICE
Feature-ID: 0x800ec812
Attribute List: 0x559cba6d0008
1: feature-acct-bitmask len= 4  value= 805306413(3000002d)
Accounting:          enabled
Interim fail count: None
Last interim failed reason: None
Last stats:
  BytesIn: 0
  BytesOut: 0
  BytesInGiga: 0
  BytesOutGiga: 0

```

```

UPID:          0x800e9470
Service-ID: 0x04000003  Service-Name: JHV_VOICE

```

```
Feature-ID: 0x800e9472
  Attribute List: 0x559cba6d0008
1: feature-acct-bitmask len= 4 value= 805306413(3000002d)
Accounting: enabled
Interim fail count: None
Last interim failed reason: None
Last stats:
  BytesIn: 0
  BytesOut: 0
  BytesInGiga: 0
  BytesOutGiga: 0

UPID: 0x800e7ee0
Service-ID: 0x04000003 Service-Name: JHV_VOICE
Feature-ID: 0x800e7ee2
  Attribute List: 0x559cba6d0008
1: feature-acct-bitmask len= 4 value= 805306413(3000002d)
Accounting: enabled
Interim fail count: None
Last interim failed reason: None
Last stats:
  BytesIn: 0
  BytesOut: 0
  BytesInGiga: 0
  BytesOutGiga: 0

UPID: 0x800e16e0
Service-ID: 0x04000004 Service-Name: LIVE_TV
Feature-ID: 0x800e16e1
  Attribute List: 0x559cba6d0008
1: feature-acct-bitmask len= 4 value= 0(0)
Accounting: disabled
Interim fail count: None
Last interim failed reason: None
Last stats:
  BytesIn: 0
  BytesOut: 0
  BytesInGiga: 0
  BytesOutGiga: 0

UPID: 0x800dda90
Service-ID: 0x04000003 Service-Name: JHV_VOICE
Feature-ID: 0x800dda91
  Attribute List: 0x559cba6d0008
1: feature-acct-bitmask len= 4 value= 805306413(3000002d)
Accounting: enabled
Interim fail count: None
Last interim failed reason: None
Last stats:
  BytesIn: 0
  BytesOut: 0
  BytesInGiga: 0
  BytesOutGiga: 0

UPID: 0x800dd4e0
Service-ID: 0x04000004 Service-Name: LIVE_TV
Feature-ID: 0x800dd4e1
  Attribute List: 0x559cba6d0008
1: feature-acct-bitmask len= 4 value= 0(0)
Accounting: disabled
Interim fail count: None
Last interim failed reason: None
Last stats:
  BytesIn: 0
```

```

BytesOut: 0
BytesInGiga: 0
BytesOutGiga: 0

```

Verify cnBNG NAL Counters

You can use the following commands to verify various NAL counters on the cnBNG user plane:

- ```

Router#show cnbng-nal counters type all
Sun Aug 2 20:42:49.548 UTC

Location: 0/RSP0/CPU0

Subscriber Counters

Counter name Value
=====
INTF Delete 500
IPv4 caps down 500
IPv6 caps down 500
IPv4 Rou del 500
IPv6 Rou del 500
Blkdis q empty 1
DB cache hit 17113

Error Counters

Counter name Value
=====

Accounting Counters

Counter name Value
=====
Sess Stop req 500
Feat Stop req 500
Stop req 3000
Stop cb 3000
Final cb 3000
Feat Final cb 500
Sess Final cb 2500

SVM Counters

Counter name Value
=====
Sess deleted 500
Delete CB 500
Feat deleted 1000
Cleanup 500
Sess stats, before svm 500
Feat stats, before svm 500

SPA Counters

```

```

Counter name Value
=====
SPA Delete Req 500
SPA Update Req 500
Sub Delete Res 500
Sub Update Res 500
Blkdic adm more 39
GTPu pkt sent 1000
PFCEP pkt sent 1463
GTPu pkt punt 500
PFCEP pkt punt 1463
DHCPv4 pkt punt 500
DHCPv6 pkt punt 500
DHCPv6 pkt inj 500
Alloc count 3463
Free count 3463
Mutex lock 6741
Mutex unlock 6741
Timer start 463
Timer expiry 463
Sub Update IPOE OK 500
Sub Delete IPOE OK 500

```

#### CP Recon Counters

-----

```

Counter name Value
=====

```

#### Histogram/API Performance Stats

-----

| API name      | 1ms  | 10ms  | 100ms | 1s  | 5s | 10s  | 20s  | 50s  | 100s  |
|---------------|------|-------|-------|-----|----|------|------|------|-------|
| =====         | ==== | ===== | ===== | ==  | == | ==== | ==== | ==== | ===== |
| Per trans     | 410  | 90    | 0     | 500 | 0  | 0    | 0    | 0    | 0     |
| Sub Create    | 0    | 0     | 0     | 0   | 0  | 0    | 0    | 0    | 0     |
| Sub Update    | 445  | 55    | 0     | 0   | 0  | 0    | 0    | 0    | 0     |
| Sub Delete    | 0    | 0     | 0     | 500 | 0  | 0    | 0    | 0    | 0     |
| IPOE Int Crt  | 0    | 0     | 0     | 0   | 0  | 0    | 0    | 0    | 0     |
| IPOE Int Upd  | 0    | 0     | 0     | 0   | 0  | 0    | 0    | 0    | 0     |
| IPOE Int Del  | 0    | 0     | 0     | 500 | 0  | 0    | 0    | 0    | 0     |
| PPPOE Int Crt | 0    | 0     | 0     | 0   | 0  | 0    | 0    | 0    | 0     |
| PPPOE Int Upd | 0    | 0     | 0     | 0   | 0  | 0    | 0    | 0    | 0     |
| PPPOE Int Del | 0    | 0     | 0     | 0   | 0  | 0    | 0    | 0    | 0     |
| Sess Create   | 0    | 0     | 0     | 0   | 0  | 0    | 0    | 0    | 0     |
| Sess Update   | 0    | 0     | 0     | 0   | 0  | 0    | 0    | 0    | 0     |
| Sess Delete   | 0    | 0     | 10    | 490 | 0  | 0    | 0    | 0    | 0     |
| V4 RT Inst    | 0    | 0     | 0     | 0   | 0  | 0    | 0    | 0    | 0     |
| V4 RT Del     | 0    | 6     | 320   | 174 | 0  | 0    | 0    | 0    | 0     |
| V4 FR Inst    | 0    | 0     | 0     | 0   | 0  | 0    | 0    | 0    | 0     |
| V4 FR Del     | 0    | 0     | 0     | 0   | 0  | 0    | 0    | 0    | 0     |
| V6 RT Inst    | 0    | 0     | 0     | 0   | 0  | 0    | 0    | 0    | 0     |
| V6 RT Del     | 0    | 6     | 310   | 184 | 0  | 0    | 0    | 0    | 0     |
| V6 PD RT Inst | 0    | 0     | 0     | 0   | 0  | 0    | 0    | 0    | 0     |
| V6 PD RT Del  | 0    | 0     | 0     | 0   | 0  | 0    | 0    | 0    | 0     |
| V6 FR Inst    | 0    | 0     | 0     | 0   | 0  | 0    | 0    | 0    | 0     |
| V6 FR Del     | 0    | 0     | 0     | 0   | 0  | 0    | 0    | 0    | 0     |
| CDM Lookup    | 0    | 0     | 0     | 0   | 0  | 0    | 0    | 0    | 0     |
| CDM Insert    | 0    | 0     | 0     | 0   | 0  | 0    | 0    | 0    | 0     |
| CDM Update    | 1469 | 31    | 0     | 0   | 0  | 0    | 0    | 0    | 0     |
| Eval Lookup   | 0    | 0     | 0     | 0   | 0  | 0    | 0    | 0    | 0     |

```

•
Router#show cnbng-nal counters type all | beg SPA LIB
Sun Aug 2 20:44:07.902 UTC
SPA LIB Counters

Counter name Value
=====
pfcpx_rx_counter 6899
pfcpx_tx_counter 6900
gtpu_tx_counter 9048
gtpu_rx_counter 7510
pfcpx_keepalive_tx_counter 891
pfcpx_keepalive_rx_counter 890

SPA API counters

```

```

•
Router#show cnbng-nal counters type spa
Sun Aug 2 20:42:13.703 UTC

Location: 0/RSP0/CPU0

SPA Counters

Counter name Value
=====
SPA Delete Req 500
SPA Update Req 500
Sub Delete Res 500
Sub Update Res 500
Blkdic adm more 39
GTPu pkt sent 1000
PFCP pkt sent 1461
GTPu pkt punt 500
PFCP pkt punt 1461
DHCPv4 pkt punt 500
DHCPv6 pkt punt 500
DHCPv6 pkt inj 500
Alloc count 3461
Free count 3461
Mutex lock 6727
Mutex unlock 6727
Timer start 461
Timer expiry 461
Sub Update IPOE OK 500
Sub Delete IPOE OK 500

```