

UP Geo Redundancy

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Feature Summary

Table 1: Feature Summary

Applicable Product(s) or Functional Area	cnBNG
Applicable Platform(s)	SMI
Feature Default Setting	Disabled – Configuration Required
Related Changes in this Release	First Release
Related Documentation	Not Applicable

Revision History

Table 2: Revision History

Revision Details	Release
Introduced IPv4 and dual-stack support for L3 routed subscriber sessions with SRG.	2026.02.0
Introduced support for SRG warm standby mode.	2025.03.0
Introduced support for L3 routed subscriber sessions with SRG.	2025.01.0
Introduced support for SRG PPPoE sessions.	2025.01.0
First introduced.	2022.04.0

Feature Description

Note This feature is Network Services Orchestrator (NSO) integrated.

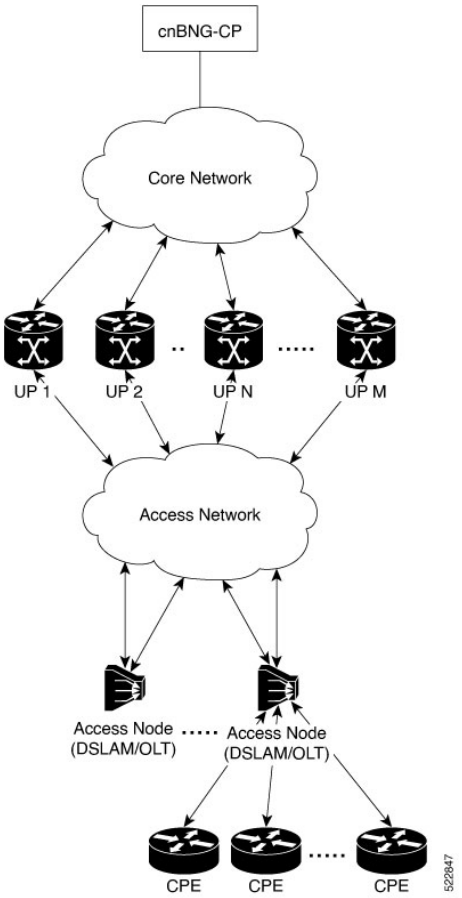
To provide redundancy for the subscriber sessions, cnBNG supports Geographical Redundancy across multiple User Planes (UPs), without having any L1 or L 2 connectivity between them. The UPs may be located in multiple geographical locations, and they have L3 connectivity over a shared core network through IP or MPLS routing.

The UP Geo redundancy feature supports IPoE DHCP-triggered sessions (IPv4, IPv6 and dual-stack), as well as PPPoE subscriber sessions.

UP Geo Redundancy Architecture

The following figure depicts a UP geo redundancy deployment network model:

Figure 1: UP Geo Redundancy Deployment Network Model



The redundancy pairing between UPs work by synchronizing the subscriber state from cnBNG CP to primary (active) and its subordinate (standby).

Geo redundancy works in conjunction with any of the access technologies. The CPEs are agnostic to redundancy; they see only one UP or gateway. The access nodes are dual or multi-homed for redundancy using a variety of technologies based on the service provider network design and choices. Multi-chassis Link Aggregation (MC-LAG), dual-homed (Multiple Spanning Tree - Access Gateway or MST-AG), Ring (MST-AG or G.8032), xSTP and seamless MPLS (pseudowires) are a few such access networks.

For more information on access technologies supported on UP, see the *Broadband Network Gateway Configuration Guide for Cisco ASR 9000 Series Routers* guide.

Subscriber Redundancy Group

Geo redundancy for subscribers is delivered by transferring the relevant session state from primary UP to subordinate UP which can then help in failover (FO) or planned switchover (SO) of sessions from one UP to another. Subscriber Redundancy Group (SRG) which is a set of access-interface (or a single access-interface) is introduced in cnBNG, and all subscribers in an SRG would FO or SO as a group.

The SRG has two modes of operation:

- Hot-standby

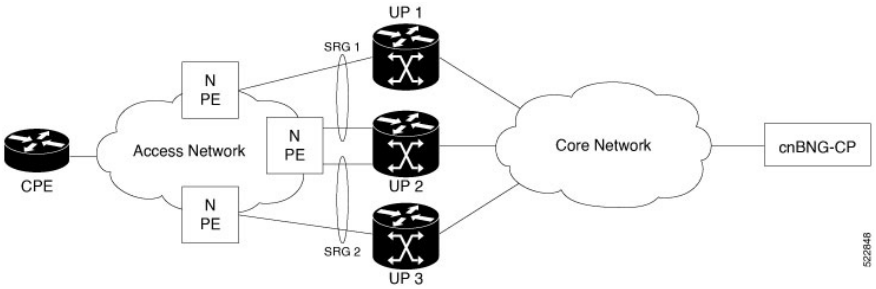
- Warm-standby

Hot-standby mode

Hot-standby is achieved by a 1:1 mirroring of subscriber session state from the primary to the subordinate where the entire provisioning is done before the FO or SO. The sessions provisioned on subordinate is in sync with the set up on the primary. Because the data plane is already set up for sub-second traffic impact, there is minimal action on switchover in the case of hot-standby mode and therefore, it is suitable for subscribers requiring high service level agreement (SLA). With appropriate capacity planning, the sessions can also be distributed across multiple UPs to achieve an M: N model. The primary-subordinate terminology is always in the context of a specific SRG; not for the UP as a whole.

The following figure depicts a typical subscriber redundancy group (SRG):

Figure 2: Subscriber Redundancy Group



SRG Virtual MAC

For seamless switchover between two UPs, the L2-connected CPE devices must not detect change in gateway MAC and IPv4 or IPv6 addresses. The access technology like MC-LAG uses the same MAC address on both UPs with active-standby roles, providing seamless switchover. Where MAC sharing is not provided by the access technology or protocol (like MST-AG, G.8032), the cnBNG SRG virtual MAC (vMAC) must be used.

For more information on SRG Virtual MAC, see the *BNG Geo Redundancy* chapter of *Broadband Network Gateway Configuration Guide for Cisco ASR 9000 Series Routers* guide.

SRG warm-standby mode

SRG warm-standby is a subscriber redundancy mode that

- pre-creates and maintains subscriber session context in process memory on standby user-plane nodes,
- enables rapid activation of subscriber services after a switchover event, and
- improves cost effectiveness by allowing a single standby User Plane (UP) node to provide redundancy for multiple user-plane instances.

Table 3: Feature History

Feature Name	Release Information	Description
SRG warm-standby mode	2025.03.0	This feature improves cost efficiency and resource utilization by allowing a single warm standby User Plane (UP) to provide redundancy for multiple UP instances. Instead of needing a separate standby for each active UP, you can use a single standby node to protect several UPs at once.

Session management between active and standby nodes

In Subscriber Redundancy Group (SRG) warm-standby mode, when a subscriber session is established, the control plane ensures that both the active and standby user-plane nodes are aware of the subscriber. However, only the active node programs subscriber sessions into hardware, while the standby node holds the session context in memory.

Switchover process and service restoration

During a switchover, the standby node quickly programs the cached sessions into hardware, reducing service restoration time to a few seconds. This approach is especially beneficial for PPPoE subscriber sessions, aligning with standards such as BBF TR-459 and providing a seamless experience during failover scenarios.

Compatible User Plane version

This feature works with cnBNG User Plane Release 25.4.1 and later versions.



Note SRG warm-standby mode is supported only for Point-to-Point Protocol over Ethernet (PPPoE) subscriber sessions.

Configure SRG warm-standby mode

Follow these steps to enable SRG warm-standby mode:

Procedure

Step 1 Use the **standby-mode warm** command in user-plane configuration mode to enable SRG warm-standby mode:

Example:

```
config
  user-plane instance instance_id
    user-plane user_plane_name
      peer-address ipv4 ipv4_address
      subscriber-profile  profile_name
      subscriber-redundancy
        group group_name
          standby-mode warm
        exit
      exit
```

```
    exit
  exit
 exit
```

NOTES:

- **subscriber-redundancy**: Configures subscriber geo-redundancy. All SRG groups are configured in this mode.
- **group** *group_name*: Specifies the name of the subscriber redundancy group that is unique to a user plane.
- **standby-mode warm**: Enables the SRG warm-standby mode.

This is a sample configuration.

```
user-plane
 instance 1
  user-plane asr9k-1
   peer-address ipv4 1.1.1.1
   subscriber-profile subs-upf
   subscriber-redundancy
    group Group1
     standby-mode warm
    exit
   exit
  exit
 exit
exit
```

Step 2 Use the **show subscriber redundancy srg-peer-id** command to verify the SRG warm-standby configuration.

Example:

```
bng# show subscriber redundancy srg-peer-id Peer1 detail
Tue Mar  18 12:19:14.448 UTC+00:00
subscriber-details
{
  "subResponses": [
    {
      "PeerID": "Peer1",
      "GroupID": "Group1",
      "Domain": "d1",
      "UP List": {
        "asr9k-1": {
          "N4 State": "Connected",
          "Srg State": "Up",
          "Srg Role": "Active",
          "Interface map": {
            "BundleEther1.100": 1,
            "BundleEther1.200": 2
          }
        },
        "asr9k-2": {
          "N4 State": "Connected",
          "Srg State": "Up",
          "Srg Role": "Standby",
          "Interface map": {
            "BundleEther1.100": 1,
            "BundleEther1.200": 2
          },
          "Standby Mode": "Warm"
        }
      },
      "Preferred Active": "asr9k-1"
    }
```

```
    ]
}
```

SRG cold standby mode

SRG cold standby mode is a subscriber redundancy configuration that

- defers subscriber session programming on the standby UPF until an SRG switchover occurs
- minimizes standby UPF resource usage by establishing subscriber state on the standby only after a switchover, and
- results in longer switchover times compared to warm standby, because state must be created after the event rather than beforehand.

Table 4: Feature History Table

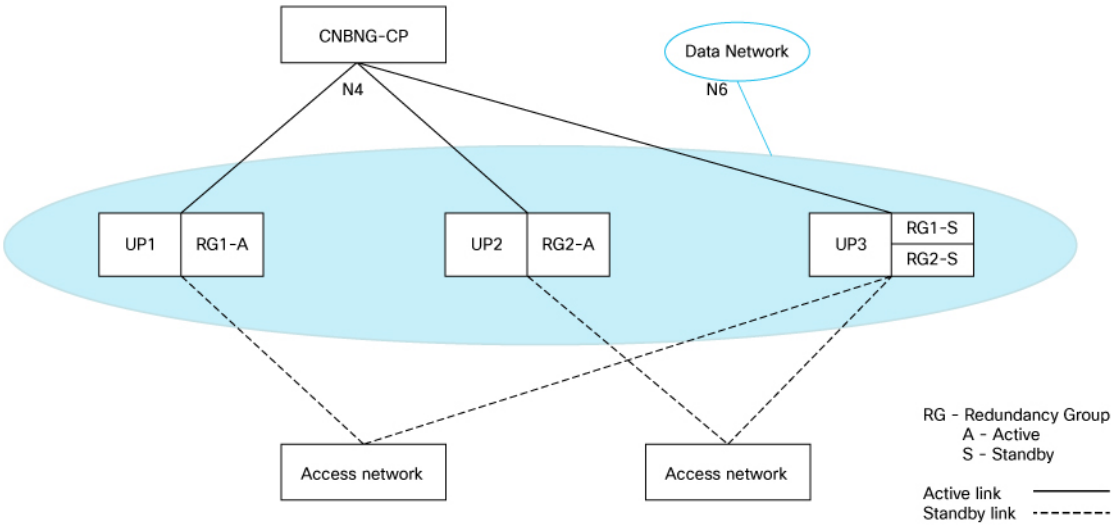
Feature Name	Release Information	Feature Description
SRG cold standby mode	Release 2026.03.0	You can optimize standby resource usage and maintain high availability for subscriber sessions using cold standby mode in Subscriber Redundancy Groups. In this mode, the Control Plane programs subscribers only on the active UPF; programming for the standby UPF is deferred until a switchover occurs. Once the standby group becomes active, the Control Plane automatically programs the subscribers on that UPF.

Recommendations and compatibility

SRG cold standby mode is recommended for scenarios where reduced resource usage on standby nodes is preferable to achieving the fastest possible switchover time. This mode supports L2-Connected IPoE and L3-Routed IPoE sessions, and works with CP-GR and rolling upgrade.

How session programming works in SRG cold standby mode

This figure illustrates how subscriber session programming is handled in SRG cold standby mode.



When a subscriber session is established in SRG cold standby mode, the Control Plane programs the session only on the active UPF. The standby UPF remains unprogrammed while in standby. During a switchover, when the standby SRG group becomes active, the Control Plane starts programming subscribers on the now-active UPF. When the cold UPF transitions back to SRG standby, the Control Plane deletes subscriber sessions from that UPF.

Configure SRG cold standby mode

Configure SRG cold standby mode to provide high availability and session continuity for IPoE subscriber sessions, while minimizing resource consumption on standby UPFs.

Before you begin

- Verify that your cnBNG platform and software version support SRG cold standby mode.
- Identify which SRG groups and session types (such as IPoE) you want to configure for cold standby mode.

Follow these steps to configure SRG cold standby mode for IPoE subscriber sessions:

Procedure

Step 1 Define the SRG group and configure the standby mode to **cold** for the group.

Example:

```
user-plane instance 1
  user-plane asr9k-1
   peer-address ipv4 10.1.1.1
   subscriber-profile subs-upf
   subscriber-redundancy
    group Group1
     standby-mode cold
    exit
   exit
```

```
  exit
 exit
exit
```

This configuration sets the SRG group to cold standby mode, ensuring the standby UPF does not maintain subscriber state until switchover.

Step 2 Use the **show subscriber redundancy srg-peer-id** command to verify that SRG cold standby mode is active.

Example:

```
bng# show subscriber redundancy srg-peer-id Peer1 detail

Tue Mar  18 12:19:14.448 UTC+00:00
subscriber-details
{
  "subResponses": [
    {
      "PeerID": "Peer1",
      "GroupID": "Group1",
      "Domain": "d1",
      "UP List": {
        "asr9k-1": {
          "N4 State": "Connected",
          "Srg State": "Up",
          "Srg Role": "Active",
          "Interface map": {
            "BundleEther1.100": 1,
            "BundleEther1.200": 2
          }
        },
        "asr9k-2": {
          "N4 State": "Connected",
          "Srg State": "Up",
          "Srg Role": "Standby",
          "Interface map": {
            "BundleEther1.100": 1,
            "BundleEther1.200": 2
          },
          "Standby Mode": "Cold"
        }
      },
      "Preferred Active": "asr9k-1"
    }
  ]
}
```

Standby Mode displays **Cold** to indicate that the SRG cold standby mode is active.

Step 3 Use the **show subscriber session count instance-id** command to view the subscriber session count information for a specific instance ID.

Example:

```
bng# show subscriber session count instance-id 1
Mon Mar  9  06:19:25.634 UTC+00:00
subscriber-details
{
  "sessionCount": 100
}
```

Step 4 Use the **show cnbng-nal subscriber all summary** command in the User Plane to view the summary of all subscriber sessions.

Example:

```
UP-asr9k-1# show cnbng-nal subscriber all summary
Mon Mar  9 06:13:42.700 UTC
=====================
Location: 0/RSP0/CPU0
=====================

               Type            PPPoE                   IPoE                    LAC             LNS
               ====            =====                   ====                    ===             ===
                                                 L2-Conn         Routed
                                                 =======         ======

Session Counts by State:
        initializing           0               0               0               0               0
          connecting           0               0               0               0               0
           connected           0               0               0               0               0
           activated           0               100             0               0               0
                idle           0               0               0               0               0
       disconnecting           0               0               0               0               0
               Total:          0               100             0               0               0


Session Counts by Address-Family:
                none           0               0               0               0               0
                ipv4           0               0               0               0               0
                ipv6           0               0               0               0               0
                dual           0               100             0               0               0
                 lac           0               0               0               0               0
              Total:           0               100             0               0               0
```

The sample output from UP-asr9k-1 shows that the sessions are programmed on the active UPF.

Example:

```
UP-asr9k-2# show cnbng-nal subscriber all summary
Mon Mar  9 06:13:42.700 UTC
=====================
Location: 0/RSP0/CPU0
=====================

               Type            PPPoE                   IPoE                    LAC             LNS
               ====            =====                   ====                    ===             ===
                                                 L2-Conn         Routed
                                                 =======         ======

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


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

The sample output from UP-asr9k-2 shows that the sessions are not programmed on the cold standby UPF.

Session Distribution Across SRG

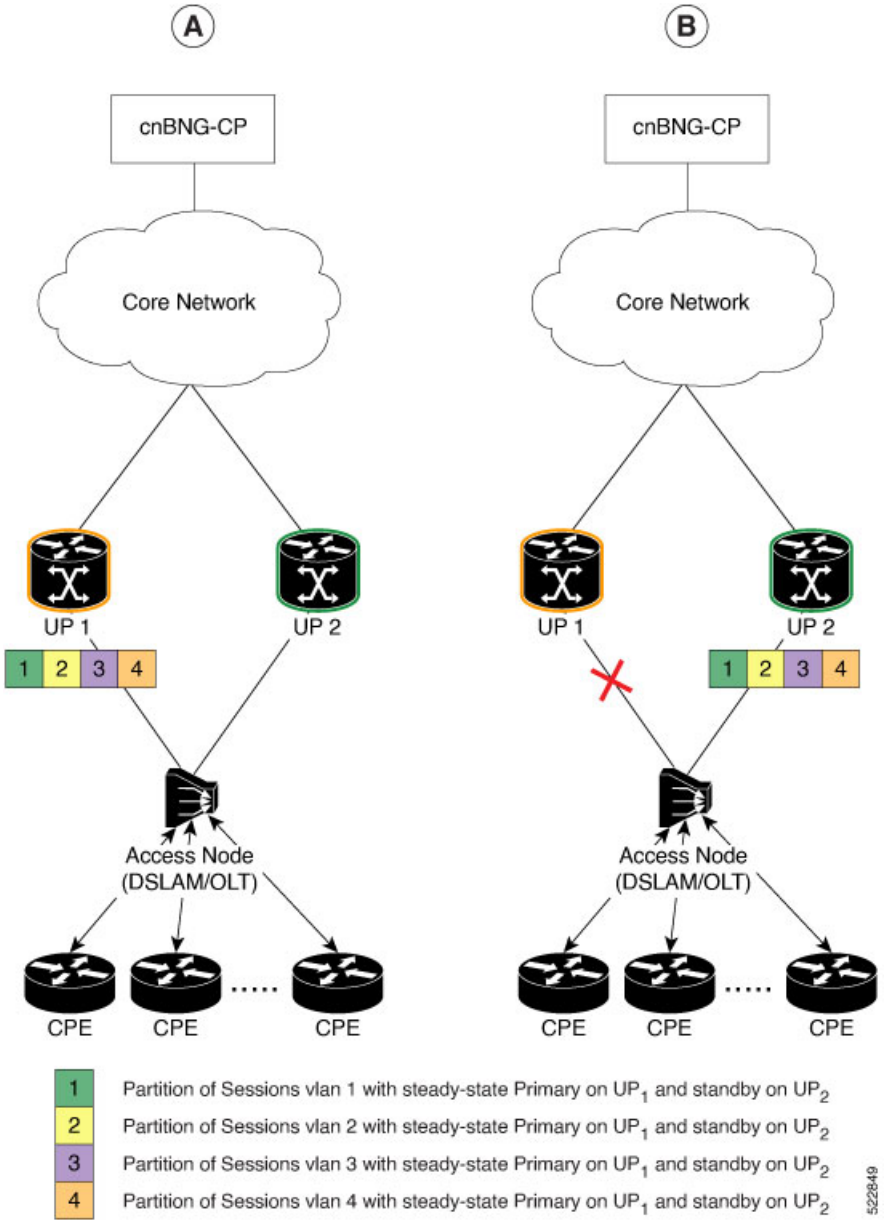
The session distribution across SRGs can be in either of these modes:

- Active-standby mode:

  In this mode, a dedicated standby UP can be a subordinate for multiple SRGs from different active UPs which are primaries for those respective SRGs.

  This figure shows an active-standby mode of session distribution across SRGs:

Figure 3: Active-standby Mode of Session Distribution



In figure A:

- Sessions are associated with partitions (VLAN 1, 2, 3 and 4) on UP1, with each VLAN mapped to separate SRG configured as primary role.
- UP2 acts as standby for all VLANs.
- Each VLAN has 8K sessions terminated on it.

In figure B:

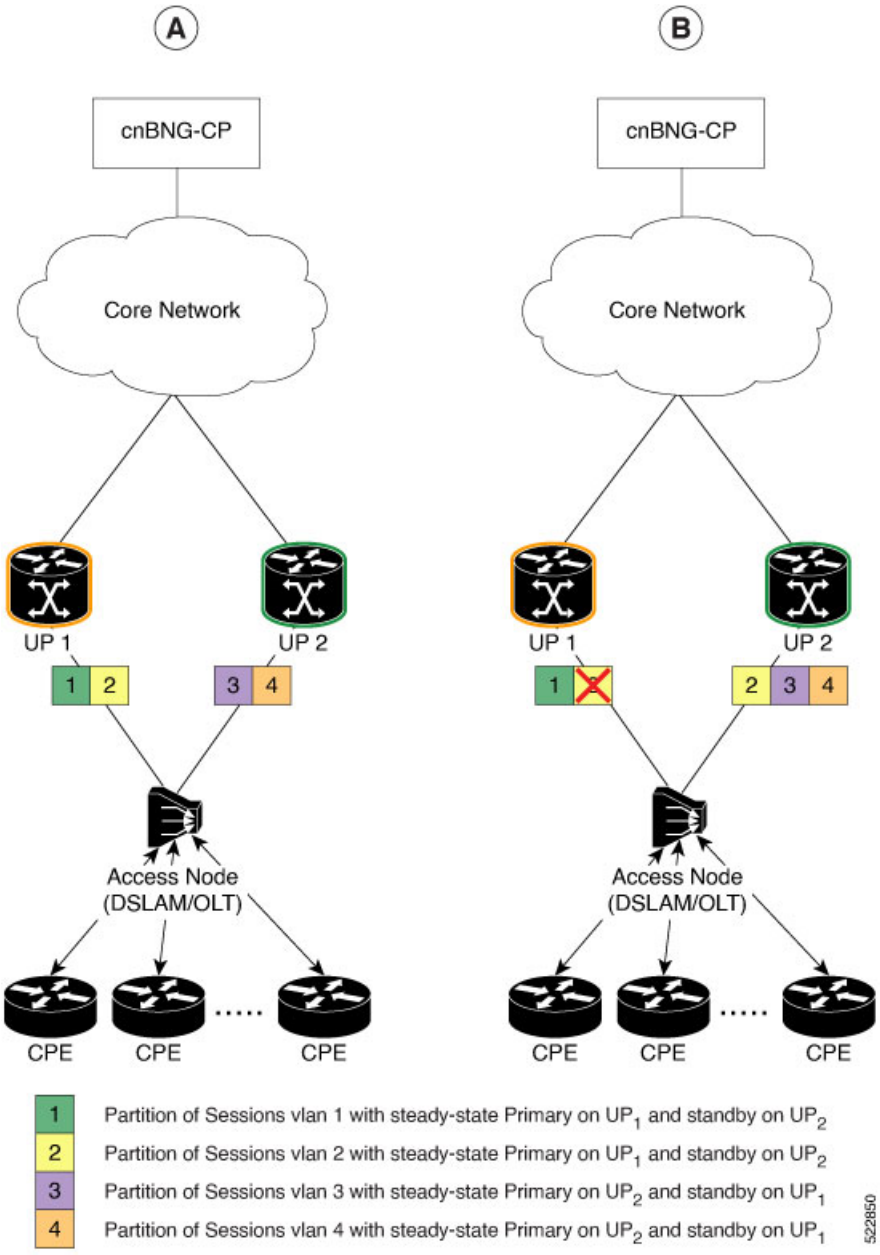
- An interface failure gets detected (using object-tracking of the access-interface).
- SRG for each VLAN on UP2 gets the primary role.
- All 32K sessions are switched to UP2.
- UP2 sees a session termination count of 32K.

- Active-active mode:

  In this mode, an UP can be primary for one SRG and a standby for another SRG at the same time.

  The following figure shows an active-active mode of session distribution across SRGs:

Figure 4: Active-active Mode of Session Distribution



In figure A:

- Sessions are associated with partitions (VLAN 1, 2) on UP1, with each VLAN mapped to separate SRG configured as primary role.
- Sessions are associated with partitions (VLAN 3, 4) on UP2, with each VLAN mapped to separate SRG configured as primary role.
- Each VLAN has 8K sessions terminated on it.
- Each UP has 16K sessions terminated on it.

In figure B:

- The interface associated with VLAN 2 on UP1 goes down.
- Sessions associated with partitions (VLAN 2) on UP1 are switched to UP2.
- UP1 sees a session termination count of 8K and UP2 sees a session termination count of 24K.

Benefits of UP Geo Redundancy

Major benefits of UP Geo Redundancy include:

- Supports various redundancy models such as 1:1 (active-active) and M:N, including M:1.
- Provides flexible redundancy pairing on access-link basis.
- Works with multiple access networks such as MC-LAG, dual-home and OLT rings.
- Supports various types of subscribers such as IPv4, IPv6 and dual-stack IPoE sessions.
- Provides failure protection to access link failures, N4 link failures, LC failures, RP failures and chassis failures.
- Performs automatic switchovers during dynamic failures or planned events such as maintenance, upgrades and transitions.
- Co-exists with other high availability (HA) or redundancy mechanisms.
- Does switchover of the impacted session group only; other session groups remain on the same UP.
- Provides fast convergence and rapid setup of sessions, with minimal subscriber impact during switchover.
- Provides automatic routing convergence towards core and efficient address pool management.
- Provides seamless switchover for subscriber CPE without the need for any signaling.
- Integrates with RADIUS systems.
- Does not impact session scale and call-per-second (CPS) during normal operation.

Supported Features in UP Geo Redundancy

These base geo redundancy features are supported:

- Multiple SRG groups to different peer routers.
- Hot-standby mode for subordinate (that is, subscribers provisioned in hardware on the subordinate as they are synchronized).
- Dynamic role negotiation between peers.
- Manual SRG switchover through command line interface (CLI).
- Dynamic failure detection using object tracking (link up-down, route and IPSLA tracking).
- Revertive timer per SRG group.

- SRG active-active mode without any access protocol.
- G.8032 (dual-home and ring) access technologies.

These DHCP features are supported:

- DHCPv6 IA-NA and IA-PD support for L2 connected sessions.
- DHCPv4 support for L2 connected sessions.
- DHCPv4 or DHCPv6 dual-stack support.
- DHCP server mode.
- Session initiation through DHCPv4 or DHCPv6 protocol.

UP Geo Redundancy Configuration Guidelines

UP Configuration Consistency

- Geo redundancy feature infrastructure synchronizes individual subscriber session state from primary to subordinate. But, it does not synchronize the UP related configurations (namely dynamic-template, DHCP profiles, policy-maps, access-interface configurations, external RADIUS or DHCP server, and so on).
- For successful synchronization and setup of subscriber sessions between the two UPs, it is mandatory that the relevant UP configurations must be identical on the two routers and on the access-interfaces pairs in the SRG.
- While the access-interfaces or their types (or both) may vary between the paired UPs, their outer-VLAN tag (that is, S-VLAN imposed by the access or aggregation devices) must be identical.
- Inconsistencies in base UP or SRG configurations may result in synchronization failure and improper setup of sessions on the subordinate.

Session Sync

Once the session is up on the primary node, the entire session information gets synced to the subordinate node. This includes dynamic synchronization of updates such as CoA or service logon.

Configuring UP Geo Redundancy

To configure the subscriber redundancy group in the control plane, use the following sample configuration:

```
config
  user-plane instance instance_id
    user-plane user_plane_name
      subscriber-redundancy
        group group_name
          disable
          domain-identifier domain_name
          peer-identifier peer_id
```

```
port-id-map port-name port_name port_number
preferred-role-active
revertive-timer revertive_timer_value
exit
```

NOTES:

- **subscriber-redundancy**: Configures subscriber geo-redundancy. All SRG groups are configured in this mode.
- **group** *group_name*: Specifies the name of the subscriber redundancy group that is unique to a user plane.
- **disable**: Disables an SRG group without deleting the entire configuration of the group. By default, an SRG group is enabled.
- **domain-identifier** *domain_name*: Specifies the domain name to identify all groups between two user planes.
- **peer-identifier** *peer_id*: Identifies the peer user-plane for the group. This identifier must be unique across all groups in the control plane. The same peer-identifier must be configured in the peer user-plane.
- **port-id-map port-name** *port_name port_number*: Specifies the mapping of access interfaces between user planes. At least one **port-map-id** must be configured.
- **preferred-role-active**: This is an optional configuration.

  Sets the preferred role active for user plane. Default value: false.
- **revertive-timer** *revertive_timer_value*: This is an optional configuration.

  Specifies the revertive timer in seconds. *revertive_timer_value* must be an integer in the range of 60 to 3600. This command is available only when **preferred-role-active** is configured.

Configuration Example

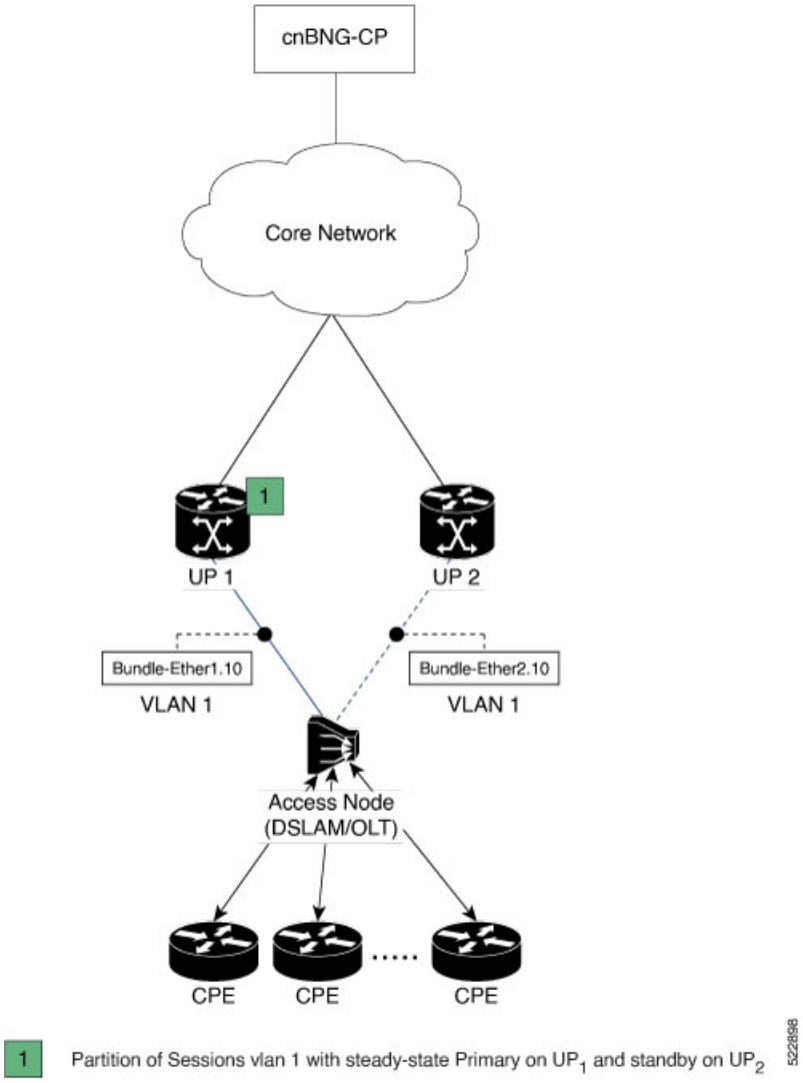
The following is a sample configuration for configuring UP Geo Redundancy, as illustrated in Figure 5.

```
config
  user-plane
   instance 1
    user-plane user-plane1
    peer-address ipv4 {UP1 ipv4-address}
     subscriber-redundancy
      group Group1
       preferred-role-active
       revertive-timer       3600
       domain-identifier     domain1
       peer-identifier       Peer1
       port-id-map port-name Bundle-Ether1.10 1
      exit
     exit
    exit
    user-plane user-plane2
    peer-address ipv4 {UP2 ipv4-address}
     subscriber-redundancy
      group Group1
       domain-identifier domain1
       peer-identifier   Peer1
       port-id-map port-name Bundle-Ether2.10 1
      exit
```

```
    exit
   exit
  exit
 exit
```

The following diagram illustrates the sample configuration.

Figure 5: Sample Configuration



Configuration Verification

To verify the configuration, execute the following commands:

- **show subscriber redundancy [count | debug | detail | gr-instance** *gr_instance_id* **| srg-peer-id** *srg_peer_id* **| upf** *upf_name* **]**
- **show subscriber redundancy-sync [gr-instance** *gr_instance_id* **| srg-peer-id** *srg_peer_id* **| upf** *upf_name* **]**

- **show subscriber dhcp [count | detail | filter** *filter_value* **| gr-instance** *instance_id* **| sublabel** *sublabel_name* **]**
- **show subscriber session [detail | filter { smupstate {** *upf_name*/**smUpSessionCreated } }]**
- **show subscriber synchronize [srg-peer-id** *peer_id* **| upf** *upf_name* **]**
- **show subscriber pppoe [detail | filter { srg-peer-id** *peer_id* **}]**

For more information on these commands, see the Monitoring Support, on page 36 section.

Configuring IPAM

Dynamic Pool Configuration

Use the following configuration to configure dynamic pool:

```
config
  ipam
    instance instance_id
    source local
      address-pool pool_name
        vrf-name string
        ipv4
          split-size
            per-cache value
            per-dp value
          exit
          address-range start_ipv4_address end_ipv4_address
        exit
        ipv6
          address-ranges
            split-size
              per-cache value
              per-dp value
            exit
            address-range start_ipv6_address end_ipv6_address
          exit
         prefix-ranges
            split-size
              per-cache value
              per-dp value }
            exit
            prefix-range prefix_value length prefix_length
          exit
        exit
      exit
```

Static Pool Configuration

Use the following configuration to configure static pool:

```
config
   ipam
     instance instance_id
       address-pool pool_name
          vrf-name string
          static enable user-plane srg_id
          ipv4
             split-size
             no-split
             exit
             address-range start_ipv4_address end_ipv4_address
          exit
          ipv6
             address-ranges
               split-size
                 no-split
               exit
               address-range start_ipv6_address end_ipv6_address
             exit
             prefix-ranges
               split-size
                 no-split
               exit
               prefix-length prefix_length
               prefix-range prefix_value length prefix_length
             exit
           exit
         exit
```

NOTES:

- **ipam**: Enters the IPAM Configuration mode.
- **instance** *instance_id*: Configures multiple instances for the specified instance and enters the instance sub-mode.
- **source local**: Enters the local datastore as the pool source.
- **address-pool** *pool_name* [**address-quarantine-timer**] [**offline**] [**static** *user_plane_name*] [**vrf-name** *string*]: Configures the address pool configuration. *pool_name* must be the name of the address pool.
- **ipv4**: Enters the IPv4 mode of the pool.
- **split-size** { **per-cache** *value* | **per-dp** *value* }: Specifies the size of the IPv4 range to be split for each IPAM cache allocation. The IPAM server consumes this configuration. The **no-split** command disables the splitting of the address-ranges into smaller chunks.

  per-cache *value*: Specifies the size of the IPv4 range to be split for each Data-Plane (User-Plane) allocation. The valid values range from 2 to 262144. The default value is 1024.

per-dp *value*: Specifies the size of the IPv4 range to be split for each Data-Plane (User-Plane) allocation. The valid values range from 2 to 262144 The default value is 256.

- **address-range** *start_ipv4_address end_ipv4_address*: Configures the IPv4 address range with the starting and ending IPv4 address.
- **ipv6**: Enters the IPv6 mode of the pool.
- **address-ranges**: Enters the IPv6 address ranges sub-mode.
- **prefix-ranges**: Enters the prefix ranges mode.
- **prefix-length** *prefix_length*: Specifies the IPv6 prefix length.
- **prefix-range** *prefix_value* **length** *prefix_length*: Specifies the IPv6 prefix range, and prefix length.
- **static enable user-plane** *srg_id*: Associates an user plane for the static pool.

Range-based interface list

The range-based interface list feature streamlines access interface management by enabling the configuration of contiguous bundle sub-interface ranges in a single command.

Table 5: Feature History Table

Range-based Interface List	2026.04.0	Introduces port-id-list-map for mapping sub-interface ranges to SRG port-id ranges and port-id-list for attaching subscriber profiles to sub-interface ranges.

Configuration guidelines

The **port-id** and **port-id-list** parameters are mutually exclusive. You must choose only one for configuration within a group or user-plane.

Configure Range-based Interfaces

SRG Configuration (port-id-list-map): Use this command to map a contiguous range of bundle sub-interfaces to a corresponding range of SRG port-ids.

```
configure
 user-plane instance <instance_id>
  user-plane <up_name>
   subscriber-redundancy
    group <group_name>
     port-id-list-map port-name <name> <identifier> sub-interface-range <start> <end>
id-range <start> <end>
     commit
```

- **port-id-list-map**: The command used to map a range of sub-interfaces to a range of port IDs for subscriber redundancy.
- **port-name**<*name*>: Specifies the physical or logical interface identifier.

- **sub-if-range<start> <end>**: Defines the range of sub-interface to be mapped.
- **id-range<start> <end>**: Defines the range of port IDs that correspond to the specified sub-interface range.

User-Plane Configuration (port-id-list): Use this command to associate a specific subscriber profile with a contiguous range of bundle sub-interfaces.

```
configure
 user-plane instance <instance_id>
  user-plane <up_name>
   subscriber-profile <profile_name>
    port-id-list <name> <identifier> sub-if-range <start> <end>
     subscriber-profile <profile_name>
     exit
     commit
```

- **port-id-list**: The command used to associate a specific subscriber profile.
- **port-name**: Specifies the physical or logical interface identifier.
- **sub-if-range <start> <end>**: Defines the range of sub-interface to be mapped.

L3 Routed Subscriber Sessions with Subscriber Redundancy Group

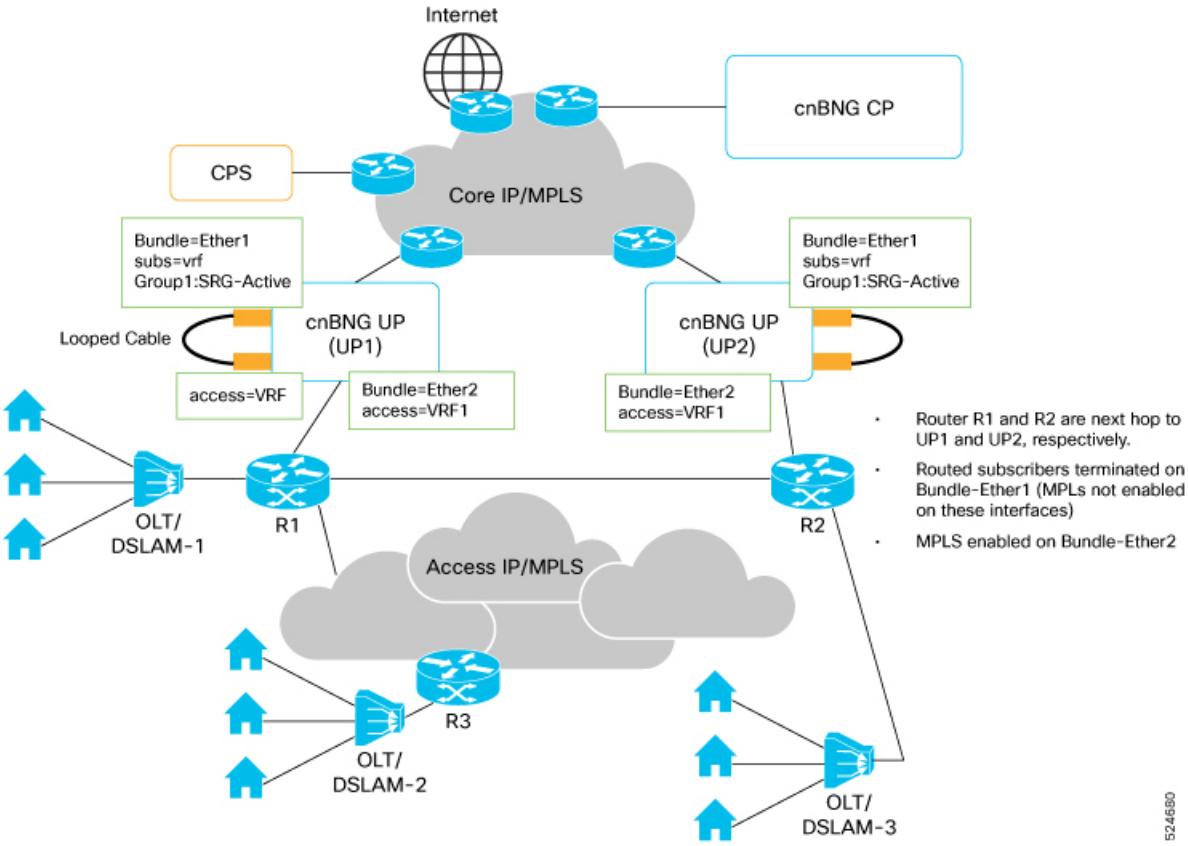
Table 6: Feature History

Feature Name	Release Information	Description
L3 Routed Subscriber Sessions with SRG	2026.04.0	Enabled support for sharing a single IPAM address pool across multiple L3 routed SRG groups within a VRF, using State Control Routes for address isolation.
L3 Routed Subscriber Sessions with SRG	2026.02.0	We have enhanced this feature to support IPv4, and dual-stack routed subscriber sessions, including on bundle-ether VLAN interfaces, which improves scalability and deployment flexibility in Layer 3 access networks. Previously, only IPv6 was supported.
L3 Routed Subscriber Sessions with SRG	2025.01.0	This feature enhances routing and redundancy for subscriber sessions by allowing subscribers to connect through a routed (L3) access network.

L3 Routed Subscriber Sessions allow subscriber connections via a routed access network, using SRG to provide redundancy. The SRG feature involves grouping access interfaces for failover (FO) and switchover (SO), ensuring continuous service in case of an active unit failure. This enhances network robustness and service continuity for subscribers connected through cnBNG.

The following topology illustrates the L3 routed subscriber sessions with SRG.

Figure 6: SRG Routed subscribers with access IP network



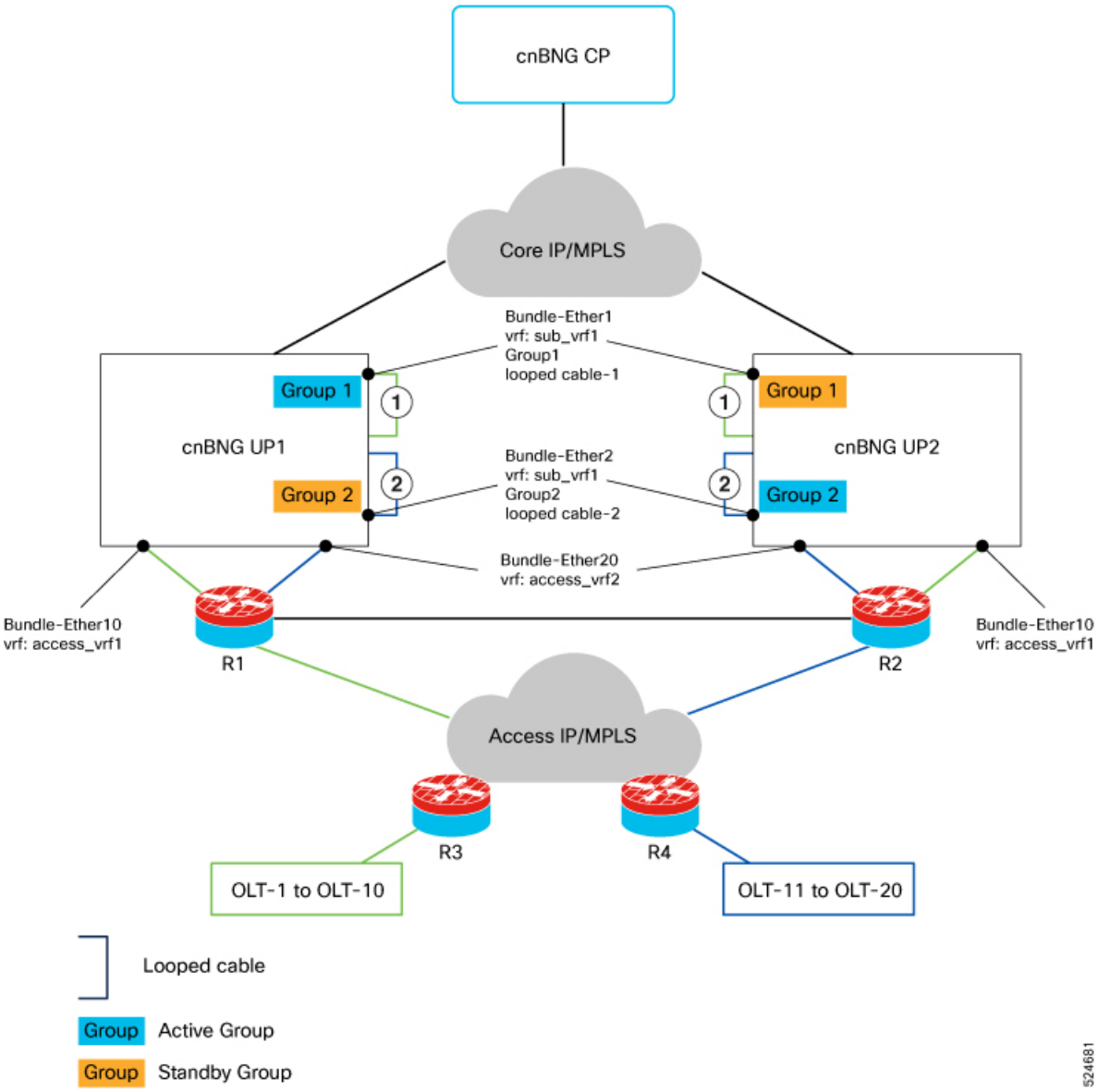
The session type determines the identifiers used for the session. For example, L2 connected sessions always use the MAC address as one of the key identifiers in both the control and data planes. In contrast, routed sessions use the MAC address as the session identifier in the control plane and the RADIUS server to uniquely identify the session. The session IP address is used in the data plane for data forwarding.

Supported Modes

The session distribution across SRGs can be in either of these modes:

- **Active-Active mode**: Distributes SRG groups across multiple user planes to balance load and ensure service continuity.
- **Hot-Standby Mode**: Uses standby user planes for quick failover, reducing downtime in case of active unit failure.

Figure 7: Active-Active mode with access IP or MPLS network



In this sample topology, two SRG groups, Group1 and Group2, are configured on both UP1 and UP2. For Group1, UP1 is the preferred active unit, while for Group2, UP2 is preferred. Ideally, Group1 should be active on UP1, and Group2 should be active on UP2. In an Active-Active mode setup, at least two SRG groups are required so that 50% of the groups are active on UP1 and the other 50% are active on UP2.

Both UPs have Bundle-Ether10 interfaces that are MPLS-enabled and are part of the same access VRF: `access_vrf1`. Since cnBNG is not supported on MPLS-enabled interfaces, a looped cable must be used to convert MPLS traffic into IP traffic for cnBNG-enabled access interfaces. Similarly, Bundle-Ether20 is configured on both UPs and is part of access VRF: `access_vrf2`.

For Group1, one port of looped-cable 1 is connected to Bundle-Ether1, and cnBNG is enabled on this interface. Note that routed subscribers are supported only on the main bundle interfaces. Bundle-Ether1 belongs to

Group1, so all subscribers on Bundle-Ether1 are considered Group1 subscribers. The subscriber VRF for Group1 is `sub_vrf1`.

For Group2, one port of looped-cable 2 is connected to Bundle-Ether2, and cnBNG is enabled on this interface. Bundle-Ether2 is part of Group2, meaning all subscribers on Bundle-Ether2 are Group2 subscribers. The subscriber VRF for Group2 is also `sub_vrf1`.



Note The SRG groups can share the same subscriber VRF or have different ones. There are no restrictions on subscriber VRF configuration, but each SRG group must have a unique access VRF.

Traffic Flow:

- **Upstream for Group1**: Traffic flows from CPE to the core network via OLTx, R3, R1, Bundle-Ether10, looped-cable 1, and Bundle-Ether1.
- **Downstream for Group1**: Traffic returns from the core network to CPE via Bundle-Ether1, looped-cable 1, Bundle-Ether10, R1, R3, OLTx.
- **Upstream for Group2**: Traffic flows from CPE to the core network via OLTx, R4, R2, Bundle-Ether20, looped-cable 2, and Bundle-Ether2.
- **Downstream for Group2**: Traffic returns from the core network to CPE via Bundle-Ether2, looped-cable 2, Bundle-Ether20, R2, R4, OLTx.

State-Control-Route: This is an aggregate route for each group, requiring configuration on both UPs. Each SRG group can have multiple state-control-routes, with a next hop specified for each. Once a group is created on the UP, these routes are sent from the Control Plane to the UP, where they are installed into the Routing Information Base (RIB). A route policy on the UP must advertise these routes to the core network to receive downstream traffic. The next hop in the state-control-route directs outgoing traffic from the subscriber interface to the access VRF.

Publish Gateway for upstream traffic from CPE

To effectively manage upstream traffic from Customer Premises Equipment (CPE), the IP address of the BNG access interface must be advertised to the IP/MPLS access network. This allows the network to route traffic originating from CPEs.

- **For Group1**: When Group1 is active in UP1, the IP address of the access interface on Bundle-Ether1 needs to be advertised to Router R3. This is done via the path: looped cable1 -> Bundle-Ether10 -> R1. The advertisement from UP1 should have higher metrics compared to UP2 to indicate that UP1 is the preferred route for Group1 traffic.
- **For Group2**: When Group2 is active in UP2, the IP address of the access interface on Bundle-Ether2 should be advertised to Router R4. This follows the path: looped cable2 -> Bundle-Ether20 -> R2. The advertisement from UP2 should have higher metrics compared to UP1 to make UP2 the preferred path for Group2 traffic.

DHCPv6 Relay Chaining

The DHCPv6 Relay Chaining feature is designed to manage DHCP packets relayed over multiple hops within a network, specifically intended for routed subscribers using DHCP as the First Sign of Life (FSOL).

Relay message processing in DHCPv6 networks

In the case of DHCPv6, each relay hop adds a Relay Forward message as the packet moves forward and removes a Relay Reply header on the return path. For example, if there are two relays between the end subscriber and the Broadband Network Gateway (BNG), the cnBNG control plane's DHCP server will encounter two Relay Forward headers. Typically, the first relay is a Light Weight Relay Agent (LDRA), and the second is an L3 relay agent. Consequently, when cnBNG functions as a DHCPv6 server, incoming packets will contain multiple relay forward headers, and the response packets must include corresponding Relay Reply headers based on these incoming headers.

Packet forwarding and address allocation in multi-hop relay environments

The Optical Line Terminal (OLT), acting as the LDRA, inserts a hop zero relay-forward header with a DHCPv6 circuit-id (interface-id) and remote-id, then sends it to the access router (R3). R3 is configured as a DHCPv6 L3 relay, using the cnBNG UP access interface IP as the helper address. R3 adds its own relay-header with its remote-id and circuit-id before forwarding the packet to cnBNG-UP. If the UP access interface is set as CNBNG routed, the multihop relay forward message is sent to the control plane as a routed DHCP packet of the GPTU type. In the DHCP pod, the hop zero circuit-id/interface-id is used by the cnBNG control plane for address chunk allocation.

Prefix route management and relay binding in multihop DHCPv6 setups

In a multihop relay setup, the L3 relay agent must install a prefix route (IAPD) for routing IAPD traffic. This route is typically installed when the Relay-Reply packet from the BNG confirms prefix allocation by parsing the IA prefix option. The relay agent also maintains a binding for this route, which is removed when a Relay Forward Release packet is received from the LDRA. By default, relay binding and route installation are enabled for IAPD (prefix) and can be configured for IANA if needed. Manual clearing of the relay binding is required for session termination triggers other than a CPE DHCPv6 Release, such as an admin clear on the BNG or a POD from RADIUS.

Address Chunk or Range Allocation

For Layer 2 connected subscribers, the BNG acts as the gateway, and address chunk allocation is based on the access interface or UPF, depending on whether the deployment is SRG or non-SRG. However, in routed scenarios, the gateway IP for subscribers is located at the first L3 hop, such as the Cell Site Switch (CSS) or R3. Therefore, address chunks should be allocated per CSS to ensure subscriber traffic is routable. The first IP in the chunk should be configured on the subscriber-facing interface of the CSS, serving as the gateway for subscribers. For IPv6, the source address of the DHCPv6 response packet, which may be a link-local address, acts as the gateway.

To allocate subnets per CSS (R3), each CSS must be identifiable by a unique identifier shared among its subscribers. In the cnBNG control plane, the identifiers for chunk allocation (DP/Dataplane keys) are:

- UPF Name for non-SRG L2 deployments
- SRG peer-id for SRG L2 deployments
- DHCP option based method, for example, **circuit-id**.

  This is a sample configuration for the DHCP option based method:

```
profile dhcp DHCP_1
ipv6
 mode server
 server
  iana-pool-name pool-1
  ipam-dp-key circuit-id delimiter # substring 0
  exit
 exit
ipv4
```

```
 mode server
 server
  pool-name pool-1
  ipam-dp-key circuit-id delimiter # substring 0
 exit
exit
```

In this context, the **ipam-dp-key** is specified as the circuit-id. This means the circuit-id, which is the DHCPv6 option 18 interface-id of the hop zero relay forward header, is used to determine the data plane identifier. There is an option to use the entire interface-id or a portion of it as the DP-key. You can extract a substring of the interface-id by using a delimiter to split the string.

When configured, DHCP uses the circuit-id as the dp-key information during IP allocation, release, or validation processes. The DHCP pod also sends an indicator to the node manager or IPAM during these processes to help IPAM identify IP interactions related to routed sessions. In routed sessions, aggregate route management is handled at the group level, so during chunk allocation, IPAM does not configure subnet or summary routes to the UP.

Pre-Allocation of Gateway IP and Address Chunks

For detailed information about this feature, see Pre-Allocation of Gateway IP and Address Chunks.

Disabling L3 Routed Subscriber Sessions with SRG

The L3 Routed Subscriber Sessions with SRG feature functions only when BNG is enabled on the access interface in both cnBNG UP and CP. To disable the feature, remove the BNG enablement configuration from the respective access interface. Similarly, to disable SRG, configure **disable** in the respective SRG group's configuration in the cnBNG CP.

Single pool for L3 routed SRG groups

Starting with 2026.04.0, we support the allocation of a single IPAM address pool per VRF instance for L3 routed subscriber sessions. This feature allows a single IPAM address pool to be shared across multiple L3 SRG groups, significantly reducing configuration complexity in Layer 3 access networks.

Guidelines to configure single pool for L3 routed SRG groups

Use these guidelines to configure a single pool for L3 routed SRG groups.

- Prefix validation: IP prefixes defined in the `state-control-route` within the SRG configuration must be valid subsets of the address ranges defined in the shared IPAM address pool.
- Route matching: The calculated subnet route for each address range must match the configured `state-control-route`.
- VRF consistency: The VRF on the `state-control-route` must match the IPAM VRF. If multiple `state-control-routes` exist in an srg-peer, all must share the same VRF; otherwise, the request is rejected.
- Active UPF: The cnBNG CP considers routes only from the active UPF for the specific SRG group.
- Address range fragmentation: If you configure multiple `state-control-route` under a single SRG group, cnBNG CP may not always use routes in the same order for each allocation request. Chunks may be allocated across different address ranges instead of using a single range first. This distribution can result in fragmentation across the available address space. Consider this distribution pattern when designing high-density deployments that require contiguous address allocation.

- SRG peer allocation: The cnBNG CP does not enforce strict L2 or L3 constraints at the pool level. The IPAM module allows the pool to be utilized according to the specific requirements of the SRG group without restricting a pool to exclusively L2 or L3 usage.
  - L3 SRG peer allocation: When an action command includes an L3 srg-peer-id and `state-control-route`, the cnBNG CP performs a context-aware lookup. Allocation is scoped specifically to the provided `state-control-route`, ensuring the chunk is fetched from the associated address range.
  - L2 SRG peer allocation: In the absence of L3-specific routing requirements, the system performs a general search in the cache pod and retrieves the first available free chunk, optimizing for immediate resource availability.

Restrictions for L3 Routed Subscriber Sessions with SRG

These restrictions apply to the L3 Routed Subscriber Sessions with SRG feature:

- Only dynamic IP allocation is supported.
- The **ipam-address-chunk** action command is supported only for SRG deployment.
- There is no impact on groups onboarded before SRG is disabled.
- Ensure to follow the MOP to remove all address pre-allocations using **ipam-address-chunk release** command before deleting an SRG group.
- The control plane does not restrict using the same ipam-dp-key for different pools or pool-group-tags. So, make sure to maintain uniqueness across pools.
- When associating multiple pools with a profile using a pool-group-tag, ensure that the same tag is used for the **ipam-address-chunk allocate** command. The **ipam-address-chunk release** command will release chunks across all pools associated with this tag. This is applicable for IPv6, IPv6-Addr, IPv6-prefix

  The **ipam-address-chunk allocate** and **ipam-address-chunk release** commands are not supported with pool group tag for IPv4.
- The control plane does not restrict using the same ipam-dp-key for different SRG groups. So, make sure to maintain uniqueness across SRG groups.
- The control plane does not restrict the use of **ipam-address-chunk release** command even when the IP is currently in use. Performing this action can cause inconsistencies within the system.
- Make sure that routed and state-control-route configurations on both user-planes are aligned. Otherwise, the system's behavior may become unpredictable.
- The control plane does not reject conflicting state-control-routes.
- Marking an address-range or pool offline without freeing address-chunks (via **ipam-address-chunk release**) is not supported.

Configure L3 Routed Subscriber Sessions with SRG

To configure L3 Routed Subscriber Sessions with SRG, use the following sample configuration:

Procedure

Step 1 Define SRG groups, assign access interfaces, and configure state-control-routes to manage traffic routing within SRG groups.

Example:

```
config
   user-plane instance instance_id
      user-plane user_plane_name
         peer-address ipv4 ipv4_address
         subscriber-profile subs-ipoe
         subscriber-redundancy
            group group_name
               peer-identifier peer_id
               l3-routed
               port-id-map port-name port_name port_number
               state-control-route route_name afi ipv6 aggregate_route vrf vrf_name
               state-control-route route_name afi ipv4 aggregate_route vrf vrf_name
               exit
```

Note Each SRG group can support multiple state-control-routes, and these must be configured on both UPs.

The following is a sample configuration:

```
user-plane
instance 1
 user-plane asr9k-1
  peer-address ipv4 10.6.1.1
  subscriber-profile subs-routedipoe-1
  subscriber-redundancy
   group Group1
    peer-identifier Peer1
    l3-routed
    port-id-map port-name Bundle-Ether5 1
    state-control-route r1 ipv6 2002:ab::/48 vrf FTTX_SUB
    state-control-route r2 ipv4 10.1.1.1/15 vrf FTTX_SUB
   exit
  exit
 exit
 user-plane asr9k-2
  peer-address ipv4 10.6.1.2
  subscriber-profile subs-routedipoe-1
  subscriber-redundancy
   group Group1
    peer-identifier Peer1
    l3-routed
    port-id-map port-name Bundle-Ether5 1
    state-control-route r1 ipv6 2002:ab::/48 vrf FTTX_SUB
    state-control-route r2 ipv4 10.1.1.2/15 vrf FTTX_SUB
   exit
  exit
 exit
```

NOTES:

- **subscriber-redundancy**: Configures subscriber geo-redundancy. All SRG groups are configured in this mode.
- **group** *group_name*: Specifies the name of the subscriber redundancy group that is unique to a user plane.
- **peer-identifier** *peer_id*: Identifies the peer user-plane for the group. This identifier must be unique across all groups in the control plane. The same peer-identifier must be configured on the peer user-plane.
- **port-id-map port-name** *port_name port_number*: Specifies the mapping of access interfaces between user planes. At least one **port-map-id** must be configured.
- **preferred-role-active**: This is an optional configuration.

  Sets the preferred role active for user plane. Default value: false.
- **state-control-route** *route_name* **afi** *ipv6/ipv4 aggregate_route* **vrf** *vrf_name*: Programs the route to the UP for a specific routed SRG group based on the active or standby state of the UP.

Step 2 Configure IP pools for SRG groups. One IP pool must be configured per SRG group.

Example:

```
config
   ipam
     instance instance_id
     address-pool pool_name
        ipv6 | ipv4
           address-range start_ip_address end_ip_address
           exit
```

The following is a sample configuration:

```
ipam
 instance 1
  address-pool pool-1
   vrf-name vrf-1
   ipv4
    split-size
     per-cache 8192
     per-dp    4096
    exit
    address-range 10.1.0.1 10.1.255.255
   exit
   ipv6
    address-ranges
     split-size
      per-cache 8192
      per-dp    4096
     exit
     address-range 2001:DB8:: 2001:DB8:3::fff
    exit
    prefix-ranges
     split-size
      per-cache 8192
      per-dp    4096
     exit
     prefix-range 2002:ab:: length 48
    exit
   exit
  exit
```

```
 exit
exit
```

Step 3 Configure the state control route nexthop and access control route on both UPs. For configuration details, see Configure SRG section in the *cnBNG User Plane Configuration guide*.

The following is a sample configuration:

```
cnbng-nal location 0/RSP0/CPU0
subscriber-redundancy
 group Group1
  access-tracking track1
  access-control-route ipv6 ::/0 vrf vrf_1 next-hop-address 2001:dB8:4:0:4:4:1:3 active-tag 10
standby-tag 20
  access-control-route ipv4 10.0.0.0/0 vrf vrf_1 next-hop-address 10.5.0.3 active-tag 10 standby-tag
 20
  access-interface-list
   interface Bundle-Ether5
   exit
  state-control-next-hop-ip ipv4 10.5.0.1
  state-control-next-hop-ip ipv6 2001:dB8:4:0:4:4:1:1
  exit
 exit
exit
```

NOTES:

- **access-control-route ipv6** *ipv6_address* **vrf** *vrf_name* **next-hop-address** *next_hop_address* **active-tag** *value* **standby-tag** *value*: Configures the access control route (IPv6) in the hub VRF as access interface IP.
- **access-control-route ipv4** *ipv4_address* **vrf** *vrf_name* **next-hop-address** *next_hop_address* **active-tag** *value* **standby-tag** *value*: Configures the access control route (IPv4) in the hub VRF as access interface IP.
- **state-control-next-hop-ip ipv6** *ipv6_address* : Configures the specified IPv6 address as the next-hop IP for the state-control route, designating it as the hub VRF IP.
- **state-control-next-hop-ip ipv4** *ipv4_address* : Configures the specified IPv4 address as the next-hop IP for the state-control route, designating it as the hub VRF IP.

Step 4 Configure the IPAM data plane key.

Example:

```
profile dhcp dhcp_profile_name
 ipv6
  server
   iana-pool-name ipam_pool_name
   ipam-dp-key circuit-id delimiter value substring value
   end
  end
 end
```

The **ipam-dp-key** configuration in the DHCP profile specifies how to create the DP key.

The following is a sample configuration:

```
profile dhcp server-1
 ipv6
  server
   iana-pool-name dhcp-ipv6-iana
   iapd-pool-name dhcp-ipv6-iapd
```

```
   dns-servers [ 2001::5 ]
   ipam-dp-key circuit-id delimiter # substring 0
   domain-name cisco.com
   lease days 1
   lease hours 1
   lease minutes 1
  exit
 exit
exit
```

NOTES:

- **profile dhcp** *dhcp_profile_name* : Specifies the DHCP profile name.
- **ipv6** : Enters IPv6 configuration mode.
- **server**: Specifies the IPv6 server details.
- **iana-pool-name**: Specifies the Internet Assigned Numbers Authority (IANA) pool name.
- **ipam-dp-key circuit-id** *value* **delimiter***value* **substring** *value*: Specifies the data plane key for IP management.
  - **circuit-id** *value*: The DHCPv6 interface-id found in the hop zero relay header will be used as the key for IPAM in the data plane.
  - **delimiter** *value*: The delimiter value must be a single character and can be one of the following: [!@#$%^&*()_+].
  - **Substring** *value*: This option can only be set to 0 or 1. It allows the string to be split into two substrings based on the first occurrence of the specified delimiter.

Step 5 Use the **ipam-address-chunk** action command to configure the pre-allocation of gateway IP and address chunks. For configuration details, see Configure Pre-Allocation of Gateway IP and Address Chunks.

The output of this action command provides information about the chunk and the first IP address that were reserved. For example,

```
bng# ipam-address-chunk allocate instance-id 1 pool-name dhcp-l3-routed-vlan-11 ipv6-prefix
ipam-dp-key INGJRJKTMDHRTW6001ENBESR001 srg-peer-id Peer1

Sat Aug  24 06:27:29.200 UTC+00:00
result
Gateway Address: 2001:DB8::1/112
```

```
bng# ipam-address-chunk allocate instance-id 1 pool-name dhcp-l3-routed-vlan-11 ipv6-addr ipam-dp-key
 INGJRJKTMDHRTW6001ENBESR001 srg-peer-id Peer1

Sat Aug  24 06:27:29.200 UTC+00:00
result
Gateway Address: 2002::1/48
```

```
bng# ipam-address-chunk allocate instance-id 1 pool-name dhcp-l3-routed-vlan-11 ipv4-addr ipam-dp-key
 INGJRJKTMDHRTW6001ENBESR001 srg-peer-id Peer11

Sat Aug  24 06:27:29.200 UTC+00:00
result
Gateway Address: 10.1.64.1/20
```

Step 6 Use the **show ipam { dp | dp-tag }** *value* **{ ipv6-addr | ipv6-prefix | ipv4-addr }** command to view the reserved IP address and the summary route of the allocated chunks.

Example:

```
bng# show ipam dp INGJRJKTMDHRTW6001ENBESR001 ipv6-addr

Tue Apr  28 09:03:28.87 UTC+00:00
==========================================================================================================
Flag  Indication: S(Static) O(Offline) R(For Remote Instance) RF(Route Sync Failed) F(Fixed Chunk
for DP)
Other Indication: A+(Waiting for route update response) QT*(Quarantined due to route delete failure)

                  QT+(Waiting for route update response post timeout)
G:N/P Indication: G(Cluster InstId) N(Native NM InstId) P(Peer NM InstId)
==========================================================================================================
StartAddress          EndAddress       Route              GatewayAddress        G:N/P    Utilization
   Flag      AllocContext
==========================================================================================================
2001:DB8::8000        2001:DB8::bfff   2001:DB8::8000/114    2001:DB8::1/112    1:1/-1   0.01%
     F         dhcp-ipv6-iana-11(FTTX_SUB)
==========================================================================================================
```

```
bng# show ipam dp INGJRJKTMDHRTW6001ENBESR001 ipv4-addr

Tue Apr  28 08:43:28.377 UTC+00:00
==========================================================================================================
Flag  Indication: S(Static) O(Offline) R(For Remote Instance) RF(Route Sync Failed) F(Fixed Chunk
for DP) V(Virtual)
Other Indication: A+(Waiting for route update response) QT*(Quarantined due to route delete failure)

                  QT+(Waiting for route update response post timeout)
G:N/P Indication: G(Cluster InstId) N(Native NM InstId) P(Peer NM InstId)
==========================================================================================================
StartAddress          EndAddress      Route          GatewayAddress   G:N/P    Utilization   Flag
     AllocContext
==========================================================================================================
10.1.64.0            10.1.79.255    10.1.64.0/20       10.1.64.1/20    1:0/-1   2.34%         F
      L3RLSP-vlan-111(vrf-1)
==========================================================================================================
```

The flag value **F** signifies that it is a fixed chunk for the DP, assigned when the **ipam-address-chunk allocate** command is executed.

Step 7 Configure the gateway address on the access side router.

The following is a sample configuration:

```
interface TenGigE0/0/0/13.100
 vrf vrf1
 ipv6 nd other-config-flag
 ipv6 nd managed-config-flag
 ipv6 address 2001:DB8::1/112
 ipv6 address 2002:ab::1/48
 ipv6 enable
exit
 encapsulation dot1q 100
exit
```

In this example, the IPv6 addresses, *2001:DB8::1/112*, and *2002:ab::1/48* are configured as gateway addresses on the access side router.

Step 8 Use the **show subscriber session filter** command to verify the routed session details.

Example:

```
bng# show subscriber session filter { mac aa11.0000.0001 } detail
```

```
Thu Jul  11 16:37:30.579 UTC+00:00
subscriber-details
{
  "subResponses": [
    {
      "subLabel": "16777228",
      "srgPeerId": "Peer1",
      "srgId": "Group1",
      "mac": "aa11.0000.0001",
      "acct-sess-id": "Local_DC_16777228",
      "sesstype": "routedipoe",
      "state": "established",
      "subCreateTime": "Thu, 11 Jul 2024 15:59:49 UTC",
      "dhcpAuditId": 2,
      "transId": "1",
<snip>
```

Step 9 You can also filter sessions based on the session type. Use the **show subscriber session filter { sesstype routedipoe }** command to filter routed subscriber sessions.

Step 10 Use the **show subscriber session filter { ipam-dp-key** *dp_key* **}** command to filter sessions based on ipam-dp-key.

Step 11 Use the **show subscriber dhcp filter { ipam-dp-key** *dp_key* **}** command to filter sessions based on ipam-dp-key in DHCP profile.

Session Synchronization between UPs

This section describes different scenarios where the subscriber needs to be synchronized to a UP manually.

Scenario 1

One UP in a Subscriber Redundancy group is active, and a session is created. Now, another UP in the same SRG is connected for the first time. All the groups in the second UP become standby. To synchronize the sessions with the second (standby) UP, use the following CLI command:

```
bng# subscriber redundancy session-synchronize add domain [ domain_ID ]
target-upf upf_ID
```

You can also use the following CLI command, if there are only two UPs involved (as in Scenario 1):

```
bng# subscriber redundancy session-synchronize add upf-id [ upf_ID ]
target-upf upf_ID
```

Example-1:

```
subscriber redundancy session-synchronize add domain [ Domain12 ] target-upf Upf2
```

The above CLI command synchronizes all the subscribers from active UP, which are part of *Domain12*, to the target UP (*Upf2*).

Or,

```
subscriber redundancy session-synchronize add upf-id [ Upf1 ] target-upf Upf2
```

The above CLI command synchronizes all the subscribers from *Upf1* to *Upf2*.

Example-2:

The following is a sample configuration if two UPs are active, and a third UP is connected later.

```
subscriber redundancy session-synchronize add domain [ Domain12 Domain13 ] target-upf Upf1
```

The above CLI command synchronizes all the subscribers from the active UPs, which are part of *Domain12*, and *Domain13* to the target UP (*Upf1*).

Scenario 2

Initially, a Subscriber Redundancy group is configured on only one UP, and a session is created. Later, the second UP is configured with SRG. Now, to synchronize the session with the second UP in the group, use the following CLI command:

bng# **subscriber redundancy session-synchronize add peer-id [** *peer_ID* **] target-upf** *upf_ID*

Example:

```
subscriber redundancy session-synchronize add peer-id [ Peer1 ] target-upf Upf2
```

The above CLI command synchronizes subscribers that are part of a group with peer-id *Peer1* to target UP (*Upf2*).

Scenario 3

A group is removed from an UP. To remove sessions in the group, use the following CLI command:

bng# **subscriber redundancy session-synchronize delete peer-id [** *peer_ID* **] target-upf** *upf_ID*

Example:

```
subscriber redundancy session-synchronize delete peer-id [ Peer1 ] target-upf Upf2
```

The above CLI command removes subscribers from target UP (*Upf2*) that are part of the SRG group with peer-id *peer1*.

Scenario 4

All groups are removed from an UP. To remove all sessions in an UP, use the following CLI command:

bng# **subscriber redundancy session-synchronize delete domain [** *domain_list* **] target-upf** *upf_ID*

Example:

```
subscriber redundancy session-synchronize delete domain [ domain12 domain13 ] target-upf
Upf3
```

The above CLI command deletes all the subscribers that are part of the domains *domain12*, and *domain13* from the target UP (Upf3).

Or,

```
subscriber redundancy session-synchronize delete upf-id [ Upf3 ] target-upf Upf3
```

The above CLI command deletes all the subscribers that are related to *Upf3* from the target UP (*Upf3*).

Note You can also delete all non-SRG sessions in the UP.

Scenario 5

An UP from a group is replaced with another UP. To synchronize the sessions, use the following CLI commands:

```
bng# subscriber redundancy session-synchronize delete peer-id [ peer_ID ]
target-upf old_upf_id
```

```
bng# subscriber redundancy session-synchronize add peer-id [ peer_ID ]
target-upf new_upf_id
```

Example:

```
subscriber redundancy session-synchronize delete peer-id [ peer1 ] target-upf Upf1
subscriber redundancy session-synchronize add peer-id [ peer1 ] target-upf Upf2
```

The above CLI commands remove the sessions in the group with peer-id *peer1* from *Upf1*, and add the group to *Upf2*.

Scenario 6

An UP is replaced with another UP in all the groups in a domain. To synchronize the sessions, use the following CLI commands:

```
bng# subscriber redundancy session-synchronize delete domain [ domain_ID ]
 target-upf upf_ID
```

```
bng# subscriber redundancy session-synchronize add domain [ domain_ID ]
target-upf upf_ID
```

Example:

```
subscriber redundancy session-synchronize delete domain [ domain1 ] target-upf Upf1
subscriber redundancy session-synchronize add domain [ domain1 ] target-upf Upf2
```

The above CLI commands remove the sessions in the groups that are part of *domain1* from *Upf1*, and add the groups to *Upf2*.

Scenario 7

All domain/group/peers are moved from one UP to another. Initially, to delete all subscribers from the UP, use the following CLI command:

```
bng# subscriber redundancy session-synchronize delete upf [ upf_ID ]
target-upf upf_ID
```

Example:

```
subscriber redundancy session-synchronize delete upf [ Upf1 ] target-upf Upf1
```

The above CLI command removes all the sessions from *Upf1*.

Configure the second UP with the configurations deleted from the first UP. Then, to synchronize the sessions, use the following CLI command:

```
bng# subscriber redundancy session-synchronize add domain [ domain_list ]
target-upf upf_ID
```

Example:

```
subscriber redundancy session-synchronize add domain [ domain1...domainN ] target-upf Upf2
```

The above CLI command synchronizes all the sessions that are in the list of given domains to the new UP (Upf2).

Route Synchronization between CP and UP

Use the following CLI command to synchronize the routes between the Control Plane and the User Plane.

subscriber route-synchronize upf *upf_name*

To check the status of route synchronization, use the following CLI commands:

- **subscriber route-synchronize upf** *upf-name* **status**
- **show subscriber route-synchronize upf** *upf-name*

Order of Reconciliation

It is recommended to perform the reconciliation activity in the following order:

1. Group reconciliation
2. Route reconciliation
3. CP reconciliation (CP-Audit)
4. CP-UP reconciliation

Monitoring Support

This section describes the monitoring support information for the UP Geo Redundancy feature.

Use the following show and clear commands for troubleshooting. The output of these commands provides specific configuration and status information.

clear subscriber sessmgr

Use this command to clear subscribers.

clear subscriber sessmgr [gr-instance *gr_instance_id* **| srg-peer-id** *srg_peer_id* **| upf** *upf_name* **]**

NOTES:

- **clear subscriber sessmgr srg-peer-id** *srg_peer_id*: Clears subscribers in CP and both UPs.
- **clear subscriber sessmgr upf** *upf_name* **srg-group-id** *srg_group_id*: If the group is active, this command clears sessions in CP and both UPs. If the group is standby, this command clears sessions in the standby UP.

clear subscriber pppoe

Use this command to clear PPPoE subscriber sessions.

clear subscriber pppoe { srg-peer-id *srg_peer_id* **| upf** *upf_name* **}**

NOTES:

- **clear subscriber pppoe srg-peer-id** *srg_peer_id*: Clears PPPoE sessions based on the SRG peer ID.
- **clear subscriber pppoe upf** *upf_name*: Clears PPPoE sessions based on the UPF name.

show subscriber redundancy

Use this command to display the key values of SRG groups.

show subscriber redundancy [count | debug | detail | gr-instance *gr_instance_id* **| srg-peer-id** *srg_peer_id* **| upf** *upf_name* **]**

NOTES:

- **show subscriber redundancy count**: Displays the count of SRG groups.
- **show subscriber redundancy detail**: Displays the detailed content of SRG groups.
- **show subscriber redundancy upf** *upf_name*: Displays all the groups related to UPF.
- **show subscriber redundancy peer-id** *peer_id* **debug**: Displays the detailed output with event history.

The following is a sample output of the **show subscriber redundancy detail** command:

```
bng# show subscriber redundancy detail
Fri Apr  29 14:48:36.840 UTC+00:00
subscriber-details
{
  "subResponses": [
    {
      "PeerID": "Peer15993-x",
      "GroupID": "Group-5-3-15993-x",
      "UP List": {
        "asr9k-3": {
          "N4 State": "Connected",
          "Srg State": "Up",
          "RoleChangeInProgress": true,
          "Srg Role": "Active",
          "Interface map": {
            "GigabitEthernet11636": 1,
            "GigabitEthernet11637": 2
          }
        },
        "asr9k-5": {
          "N4 State": "Disconnected",
          "Srg State": "Init",
          "Srg Role": "Standby",
          "Interface map": {
            "GigabitEthernet58174": 1,
            "GigabitEthernet58175": 2
          }
        }
      }
    }
```

```
  ]
}
```

show subscriber redundancy-sync

Use this command to display the subscriber reconciliation details.

show subscriber redundancy-sync [gr-instance *gr_instance_id* **| srg-peer-id** *srg_peer_id* **| upf** *upf_name* **]**

NOTES:

- **gr-instance** *gr_instance_id*: Displays the reconciliation details for the specified GR instance.
- **srg-peer-id** *srg_peer_id*: Displays the reconciliation details for the specified SRG peer ID.
- **upf** *upf_name*: Displays the reconciliation details for the specified UPF.

The following is a sample output of the **show subscriber redundancy-sync upf** *upf_name* command:

```
bng#  show subscriber redundancy-sync upf asr9k-1
Tue Apr  5  17:31:15.659 UTC+00:00
subscriber-details
{
  "Upf": "asr9k-1",
  "State": "Completed",
  "Status": "Passed",
  "Total Number of Groups": 2914,
  "Number of enabled Groups": 2914,
  "Maximum Duration": 180,
  "Started": "2022-04-05 17:31:30 +0000 UTC",
  "Ended": "2022-04-05 17:31:33 +0000 UTC",
  "Time Taken": "3 Seconds"
}
```

show subscriber dhcp

Use this command to display the DHCP CDL record keys per session.

show subscriber dhcp [count | detail | filter *filter_value* **| gr-instance** *instance_id* **| sublabel** *sublabel_name* **]**

NOTES:

- **show subscriber dhcp detail**: Displays the session details from DHCP CDL record.

The following is a sample output of the **show subscriber dhcp** command:

```
bng# show subscriber dhcp
Mon Mar  14 09:12:59.135 UTC+00:00
subscriber-details
{
  "subResponses": [
    {
      "records": [
        {
          "cdl-keys": [
            "aa11.0000.0001:m:100:v1:200:v2:1:p:Peer1:r@dhcp",
            "sublabel:33554433@dhcp",
            "type:dhcp",
            "mac:aa11.0000.0001",
```

```
            "srg-peer-id:Peer1",
            "upf:asr9k-2",
            "upf:asr9k-1",
            "port-id:asr9k-1/GigabitEthernet0/0/0/1",
            "port-id:asr9k-2/GigabitEthernet0/0/0/3",
            "vrf:ISP",
            "ipv4-addr:pool-ISP/11.0.96.2",
            "ipv4-pool:pool-ISP",
            "ipv4-range:pool-ISP/11.0.0.1",
            "ipv4-startrange:pool-ISP/11.0.96.0",
            "ipv4-state:bound",
            "ipv6-addr-startrange:pool-ISP/1:2::2000",
            "ipv6-addr:pool-ISP/1:2::2000",
            "ipv6-addr-pool:pool-ISP",
            "ipv6-addr-range:pool-ISP/1:2::1",
            "ipv6-addr-state:bound",
            "afi:dual"
          ]
        }
      ]
    }
  ]
}
```

show subscriber pppoe

Use this command to display information about PPPoE subscribers.

show subscriber pppoe [detail | filter { srg-peer-id *srg_peer_id* **}]**

NOTES:

- **show subscriber pppoe detail**: Displays detailed information about PPPoE subscriber sessions on a router.
- **show subscriber pppoe filter { srg-peer-id** *srg_peer_id* **}** : Filters PPPoE sessions based on the SRG peer ID.

Examples

The following is a sample output of the **show subscriber pppoe detail** command:

```
bng# show subscriber pppoe detail

Fri Jun  14 12:44:52.471 UTC+00:00
subscriber-details
{
  "subResponses": [
    {
      "state": "complete",
      "key": {
        "routerID": "asr9k-1",
        "portID": "GigabitEthernet0/0/0/1",
        "outerVlan": 100,
        "innerVlan": 200,
        "macAddr": "cc11.0000.0001",
        "pppoesessionID": 32771,
        "sublabel": "33554435",
        "upSubID": "4",
        "SrgPeerID": "Peer1",
        "SrgGroupID": "Group1",
```

```
        "SrgIntfID": "1"
      },
      "flags": [
        "SM_START_DONE",
        "SM_ACTIVATE_DONE",
        "SM_UPDATE_DONE",
        "PPPOE_UP_DONE",
        "IPCP_UP",
        "IPV6CP_UP"
      ],
      "pppoeInfo": {
        "profileName": "abc",
        "mtu": 1500
      },
      "lcpInfo": {
        "state": "opened",
        "keepAliveInterval": 60,
        "keepAliveRetries": 5,
        "localMru": 1500,
        "peerMru": 1500,
        "localMagic": "0xc23c756",
        "peerMagic": "0x112233",
        "authOption": "PAP",
        "authCompleted": true,
        "username": "cnbng"
      },
      "ipcpInfo": {
        "state": "opened",
        "peerIpv4Pool": "pool-ISP",
        "peerIpv4Address": "11.0.32.2",
        "peerIpv4Netmask": 22,
        "localIpv4Address": "11.0.32.1",
        "isIpamPoolIPaddr": true
      },
      "ipv6cpInfo": {
        "state": "opened",
        "localIntfID": "0x1",
        "peerIntfID": "0xcc11000000010000"
      },
      "sessionType": "pta",
      "vrf": "default",
      "AuditId": 4,
      "slaacInfo": {
        "prefix": "3001:ab::",
        "prefixlength": 64,
        "poolname": "slaac-pool",
        "fsmstate": "connected",
        "profilename": "profile1",
        "otherconfig": true
      }
    }
  ]
}
```


show subscriber session

Use this command to display the session manager (SM) CDL record keys per session.

show subscriber session [detail | filter { smupstate { *upf_name*/**smUpSessionCreated } }]**

NOTES:

- **show subscriber session detail**: Displays the session details from SM CDL record.
- **show subscriber session filter { smupstate {** *upf_name*/**smUpSessionCreated } }**: Use this command to check whether the session is created in the respective UPF for the SRG sessions.

  The session count for both UPFs show up in both SM and DHCP CDL records after SRG is created successfully in the respective UPFs.

The following is a sample output of the **show subscriber session** command:

```
bng# show subscriber session
Mon Mar  14 09:12:52.653 UTC+00:00
subscriber-details
{
  "subResponses": [
    {
      "records": [
        {
          "cdl-keys": [
            "33554433@sm",
            "acct-sess-id:Local_DC_33554433@sm",
            "upf:asr9k-1",
            "port-id:asr9k-1/GigabitEthernet0/0/0/1",
            "feat-template:svc1",
            "feat-template:automation-feature-template-accounting",
            "type:sessmgr",
            "mac:aa11.0000.0001",
            "sesstype:ipoe",
            "sesstype:ipoeRouted"
            "srg-peer-id:Peer1",
            "smupstate:smUpSessionCreated",
            "up-subs-id:asr9k-1/1",
            "smupstate:asr9k-1/smUpSessionCreated",
            "srg-group-id:asr9k-1/Group1",
            "upf:asr9k-2",
            "port-id:asr9k-2/GigabitEthernet0/0/0/3",
            "srg-group-id:asr9k-2/Group1",
            "smstate:established",
            "up-subs-id:asr9k-2/1",
            "smupstate:asr9k-2/smUpSessionCreated",
            "afi:dual"
          ]
        }
      ]
    }
  ]
}
```

show subscriber synchronize

The **subscriber session-synchronize [srg-peer-id** *peer_id* **| upf** *upf_name* **]** command is used to synchronize subscriber information on the UP.

To view the status of subscriber information synchronization, use the following CLI command:

show subscriber synchronize [srg-peer-id *peer_id* **| upf** *upf_name* **]**

The following is a sample output of the **show subscriber synchronize** command:

```
bng# show subscriber synchronize srg-peer-id Peer108-x
Tue Apr  5  06:31:51.167 UTC+00:00
subscriber-details
```

```
{
  "asr9k-11": {
    "upf": "asr9k-11",
    "sync status": "sync start in progress",
    "sync state": "Start",
    "sync startTIme": "05 Apr 22 06:31 UTC",
    "sync srgGroupId": "Group-11-8-108-x"
  },
  "asr9k-8": {
    "upf": "asr9k-8",
    "sync status": "sync start in progress",
    "sync state": "Start",
    "sync startTIme": "05 Apr 22 06:31 UTC",
    "sync srgGroupId": "Group-11-8-108-x"
  }
}
```


show ipam dp

Use this command to view the list of UPFs to which the corresponding routes (both static and dynamic) are pushed.

- **show ipam dp** *peerid* { **ipv4-address** | **ipv6-address** | **ipv6-prefix** }

NOTES:

- **show ipam dp** *peerid* **ipv4-address**: Displays the UPFs of IPv4 address type
- **show ipam dp** *peerid* **ipv6-address**: Displays the UPFs of IPv6 address type
- **show ipam dp** *peerid* **ipv6-prefix**: Displays the UPFs of IPv6 prefix type

The following is a sample output of the **show ipam dp** *peerid* **ipv4-address**:

```
bng# show ipam dp peer-asr9k2 ipv4-addr
Wed Mar  30 12:43:09.313 UTC+00:00

=================================================================================================
Flag  Indication: S(Static) O(Offline) R(For Remote Instance) RF(Route Sync Failed)
G:N/P Indication: G(Cluster InstId) N(Native NM InstId) P(Peer NM InstId)
=================================================================================================
StartAddress          EndAddress      Route            G:N/P    Utilization   Flag
AllocContext
=================================================================================================
7.67.133.0            7.67.133.255    7.67.133.0/24    1:N/A                  S
srg-9k-static2(default)(asr9k-11,asr9k-12)
7.67.134.0            7.67.134.255    7.67.134.0/24    1:N/A                  S
srg-9k-static2(default)(asr9k-11,asr9k-12)
7.67.135.0            7.67.135.255    7.67.135.0/24    1:N/A                  S
srg-9k-static2(default)(asr9k-11,asr9k-12)
7.67.136.0            7.67.136.255    7.67.136.0/24    1:N/A                  S
srg-9k-static2(default)(asr9k-11,asr9k-12)
7.67.137.0            7.67.137.255    7.67.137.0/24    1:N/A                  S
srg-9k-static2(default)(asr9k-11,asr9k-12)
7.67.138.0            7.67.138.255    7.67.138.0/24    1:N/A                  S
srg-9k-static2(default)(asr9k-11,asr9k-12)
7.67.139.0            7.67.139.255    7.67.139.0/24    1:N/A                  S
srg-9k-static2(default)(asr9k-11,asr9k-12)
7.67.140.0            7.67.140.255    7.67.140.0/24    1:N/A                  S
srg-9k-static2(default)(asr9k-11,asr9k-12)
7.67.141.0            7.67.141.255    7.67.141.0/24    1:N/A                  S
srg-9k-static2(default)(asr9k-11,asr9k-12)
```

```
7.67.142.0            7.67.142.255    7.67.142.0/24    1:N/A                  S
srg-9k-static2(default)(asr9k-11,asr9k-12)
33.0.0.0              33.0.7.255      33.0.0.0/21      1:0/-1   0.20%
automation-poolv4(default)(asr9k-11,asr9k-12)
=============================================================================================================
```