



Subscriber Manager

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Feature Summary and Revision History

Summary Data

Table 1: Summary Data

Applicable Product(s) or Functional Area	cnBNG
Applicable Platform(s)	SMI
Feature Default Setting	Disabled - Configuration Required
Related Changes in this Release	Not Applicable
Related Documentation	<i>Cloud Native BNG Control Plane Command Reference Guide</i>

Revision History

Table 2: Revision History

Revision Details	Release
Introduced support for Radius-Based Policy (RaBaPol)	2025.02.0
Introduced support for Shared Policy Instance (SPI)	2025.02.0

Revision Details	Release
Introduced support for session disconnect history.	2025.01.0
First introduced.	2021.01.0

Feature Description

In the Subscriber Manager (SM) context, a subscriber is a binding between the cnBNG Control Plane (CP) and a single subscriber end device. The SM is designed to provide a generic mechanism to connect edge subscribers to services enabling features. Subscribers are identified, authenticated, authorized, and accounted for in the SM.



Note The Subscriber Manager is also referred to as the Session Manager.

The following is a high-level list of the SM functionalities:

- Provides a generic mechanism for different Broadband Access Protocols such as DHCP and PPPoE.
- Provides an interface with off-box Radius servers using policy-plane to meet protocol and network provisioning requirements.
- Supports different subscriber lifecycle events such as CoA, idle timeout processing, and periodic reauthorization.
- Provides support for configuring subscriber lifecycle events that help customer define the subscriber behavior for the different subscriber lifecycle events.
- Derives per subscriber configuration from multiple sources.
- Maintains the subscriber state and subscriber configuration in a centralized session database.
- Interacts with the User Plane (UP) for subscriber session creation and subscriber feature configurations.

Subscriber features that are configured on cnBNG enable service providers to deploy certain specific functionalities like restricting the use of certain network resources, allowing Law Enforcement Agencies (LEAs) to conduct electronic surveillance, and so on.

Subscriber Features

The cnBNG supports the following subscriber features on the UP. For details, see the latest version of the Broadband Network Gateway Configuration Guide for Cisco ASR 9000 Series Routers listed here: <https://www.cisco.com/c/en/us/support/routers/asr-9000-series-aggregation-services-routers/products-installation-and-configuration-guides-list.html>.

- IPv4 or IPv6
 - Maximum Transmission Unit (MTU)
 - Unicast Reverse Path Forwarding (URPF)
 - Internet Control Message Protocol (ICMP)

- Access Control List (ACL)
 - Input ACL (IPv4 or IPv6)
 - Output ACL (IPv4 or IPv6)
- QoS (Quality of Service)
 - Input (policing)
 - Output (policing, shaping)
 - Policy merging (up to 6 policy maps and 10 class maps, including the default)
- Policy-based Routing (PBR)
 - Input policy (HTTP redirect)
- Accounting
 - Session Accounting
 - Periodic accounting
 - Service Accounting
 - Periodic accounting

To configure subscriber features, see [Configuring Subscriber Manager Features, on page 3](#).

How it Works

This section provides a brief about how the Subscriber Manager works.

The SM functionality is hosted in a SM pod having one container in it. The SM pod communicates with the BNG Ops Center, policy-plane, and PFCP-EP pods using the APP infrastructure inter-pod communication (IPC).

The Subscriber Microservices Infrastructure (SMI) instantiates the SM pod. There can be more than one SM pod in the cluster. Each SM pod instance is independent. The per subscriber data is stored in a centralized database such that any SM pod can access this data.

Configuring Subscriber Manager Features

This section describes how to configure Subscriber Manager features on the CP.

The configuration of the Subscriber Manager features involves the following procedures:

- [Configuring the HTTPR Policy Name, on page 4](#)
- [Configuring IPv4 Options, on page 4](#)
- [Configuring IPv6 Options, on page 5](#)
- [Configuring QoS Parameters](#)

- [Configuring the VRF Name, on page 6](#)
- [Configuring a Subscriber Profile, on page 6](#)

**Note**

- To configure PPP feature options, see [Creating the PPP Feature Template](#)
- To configure service accounting, see [Configuring Service Accounting, on page 13](#)
- To configure session accounting, see [Configuring Session Accounting, on page 13](#)

Configuring the HTTPR Policy Name

Use the following commands to configure the Policy Based Routing (PBR) HTTP Redirect (HTTPR) policy name.

```
config
  profile feature-template feature_template_name
  httppr-policy httppr_policy_name
  exit
```

NOTES:

- **profile feature-template** *feature_template_name*: Specifies the profile feature template name.
- **httppr-policy** *httppr_policy_name*: Specifies the PBR HTTPR policy name. The *httppr_policy_name* value can range from 1 to 128 characters.

Configuring IPv4 Options

Use the following commands to configure IPv4 options.

```
config
  profile feature-template feature_template_name
  ipv4
    disable-unreachables
    egress-acl string
    ingress-acl string
    mtu mtu_bytes
    verify-unicast-source reachable-via-rx
  exit
```

NOTES:

- **profile feature-template** *feature_template_name*: Specifies the profile feature template name.
- **ipv4**: Enters the IPv4 Configuration mode to configure the IPv4 features.
- **disable-unreachables**: Disables sending the Internet Control Message Protocol (ICMP) Unreachable messages.
- **egress-acl** *string*: Specifies the IPv4-based egress Access Control List (ACL) list. The supported length of the *string* ranges from 1 to 128 characters.

- **ingress-acl** *string*: Specifies the IPv4-based ingress ACL list. The supported length of the *string* ranges from 1 to 128 characters.
- **mtu** *mtu_bytes*: Specifies the maximum transmission unit (MTU). The supported *mtu_bytes* value can range from 68 to 65535 bytes.
- **verify-unicast-source reachable-via-rx**: Enables per packet validation for unicast. The source is reachable via the interface on which packet is received.

Configuring IPv6 Options

Use the following commands to configure IPv6 options.

```
config
profile feature-template feature_template_name
ipv6
  disable-unreachables
  egress-acl string
  ingress-acl string
  mtu mtu_bytes
  verify-unicast-source reachable-via-rx
exit
```

NOTES:

- **profile feature-template** *feature_template_name*: Specifies the profile feature template name.
- **ipv6**: Enters the IPv6 Configuration mode to configure the IPv6 features.
- **disable-unreachables**: Disables sending the Internet Control Message Protocol (ICMP) Unreachable messages.
- **egress-acl** *string*: Specifies the IPv6-based egress Access Control List (ACL) list. The supported length of the *string* ranges from 1 to 128 characters.
- **ingress-acl** *string*: Specifies the IPv6-based ingress ACL list. The supported length of the *string* ranges from 1 to 128 characters.
- **mtu** *mtu_bytes*: Specifies the maximum transmission unit (MTU). The supported *mtu_bytes* value can range from 68 to 65535 bytes.
- **verify-unicast-source reachable-via-rx**: Enables per packet validation for unicast. The source is reachable via the interface on which packet is received.

Configuring QoS Parameters

Use the following commands to configure the Quality of Service (QoS) parameters.

```
config
profile feature-template feature_template_name
qos
  in-policy qos_input_policy_name
  merge-level integer
```

```

out-policy qos_output_policy_name
exit

```

NOTES:

- **profile feature-template** *feature_template_name*: Specifies the profile feature template name.
- **qos**: Enters the QoS Configuration mode to configure the parameters.
- **in-policy** *qos_input_policy_name*: Specifies the QoS input policy name. The supported length of the *qos_input_policy_name* ranges from 1 to 128 characters.
- **merge-level** *integer*: Enables or disables the merge level. A merge value of 0 disables the merge-level. Any value greater than 0, enables the merge level.
- **out-policy** *qos_output_policy_name*: Specifies the QoS output policy name. The supported length of the *qos_output_policy_name* ranges from 1 to 128 characters.

Configuring the VRF Name

Use the following commands to configure the virtual routing and forwarding (VRF) name.

```

config
  profile feature-template feature_template_name
  vrf-name vrf_name
exit

```

NOTES:

- **profile feature-template** *feature_template_name*: Specifies the profile feature template name.
- **vrf-name** *vrf_name*: Specifies the VRF name. The supported length of the *vrf_name* ranges from 1 to 128 characters.

Configuring a Subscriber Profile

Use the following commands to create a subscriber profile.

```

configure
  profile subscriber subscriber_profile
    aaa { authenticate aaa_profile_for_authentication |
          authorize aaa_profile_for_authorization }
    activate-feature-template feature_template_name
    apply-all-class
    class class_name
      aaa aaa_profile_for_authentication | authorize aaa_profile_for_authorization
      activate-feature-template feature_template_name
      matches
        match { protocol { dhcp | ppp } } | username { ascii
          ascii_string | regex reg-exp string }
          | source-mac { ascii ascii_string
          | regex reg-exp string } |
          circuit-id { ascii ascii_string
          | regex reg-exp string } |

```

```

remote-id { ascii ascii_string
| regex reg-exp string }
match-type { all match { protocol | username |
source-mac | circuit-id | remote-id } | any match {
protocol | username | source-mac | circuit-id
| remote-id } }

exit
dhcp-profile dhcp_profile_name
event session-activate { aaa { authenticate | authorize } |
activate-feature-templates
feature_templates_list
| apply-all-class | class class_name
| deactivate-feature-templates
feature_templates_list
pppoe-profile pppoe_profile_name
session-type { ipv4 | ipv4v6 | ipv6 }
exit

```

NOTES:

- **profile subscriber** *subscriber_profile_name*: Specifies the profile subscriber name and enters the Profile Subscriber Configuration mode.
- **aaa { authenticate *aaa_profile_for_authentication* | authorize *aaa_profile_for_authorization* }**: Specifies the AAA profile to associate for authentication and authorization.
- **activate-feature-templates** *feature_template_name*: Specifies the list of feature-templates in sequence for activation.
- **apply-all-class**: Applies all classes that are enabled.
- **class** *class_name* : Specifies the subscriber class name.
- **matches**: Enters the matches Configuration sub-mode to specify the match values.
 - **match { protocol { dhcp | ppp } | username { ascii *ascii_string* | regex *reg-exp string* } | source-mac { ascii *ascii_string* | regex *reg-exp string* } | { circuit-id { ascii *ascii_string* | regex *reg-exp string* } | remote-id { ascii *ascii_string* | regex *reg-exp string* } }**: Specifies the list of match values.
 - **match { protocol { dhcp | ppp } }**: Specifies the match protocol as DHCP or PPP.
 - **username { ascii *ascii_string* | regex *reg-exp string* }**: Specifies the username in ascii format or regular express (reg-exp) string.
 - **source-mac { ascii *ascii_string* | regex *reg-exp string* }**: Specifies the source MAC address in ascii format or regular express (reg-exp) string.
 - **remote-id { ascii *ascii_string* | regex *reg-exp string* }**: Specifies the remote identifier in ascii format or regular express (reg-exp) string.
 - **circuit-id { ascii *ascii_string* | regex *reg-exp string* }**: Specifies the circuit identifier in ascii format or regular express (reg-exp) string.
 - **match-type { all match { protocol | username | source-mac | circuit-id | remote-id } | any match { protocol | username | source-mac | circuit-id | remote-id } }**: Specifies the match key and value for matching any or all of the options: protocol, username, source-mac, circuit-id, and remote-id.

- **dhcp-profile** *dhcp_profile_name*: Associates the DHCP first sign of life (FSOL) profile.
- **pppoe-profile** *pppoe_profile_name*: Associates the PPPoE FSOL profile.
- **session-type** { **ipv4** | **ipv4v6** | **ipv6** }: Specifies the allowed session-types as IPv4, IPv4v6, and IPv6.

Session Disconnect History

Table 3: Feature History

Feature Name	Release Information	Description
Session Disconnect History	2025.01.0	This feature enhances troubleshooting by providing detailed records of past session disconnections in cnBNGs. This feature is crucial for understanding why sessions have been disconnected in the past, allowing for effective problem resolution and network management.

The Session Disconnect History feature enables the storage of details for the last <n> disconnected sessions, specifically for debugging purposes. The feature records the session disconnect reasons for the session manager, along with complete session context, facilitating in-depth analysis of disconnect events.

Restrictions for Session Disconnect History

These restrictions apply to the Session Disconnect History feature:

- This feature cannot be enabled or disabled via the CLI.
- Display is limited to per UPF or per SRG-peer-id only.
- Each UPF can store a maximum of 1000 calls in the disconnect history.

Verify Session Disconnect History

Use the **show subscriber session disconnect-history** command to view the disconnected session details.

UPF based CLIs

- **bng# show subscriber session disconnect-history upf up1 unique**

```
Tue Dec 17 03:32:08.430 UTC+00:00
subscriber-details
```

[Disconnect Reason]	[Last Disconnect Time]	[Mac-Address]	[Sublabel]
[Srg-Peer-Id] [Count]			

UPF: [up1]

Dhcp admin delete	2024/12/16 14:34:36.080	aa11.0000.0001	16777223
Peer1 1			
PPPoE admin delete	2024/12/16 14:44:27.079	cc11.0000.0001	16777229
Peer1 1			
PPPoE received PADT			


```

from the client          2024/12/16 14:43:59.983  cc11.0000.0001  16777228
Peer1                    1
SessionDisconnect        2024/12/16 14:31:59.338  aa11.0000.0001  16777222
Peer4                    6
admin triggered subscriber
session-synchronize-cp failed 2024/12/16 14:38:44.085  aa11.0000.0001  16777226
Peer1                    1
session timeout          2024/12/16 14:35:45.055  aa11.0000.0001  16777224
Peer1                    1
CoA Session-Disconnect    2024/12/16 14:42:46.001  aa11.0000.0001  16777227
Peer1                    1

```

This command displays the time of the last disconnected call and the total number of calls for each recorded disconnect reason for the UPF.

```
bng# show subscriber session disconnect-history upf up1 last 1
```

```
Tue Dec 17 03:32:56.705 UTC+00:00
```

```
subscriber-details
```

```
-----
[Disconnect Reason]    [Last Disconnect Time]    [Mac-Address]    [Sublabel]    [Srg-Peer-Id]
-----
```

```
UPF: [up1]
-----
```

```
PPPoE admin delete    2024/12/16 14:44:27.079  cc11.0000.0001  16777229  Peer1
```

This command displays the most recent disconnected calls for the selected number, covering all disconnect reasons, in reverse chronological order for the UPF.

```
bng# show subscriber session disconnect-history upf up1 filter mac
aa11.0000.0064
```

```
Mon Nov 25 03:49:26.734 UTC+00:00
```

```
subscriber-details
```

```

{
  "subResponses": [
    {
      "subLabel": "16777514",
      "srgPeerId": "Peer1",
      "srgGroupId": "Group1",
      "srgIntfId": "1",
      "mac": "aa11.0000.0064",
      "acct-sess-id": "0100012a",
      "sesstype": "ipoe",
      "state": "established",
      "subCreateTime": "Mon, 25 Nov 2024 03:40:57 UTC",
      "dhcpAuditId": 2,
      "transId": "1",
      "subsAttr": {
        "attrs": {
<snip>
"upfsInfo": {
  "up1": {
    "portName": "GigabitEthernet0/0/0/1",
    "upId": 293,
    "transId": 1,
    "smupState": "smUpSessionCreated"
  },
  "up1-stby": {
    "portName": "GigabitEthernet0/0/0/3",
    "upId": 296,
    "transId": 1,
    "smupState": "smUpSessionCreated",
    "lastUpdateTime": "Mon, 25 Nov 2024 03:40:57 UTC"
  }
}

```

```

    }
  },
  "sess-events": [
    "Time, Event, Status",
    "2024-11-25 03:40:57.85041449 +0000 UTC, SessionCreate, success",
    "2024-11-25 03:40:57.875228277 +0000 UTC, N4-Create:up1, PASS",
    "2024-11-25 03:40:57.876039904 +0000 UTC, SessionUpdate, success",
    "2024-11-25 03:40:57.887317627 +0000 UTC, N4CreateToStdb:up1-stby, PASS",
    "2024-11-25 03:41:08.735558746 +0000 UTC, SessionTimerExpiry:up1, PASS"
  ]
}

```

This command displays all CDL lines in the disconnect history cache for the given MAC address. It displays the complete session context.

```

• bng# show subscriber session disconnect-history upf up1 filter sublabel
  16777514

```

```

Mon Nov 25 03:50:02.691 UTC+00:00
subscriber-details

```

```

{
  "subResponses": [
    {
      "subLabel": "16777514",
      "srgPeerId": "Peer1",
      "srgGroupId": "Group1",
      "srgIntfId": "1",
      "mac": "aa11.0000.0064",
      "acct-sess-id": "0100012a",
      "sesstype": "ipoe",
      "state": "established",
      "subCreateTime": "Mon, 25 Nov 2024 03:40:57 UTC",
      "dhcpAuditId": 2,
      "transId": "1",
      "subsAttr": {
        "attrs": {
<snip>

      "upfsInfo": {
        "up1": {
          "portName": "GigabitEthernet0/0/0/1",
          "upId": 293,
          "transId": 1,
          "smupState": "smUpSessionCreated"
        },
        "up1-stby": {
          "portName": "GigabitEthernet0/0/0/3",
          "upId": 296,
          "transId": 1,
          "smupState": "smUpSessionCreated",
          "lastUpdateTime": "Mon, 25 Nov 2024 03:40:57 UTC"
        }
      },
      "sess-events": [
        "Time, Event, Status",
        "2024-11-25 03:40:57.85041449 +0000 UTC, SessionCreate, success",
        "2024-11-25 03:40:57.875228277 +0000 UTC, N4-Create:up1, PASS",
        "2024-11-25 03:40:57.876039904 +0000 UTC, SessionUpdate, success",
        "2024-11-25 03:40:57.887317627 +0000 UTC, N4CreateToStdb:up1-stby, PASS",
        "2024-11-25 03:41:08.735558746 +0000 UTC, SessionTimerExpiry:up1, PASS"
      ]
    }
  ]
}

```

This command displays all CDL lines in the disconnect history cache for the given sublabel. It displays the complete session context.

SRG Peer-id based CLIs

- bng# **show subscriber session disconnect-history srg-peer-id** *Peer4* **last** 5

Tue Dec 17 03:36:39.161 UTC+00:00
subscriber-details

[Disconnect Reason]	[Last Disconnect Time]	[Mac-Address]	[Sublabel]	[UserPlane]
---------------------	------------------------	---------------	------------	-------------

PeerID: [Peer4]

SessionDisconnect	2024/12/16 14:31:59.338	aa11.0000.0001	16777222	up1
SessionDisconnect	2024/12/16 14:29:56.763	aa11.0000.0001	16777221	up1
SessionDisconnect	2024/12/16 14:29:08.779	aa11.0000.0004	16777220	up1
SessionDisconnect	2024/12/16 14:29:07.783	aa11.0000.0003	16777219	up1
SessionDisconnect	2024/12/16 14:29:06.784	aa11.0000.0002	16777218	up1

This command displays the most recent disconnected calls for the selected number, covering all disconnect reasons, in reverse chronological order for the specific SRG peer-id.

- bng# **show subscriber session disconnect-history srg-peer-id** *Peer1* **unique**

Tue Dec 17 03:37:36.656 UTC+00:00
subscriber-details

[Disconnect Reason]	[Last Disconnect Time]	[Mac-Address]	[Sublabel]	[UserPlane]	[Count]
---------------------	------------------------	---------------	------------	-------------	---------

PeerID: [Peer1]

Dhcp admin delete	2024/12/16 14:34:36.080	aa11.0000.0001	16777223	up1	1
PPPoE admin delete	2024/12/16 14:44:27.079	cc11.0000.0001	16777229	up1	1
PPPoE received PADT from the client	2024/12/16 14:43:59.983	cc11.0000.0001	16777228	up1	1
admin triggered subscriber session-synchronize-cp failed	2024/12/16 14:38:44.085	aa11.0000.0001	16777226	up1	1
session timeout	2024/12/16 14:35:45.055	aa11.0000.0001	16777224	up1	1
CoA Session-Disconnect	2024/12/16 14:42:46.001	aa11.0000.0001	16777227	up1	1

This command displays the time of the last disconnected call and the total number of calls for each recorded disconnect reason for the specific SRG peer-id.

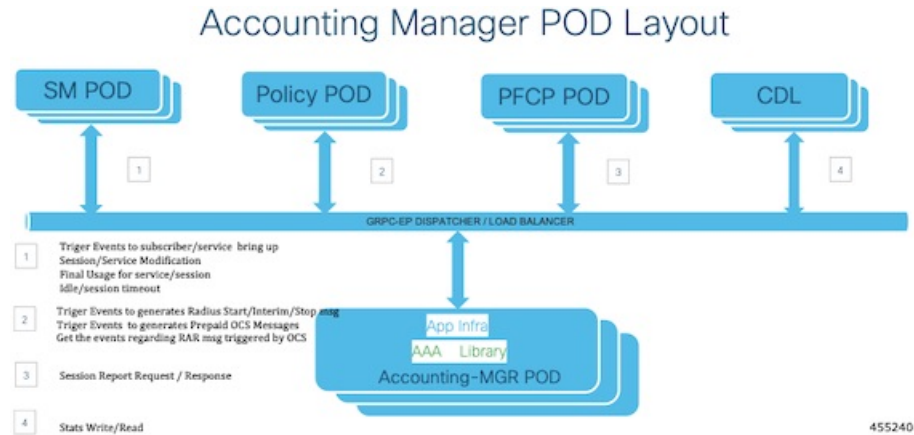
Subscriber Accounting Functions

Feature Description

The Accounting Manager handles the Subscriber Accounting functions in the cnBNG CP. The Accounting function includes features that track traffic either in volume or duration. It provides accounting information

for subscribers on a session or per service. The Accounting function determines the length and duration of a given service that a subscriber has used. Certain regulations require service providers to account for services they provide to the subscriber.

The following figure illustrates the Accounting Manager external interfaces.



The Accounting Manager in cnBNG supports the following forms of accounting:

Service Accounting

ISPs can offer different tiered services to their subscribers with the ability to move between different tiers. Different tiers could correspond to different bandwidths offered to the subscriber. A subscriber can enable a new service that corresponds to temporarily moving from one tier of service to another. ISPs need to keep track of when a new service is enabled and how long it is active for each subscriber. Often there might be a need to count the number of packets and bytes associated with a service. Both of these forms of accounting are referred to as service accounting. When service accounting is enabled, BNG sends a Service-Start request when service is activated and a Service-Stop request when the service is deactivated. A timestamp is sent with both the actions. Service-Stop can also contain statistics associated with the service.

To configure Service Accounting, see [Configuring Service Accounting, on page 13](#).

Session Accounting

When Session Accounting is activated, an Accounting-Start request is sent to AAA when the session is started. When the session is terminated, an Accounting-Stop request is sent. The Accounting-Stop request contains the final session accounting statistics (packets, bytes in, bytes out). An “interim” session accounting can be optionally activated that sends Interim-Updates periodically while the session is active. These updates provide the current session statistics accumulated since the start of the session.

Session Accounting is configured directly on the template.

To configure Session Accounting, see [Configuring Session Accounting, on page 13](#).

Limitations and Restrictions

The Subscriber Accounting Function has the following limitation in this release:

- An interim Interval of zero is not supported.
- AAA profile change at service level is not supported.

- Service-level attributes changes are not supported after service bring-up.
- Session accounting is mandatory to enable Service accounting due to User Plane (UP) (asr9k) limitation.
- Session and Service Accounting enable or disable is not supported after session or service is up because of UP limitations. Session Accounting must be enabled only during session bring-up.

Configuring Subscriber Accounting Functions

This section describes how to configure the Subscriber Accounting Functions.

The configuration of the Subscriber Accounting Functions involve the following procedures:

- Configuring Service Accounting
- Configuring Session Accounting

Configuring Service Accounting

Use the following commands to configure service accounting.

```
config
  profile feature-template feature-template
  service accounting
    aaa-profile aaa_profile_name
    enable
    periodic-interval interval_in_seconds
  exit
```

NOTES:

- **profile feature-template** *feature-template*: Specifies the profile feature template name and enters Feature-Template Configuration mode.
- **service accounting**: Enters the Service Configuration mode to configure service accounting for a AAA profile.
- **aaa-profile** *aaa_profile_name*: Specifies the AAA profile to use for service accounting.
- **enable**: Enables service accounting for the specified AAA profile.
- **periodic-interval** *interval_in_seconds*: Specifies the interim interval in seconds. The valid values range from 60 to 4320000 seconds.

Configuring Session Accounting

Use the following commands to configure session accounting.

```
config
  profile feature-template feature-template
  session accounting
    aaa-profile aaa_profile_name
    dual-stack-delay delay_in_seconds
    enable
```

```
periodic-interval interval_in_seconds
exit
```

NOTES:

- **profile feature-template** *feature-template*: Specifies the profile feature template name and enters Feature-Template Configuration mode.
- **session accounting**: Enters the Session Configuration mode to configure session accounting for a AAA profile.
- **aaa-profile** *aaa_profile_name*: Specifies the AAA profile to use for session accounting.
- **dual-stack-delay** *delay_in_seconds*: Specifies the dual stack set delay time in seconds. The valid values range from 1 to 30 seconds.
- **enable**: Enables session accounting for the specified AAA profile.
- **periodic-interval** *interval_in_seconds*: Specifies the interim interval in seconds. The valid values range from 60 to 4320000 seconds.

RADIUS-Based Policing - QoS Shape-Rate parameterization

RADIUS-Based Policing (RaBaPol) is a network management approach that

- enables the use of customized parameters instead of default parameters to activate cnBNG subscriber services.
- allows for greater flexibility and control over service configurations.

Table 4: Feature History

Feature Name	Release Information	Description
RADIUS-Based Policing - QoS Shape-Rate parameterization	2025.02.0	You can now dynamically manage your cnBNG subscriber services through RADIUS-based activation. With RADIUS-Based Policing (RaBaPol), you can customize service parameters, such as the QoS shape-rate, according to your requirements, giving you greater control over service management.

Parameterization of QoS shape-rate

RaBaPol supports the customization of the QoS shape-rate parameter. This parameter can be sent to the cnBNG Control Plane (CP) by the RADIUS server either during the initial connection setup as Cisco VSAs in an Access Accept message, or through Change of Authorization (CoA) messages.

Configuring QoS shape-rate parameterization

To establish QoS shape-rate parameterization, use the **shape average \$var_name = value** command in the policy-map class configuration mode in the cnBNG User Plane (UP). This customization is feature-dependent and requires specific syntax and semantics. For QoS, a dollar sign (\$) is added as a prefix to the **shape-rate** variable, and the default value, along with the variables, is configured in the policy-map definition.

Handling service changes and errors

If a service associated with a subscriber needs a change in the variable list, deactivate the current service using CoA Session-Disconnect and activate the updated service using CoA Session-Activate process. If an error occurs during feature activation, the cnBNG UP reverts all features and associated variable lists to their previous states.

Policy merging support

You can merge QoS policies from multiple dynamic templates. Configure these templates through CLI or download them from an AAA server for comprehensive policy integration.

Benefits of RADIUS-Based Policing

The RADIUS-Based Policing feature provides these benefits.

- **Dynamic activation:** Enables dynamic and flexible service activation based on RADIUS messages.
- **QoS customization:** Allows for the customization of QoS parameters to meet specific subscriber needs.
- **Policy merging:** Supports the merging of QoS policies from multiple dynamic templates for a subscriber.
- **Error rollback:** Provides rollback capabilities to previous states in case of errors during service activation.

Use case for QoS shape-rate parameterization

This use case illustrates how to manage and customize network QoS settings when a subscriber starts a session.

1. **Subscriber session initiation:** A user starts a session with specific credentials and settings, such as a username, password, and protocol type. For example,

```
user-cpe@abc.com      Password="abc"
                      Framed-Protocol=PPP,
                      Service-Type=Framed-User
                      .
                      .
                      Cisco-avpair = "subscriber:sa=DEFAULT-QOS(shape-rate=120000)
```

2. **AAA server communication:** The Authentication, Authorization, and Accounting (AAA) server sends an Access-Accept message to the cnBNG. This message specifies the service name, action type, and a list of variables with their values, like the QoS shape-rate.
3. **Policy configuration:** The service name from the AAA message maps to a feature-template on the cnBNG's control plane, and the specified QoS shape-rate is used to override the default settings on the cnBNG's user plane. The policy merges these custom values with default values, retaining defaults where no specific values are provided.
4. **Service activation via CoA:** Alternatively, service activation can be achieved using CoA, which involves removing the old policy and configuring a new, merged policy in the hardware.

Limitations of configuring RADIUS-Based Policy

This limitation applies to the RADIUS-Based Policy feature:

- Service modifications with different RaBaPol configurations are not supported.

Configure QoS shape-rate parameterization

Follow these steps to configure QoS shape-rate parameterization.

Procedure

Step 1 Define a feature template with the desired QoS configuration on the cnBNG CP.

Example:

```
config
  profile feature-template feature_template_name
    qos
      in-policy qos_input_policy_name
      out-policy qos_output_policy_name
      merge-level integer
    exit
  exit
```

NOTES:

- **profile feature-template** *feature_template_name*: Specifies the profile feature template name.
- **qos**: Enters the QoS configuration mode to configure the parameters.
- **in-policy** *qos_input_policy_name*: Specifies the QoS input policy name. The supported length of the *qos_input_policy_name* ranges from 1 to 128 characters.
- **out-policy** *qos_output_policy_name*: Specifies the QoS output policy name. The supported length of the *qos_output_policy_name* ranges from 1 to 128 characters.
- **merge-level** *integer*: Enables or disables the merge level. A merge value of 0 disables the merge-level. Any value greater than 0, enables the merge level.

This is a sample configuration.

```
config
  profile feature-template DEFAULT-QOS
    qos
      in-policy hqos-policy1
      out-policy hqos-policy2
      merge-level 10
    exit
  exit
```

Step 2 Configure the policy map with a shape-rate value, on the cnBNG UP.

Example:

```
config
  policy-map policy_map_name
    class class-default
      shape average $shape-rate = rate (units)
    exit
  end-policy-map
exit
```


NOTES:

- **policy-map** *policy_map_name*: Creates or modifies a policy map that can be attached to one or more interfaces to specify a service policy.
- **class class-default**: Configures a traffic policy for the default class of the traffic policy.
- **shape average \$shape-rate = rate (units)**: Average shaping rate in the specified units. Values can be from 1 to 4294967295. *Units* can be one of the following:
 - bps
 - gbps
 - kbps
 - mbps

This is a sample configuration.

```
config
 policy-map hqos-policy2
   class class-default
     shape average $shape-rate = 100000 kbps
   exit
 end-policy-map
exit
```

In this example, the service named DEFAULT-QOS has QoS features enabled. The associated feature template is configured with outgoing QoS policies. The default value of shape-rate (the rate at which traffic is shaped) is set to 100000 kbps.

Step 3 Add the user profile to the USER file in RADIUS.

Example:

```
user-cpe@abc.com          Password="abc"
    Framed-Protocol=PPP,
    Service-Type=Framed-User
    .....
    Cisco-avpair = "subscriber:sa=DEFAULT-QOS(shape-rate=120000)"
```

This specified QoS shape-rate value (for example, 120000) overrides the default value configured on the cnBNG UP.

Step 4 Use the **show subscriber session detail** command to verify the configuration, on the cnBNG CP.

Example:**show subscriber session detail**

```
subscriber-details
{
  "subResponses": [
    {
      "subLabel": "16777218",
      "mac": "cc11.0000.0001",
      "acct-sess-id": "01000002",
      "upf": "asr9k-1",
      "port-id": "Bundle-Ether1",
      "up-subs-id": "1",
      "sesstype": "ppp",
      "state": "established",
```

```

    "subCreateTime": "Fri, 15 Nov 2024 03:34:47 UTC",
    "pppAuditId": 3,
    "transId": "2",
    "subcfgInfo": {
    "activatedServices": [
        {
            "serviceName": "DEFAULT-QOS",
            "serviceAttrs": {
                "attrs": {
                    "accounting-list": "automation-aaaprofile",
                    "acct-interval": "900",
                    "service-acct-enabled": "true",
                    "service-parameters": "shape-rate=120000",
                    "sub-qos-policy-in": "hqos-policy1",
                    "sub-qos-policy-out": "hqos-policy2"
                }
            }
        }
    ]
    }
}

```

Step 5 Use the **show policy-map applied interface** command to view sessions configured with RaBaPol, on the cnBNG UP.

Example:

```
bng# show policy-map applied interface Bundle-Ether1.1.pppoe100
```

Input policy-map applied to Bundle-Ether1.1.pppoe100:

```

policy-map hqos-policy1
class class-default
  police rate 200 kbps
!
!

```

Output policy-map applied to Bundle-Ether1.1.pppoe100:

```

policy-map hqos-policy2
class class-default
  shape average $shape-rate = 100000 kbps
!

```

Shared Policy Instance

Shared Policy Instance (SPI) is a mechanism that enables

- allocation of a single set of QoS resources among groups of cnBNG sub-interfaces and bundle sub-interfaces
- sharing of these resources across multiple Ethernet flow points, bundle interfaces, or groups of sub-interfaces.

Table 5: Feature History

Feature Name	Release Information	Description
Shared Policy Instance	2025.02.0	You can now allocate and share a single set of QoS resources across multiple cnBNG sub-interfaces and bundle sub-interfaces. By using a single QoS policy instance across multiple sub-interfaces, you can achieve aggregate shaping across your sub-interfaces, promoting streamlined bandwidth management.

Efficient QoS policy sharing across sub-interfaces: SPI allows you to share a single QoS policy instance among multiple sub-interfaces to maintain a unified rate through aggregate shaping. Sub-interfaces sharing the QoS policy must belong to the same physical interface, with the number ranging from 2 to the maximum supported by the port.

Configuration and application of policies: To implement SPI, you must configure a complete hierarchical policy-map that includes both parent and child policies. The SPI name can be defined and linked to a feature template or downloaded from a RADIUS server.

There are two main ways to configure these policies:

- **CLI and Feature Template:** Policy is configured through a Command Line Interface (CLI) and applied through a feature-template.
- **CLI and AAA Server:** Policy is configured through CLI and applied through an AAA server.

Limitations of configuring Shared Policy Instance

Session consistency within S-VLAN interface

Sessions sharing the same SPI must remain within the same S-VLAN interface.

Service accounting

Service accounting is not supported for services configured with an SPI.

SPI name change requirements

- If you modify the policy-map associated with an SPI, you must also change the SPI name.
- Avoid the following scenarios:
 - Applying a new policy with the same policy-map name but a different SPI name to a subscriber who already has an SPI policy applied. The system will reject this configuration.
 - Applying a new policy with a different policy-map name but the same SPI name. The system will reject this configuration as well.

CoA service-update request limitation

When a service policy with a user profile configuration that includes an SPI is enabled, you cannot simultaneously use an SPI in a CoA service-update request.

Configure a policy with SPI using feature template

Perform this task to configure a policy with shared policy instance in the input and output direction using feature template.

Procedure

Step 1 Define a feature template on the Control Plane (CP) that includes the SPI configuration.

Example:

```
config
  profile feature-template feature_template_name
    qos
      in-policy qos_input_policy_name
      in-shared-policy-instance spi_name
      out-policy qos_output_policy_name
      out-shared-policy-instance spi_name
    exit
  exit
```

NOTES:

- **profile feature-template** *feature_template_name*: Specifies the profile feature template name.
- **qos**: Enters the QoS configuration mode to configure the parameters.
- **in-policy** *qos_input_policy_name*: Specifies the QoS input policy associated with SPI. The supported length of the *qos_input_policy_name* ranges from 1 to 128 characters.
- **in-shared-policy-instance** *input_spi_name*: Specifies the input SPI name for the QoS policy. This command applies a shared traffic policy to inbound traffic across multiple interfaces.
- **out-policy** *qos_output_policy_name*: Specifies the QoS output policy associated with SPI. The supported length of the *qos_output_policy_name* ranges from 1 to 128 characters.
- **out-shared-policy-instance** *output_spi_name*: Specifies the output SPI name for the QoS Policy. This command applies a shared traffic policy to outbound traffic across multiple interfaces.

This is a sample configuration.

```
config
  profile feature-template DEFAULT-QOS
    qos
      in-policy hqos-policy1
      in-shared-policy-instance spi1
      out-policy hqos-policy2
      out-shared-policy-instance spi2
    exit
  exit
```

Step 2 Configure traffic policing on the cnBNG UP to monitor the traffic rate and apply actions (such as dropping or remarking packets) when the traffic exceeds the allowed limit.

Example:

```

config
  policy-map policy_map_name
    class class-default
      police rate value
    exit
  end-policy-map
exit

```

NOTES:

- **policy-map** *policy_map_name*: Creates or modifies a policy map that can be attached to one or more interfaces to specify a service policy.
- **class class-default**: Configures a traffic policy for the default class of the traffic policy.
- **police rate** *value*: Configures traffic policing. The *value* indicates Committed information rate (CIR). Range is from 1 to 4294967295.

Step 3 Configure traffic shaping for a specific interface on the cnBNG UP.

Example:

```

config
  policy-map policy_map_name
    class class-default
      shape average value
    exit
  end-policy-map
exit

```

NOTES:

- **shape average** *value*: Specifies the average shaping rate in the specified units. This command limits the average rate of outgoing traffic to a predefined value. Values can be from 1 to 4294967295.

Step 4 Use the **show subscriber session detail** command to verify the configuration.

Example:

```

bng# show subscriber session detail
subscriber-details
{
  "subResponses": [
    {
      "subLabel": "16777220",
      "mac": "0011.9400.0001",
      "acct-sess-id": "01000004",
      "upf": "asr9k-1",
      "port-id": "Bundle-Ether1.1",
      "up-subs-id": "3",
      "sesstype": "ppp",
      "state": "established",
      "subCreateTime": "Fri, 15 Nov 2024 04:18:51 UTC",
      "pppAuditId": 3,
      "transId": "2",
      "subcfgInfo": {
        "committedAttrs": {
          "activatedServices": [
            {
              "serviceName": "DEFAULT-QOS",

```

```

"serviceAttrs": {
  "attrs": {
    "accounting-list": "aaaprofile",
    "acct-interval": "900",
    "service-acct-enabled": "true",
    "sub-qos-policy-in": "hqos-policy1",
    "sub-qos-policy-out": "hqos-policy2",
    "sub-qos-spi-in": "spi1",
    "sub-qos-spi-out": "spi2"
  }
} } ] } ] }

```

Configure a Policy with SPI using RADIUS

Follow these steps to configure a policy with shared policy instance using RADIUS.

Procedure

Step 1 Configure a policy map that can be shared to one or more interfaces to specify a service policy, on the cnBNG UP.

Example:

```

config
  policy-map policy_map_name1
    class class-default
      police rate value
    exit
  end-policy-map
exit

policy-map policy_map_name2
  class class-default
    shape average value
  exit
end-policy-map
exit

```

This is a sample configuration.

```

config
  policy-map hqos-policy1
    class class-default
      police rate 1024 kbps
    !
  end-policy-map
  !
  policy-map hqos-policy2
    class class-default
      shape average 4096 kbps
    !
  end-policy-map
  !

```

NOTES:

- **police rate value:** Specifies the policing rate for the policy-map. The value represents the committed information rate and ranges from 1 to 4294967295.
- **shape average value:** Specifies the average shaping rate in specified units. Values can be from 1 to 4294967295.

Step 2 Add the QoS policy with the SPI name to the USER file in RADIUS.

Example:

```
abc@example.com Cleartext-Password:= "xyz"
cisco-avpair += "sub-qos-policy-in=hqos-policy1 shared-policy-instance spi1",
cisco-avpair += "sub-qos-policy-out=hqos-policy2 shared-policy-instance spi2",
```

Step 3 Use the **show subscriber session detail** command to verify the configuration of a subscriber with a user-profile that includes both QoS and SPI settings, on the cnBNG CP.

Example:

```
bng# show subscriber session detail
subscriber-details
{
  "subResponses": [
    {
      "subLabel": "16777221",
      "mac": "cc11.0000.0001",
      "acct-sess-id": "01000005",
      "upf": "asr9k-1",
      "port-id": "Bundle-Ether1",
      "up-subs-id": "4",
      "sesstype": "ppp",
      "state": "established",
      "subCreateTime": "Fri, 15 Nov 2024 04:35:15 UTC",
      "pppAuditId": 3,
      "transId": "2",
      "subcfgInfo": {
        "committedAttrs": {
          "attrs": {
            "accounting-list": "aaaprofile",
            "acct-interval": "900",
            "addr-pool": "pool-ISP",
            "ppp-authentication": "pap, chap",
            "ppp-ipcp-reneg-ignore": "true",
            "ppp-ipv6cp-reneg-ignore": "true",
            "ppp-lcp-delay-seconds": "1",
            "ppp-lcp-reneg-ignore": "true",
            "service-type": "Framed(2)",
            "session-acct-enabled": "true",
            "sub-qos-policy-in": "hqos-policy1 shared-policy-instance spi1",
            "sub-qos-policy-out": "hqos-policy2 shared-policy-instance spi2",
            "vrf": "default"
          }
        }
      }
    }
  ]
}
```

Step 4 Use the **show cnbng-nal subscriber all detail** command to display sessions with user-profile having QoS and SPI, on the cnBNG UP.

Example:

```
show cnbng-nal subscriber all detail
Interface:      Bundle-Ether1.1.pppoe4
UPID:           0x00000004
CPID:           0x01000005
Type:           PPPoE
PPPOE Session Id: 00000006
```

Attribute List: 0x175d470

1: ipv4-unnumbered len= 9 value= Loopback0

2: sub-qos-policy-in len= 59 value= hqos-policy1 shared-policy-instance spi1

3: sub-qos-policy-out len= 63 value= hqos-policy2 shared-policy-instance spi2
