5G NSA for SAEGW

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Feature Summary and Revision History

Summary Data

Applicable Product(s) or Functional Area	• P-GW • S-GW • SAEGW
Applicable Platform(s)	• ASR 5000 • ASR 5500 • VPC-DI • VPC-SI
Feature Default	Disabled - Configuration Required
Related Changes in This Release	Not applicable

Related Documentation	• *5G Non Standalone Solution Guide* • *AAA Interface Administration and Reference* • *Command Line Interface Reference* • *P-GW Administration Guide* • *S-GW Administration Guide* • *SAEGW Administration Guide* • *Statistics and Counters Reference*

Revision History

The 5G NSA solution for SAEGW supports dcca-custom26 dictionary.	21.26
The 5G NSA solution for SAEGW supports Secondary RAT Usage IE during GnGp handover.	21.22
The 5G NSA solution for SAEGW supports dcca-custom1, dcca-custom7 and dcca-custom8 dictionaries.	21.11
The 5G NSA solution for SAEGW supports the following functionality: • P-GW Custom Dictionaries support over Gz for extended bitrate • S-GW Custom Dictionaries support over Gz for extended bitrate • P-GW Custom Dictionaries support over Gy and Rf for extended bitrate • S-GW support of Secondary RAT Data Usage Report in Gz CDRs	21.10
The 5G NSA solution for SAEGW supports the following functionality: • P-GW support of Secondary RAT Data Usage Report in Gz CDRs • P-GW support of Secondary RAT Data Usage Report in Rf CDRs • S-GW and P-GW support of statistics for DCNR PDNs	21.9
The 5G NSA solution is qualified on the ASR 5000 platform.	21.5
The 5G NSA solution for SAEGW supports the following functionality: • Feature License • Dedicated Bearers • Gy interface • URLLC QCI	21.8
First introduced.	21.6

Feature Description

Important 5G NSA feature is license controlled from release 21.8 onwards. Contact your Cisco account representative for detailed information on specific licensing requirements.

The 5G NSA solution for SAEGW supports the following functionalists:

- **High Throughput**

  5G NR offers downlink data throughput up to 20 Gbps and uplink data throughput up to 10 Gbps. Some interfaces in EPC have the support to handle (encode/decode) 5G throughput. For example, NAS supports up to 65.2 Gbps (APN-AMBR) and S5/S8/S10/S3 (GTP-v2 interfaces) support up to 4.2 Tbps. The diameter interfaces S6a and Gx support only up to 4.2Gbps throughput, S1-AP supports only up to 10 Gbps and NAS supports up to 10 Gbps (MBR, GBR). New AVP/IE have been introduced in S6a, Gx , S1-AP, and NAS interfaces to support 5G throughput. See the *How It Works* section for more information.

- **DCNR Support on P-GW:**

  Supports configuration of DCNR feature at the P-GW-service, by configuring “Extended-BW-NR” feature in IMSA service. Advertises the DCNR feature support by sending “Extended-BW-NR” feature bit in “Feature-List-ID-2” towards PCRF. Forwards AVP "Extended-APN-AMBR-UL" and "Extended-APN-AMBR-DL" in CCR messages when it receives APN-AMBR values greater than 4.2Gbps from MME/S-GW. Decodes the extended AVP "Extended-APN-AMBR-UL" and "Extended-APN-AMBR-DL" when it is received from PCRF.

- Sends AVP "Extended-Max-Requested-BW-UL", "Extended-Max-Requested-BW-DL", "Extended-GBR-UL" and "Extended-GBR-DL" when it receives MBR and GBR values greater than 4.2Gbps from MME/S-GW. Decodes the AVP "Extended-Max-Requested-BW-UL", "Extended-Max-Requested-BW-DL", "Extended-GBR-UL" and "Extended-GBR-DL" when received from PCRF. Supports dedicated bearer establishment with extended QoS. Sends AVP Extended-Max-Requested-BW-UL and "Extended-Max-Requested-BW-DL" in Gy records.

- **Ultra Low Latency Support**:

  Supports 5G requirements of Ultra-Reliable and Low Latency Communications (URLLC). 3GPP introduced URLCC QCI 80 (Non-GBR resource type), QCI 82 and 83 (GBR resource type). P-GW establishes default bearers with URLLC QCI 80, which is typically used by low latency eMBB applications. P-GW establishes dedicated bearers with URLLC QCI 82 and 83 (also with QCI 80 if dedicated bearers of Non-GBR type to be established), which is typically used by discrete automation services (industrial automation).

- **ICSR Support**

  With release 21.10 onwards ICSR for 5G NSA on SAEGW is supported.

- **Dynamic S-GW and P-GW selection by MME for DCNR capable UE**

  When DCNR capable UE attempts to register in MME and when all DCNR validations are successful (for example DCNR feature configuration on MME, HSS not sending access-restriction for NR, and son on), the MME sets “UP Function Selection Indication Flags” IE with DCNR flag set to 1 in “Create Session Request” message. This feature is relevant for CUPS architecture to help SGW-C and PGW-C

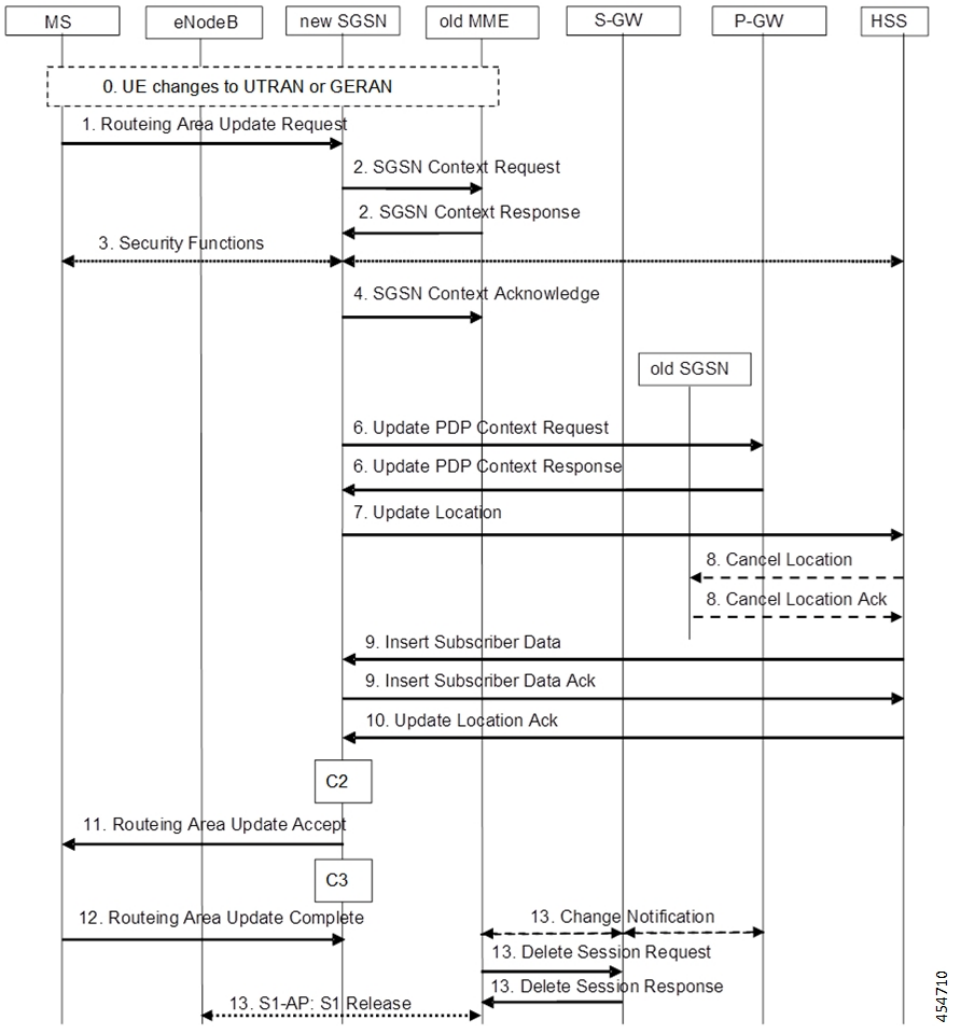
to select SGW-U and PGW-U which supports dual connectivity with NR. When S-GW receives this IE over S11, it sends this IE over S5 to P-GW. S-GW ignores IE if it receives it in Non-CUPS deployment.

- **P-GW Secondary RAT Usage Data Report Handling:**

  P-GW supports custom24 and custom44 for Gz and aaa-custom3, aaa-custom4 and aaa-custom6 dictionaries for Rf to support Secondary RAT Data Usage Report in CDRs.

Support for Secondary RAT Usage During GnGp Handover

This feature supports the Secondary RAT usage reported in change notification request during 4G to 3G handover. The support is for handling the change notification with Secondary RAT Usage during the GnGp handover. Step 13 is added in the following diagram in support of this feature. The usage must be reported in next CDR generation.



IMSI Not Known

If there’s no context found for IMSI specified in Secondary RAT Usage IE of change notification request Message, it returns the change notification response with cause value "IMSI/IMEI not known".

Limitations

Following are the known limitations for this feature:

- This feature only supports the handling of the secondary RAT usage IE.
- During the 4G to 3G handover, dedicated bearers are retained and Secondary RAT usage is reported for both Default and Dedicated bearers.

Enabling Secondary RAT Data Usage Report

Use the following configuration to enable Secondary RAT Data Usage Report:

```
configure
  context context_name
    pgw-service service_name
      dcnr
      end
```

Note The GGSN service associated with the P-GW service must have the DCNR enabled using the preceding CLI.

- **Statictics support for DCNR PDNs:**

  S-GW and P-GW statistics support for DCNR PDNs

- **S-GW Secondary RAT Usage Data Report Handling:**

  S-GW supports custom24 and custom6 dictionaries to support Secondary RAT Data Usage Report in CDRs over Gz.

- **P-GW Custom Dictionaries Support over Gz:**

  P-GW supports Custom44 and Custom24 dictionaries to support sending the following AVPs when it receives MBR, GBR and APN-AMBR values greater than 4.2Gbps:

  - Extended-Max-Requested-BW-UL
  - Extended-Max-Requested-BW-DL
  - Extended-GBR-UL
  - Extended-GBR-DL
  - Extended-APN-AMBR-UL
  - Extended-APN-AMBR-DL

- **Multiple Presence Reporting Area Support:**

  S-GW supports Multiple-PRA action and Multiple-PRA Information over S11/S4 and S5/S8 interfaces. P-GW supports Multiple-PRA Action and Multiple-PRA Information over S5/S8 and Gx interfaces.

- **S-GW Custom Dictionaries Support over Gz :**

  S-GW supports custom24 and custom6 dictionaries to support sending the following AVPs when it receives MBR, GBR and APN-AMBR values greater than 4.2Gbps:

- Extended-Max-Requested-BW-UL
- Extended-Max-Requested-BW-DL
- Extended-GBR-UL
- Extended-GBR-DL
- Extended-APN-AMBR-UL
- Extended-APN-AMBR-DL

- **P-GW Custom Dictionaries Support over Gx:**

  P-GW supports dpca-custom15, dpca-custom11, dpca-custom23, dpca-custom19 and dpca-custom17, dictionaries to support sending the following AVPs when it receives GBR and APN-AMBR values greater than 4.2Gbps:

  - Extended-Max-Requested-BW-UL
  - Extended-Max-Requested-BW-DL
  - Extended-GBR-DL
  - Extended-GBR-UL
  - Extended-APN-AMBR-UL
  - Extended-APN-AMBR-DL

- **P-GW Custom Dictionaries Support over Gy:**

  P-GW supports dcca-custom1, dcca-custom7, dcca-custom8, dcca-custom13 and dcca-custom26 dictionaries to support sending the following AVPs when it receives GBR and APN-AMBR values greater than 4.2Gbps:

  - Extended-Max-Requested-BW-UL
  - Extended-Max-Requested-BW-DL
  - Extended-GBR-DL
  - Extended-GBR-UL
  - Extended-APN-AMBR-UL
  - Extended-APN-AMBR-DL

- **P-GW Custom Dictionaries Support over Rf:**

  P-GW supports aaa-custom3, aaa-custom4 and aaa-custom6 dictionaries to support sending the following AVPs when it receives GBR and APN-AMBR values greater than 4.2Gbps:

  - Extended-Max-Requested-BW-UL
  - Extended-Max-Requested-BW-DL
  - Extended-GBR-UL
  - Extended-GBR-DL

- Extended-APN-AMBR-UL
- Extended-APN-AMBR-DL

Multiple Presence Reporting Area

P-GW supports negotiation of Multiple-Presence Reporting Area feature in Feature-List-ID 2 over Gx interface with PCRF. The CNO-ULI feature will be used only when the P-GW and/or the PCRF does not support Multiple-PRA and both P-GW and PCRF support CNO-ULI.

Note This feature is introduced in release 21.9.1. For more information, refer to the *Presence Reporting Area* chapter in the *P-GW Administration Guide*.

How It Works

Architecture

This section describes the architecture for Gx (PCRF), Gy (OCS), Gz (P-GW), and Rf (P-GW) interfaces with respect to 5G NSA for SEAEGW feature.

Gx (PCRF)

The Gx interface supports new AVPs to handle 5G throughput for default bearers and dedicated bearers. Gx interface introduced new "AVP Extended-APN-AMBR-UL" and "Extended-APN-AMBR-DL" in grouped "AVP QoS-Information" and "Conditional-APN-Aggregate-Max-Bitrate" to handle 5G throughput for default bearers. New AVPs "Extended-GBR-UL", "Extended-GBR-DL", "Extended-Max-Requested-BW-UL" and "Extended-Max-Requested-BW-DL" are added in grouped AVP "QoS-Information" for dedicated bearers.

When the maximum bandwidth value set for UL or DL traffic is higher than 4294967295 bits per second, the "Max-Requested-Bandwidth-UL" or DL, AVP must be present, and set to its upper limit 4294967295 along with the "Extended-Max-Requested-BW-UL" or DL must be present, and set to the requested bandwidth value in kilobits per second. The same principal applies for "Extended-GBR-UL/DL" and "Extended-APN-AMBR-UL/DL".

The following new AVPs are introduced in the grouped AVP QoS-Information:

- Extended-Max-Requested-BW-UL
- Extended-Max-Requested-BW-DL
- Extended-GBR-UL
- Extended-GBR-DL
- Extended-APN-AMBR-UL
- Extended-APN-AMBR-DL

the following new AVPs are introduced in the grouped AVP Conditional-APN-Aggregate-Max-Bitrate.

- Extended-APN-AMBR-UL
- Extended-APN-AMBR-DL

Gy (OCS)

New AVPs "Extended-Max-Request-BW-UL", "Extended-Max-Requested-BW-DL", "Extended-GBR-UL", "Extended-GBR-DL", "Extended-APN-AMBR-UL" and "Extended-APN-AMBR-DL" in grouped AVP “QoS-Information” are introduced Gy interface to handle 5G throughput for dedicated bearers.

When the maximum bandwidth value set for UL/DL traffic is higher than 4294967295 bits per second, P-GW sets the "Max-Requested-Bandwidth-UL/DL" AVP to its upper limit 4294967295 and sets the "Extended-Max-Requested-BW-UL/DL" to the required bandwidth value in kilobits per second in CCR-I/CCR-U messages. The same principal applies for "Extended-GBR-UL/DL" and "Extended-APN-AMBR-UL/DL".

5G NSA feature supports Gy dcca-custom1, dcca-custom7, dcca-custom8, standard dcca-custom13 and dcca-custom26 dictionaries.

Gz (P-GW)

c

New sequence of container in PGWRecord for PGW-CDR to support RAN secondary RAT usage data report is introduced in Gz interface. AVPs "listOfRANSecondaryRATUsageReports" and "RANSecondaryRATUsageReport" are introduced.

New AVPs "Extended-Max-Requested-BW-UL", "Extended-Max-Requested-BW-DL", "Extended-GBR-UL", "Extended-GBR-DL", "Extended-APN-AMBR-UL" and "Extended-APN-AMBR-DL" are introduced over Gz interface as part of existing "EPCQoSInformation" AVP to handle 5G throughput for default and dedicated bearers.

Rf (P-GW)

New AVPs "RAN-Secondary-RAT-Usage-Report" which is grouped type to support secondary RAT usage data report values is introduced in Rf interface. This contains the volume count as reported by the RAN for the secondary RAT(separated for uplink and downlink) including the time of the report.

AVPs "Extended-Max-Requested-BW-UL", "Extended-Max-Requested-BW-DL", "Extended-GBR-UL", "Extended-GBR-DL", "Extended-APN-AMBR-UL" and "Extended-APN-AMBR-DL" are introduced over Rf interface to handle 5G throughput for default and dedicated bearers.

Gz(S-GW)

New sequence of container in SGWRecord for SGW-CDR to support RAN secondary RAT usage data report is introduced in Gz interface. AVPs "listOfRANSecondaryRATUsageReports" and "RANSecondaryRATUsageReport" are introduced.

New AVPs "Extended-Max-Requested-BW-UL", "Extended-Max-Requested-BW-DL", "Extended-GBR-UL", "Extended-GBR-DL", "Extended-APN-AMBR-UL" and "Extended-APN-AMBR-DL" are introduced over Gz interface as part of existing "EPCQoSInformation" AVP to handle 5G throughput for default and dedicated bearers.

Limitations

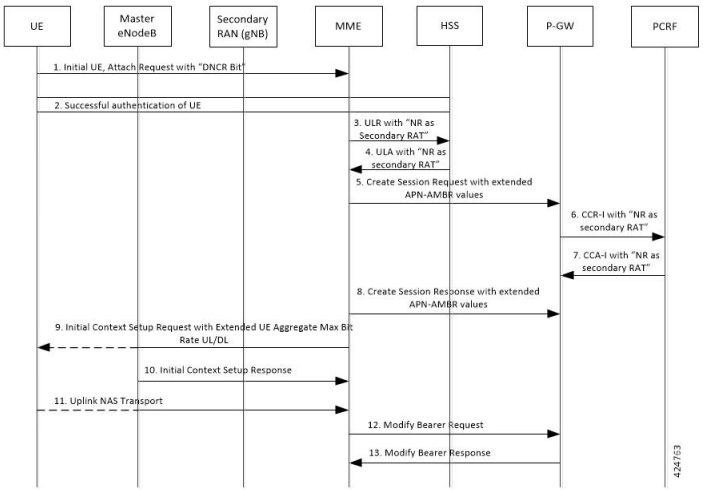
This section describes the known limitations for 5G NSA feature

- 5G NSA supports Gx standard dictionary (r8-gx-standard), dpca-custom11, dpca-custom15, dpca-custom17, dpca-custom19, and dpca-custom23.
- 5G NSA has been implemented for Gy dictionaries—dcca-custom1, dcca-custom7, dcca-custom8, standard dcca-custom13 and dcca-custom26. In order to support NSA for other Gx and Gy dictionaries, dynamic dictionary must be built. Contact your Cisco Account representative for more details.
- Secondary RAT usage data report will not carry start or end time values prior to “00:00:00 UTC, Thursday, 1 January 1970".

Flows

This section describes the following call flows related to the DCNR feature.

Initial Registration by DCNR Capable UE



Step	Description
1	The DCNR capable UE sets the "DCNR bit" in the NAS message "Attach Request" of "UE Network Capability" IE.
2	MME successfully authenticates the UE.
3	As part of the authorization process, while sending ULR to HSS, MME advertises the DCNR support by sending “NR as Secondary RAT" feature bit in “Feature-List-ID-2".

Step	Description
4	HSS sends ULA by advertising the DCNR by sending "NR as Secondary RAT" feature bit in “Feature-List-ID-2" and sends Max-Requested-Bandwidth-UL as 4294967295 bps, Max-Requested-Bandwidth-DL as 4294967295 bps and the extended bandwidth values in new AVPs "Extended-Max-Requested-BW-UL" and "Extended-Max-Requested-BW-DL". If HSS determines that the UE is not authorized for DCNR services, HSS sends Subscription-Data with “Access-Restriction" carrying “NR as Secondary RAT Not Allowed".
5	MME sends Create Session Request with the extended APN-AMBR values in existing AMBR IE. As the APN-AMBR values in GTP-v2 interface are encoded in kbps, the existing AMBR IE handles the 5G NSA bit rates.
6	P-W sends CCR-I to PCRF advertising the DCNR by sending “Extended-BW-NR" feature bit in “Feature-List-ID-2". P-GW also sends "APN-Aggregate-Max-Bitrate-UL" as 4294967295 bps, "APN-Aggregate-Max-Bitrate-DL" as 4294967295 bps and the extended bandwidth values in new AVPs "Extended-APN-AMBR-UL" and "Extended-APN-AMBR-DL".
7	PCRF sends CCA-I advertising the DCNR by sending the “Extended-BW-NR" feature bit in “Feature-List-ID-2". PCRF also sends "APN-Aggregate-Max-Bitrate-UL" as 4294967295 bps and "APN-Aggregate-Max-Bitrate-DL" as 4294967295 bps and the extended bandwidth values in new "AVPs Extended-APN-AMBR-UL" and "Extended-APN-AMBR-DL". PCRF offers the same extended APN-AMBR values requested by PCEF or modify the extended APN-AMBR values. P-GW enforces the APN-AMBR values accordingly.
8	P-GW honors the APN-AMBR values as offered by PCRF and sends the extended APN-AMBR values in existing IE APN-AMBR in the Create Session Response message.

Step	Description
9	MME computes the UE-AMBR values and sends the extended UE-AMBR values in new IEs “Extended UE Aggregate Maximum Bit Rate Downlink" and “Extended UE Aggregate Maximum Bit Rate Uplink" by setting the legacy “UE AMBR Uplink" and “UE AMBR Downlink" values to the maximum allowed value 10000000000 bps(10 Gbps) in Initial Context Setup Request. MME sends the APN-AMBR values up to 65.2 Gbps in existing IE APN-AMBR in NAS Activate Default EPS Bearer Context Request – Attach Accept. If the APN-AMBR values are beyond 65.2 Gbps, MME sends the extended APN-AMBR values in new IE “Extended APN aggregate maximum bit rate. If ULA is received with “Access-Restriction" carrying “NR as Secondary RAT Not Allowed", MME sends the “Initial Context Setup Request" with “NR Restriction" bit set in “Handover Restriction List" IE. Also MME sets the "RestrictDCNR" bit to "Use of dual connectivity with NR is restricted" in the EPS network feature support IE of the Attach Accept message. Accordingly, UE provides the indication that DCNR is restricted to the upper layers. If DCNR is not configured at MME service or call control profile level, MME sets the RestrictDCNR bit to "Use of dual connectivity with NR is restricted" in the EPS network feature support IE of the Attach Accept message. Accordingly, UE provides the indication that DCNR is restricted to the upper layers.
10	eNodeB sends the Initial Context Setup Response message. If master eNodeB determines to establish the bearer on secondary eNodeB, F-TEID of secondary eNodeB may be sent in this step (Transport layer address and TEID of secondary eNodeB). It is transparent to MME if the bearer is established on master eNodeB or secondary eNodeB.
11	eNodeB sends Uplink NAS Transport with NAS message Attach Complete - Activate Default EPS Bearer Context Accept.
12	MME sends Modify Bearer Request to S-GW with S1-U FTEID details as received in the Initial Context Setup Response message.
13	MME receives the Modify Bearer Response message from S-GW.

Supported Standards

Cisco's implementation of the 5G NSA complies with the following standards:

- 3GPP 23.401 Release 15.2.0 - General Packet Radio Service (GPRS) enhancements for Evolved Universal Terrestrial Radio Access Network (E-UTRAN) access
- 3GPP 29.212 Release 15.2.0 - Policy and Charging Control (PCC)
- 3GPP 29.274 Release 15.2.0 - 3GPP Evolved Packet System (EPS); Evolved General Packet Radio Service (GPRS) Tunneling Protocol for Control plane (GTPv2-C); Stage 3
- 3GPP 32.299 Release 15.2.0 - Charging Management; Diameter Charging Applications
- 3GPP 32.298 Release 15.2.0 - Charging Management; Charging Data Record (CDR) parameter description

Configuring 5G NSA for SAEGW

This section describes how to configure 5G NSA to support SAEGW.

Configuring 5G NSA on SAEGW involves:

- Enabling DCNR in P-GW Service, on page 12
- Configuring Bearer Duration Statistics for URLLC QCI, on page 12
- Configuring EGTPC QCI Statistics for URLLC QCI, on page 13
- Configuring Extended Bandwidth with New Radio, on page 13
- Configuring Network-Initiated Setup/Teardown Events for URLLC QCI, on page 14
- Configuring URLLC QCI in APN Configuration, on page 14
- Configuring URLCC QCI In Charging Action, on page 15
- Configuring URLCC QCI in QCI QOS Mapping Table , on page 15

Enabling DCNR in P-GW Service

Use the following configuration to enable Dual Connectivity with New Radio (DCNR) to support 5G Non Standalone (NSA).

```
configure
   context context_name
      pgw-service service_name
         [ no ] dcnr
         end
```

NOTES:

- **pgw-service** *service_name*: Creates an P-GW service or configures a existing P-GW service. *service_name* must be an alphanumeric string of 1 to 63 characters.
- **no**: Disables the DCNR configuration.
- The **dcnr** CLI command is disabled by default.

Configuring Bearer Duration Statistics for URLLC QCI

Use the following configuration to configure QCI based duration statistics for URLLC QCI.

```
configure
   context context_name
      apn apn_name
          [ no ] bearer-duration-stats qci qci_val
          end
```

NOTES:

- **apn** *apn_name*: Creates or deletes Access Point Name (APN) templates and enters the APN Configuration Mode within the current context. *apn_name* specifies a name for the APN template as an alphanumeric string of 1 through 62 characters that is case insensitive.
- **bearer-duration-stats**: Enables or disables per QCI call duration statistics for dedicated bearers.
- **qci** *qci_val*: Specifies the QoS Class Identifier. *qci_val* must be an integer between 1 to 9, 80, 82, and 83.
- **no**: Disables per QCI call duration statistics.

Configuring EGTPC QCI Statistics for URLLC QCI

Use the following configuration to configure QCI based EGTPC QCI statistics for URLLC QCI.

```
configure
  context context_name
    apn apn_name
       [ no ] egtpc-qci-stats { qci80 | qci82 | qci83 }
       default egtpc-qci-stats
       end
```

Notes:

- **apn** *apn_name*: Creates or deletes Access Point Name (APN) templates and enters the APN Configuration Mode within the current context. *apn_name* specifies a name for the APN template as an alphanumeric string of 1 through 62 characters that is case insensitive.
- **egtpc-qci-stats**: Enables/Disables an APN candidate list for the **apn-expansion** bulkstats schema.
- **qci80**: Configure apn-qci-egtpc statistics for QCI 80.
- **qci82**: Configure apn-qci-egtpc statistics for QCI 82.
- **qci83**: Configure apn-qci-egtpc statistics for QCI 83.
- **no**: Disables APN candidate list(s) for the apn-expansion bulkstats schema.
- **default**: Disables an APN candidate list for the apn-expansion bulkstats schema.

Configuring Extended Bandwidth with New Radio

Use the following configuration to configure extended bandwidth with new radio in IMS authorization service mode.

```
configure
  context context_name
    ims-auth-service ims_auth_service_name
      policy-control
        diameter encode-supported-features extended-bw-newradio
        [ no ] diameter encode-supported-features
        end
```

NOTES:

- **ims-auth-service** *ims_auth_service_name*: Creates an IMS authentication service. *ims_auth_service_name* must be an alphanumeric string of 1 through 63 characters.
- **policy-control**: Configures Diameter authorization and policy control parameter for IMS authorization.
- **extended-bw-newradio**: Enables extended bandwidth with New-Radio feature.
- **diameter encode-supported-features**: Enables/Disables encoding and sending of Supported-Features AVP.
- **no**: Removes the configuration of extended bandwidth with new-radio in IMS authorization service mode.

Configuring Network-Initiated Setup/Teardown Events for URLLC QCI

Use the following configuration to configure network initiated setup or teardown events KPI for URLCC QCI.

```
configure
   transaction-rate nw-initiated-setup-teardown-events qci qci_val
   [ default | no ] transaction-rate nw-initiated-setup-teardown-events
qci
   end
```

NOTES:

- **transaction-rate nw-initiated-setup-teardown-events**: Enables operators to set the Quality of Class Identifier (QCI) value for use in tracking Network Initiated Setup/Tear down Events per Second key performance indicator (KPI) information.
- **qci** *qci_val*: Specifies the QoS Class Identifier. *qci_val* must be an integer between 1 to 9, 65, 66, 69, 70, 80, 82, 83, and 128 to 254.
- **no**: Disables the collection of network-initiated setup/teardown events for the specified QCI value.
- **default**: Returns the setting to its default value. The default is for network-initiated setup/teardown events to be tracked for all supported QCI values.

Configuring URLLC QCI in APN Configuration

Use the following configuration to configure URLCC QCI in the APN Configuration mode.

```
configure
   context context_name
      apn apn_name
         qos rate-limit direction { downlink | uplink } qci qci_val
         no qos rate-limit direction { downlink | uplink }
         end
```

NOTES:

- **apn** *apn_name*: Allows to specify the APN name as a condition. *apn_name* must be an alphanumeric string of 1 through 63 characters.

- **qos rate-limit**: Configures the action on a subscriber traffic flow that violates or exceeds the peak/committed data rate under traffic shaping and policing functionality.
- **direction { downlink | uplink }**: Specifies the direction of traffic on which this QoS configuration needs to be applied.
  - **downlink**: Apply the specified limits and actions to the downlink.
  - **uplink**: Apply the specified limits and actions to the uplink.
- **qci** *qci_val*: Specifies the QoS Class Identifier. *qci_val* must be an integer between 1 to 9, 80, 82, and 83.
- **no**: Disables the QoS data rate limit configuration for the APN.

Configuring URLCC QCI In Charging Action

Use the following configuration to configure URLCC QCI in the Charging Action Configuration mode.

```
configure
  active-charging service service_name
    charging-action charging_action_name
       qos-class-identifier qos_class_identifier
       no qos-class-identifier
       end
```

NOTES:

- **active-charging service** *service_name*: Specifies name of the active charging service. *service_name* must be an alphanumeric string of 1 through 15 characters.
- **charging-action** *charging_action_name* : Creates a charging action. *qos_class_identifier* must be an alphanumeric string of 1 through 63 characters.
- **qos-class-identifier** *qos_class_identifier*: Specifies the QoS Class Identifier. *qos_class_identifier* must be an integer between 1 to 9, 65, 66, 69, 70, 80, 82, and 83.
- **no**: Disables the QoS Class Identifier.

Configuring URLCC QCI in QCI QOS Mapping Table

Use the following configuration to configure URLCC QCI in the QCI QOS Mapping Table.

```
configure
  qci-qos-mapping name
     [ no ] qci qci_value
     end
```

NOTES:

- **qci-qos-mapping** *name*: Specifies the map name. *name* must be an alphanumeric string of 1 through 63 characters.
- **qci** *qci_val*: Specifies the QoS Class Identifier. *qci_val* must be an integer between 1 to 9, 65, 66, 69, 70, 80, 82, and 83.

- **no**: Disables the QCI value.

Monitoring and Troubleshooting

This section provides information regarding show commands and bulk statistics available to monitor and troubleshoot the 5G NSA feature.

Show Commands and Outputs

This section provides information on show commands and their corresponding outputs for the DCNR feature.

show pgw-service name

The output of this command includes the "DCNR" field to indicate if the DCNR feature is enabled or disabled at P-GW service.

show ims-authorization service name

The output of this command includes the following fields:

Diameter Policy Control:

Supported Features:

- extended-bw-nr

show gtpu statistics

The output of this command includes the following fields:

- Uplink Packets — Displays the total number of QCI 80, QCI 82, and QCI 83 uplink packets.
- Uplink Bytes — Displays the total number of QCI 80, QCI 82, and QCI 83 uplink bytes.
- Downlink Packets — Displays the total number of QCI 80, QCI 82, and QCI 83 downlink packets.
- Downlink Bytes — Displays the total number of QCI 80, QCI 82, and QCI 83 downlink bytes.
- Packets Discarded — Displays the total number of discarded QCI 80, QCI 82, and QCI 83 packets.
- Bytes Discarded — Displays the total number of discarded QCI 80, QCI 82, and QCI 83 bytes.

show apn statistics all

The output of this command includes the following fields:

4G Bearers Released By Reasons:

Admin disconnect — Displays dedicated bearers released due to administration clear from P-GW for QCI 80, QCI 82, and QCI 83.

- Bearer Active — Displays the total number for QCI 80, QCI 82, and QCI 83 active bearers.
- Bearer setup — Displays the total number for QCI 80, QCI 82, and QCI 83 bearers setup.

- Bearer Released — Displays the total number for QCI 80, QCI 82, and QCI 83 released bearers.
- Bearer Rejected —
- Uplink Bytes Forwarded — Displays the total number for QCI 80, QCI 82, and QCI 83 uplink packets forwarded.
- Uplink pkts forwarded — Displays the total number for QCI 80, QCI 82, and QCI 83 downlink packets forwarded.
- Uplink Bytes dropped — Displays the total number for QCI 80, QCI 82, and QCI 83 uplink bytes forwarded.
- Downlink Bytes forwarded — Displays the total number for QCI 80, QCI 82, and QCI 83 downlink bytes forwarded.
- Uplink pkts dropped — Displays the total number for QCI 80, QCI 82, and QCI 83 uplink packets dropped.
- Downlink Bytes dropped — Displays the total number for QCI 80, QCI 82, and QCI 83 downlink bytes dropped.
- Uplink Bytes dropped(MBR Excd) — Displays the total number for QCI 80, QCI 82, and QCI 83 uplink bytes dropped due to MBR being exceeded.
- Uplink pkts dropped(MBR Excd) — Displays the total number for QCI 80, QCI 82, and QCI 83 uplink packets dropped due to MBR being exceeded.
- Downlink pkts forwarded — Displays the total number for QCI 80, QCI 82, and QCI 83 downlink packets forwarded.
- Downlink pkts dropped — Displays the total number for QCI 80, QCI 82, and QCI 83 downlink packets dropped.
- Downlink Bytes dropped(MBR Excd) — Displays the total number for QCI 80, QCI 82, and QCI 83 downlink bytes dropped due to MBR being exceeded.
- Downlink pkts dropped(MBR Excd) — Displays the total number for QCI 80, QCI 82, and QCI 83 downlink packets dropped due to MBR being exceeded.

show pgw-service statistics all verbose

The output of this command includes the following fields:

Bearers By QoS characteristics:

- Active — Displays the total number of active bearers for QCI 80, QCI 82, and QCI 83.
- Released — Displays the total number of bearers released for QCI 80, QCI 82, and QCI 83.
- Setup — Displays the total number of bearers setup for QCI 80, QCI 82, and QCI 83.

Data Statistics Per PDN-Type:

Uplink:

- Packets — Displays the total number of uplink packets forwarded for QCI 80, QCI 82, and QCI 83.
- Bytes — Displays the total number of uplink bytes forwarded for QCI 80, QCI 82, and QCI 83.

- Dropped Packets — Displays the total number of uplink packets dropped for QCI 80, QCI 82, and QCI 83.
- Dropped Bytes — Displays the total number of uplink bytes dropped for QCI 80, QCI 82, and QCI 83.

Downlink:

- Packets — Displays the total number of downlink packets forwarded for QCI 80, QCI 82, and QCI 83.
- Bytes — Displays the total number of downlink bytes forwarded for QCI 80, QCI 82, and QCI 83.
- Dropped Packets — Displays the total number of downlink packets dropped for QCI 80, QCI 82, and QCI 83.
- Dropped Bytes — Displays the total number of downlink bytes dropped for QCI 80, QCI 82, and QCI 83.

DCNR PDN Statistics:

- Active — The total number of current active P-GW DCNR PDNs.
- Setup — The total number of P-GW PDNs that are setup as a DCNR PDN.
- Released — The total number of P-GW DCNR PDNs released.

show sgw-service statistics all verbose

The output of this command includes the following fields:

Bearers By QoS characteristics:

- Active — Displays the total active EPS Bearers for QCI 80, QCI 82, and QCI 83.
- Released — Displays the total number of EPS Bearers released for QCI 80, QCI 82, and QCI 83.
- Setup — Displays the total number of EPS bearers setup for QCI 80, QCI 82, and QCI 83.
- Modified — Displays the total number of EPS bearers modified for QCI 80, QCI 82, and QCI 83.

Dedicated Bearers Released By Reason:

- P-GW Initiated — Displays the total number of dedicated EPS bearers for QCI 80, QCI 82, and QCI 83 released with the reason P-GW initiated on the S-GW.
- S1 Error Indication — Displays the total number of dedicated EPS bearers for QCI 80, QCI 82, and QCI 83 released with the reason S1 error indication on the S-GW.
- S5 Error Indication — Displays the total number of dedicated EPS bearers for QCI 80, QCI 82, and QCI 83 released with the reason S5 error indication on the S-GW.
- S4 Error Indication — Displays the total number of dedicated EPS bearers for QCI 80, QCI 82, and QCI 83 released with the reason S4 error indication on the S-GW.
- S12 Error Indication — Displays the total number of dedicated EPS bearers for QCI 80, QCI 82, and QCI 83 released with the reason S12 error indication on the S-GW.
- Local — Displays the total number of dedicated EPS bearers for QCI 80, QCI 82, and QCI 83 released with the reason local error indication on the S-GW.

- PDN Down — Displays the total number of dedicated EPS bearers for QCI 80, QCI 82, and QCI 83 released due to PDN cleanup on the S-GW.
- Path Failure S1-U — Displays the total number of dedicated EPS bearers for QCI 80, QCI 82, and QCI 83 released with the reason S1-U path failure on the S-GW.
- Path Failure S5-U — Displays the total number of dedicated EPS bearers for QCI 80, QCI 82, and QCI 83 released with the reason S5-U path failure on the S-GW.
- Path Failure S5 — Displays the total number of dedicated EPS bearers for QCI 80, QCI 82, and QCI 83 released with the reason S5 path failure on the S-GW.
- Path Failure S11 — Displays the total number of dedicated bearers for QCI 80, QCI 82, and QCI 83 released due to path failure on the S11 interface.
- Path Failure S4-U — Displays the total number of dedicated bearers for QCI 80, QCI 82, and QCI 83 released due to path failure on S4-U interface.
- Path Failure S12 — Displays the total number of dedicated bearers for QCI 80, QCI 82, and QCI 83 released due to path failure on S12 interface.
- Inactivity Timeout — Displays the total number of dedicated bearers for QCI 80, QCI 82, and QCI 83 released due to the inactivity timeout.
- Other — Displays the total number of dedicated bearers for QCI 80, QCI 82, and QCI 83 released due to other reasons.

Data Statistics Per Interface:

S1-U/S11-U/S4-U/S12/S5-U/S8-U Total Data Statistics:

Uplink:

- Packets — Displays the total number of uplink data packets received by the S-GW for a bearer with QCI 80, QCI 82, and QCI 83.
- Bytes — Displays the total number of uplink data bytes received by the S-GW for a bearer with QCI 80, QCI 82, and QCI 83.
- Dropped Packets — Displays the total number of uplink data packets dropped by the S-GW for a bearer with a QCI 80, QCI 82, and QCI 83.
- Dropped Bytes — Displays the total number of uplink data bytes dropped by the S-GW for a bearer with QCI 80, QCI 82, and QCI 83.

Downlink:

- Packets — Displays the total number of downlink data packets received by the S-GW for a bearer with QCI 80, QCI 82, and QCI 83.
- Bytes — Displays the total number of downlink data bytes received by the S-GW for a bearer with QCI 80, QCI 82, and QCI 83.
- Dropped Packets — Displays the total number of downlink data packets dropped by the S-GW for bearer with QCI 80, QCI 82, and QCI 83.
- Dropped Bytes — Displays the total number of downlink data bytes dropped by the S-GW for a bearer with QCI 80, QCI 82, and QCI 83.

DCNR PDN Statistics:

- Active — The total number of current active S-GW DCNR PDNs.
- Setup — The total number of S-GW PDNs that are setup as a DCNR PDN.
- Released — The total number of S-GW DCNR PDNs released.

show saegw-service statistics all verbose

The output of this command includes the following fields:

Bearers By QoS characteristics:

- Active — Displays the total number of QCI 80, QCI 82, and QCI 83 active bearers.
- Released — Displays the total number of QCI 80, QCI 82, and QCI 83 released bearers.
- Setup — Displays the total number of QCI 80, QCI 82, and QCI 83 bearers setup.

Data Statistics Per PDN-Type:

Uplink:

- Packets — Displays the total number of QCI 80, QCI 82, and QCI 83 uplink packets forwarded.
- Bytes — Displays the total number of QCI 80, QCI 82, and QCI 83 uplink bytes forwarded.
- Dropped Packets — Displays the total number of QCI 80, QCI 82, and QCI 83 uplink packets dropped.
- Dropped Bytes — Displays the total number of QCI 80, QCI 82, and QCI 83 uplink bytes dropped.

Downlink:

- Packets — Displays the total number of QCI 80, QCI 82, and QCI 83 downlink packets forwarded.
- Bytes — Displays the total number of QCI 80, QCI 82, and QCI 83 downlink bytes forwarded.
- Dropped Packets — Displays the total number of QCI 80, QCI 82, and QCI 83 downlink packets dropped.
- Dropped Bytes — Displays the total number of QCI 80, QCI 82, and QCI 83 downlink bytes dropped.

DCNR PDNs:

Colocated PDNs:

- Active — The total number of currently active SAEGW collapsed DCNR PDNs.
- Setup — The total number of SAEGW collapsed PDNs that are setup as a DCNR PDN.
- Released — The total number of SAEGW collapsed DCNR PDNs released.

PGW-Anchor PDNs:

- Active — The total number of currently active P-GW anchored DCNR PDNs.
- Setup — The total number of P-GW anchored PDNs that are setup as a DCNR PDN.
- Released — The total number of P-GW anchored DCNR PDNs that are released.

SGW-Anchor PDNs:

- Active — The total number of current active S-GW anchored DCNR PDNs.
- Setup — The total number of S-GW anchored PDNs that are setup as a DCNR PDN.
- Released — The total number of S-GW anchored DCNR PDNs that are released.

Bulk Statistics

The following statistics are added in support of the 5G NSA feature.

APN Schema

The following 5G NSA feature related bulk statistics are available in the APN schema.

Bulk Statistics	Description
qci80-actbear	The total number of QCI80 active bearers.
qci82-actbear	The total number of QCI82 active bearers.
qci83-actbear	The total number of QCI83 active bearers.
qci80-setupbear	The total number of QCI80 bearers setup.
qci82-setupbear	The total number of QCI82 bearers setup.
qci83-setupbear	The total number of QCI83 bearers setup.
qci80-relbear	The total number of QCI80 released bearers.
qci82-relbear	The total number of QCI82 released bearers.
qci83-relbear	The total number of QCI83 released bearers.
qci80-uplinkpkt-fwd	The total number of QCI80 uplink packets forwarded.
qci82-uplinkpkt-fwd	The total number of QCI82 uplink packets forwarded.
qci83-uplinkpkt-fwd	The total number of QCI83 uplink packets forwarded.
qci80-dwlinkpkt-fwd	The total number of QCI80 downlink packets forwarded.
qci82-dwlinkpkt-fwd	The total number of QCI82 downlink packets forwarded.
qci83-dwlinkpkt-fwd	The total number of QCI83 downlink packets forwarded.
qci80-uplinkbyte-fwd	The total number of QCI80 uplink bytes forwarded.
qci82-uplinkbyte-fwd	The total number of QCI82 uplink bytes forwarded.
qci83-uplinkbyte-fwd	The total number of QCI83 uplink bytes forwarded.

Bulk Statistics	Description
qci80-dwlinkbyte-fwd	The total number of QCI80 downlink bytes forwarded.
qci82-dwlinkbyte-fwd	The total number of QCI82 downlink bytes forwarded.
qci83-dwlinkbyte-fwd	The total number of QCI83 downlink bytes forwarded.
qci80-uplinkpkt-drop	The total number of QCI80 uplink packets dropped.
qci82-uplinkpkt-drop	The total number of QCI82 uplink packets dropped.
qci83-uplinkpkt-drop	The total number of QCI83 uplink packets dropped.
qci80-dwlinkpkt-drop	The total number of QCI80 downlink packets dropped.
qci82-dwlinkpkt-drop	The total number of QCI82 downlink packets dropped.
qci83-dwlinkpkt-drop	The total number of QCI83 downlink packets dropped.
qci80-uplinkbyte-drop	The total number of QCI80 uplink bytes dropped.
qci82-uplinkbyte-drop	The total number of QCI82 uplink bytes dropped.
qci83-uplinkbyte-drop	The total number of QCI83 uplink bytes dropped.
qci80-dwlinkbyte-drop	The total number of QCI80 downlink bytes dropped.
qci82-dwlinkbyte-drop	The total number of QCI82 downlink bytes dropped.
qci83-dwlinkbyte-drop	The total number of QCI83 downlink bytes dropped.
qci80-uplinkpkt-drop-mbrexcd	The total number of QCI80 uplink packets dropped due to MBR being exceeded.
qci82-uplinkpkt-drop-mbrexcd	The total number of QCI82 uplink packets dropped due to MBR being exceeded.
qci83-uplinkpkt-drop-mbrexcd	The total number of QCI83 uplink packets dropped due to MBR being exceeded.
qci80-dwlinkpkt-drop-mbrexcd	The total number of QCI80 downlink packets dropped due to MBR being exceeded.
qci82-dwlinkpkt-drop-mbrexcd	The total number of QCI82 downlink packets dropped due to MBR being exceeded.
qci83-dwlinkpkt-drop-mbrexcd	The total number of QCI83 downlink packets dropped due to MBR being exceeded.

P-GW Schema

The following 5G NSA feature related bulk statistics available in the P-GW schema.

Bulk Statistics	Description
pgw-anchor-pdns-dcnr-current-active	The total number of currently active P-GW anchored DCNR PDNs.
pgw-anchor-pdns-dcnr-cumulative-activated	The total number of P-GW anchored PDNs that are setup as DCNR PDN.
pgw-anchor-pdns-dcnr-cumulative-deactivated	The total number of P-GW anchored PDNs that were either released or degrades to a non-DNCR PDN.
sessstat-pdn-dcnr-current-active	Session Statistics - DCNR PDN-Type Statistics - Current Active.
sessstat-pdn-dcnr-cumulative-activated	Session Statistics - DCNR PDN-Type Statistics - Cumulative PDNs Activated.
sessstat-pdn-dcnr-cumulative-deactivated	Session Statistics - DCNR PDN-Type Statistics - Cumulative PDNs Deactivated.

SAEGW Schema

The following 5G NSA feature related bulk statistics available in the SAEGW schema.

Bulk Statistics	Description
saegw-collocated-pdns-dcnr-current-active	The total number of currently active SAEGW collapsed DCNR PDNs.
saegw-collocated-pdns-dcnr-cumulative-activated	The total number of SAEGW collapsed PDNs that are setup as a DCNR PDN.
saegw-collocated-pdns-dcnr-cumulative-deactivated	The total number of SAEGW collapsed DCNR PDNs released.

S-GW Schema

The following 5G NSA feature related bulk statistics available in the S-GW schema.

Bulk Statistics	Description
sessstat-pdn-dcnr-current-active	The total number of currently active S-GW DCNR PDNs.
sessstat-pdn-dcnr-cumulative-activated	The total number of S-GW PDNs that are setup as a DCNR PDN.
sessstat-pdn-dcnr-cumulative-deactivated	The total number of S-GW DCNR PDNs released.
sgw-anchor-pdns-dcnr-current-active	The total number of currently active S-GW anchored DCNR PDNs.
sgw-anchor-pdns-dcnr-cumulative-activated	The total number of S-GW anchored PDNs that are setup as a DCNR PDN.

Bulk Statistics	Description
sgw-anchor-pdns-dcnr-cumulative-deactivated	The total number of S-GW anchored DCNR PDNs that are released.

System Schema

The following 5G NSA feature related bulk statistics are available in the System schema.

Bulk Statistics	Description
sess-bearerdur-5sec-qci80	The current number of bearer sessions with a duration of 5 seconds and having a QCI of 80.
sess-bearerdur-5sec-qci82	The current number of bearer sessions with a duration of 5 seconds and having a QCI of 82.
sess-bearerdur-5sec-qci83	The current number of bearer sessions with a duration of 5 seconds and having a QCI of 83.
sess-bearerdur-10sec-qci80	The current number of bearer sessions with a duration of 10 seconds and having a QCI of 80.
sess-bearerdur-10sec-qci82	The current number of bearer sessions with a duration of 10 seconds and having a QCI of 82.
sess-bearerdur-10sec-qci83	The current number of bearer sessions with a duration of 10 seconds and having a QCI of 83.
sess-bearerdur-30sec-qci80	The current number of bearer sessions with a duration of 30 seconds and having a QCI of 80.
sess-bearerdur-30sec-qci82	The current number of bearer sessions with a duration of 30 seconds and having a QCI of 82.
sess-bearerdur-30sec-qci83	The current number of bearer sessions with a duration of 30 seconds and having a QCI of 83.
sess-bearerdur-1min-qci80	The current number of bearer sessions with a duration of 1 minute and having a QCI of 80.
sess-bearerdur-1min-qci82	The current number of bearer sessions with a duration of 1 minute and having a QCI of 82.
sess-bearerdur-1min-qci83	The current number of bearer sessions with a duration of 1 minute and having a QCI of 83.
sess-bearerdur-2min-qci80	The current number of bearer sessions with a duration of 2 minutes and having a QCI of 80.
sess-bearerdur-2min-qci82	The current number of bearer sessions with a duration of 2 minutes and having a QCI of 82.

Bulk Statistics	Description
sess-bearerdur-2min-qci83	The current number of bearer sessions with a duration of 2 minutes and having a QCI of 83.
sess-bearerdur-5min-qci80	The current number of bearer sessions with a duration of 5 minutes and having a QCI of 80.
sess-bearerdur-5min-qci82	The current number of bearer sessions with a duration of 5 minutes and having a QCI of 82.
sess-bearerdur-5min-qci83	The current number of bearer sessions with a duration of 5 minutes and having a QCI of 83.
sess-bearerdur-15min-qci80	The current number of bearer sessions with a duration of 15 minutes and having a QCI of 80.
sess-bearerdur-15min-qci82	The current number of bearer sessions with a duration of 15 minutes and having a QCI of 82.
sess-bearerdur-15min-qci83	The current number of bearer sessions with a duration of 15 minutes and having a QCI of 83.
sess-bearerdur-30min-qci80	The current number of bearer sessions with a duration of 30 minutes and having a QCI of 80.
sess-bearerdur-30min-qci82	The current number of bearer sessions with a duration of 30 minutes and having a QCI of 82.
sess-bearerdur-30min-qci83	The current number of bearer sessions with a duration of 30 minutes and having a QCI of 83.
sess-bearerdur-1hr-qci80	The current number of bearer sessions with a duration of 1 hour and having a QCI of 80.
sess-bearerdur-1hr-qci82	The current number of bearer sessions with a duration of 1 hour and having a QCI of 82.
sess-bearerdur-1hr-qci83	The current number of bearer sessions with a duration of 1 hour and having a QCI of 83.
sess-bearerdur-4hr-qci80	The current number of bearer sessions with a duration of 4 hours and having a QCI of 80.
sess-bearerdur-4hr-qci82	The current number of bearer sessions with a duration of 4 hours and having a QCI of 82.
sess-bearerdur-4hr-qci83	The current number of bearer sessions with a duration of 4 hours and having a QCI of 83.
sess-bearerdur-12hr-qci80	The current number of bearer sessions with a duration of 12 hours and having a QCI of 80.
sess-bearerdur-12hr-qci82	The current number of bearer sessions with a duration of 12 hours and having a QCI of 82.

Bulk Statistics	Description
sess-bearerdur-12hr-qci83	The current number of bearer sessions with a duration of 12 hours and having a QCI of 83.
sess-bearerdur-24hr-qci80	The current number of bearer sessions with a duration of 24 hours and having a QCI of 80.
sess-bearerdur-24hr-qci82	The current number of bearer sessions with a duration of 24 hours and having a QCI of 82.
sess-bearerdur-24hr-qci83	The current number of bearer sessions with a duration of 24 hours and having a QCI of 83.
sess-bearerdur-over24hr-qci80	The current number of bearer sessions with a duration of over 24 hours and having a QCI of 80.
sess-bearerdur-over24hr-qci82	The current number of bearer sessions with a duration of over 24 hours and having a QCI of 82.
sess-bearerdur-over24hr-qci83	The current number of bearer sessions with a duration of over 24 hours and having a QCI of 83.
sess-bearerdur-2day-qci80	The current number of bearer sessions with a duration of 2 days and having a QCI of 80.
sess-bearerdur-2day-qci82	The current number of bearer sessions with a duration of 2 days and having a QCI of 82.
sess-bearerdur-2day-qci83	The current number of bearer sessions with a duration of 2 days and having a QCI of 83.
sess-bearerdur-4day-qci80	The current number of bearer sessions with a duration of 4 days and having a QCI of 80.
sess-bearerdur-4day-qci82	The current number of bearer sessions with a duration of 4 days and having a QCI of 82.
sess-bearerdur-4day-qci83	The current number of bearer sessions with a duration of 4 days and having a QCI of 83.
sess-bearerdur-5day-qci80	The current number of bearer sessions with a duration of 5 days and having a QCI of 80.
sess-bearerdur-5day-qci82	The current number of bearer sessions with a duration of 5 days and having a QCI of 82.
sess-bearerdur-5day-qci83	The current number of bearer sessions with a duration of 5 days and having a QCI of 83.