

5G Non-standalone Solution Guide, StarOS Release 21.19

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Americas Headquarters
Cisco Systems, Inc.
170 West Tasman Drive
San Jose, CA 95134-1706
USA
http://www.cisco.com
Tel: 408 526-4000
800 553-NETS (6387)
Fax: 408 527-0883

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About this Guide

Note The HA, HSGW, PDSN, and SecGW products have reached end of life and are not supported in this release. Any references to these products (specific or implied) their components or functions including CLI commands and parameters in this document are coincidental and are not supported. Full details on the end of life for these products are available at https://www.cisco.com/c/en/us/products/collateral/wireless/asr-5000-series/eos-eol-notice-c51-740422.html.

This preface describes the *5G Non Standalone Solution Guide*, how it is organized and its document conventions.

The 5G Non Standalone (NSA) solution runs on Cisco® ASR 5000, ASR 5500 and virtualized platforms.

- Conventions Used, on page vii
- Supported Documents and Resources, on page viii
- Contacting Customer Support, on page ix

Conventions Used

The following tables describe the conventions used throughout this documentation.

Notice Type	Description
Information Note	Provides information about important features or instructions.
Caution	Alerts you of potential damage to a program, device, or system.
Warning	Alerts you of potential personal injury or fatality. May also alert you of potential electrical hazards.

Typeface Conventions	Description
Text represented as a `screen display`	This typeface represents displays that appear on your terminal screen, for example: `Login:`

Typeface Conventions	Description
Text represented as **commands**	This typeface represents commands that you enter, for example: **show ip access-list** This document always gives the full form of a command in lowercase letters. Commands are not case sensitive.
Text represented as a **command** *variable*	This typeface represents a variable that is part of a command, for example: **show card** *slot_number* *slot_number* is a variable representing the desired chassis slot number.
Text represented as menu or sub-menu names	This typeface represents menus and sub-menus that you access within a software application, for example: Click the **File** menu, then click **New**

Supported Documents and Resources

Related Common Documentation

The most up-to-date information for this product is available in the product Release Notes provided with each product release.

- *AAA Interface Administration and Reference*
- *Command Line Interface Reference*
- *GTPP Interface Administration and Reference*
- *Installation Guide* (platform dependent)
- *Release Change Reference*
- *Statistics and Counters Reference*
- *System Administration Guide* (platform dependent)

Related Product Documentation

The following product documents are also available and work in conjunction with the 5G NSA solution:

- *MME Administration Guide*
- *P-GW Administration Guide*
- *S-GW Administration Guide*

- *SAEGW Administration Guide*
- *SGSN Administration Guide*

Obtaining Documentation

The most current Cisco documentation is available on the following website:

http://www.cisco.com/cisco/web/psa/default.html

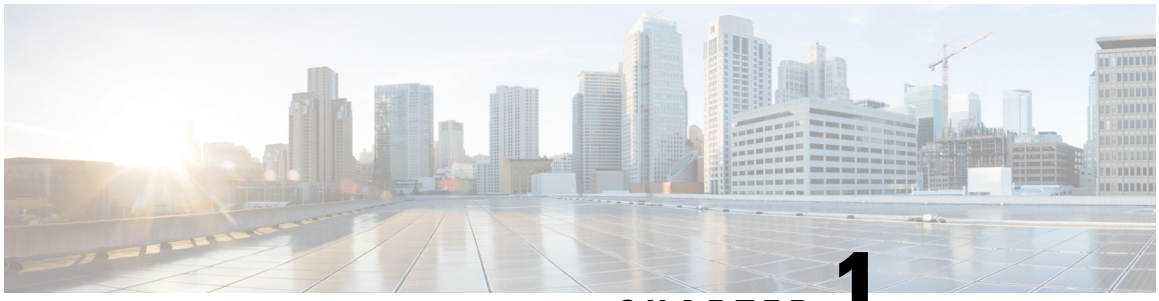
Use the following path selections to access the 5G NSA documentation:

Products > Wireless > Mobile Internet> Platforms > Cisco ASR 5000 Series

Contacting Customer Support

Use the information in this section to contact customer support.

Refer to the support area of http://www.cisco.com for up-to-date product documentation or to submit a service request. A valid username and password are required to access this site. Please contact your Cisco sales or service representative for additional information.



CHAPTER 1

5G Non Standalone Solution Overview

This chapter contains general overview information about the 5G NR Non Standalone (NSA) solution, including sections for:

- Overview, on page 1
- Product Description, on page 1
- How the 5G NSA Works, on page 2

Overview

5G is the next generation of 3GPP technology, after 4G/LTE, defined for wireless mobile data communication. 5G will bridge wireless and wireline networks by introducing a major network architectural change from radio access to core.

The 5G standards are introduced in 3GPP Release 15 to cater to the needs of 5G networks. The 5G framework will take advantage of the massive throughput and low latency that new radio provides.

The two solutions defined by 3GPP for 5G networks are:

- 5G Non Standalone (NSA): The existing LTE radio access and core network (EPC) is used as an anchor for mobility management and coverage to add the 5G carrier. This solution enables operators to provide 5G services with shorter time and lesser cost.

  Note The 5G NSA solution is supported in this release.

- 5G Standalone (SA): An all new 5G Packet Core will be introduced with several new capabilities built inherently into it. The SA architecture comprises of 5G New Radio (5G NR) and 5G Core Network (5GC).

  Network Slicing, CUPS, Virtualization, Multi-Gbps support, Ultra low latency, and other such aspects will be natively built into the 5G SA Packet Core architecture.

Product Description

The 5G Non Standalone (NSA) solution enables operators using Cisco EPC Packet Core to launch 5G services in shorter time and leverage existing infrastructure. NSA leverages the existing LTE radio access and core

network (EPC) to anchor 5G NR using the Dual Connectivity feature. This solution provides a seamless option to deploy 5G services with very less disruption in the network.

The 5G NSA solution is 3GPP compliant and can inter-operate with any RAN and network functions. Cisco MME, SGSN, S-GW, P-GW, and PCRF services support 5G NSA. See the product-specific feature chapters in this guide for 5G NSA.

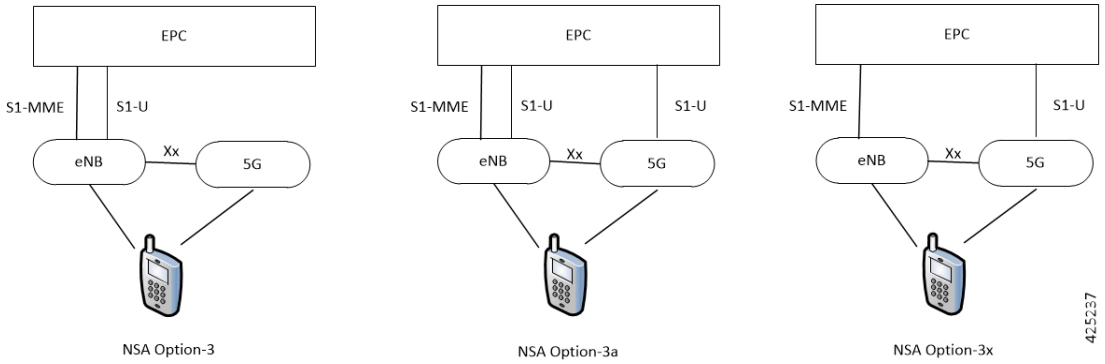
The initial deployments of 5G services are based on 5G NSA, also called option-3. The variants of option-3 are option-3, option-3a and option-3x.

Option-3/3a/3x are transparent to MME and P-GW, and translates to an E-RAB modification procedure at MME.

- Option-3 — Traffic is split across 4G and 5G at eNodeB.
- Option-3a — Traffic is split across 4G and 5G at EPC (S-GW).
- Option-3x — Traffic is split across 4G and 5G at 5G cell.

The following figure illustrates the interfaces and nodes for option-3 and the variants.

Figure 1: NSA Option-3 Variants



Qualified Platforms

The 5G NSA solution runs on Cisco ASR 5000, ASR 5500, and virtualized platforms. For additional platform information, see the appropriate System Administration Guide and/or contact your Cisco account representative.

Licenses

5G NSA is a licensed Cisco solution. Contact your Cisco account representative for detailed information on specific licensing requirements. For information on installing and verifying licenses, refer to the *Managing License Keys* section of the *Software Management Operations* chapter in the *System Administration Guide*.

How the 5G NSA Works

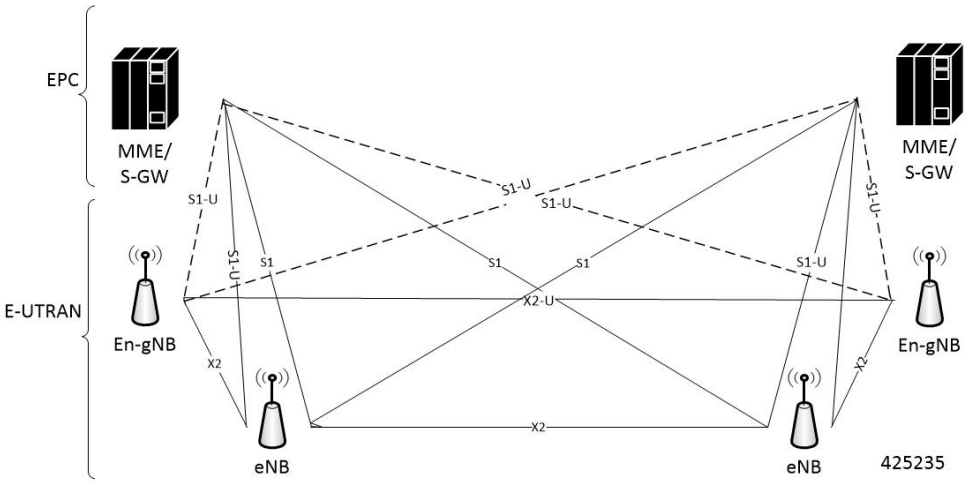
This section provides information on the function of the 5G NSA in an EPC network.

Dual Connectivity

The E-UTRA-NR Dual Connectivity (EN-DC) feature supports 5G New Radio (NR) with EPC. A UE connected to an eNodeB acts as a Master Node (MN) and an en-gNB acts as a Secondary Node (SN). The eNodeB is connected to the EPC through the S1 interface and to the en-gNB through the X2 interface. The en-gNB can be connected to the EPC through the S1-U interface and other en-gNBs through the X2-U interface.

The following figure illustrates the E-UTRA-NR Dual Connectivity architecture.

Figure 2: EN-DC Architecture



If the UE supports dual connectivity with NR, then the UE must set the DCNR bit to "dual connectivity with NR supported" in the UE network capability IE of the Attach Request/Tracking Area Update Request message.

If the UE indicates support for dual connectivity with NR in the Attach Request/Tracking Area Update Request message, and the MME decides to restrict the use of dual connectivity with NR for the UE, then the 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/Tracking Area Update Accept message.

If the RestrictDCNR bit is set to "Use of dual connectivity with NR is restricted" in the EPS network feature support IE of the Attach Accept/Tracking Area Update Accept message, the UE provides the indication that dual connectivity with NR is restricted to the upper layers.

If the UE supports DCNR and DCNR is configured on MME, and if HSS sends ULA/IDR with "Access-Restriction" carrying "NR as Secondary RAT Not Allowed", MME sends the "NR Restriction" bit set in "Handover Restriction List" IE during Attach/TAU/Handover procedures. Similarly, 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/Tracking Area Update Accept message. Accordingly, UE provides the indication that dual connectivity with NR is restricted to the upper layers.

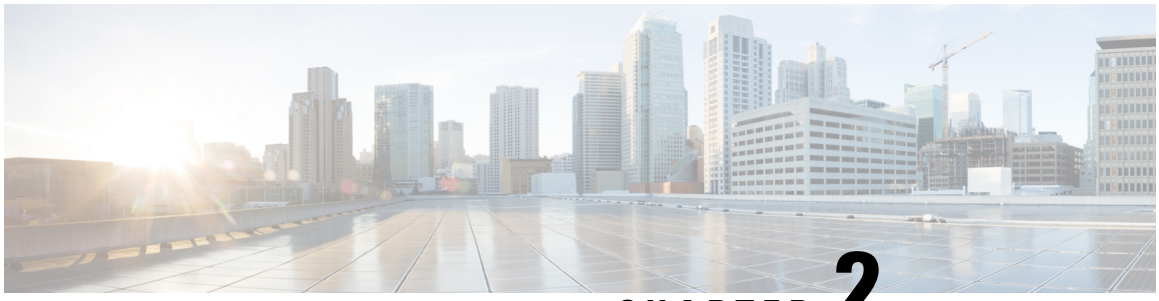
The "Handover Restriction List" IE is present in the "Initial Context Setup Request" message for Attach and TAU procedure with data forwarding procedure, in the "Handover Required" message for S1 handover procedure, in the "Downlink NAS Transport" message for TAU without active flag procedure.



PART I

MME: 5G Non Standalone Solution

- 5G NSA for MME, on page 7



CHAPTER 2

5G NSA for MME

- Feature Summary and Revision History, on page 7
- Feature Description, on page 8
- How It Works, on page 11
- Configuring 5G NSA for MME, on page 17
- Monitoring and Troubleshooting, on page 22

Feature Summary and Revision History

Summary Data

Applicable Product(s) or Functional Area	MME
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* • *MME Administration Guide* • *Statistics and Counters Reference*

Revision History

Revision Details	Release

The 5G NSA support for Secondary RAT Usage Reporting feature is qualified on the ASR 5500 platform.	21.17
The 5G NSA supports Secondary RAT Usage Reporting. **Important** This feature is not fully qualified in this release, and is available only for testing purposes. For more information, contact your Cisco Account Representative.	21.16
The 5G NSA solution for MME supports the following functionality in this release: • Ultra-Low Latency QCI bearers handover from MME to Gn-SGSN • NR security algorithms for DCNR capable UEs to support 5G security	21.10
The 5G NSA solution for MME supports the following functionality in this release: • DCNR capability exchange with peer SGSN in MM context over S3 interface • MME support of statistics for DCNR PDNs • NR security algorithms for DCNR capable UEs to support 5G security **Important** Support for 5G security is not fully qualified in this release.	21.9
The 5G NSA solution is qualified on the ASR 5000 platform.	21.5
First introduced.	21.8

Feature Description

The 5G NSA solution for MME supports the following functionalities:

- **E-RAB Modification Procedure:**

  When SCG (Secondary Cell Group) bearer option is applied to support DCNR, this procedure allows the Master eNodeB to switch a bearer to Secondary eNodeB without changing the S1-MME association.

- **NR Capable S-GW/P-GW Selection:**

  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 so on), for dynamic S-GW and P-GW selection, MME uses the following service parameters received from DNS server (in NAPTR response) over other service parameters to select NR capable S-GW/P-GW.

  - x-3gpp-sgw:x-s5-gtp+nc-nr
  - x-3gpp-pgw:x-s5-gtp+nc-nr

When the dynamic selection of S-GW/P-GW fails for any other reasons, MME falls back and selects the locally configured S-GW/P-GW.

- **Dynamic S-GW/P-GW Selection:**

  Dynamic S-GW and P-GW selection by MME for DCNR capable UE is supported. When a DCNR capable UE attempts to register in MME and when all DCNR validations are successful (DCNR feature configuration on MME, HSS not sending access-restriction for NR, and so on), the MME sets the "UP Function Selection Indication Flags" IE with DCNR flag set to 1 in "Create Session Request" message. This feature supports the CUPS architecture for SGW-C and PGW-C to select SGW-U and PGW-U and support dual connectivity with NR. When S-GW receives this IE over S11, it sends the IE over S5 to P-GW. If S-GW receives the IE in a non-CUPS deployment, it is ignored.

- **URLCC QCI Support:**

  For Ultra-Reliable and Low Latency Communications (URLCC), MME supports — QCI 80 (Non-GBR resource type), QCI 82 (GBR resource type), and QCI 83 (GBR resource type). MME establishes the default bearers with URLLC QCI 80, which is typically used by low latency eMBB applications. MME establishes the dedicated bearers with URLLC QCI 82 and QCI 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).

- **PDNs with UP Function Selection Indication:**

  Based on the DCNR flag in the UP Function Selection Indication Flags IE, new statistics and bulk statistics are supported for the total number of current active, setup, and released DCNR PDNs on MME.

- **NR Support in GTP MM Context over S3 Interface:**

  MME supports the DCNR capability exchange with peer SGSN over the S3 interface. The DCNR restriction can be notified by the peer SGSN during handover to MME. The DCNR restriction information helps the target MME in performing the right S-GW selection.

  During handovers, the target MME performs gateway selection before getting the subscription information from the HSS and hence MME may select the NR capable S-GW for DCNR restricted UE. To prevent this, the peer SGSN will notify the Restriction information (NRSRNA) through the GTP MM context in Identification-Response/Context-Response/Forward-Relocation-Request message to MME. The S3-DCNR support includes both GTPv2 and GTPv1 protocol for S4-SGSN and Gn-SGSN respectively.

- **5G Security:**

  The "UE Additional Security Capability" and "Replayed UE Additional Security Capability" IEs for MME are supported as per 3GPP TS 24.301.

  The MME supports handling of the "UE Additional Security Capability" IE for DCNR capable UEs. This information element is used by the UE in Attach Request and Tracking Area Update messages to indicate which additional security algorithms are supported by the UE.

  The MME includes the "Replayed UE Additional Security Capability" IE if the MME supports handling of UE additional security capabilities, if the MME is initiating a Security Mode Command during an Attach or Tracking Area Update procedure and the Attach Request or Tracking Area Update Request message included a "UE Additional Security Capability" IE.

  The "NR UE Security Capability" IE will be included by MME in the S1AP messages — INITIAL CONTEXT SETUP REQUEST, UE CONTEXT MODIFICATION REQUEST, HANDOVER REQUEST, PATH SWITCH ACKNOWLEDGE and DOWNLINK NAS TRANSPORT for MME as per 3GPP TS36.41.

The eNode-B includes the "NR UE Security Capability" IE in PATH SWITCH REQUEST to be processed by the MME.

- **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 ranges. 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 such as 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 are introduced in S6a, Gx , S1-AP and NAS interfaces to support 5G throughput rates. See the *How It Works* section for more information.

- **Extended QoS:**

  MME supports the extended QoS values towards S-GW in legacy IEs - APN-AMBR, Bearer QoS, and Flow QoS.

- **Supported IEs:**

  S1-AP interface:

  - Extended UE-AMBR Downlink
  - Extended UE-AMBR Uplink
  - Extended E-RAB Maximum Bit Rate Downlink
  - Extended E-RAB Maximum Bit Rate Uplink
  - Extended E-RAB Guaranteed Maximum Bit Rate Downlink
  - Extended E-RAB Guaranteed Maximum Bit Rate Uplink

  NAS interface:

  - Extended EPS quality of service
  - Extended APN aggregate maximum bit rate

- **ULL QCI bearers handover from MME to Gn-SGSN Support:**

  For Ultra-Low Latency (ULL) MME is configured to map the Ultra-Low Latency values 80, 82, and 83 to Pre-Release8 QoS during handover from MME. Maximum Bit Rate (MBR) and Guaranteed Bit Rate (GBR) limits are increased to 4Tbps. MME supports outbound handover on GnGp interface to Gn-SGSN with ULL-QCI values 80, 82, and 83.

- **UE additional Security Capability:**

  MME includes “UE additional security capability” IE in MM-Context over S10 interface during handover if it is available, otherwise includes the length of UE additional security capability as zero.

  MME processes “UE additional security capability” for NR received in MM-Context over S10 interface during Handover only if it is not available. If the received length of UE additional security capability is zero, then it is not present in MM-context.

Secondary RAT Usage Reporting

When a Secondary RAT is used in conjunction with E-UTRAN, operator may wish to record the data volume sent on the Secondary RAT. The PLMN locally activates the Secondary RAT Usage Data Reporting by E-UTRAN O & M. The E-UTRAN reports uplink and downlink data volumes to the EPC for the Secondary RAT on a per EPS bearer basis and per time interval. If E-UTRAN is also configured to make periodic reports, if there is no event to trigger a report before the period expires. MME handle these reports received from eNodeB in S1-AP messages and forwards it to S-GW / P-GW via GTPV2 messages.



Important MME behavior in Routing Area Update Procedure involving “MME and S3 SGSN”, will be similar to Routing Area Update Procedure involving “MME and Gn/Gp SGSN” where secondary RAT report will be sent over Change Notification to P-GW if reporting to P-GW is enabled. And report will be sent over Delete Session Request to S-GW if MME had received the Serving GW change indication.

How It Works

Architecture

This section describes the external interfaces required to support the 5G NSA architecture.

S6a (HSS) Interface

The S6a interface supports new AVPs "Extended-Max-Requested-BW-UL" and "Extended-Max-Requested-BW-DL" in grouped AVP "AMBR" to handle the 5G throughput ranges. When the maximum bandwidth value for UL (or DL) traffic is higher than 4294967295 bits per second, the "Max-Requested-Bandwidth-UL" AVP (or DL) must be set to the upper limit 4294967295 and the "Extended-Max-Requested-BW-UL" AVP (or DL) must be set to the requested bandwidth value in kilobits per second.

S1AP (eNodeB) Interface

Extended UE-AMBR

The S1AP interface supports new IEs "Extended UE Aggregate Maximum Bit Rate Downlink" and "Extended UE Aggregate Maximum Bit Rate Uplink" in the grouped IE "UE Aggregate Maximum Bit Rate", where the units are bits/second. If the Extended UE Aggregate Maximum Bit Rate Downlink/Uplink IE is included, then the UE Aggregate Maximum Bit Rate Downlink/Uplink IE must be ignored.

Extended E-RAB MBR/GBR

The S1AP interface supports new AVPs "Extended E-RAB Maximum Bit Rate Downlink/Uplink" and "Extended E-RAB Guaranteed Bit Rate Downlink/Uplink" in the "GBR QoS Information" grouped IE, where the units are bits/second.

NAS (UE) Interface

Extended APN Aggregate Maximum Bit Rate

The new IE "Extended APN aggregate maximum bit rate" is added in all applicable NAS messages to convey the 5G throughput (beyond 65.2Gbps) over NAS. The existing IE in NAS "APN-AMBR" supports APN-AMBR values up to 65.2Gbps.

Extended EPS Quality of Service

The new IE "Extended EPS Quality of Service" is added in all applicable NAS messages to convey the 5G throughput (beyond 10Gbps) over NAS. The existing IE in NAS "EPS Quality of Service" supports MBR and GBR values up to 10Gbps.

Limitations

This section describes the known limitations for the 5G NSA feature:

- DCNR for S3 interface is supported only for inbound handover of UE from 2G/3G to 4G.
- MME does not support the NR capable gateway selection during connected mode inbound handover from Gn-SGSN.
- Maximum of 11 reports can be sent in single GTPV2 message towards S-GW.
- Reports sent without handover flag during handover procedure will be dropped by MME.
- Reports are not stored as part of session recovery.
- At any point of time only two reports per bearer will be handled by MME.
- Filling of “Secondary RAT Data Usage Request” IE in E-RAB MODIFY REQUEST message and handling of report in ERAB Modify RESPONSE is not supported.
- During 4g to 3g/2g IRAT handover without S-GW change, if PGW reporting is enabled, reports will be sent over the Change Notification message. Reports will not be sent to S-GW, even if the S-GW reporting is configured.

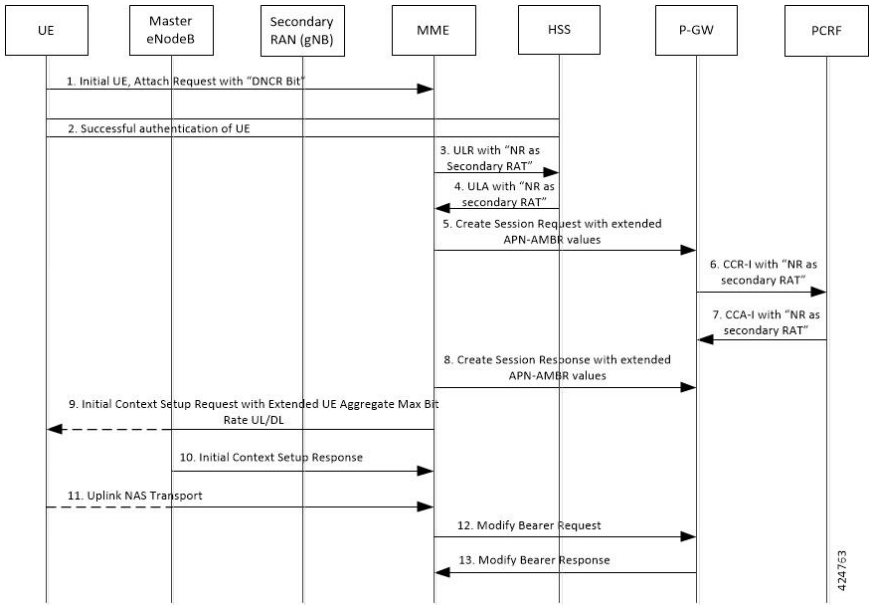
Flows

This section describes the call flow procedures related to MME for 5G NSA.

Initial Registration Procedure

The following call flow illustrates the Initial Registration procedure for DCNR capable UE.

Initial Registration of DCNR Capable UE



Step	Description
1	The DCNR capable UE sets the "DCNR bit" in NAS message "Attach Request" in "UE Network Capability" IE. DCNR must be enabled at MME service or call control profile depending upon the operator requirement.
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 the "NR as Secondary RAT" feature bit in "Feature-List-ID-2".
4	HSS sends ULA by advertising the DCNR by sending "NR as Secondary RAT" feature bit in "Feature-List-ID-2", "Max-Requested-Bandwidth-UL" as 4294967295 bps, "Max-Requested-Bandwidth-DL" as 4294967295 bps, and the extended bandwidth values in AVPs "Extended-Max-Requested-BW-UL" and "Extended-Max-Requested-BW-DL". If HSS determines that the UE is not authorized for DCNR services, then HSS sends Subscription-Data with "Access-Restriction" carrying "NR as Secondary RAT Not Allowed".
5	MME sends the Create Session Request message with the extended APN-AMBR values in existing AMBR IE. As the APN-AMBR values in GTPv2 interface are encoded in kbps, the existing AMBR IE handles the 5G NSA bit rates.

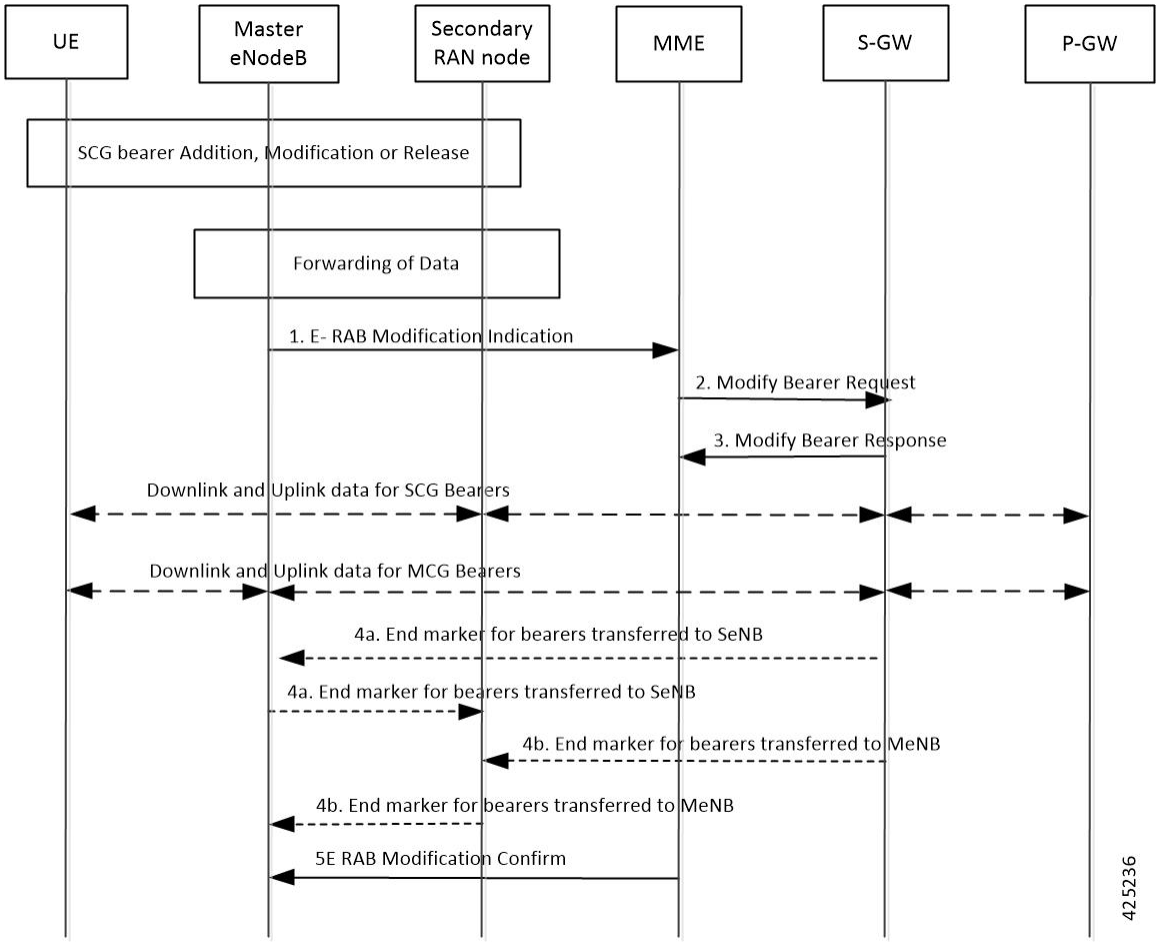
Step	Description
6	P-GW sends CCR-I to PCRF advertising the DCNR by sending "Extended-BW-NR" feature bit in "Feature-List-ID-2", "APN-Aggregate-Max-Bitrate-UL" as 4294967295 bps, "APN-Aggregate-Max-Bitrate-DL" as 4294967295 bps, and the extended bandwidth values in AVPs "Extended-APN-AMBR-UL" and "Extended-APN-AMBR-DL".
7	PCRF sends CCA-I advertising the DCNR by sending "Extended-BW-NR" feature bit in "Feature-List-ID-2", "APN-Aggregate-Max-Bitrate-UL" as 4294967295 bps, "APN-Aggregate-Max-Bitrate-DL" as 4294967295 bps, and the extended bandwidth values in AVPs "Extended-APN-AMBR-UL" and "Extended-APN-AMBR-DL". PCRF can offer the same extended APN-AMBR values that are requested by PCRF 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 APN-AMBR IE in the Create Session Response message.
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 the "Initial Context Setup Request" message. MME sends the APN-AMBR values up to 65.2 Gbps in existing APN-AMBR IE 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 "Extended APN Aggregate Maximum Bit Rate" IE. If ULA is received with "Access-Restriction" carrying "NR as Secondary RAT Not Allowed", MME sends the Initial Context Setup Request message with "NR Restriction" bit set in Handover Restriction List IE. 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. UE provides the indication that dual connectivity with NR is restricted to the upper layers accordingly. If the DCNR feature is not configured at MME service or call control profile, then 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. UE provides the indication that dual connectivity with NR is restricted to the upper layers accordingly.
10	eNodeB sends the Initial Context Setup Response message. If master eNodeB determines to establish the bearer on secondary eNodeB, F-TEID of the secondary eNodeB may be sent (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 "Complete - Activate Default EPS Bearer Context Accept".

Step	Description
12	MME sends the Modify Bearer Request message to S-GW with S1-U F-TEID details as received in the Initial Context Setup Response message.
13	MME receives the Modify Bearer Response message from S-GW.

E-RAB Modification Procedure

When Secondary Cell Group (SCG) bearer option is applied to support DCNR, the E-RAB Modification procedure is used to transfer bearer contexts to and from secondary eNodeB or secondary gNodeB.

Figure 3: E-RAB Modification Procedure by Master eNodeB



Step	Description
1	The master eNodeB (MeNB) sends an E-RAB Modification Indication message (eNodeB address(es) and TEIDs for downlink user plane for all the EPS bearers) to the MME. The MeNB indicates if each bearer is modified or not. The "E-RAB to be Modified List" IE contains both "E-RAB to Be Modified Item" and "E-RAB not to Be Modified Item" IEs. For the bearer that need to be switched to secondary eNodeB/gNodeB (SeNB), the "E-RAB to Be Modified Item" IE contains the transport layer address of gNodeB and TEID of gNodeB.
2	The MME sends a Modify Bearer Request message (eNodeB address(es) and TEIDs for downlink user plane for all the EPS bearers) per PDN connection to the S-GW, only for the affected PDN connections.
3	The S-GW returns a Modify Bearer Response message (S-GW address and TEID for uplink traffic) to the MME as a response to the Modify Bearer Request message.
4	For the bearers transferred to SeNB, S-GW sends one or more end marker packets on the old path (to MeNB) immediately after switching the path.
5	The MME confirms E-RAB modification with the E-RAB Modification Confirm message. The MME indicates if each bearer was successfully modified, retained, unmodified or already released by the EPC.

Standards Compliance

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

- 3GPP 23.003 Release 15.2.0 - Numbering, addressing and identification.
- 3GPP 23.401 Release 15.2.0 - General Packet Radio Service (GPRS) enhancements for Evolved Universal Terrestrial Radio Access Network (E-UTRAN) access
- 3GPP 29.272 Release 15.2.0 - Evolved Packet System (EPS); Mobility Management Entity (MME) and Serving GPRS Support Node (SGSN) related interfaces based on Diameter protocol
- 3GPP 29.274 Release 15.2.0 - 3GPP Evolved Packet System (EPS); Evolved General Packet Radio Service (GPRS) Tunnelling Protocol for Control plane (GTPv2-C); Stage 3
- 3GPP 29.303 Release 15.2.0 - Domain Name System Procedures

Cisco's implementation of the Secondary RAT Usage Reporting complies with the following standards:

- 3GPP 29.274: 15.5.0 3GPP Evolved Packet System (EPS); Evolved General Packet Radio Service (GPRS) Tunneling Protocol for Control plane (GTPv2-C) Stage 3
- 3GPP 36.413: 15.3.0 Evolved Universal Terrestrial Radio Access Network (E-UTRAN); S1 Application Protocol (S1AP)
- 3GPP 23.401: 15.5.0 General Packet Radio Service (GPRS) enhancements for Evolved Universal Terrestrial Radio Access Network (E-UTRAN) access

Configuring 5G NSA for MME

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

Configuring 5G NSA on MME involves:

- Enabling DCNR in MME Service, on page 17
- Enabling DCNR in Call Control Profile, on page 17
- Configuring APN AMBR Values, on page 18
- Configuring Dedicated Bearer MBR Values, on page 20
- Configuring UE AMBR Values , on page 21

Enabling DCNR in MME Service

Use the following configuration to enable DCNR to support 5G NSA.

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

NOTES:

- **mme-service** *service_name*: Creates an MME service or configures an existing MME service in the current context. *service_name* specifies the name of the MME service, name must be an string from 1 to 63 characters.
- **no**: Disables the DCNR configuration.
- The **dcnr** CLI command is disabled by default.

Enabling DCNR in Call Control Profile

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

```
configure
  call-control-profile profile_name
    [ no | remove ] dcnr
    end
```

NOTES:

- **call-control-profile** *profile_name*: Creates an instance of a call control profile. *profile_name* specifies the name of the call control profile, it must be an string from 1 to 64 characters.
- **no**: Disables the DCNR configuration in the call control profile.
- **remove**: Removes the DCNR configuration from the call control profile.

- The **dcnr** CLI command is disabled by default.

Configuring APN AMBR Values

Use the following configuration to configure the APN aggregate maximum bit rate (AMBR) that will be stored in the Home Subscriber Server (HSS).

```
configure
  apn-profile profile_name
    qos apn-ambr max-ul mbr_up max-dl mbr_down
    remove qos apn-ambr
    end
```

NOTES:

- **apn-profile** *profile_name*: Creates an instance of an access point name (APN) profile. *profile_name* specifies the name of the APN profile as an alphanumeric string of 1 to 64 characters.
- **qos**: Configures the quality of service (QoS) parameters to be applied.
- **apn-ambr**: Configures the aggregate maximum bit rate (AMBR) for the APN.
- **max-ul** *mbr_up*: Defines the maximum bit rates for uplink traffic. *mbr_up* must be an integer from 1 to 4000000000000 (4 Tbps).
- **max-dl** *mbr_down*: Defines the maximum bit rates for downlink traffic. *mbr_up* must be an integer from 1 to 4000000000000 (4 Tbps).
- **remove**: Removes the APN AMBR changes from the configuration for this APN profile.

Enabling Secondary RAT Data Usage Report in Call Control Profile

Use the following configuration to enable Secondary RAT Data Usage Report to support 5G NSA.

```
configure
     call-control-profile profile_name
        secondary-rat data-usage-report { pgw [ sgw ] | sgw [ pgw ] }
        [ no | remove ] secondary-rat data-usage-report
        end
```



Important Both CLI configuration and the current running procedure are taken into account while filling the flags IRSGW/IRPGW in GTPv2 messages towards S-GW/P-GW.

NOTES:

- **no**: Disables the Secondary RAT Usage Report at call-control-profile.
- **remove**: Removes the Secondary-RAT Usage Report configuration from call-control-profile. It fallbacks to MME service-level configuration.
- **secondary-rat data-usage-report { pgw [sgw] | sgw [pgw] }** MME sets IR-SGW and IR-PGW flags based on the available options configured for Secondary-RAT data usage report. By default, MME

disables the Secondary-RAT data usage reporting towards both SGW and PGW. If the configuration is removed from call-control-profile, then it fall-back to MME-SERVICE level configuration for Secondary-RAT-Data-Usage-Report functionality.

- **secondary-rat data-usage-report sgw** Disables the Secondary-RAT Usage Report option for P-GW and enables only for S-GW.
- **secondary-rat data-usage-report pgw** Disables the Secondary-RAT Usage Report option for SGW and enables only for PGW.
- **secondary-rat data-usage-report sgw pgw** Enables Secondary-RAT Usage Report option for both SGW and PGW.
- **secondary-rat data-usage-report pgw sgw** Enables Secondary-RAT Usage Report option for both SGW and PGW.

Enabling Secondary RAT Data Usage Report in MME Service

Use the following configuration to enable Secondary RAT Data Usage Report to support 5G NSA.

```
configure
  context context_name
    mme-service service_name
      secondary-rat data-usage-report { pgw [ sgw ] | sgw [ pgw ] }
      no secondary-rat data-usage-report
      end
```



Important Both CLI configuration and the current running procedure are taken into account while filling the flags IRSGW/IRPGW in GTPv2 messages towards S-GW/P-GW.

NOTES:

- **no**: Disables the Secondary RAT Usage Report at mme-service.
- **secondary-rat data-usage-report { pgw [sgw] | sgw [pgw] }** MME sets IR-SGW and IR-PGW flags based on the available options configured for Secondary-RAT data usage report. By default, MME disables the Secondary-RAT data usage reporting towards both SGW and PGW. If the configuration is removed from call-control-profile, then it fall-back to MME-SERVICE level configuration for Secondary-RAT-Data-Usage-Report functionality.
  - **secondary-rat data-usage-report sgw**: Disables the Secondary-RAT Usage Report option for P-GW and enables only for S-GW.
  - **secondary-rat data-usage-report pgw** : Disables the Secondary-RAT Usage Report option for S-GW and enables only for P-GW.
  - **secondary-rat data-usage-report sgw pgw**: Enables Secondary-RAT Usage Report option for both S-GW and P-GW.
  - **secondary-rat data-usage-report pgw sgw**: Enables Secondary-RAT Usage Report option for both S-GW and P-GW.

Configuring Pre-Release 8 QoS Mapping QCI

Use the following configuration to configure mapping of EPC QOS (non-standard QCIs) to 3GPP Pre-Release 8 QOS.

```
configure
  bearer-control-profile profile_name
    pre-rel8-qos-mapping qci qci_val
    remove pre-rel8-qos-mapping qci
    end
```

NOTES:

- **bearer-control-profile** *profile_name*: Creates an instance of a bearer control profile. *profile_name* specifies the name of the bearer control profile as an alphanumeric string of 1 to 64 characters.
- **remove**: Removes the DCNR configuration from the call control profile.
- **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.

Configuring Dedicated Bearer MBR Values

Use the following configuration to configure the quality of service maximum bit rate (MBR) values for the dedicated bearer.

```
configure
  apn-profile apn_profile_name
    qos dedicated-bearer mbr max-ul mbr_up max-dl mbr_down
    remove qos dedicated-bearer
    end
```

NOTES:

- **apn-profile** *apn_profile*: Creates an instance of an Access Point Name (APN) profile. *apn_profile_name* specifies the name of the APN profile as an alphanumeric string of 1 to 64 characters.
- **qos**: Configures the quality of service (QoS) parameters to be applied.
- **dedicated-bearer mbr**: Configures the maximum bit rate (MBR) for the dedicated bearer.
- **max-ul** *mbr_up*: Defines the maximum bit rate for uplink traffic. *mbr_up* must be an integer from 1 to 4000000000000 (4 Tbps).
- **max-dl** *mbr_down*: Defines the maximum bit rate for downlink traffic. *mbr_down* must be an integer from 1 to 4000000000000 (4 Tbps).
- **remove**: Deletes the dedicated bearer MBR changes from the configuration for this APN profile.

Configuring Dedicated Bearer MBR Values

Use the following configuration to configure the quality of service maximum bit rate (MBR) values for the dedicated bearer.

```
configure
  bearer-control-profile profile_name
    dedicated-bearer { mbr mbr-up mbr_up mbr-down mbr_down | gbr gbr-up gbr_up
 gbr-down gbr_down
     remove dedicated-bearer { gbr | mbr }
     end
```

NOTES:

- **bearer-control-profile** *profile_name*: Creates an instance of a bearer control profile. *profile_name* specifies the name of the bearer control profile as an string from 1 to 64 characters.
- **dedicated-bearer mbr**: Configures the maximum bit rate (MBR) for the dedicated bearer.
- **gbr-up** *gbr_up*: Defines the guaranteed bit rate for uplink traffic. *gbr_up* must be an integer from 1 to 4000000000000 (4 Tbps).
- **gbr-down** *gbr_down*: Defines the guaranteed bit rate for downlink traffic. *gbr_down* must be an integer from 1 to 4000000000000 (4 Tbps).
- **mbr-up** *mbr_up*: Defines the maximum bit rate for uplink traffic. *mbr_up* must be an integer from 1 to 4000000000000 (4 Tbps).
- **mbr-down** *mbr_down*: Defines the maximum bit rate for downlink traffic. *mbr_down* must be an integer from 1 to 4000000000000 (4 Tbps).
- **remove**: Deletes the dedicated bearer MBR changes from the configuration for this bearer control profile.

Configuring UE AMBR Values

Use the following configuration to configure the values for aggregate maximum bit rate stored on the UE (UE AMBR).

```
configure
  call-control-profile profile_name
    qos ue-ambr { max-ul mbr_up max-dl mbr_down }
    remove qos ue-ambr
    end
```

NOTES:

- **call-control-profile** *profile_name*: Creates an instance of a call control profile. *profile_name* specifies the name of a call control profile entered as an alphanumeric string of 1 to 64 characters.
- **qos**: Configures the quality of service (QoS) parameters to be applied.
- **ue-ambr**: Configures the aggregate maximum bit rate stored on the UE (UE AMBR).
- **max-ul** *mbr_up*: Defines the maximum bit rate for uplink traffic. *mbr_up* must be an integer from 1 to 4000000000000 (4 Tbps).
- **max-dl** *mbr_down*: Defines the maximum bit rate for uplink traffic. *mbr_down* must be an integer from 1 to 4000000000000 (4 Tbps).
- **remove**: Deletes the configuration from the call control profile.

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

show mme-service db record imsi

The output of this command includes the following fields:

ARD:

- Dual-Connectivity-NR-not-allowed — Displays True or False to identify if the ARD received from HSS indicates the DCNR feature is allowed for the given IMSI or not.

show mme-service name <mme_svc_name>

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

show mme-service session full all

The output of this command includes the following fields:

UE DC-NR Information:

- DC-NR capable UE — Indicates whether the UE is DCNR capable.
- DC-NR operation allowed — Indicates whether the DCNR operation is allowed by MME for the DCNR capable UE.

show mme-service statistics

- Dual Connectivity with NR Statistics:

  Attach Procedure

  - Attach Request Rcvd — The number of Attach Request messages received with UE advertising DCNR support.
  - Attach Acc DCNR allowed — The number of Attach Accept messages sent by the MME acknowledging the DCNR support for UE (Restrict DCNR bit not set in Attach Accept).
  - Attach Acc DCNR denied — The number of Attach Accepts sent by MME rejecting the DCNR support for the UE (Restrict DCNR bit set in Attach Accept).
  - Attach Reject Sent — The number of Attach Reject messages sent by MME whose corresponding Attach Request messages have DCNR support capability.
  - Attach Complete Rcvd — The number of Attach Complete messages received by MME whose corresponding Attach Request messages have DCNR support capability.

Intra-MME TAU Procedure

- TAU Request Rcvd — The number of TAU Request messages received for Intra-MME TAU procedure with UE advertising DCNR support.
- TAU Accept DCNR allowed — The number of TAU Accept messages sent by the MME acknowledging the DCNR support for UE (Restrict DCNR bit not set in TAU Accept) for Intra-MME TAU procedure.
- TAU Accept DCNR denied — The number of TAU Accept messages sent by the MME rejecting the DCNR support for UE (Restrict DCNR bit set in TAU Accept) for Intra-MME TAU procedure.
- TAU Complete Rcvd — The number of TAU Complete messages received by the MME whose corresponding Intra-MME TAU Requests have DCNR support capability.

Inter-MME TAU Procedure

- TAU Request Rcvd — The number of TAU Request messages received for Inter-MME TAU procedure with UE advertising DCNR support.
- TAU Accept DCNR allowed — The number of TAU Accept messages sent by the MME acknowledging the DCNR support for UE (Restrict DCNR bit not set in TAU Accept) for Inter-MME TAU procedure.
- TAU Accept DCNR denied — The number of TAU Accept messages sent by the MME rejecting the DCNR support for UE (Restrict DCNR bit set in TAU Accept) for Inter-MME TAU procedure.
- TAU Reject Sent — The number of TAU Reject messages sent by the MME whose corresponding Inter-MME TAU Requests have DCNR support capability.
- TAU Complete Rcvd — The number of TAU Complete messages received by the MME whose corresponding Inter-MME TAU Requests have DCNR support capability.

Dual Connectivity with NR Subscribers

- Attached Calls — The number of DCNR supported UEs attached with the MME.
- Connected Calls — The number of DCNR supported UEs in connected mode at the MME.
- Idle Calls — The number of DCNR supported UEs in idle mode at the MME.

Node Selection:

SGW DNS:

- Common — The number of times S-GW DNS selection procedures are performed with DNS RR excluding the NR network capability.
- NR Capable — The number of times S-GW DNS selection procedures are performed with DNS RR including the NR network capability.

SGW Local Config

- Common — The number of times S-GW selection procedures are performed with locally configured S-GW address, without considering the NR network capability.

PGW DNS:

- Common — The number of times P-GW DNS selection procedures are performed with DNS RR excluding the NR network capability.
- NR Capable — The number of times P-GW DNS selection procedures are performed with DNS RR including the NR network capability.

PGW Local Config:

- Common — The number of times P-GW selection procedures are performed with locally configured P-GW address, without considering the NR network capability.



Important When UE is defined with "UE usage type" and "NR Capable", S-GW/P-GW via DNS is selected in the following order:

1. MME chooses S-GW/P-GW that support both +ue and +nr services.
2. If step 1 fails, MME selects S-GW/P-GW that supports +nr service only.
3. If step 2 fails, MME selects S-GW/P-GW that supports +ue service only.
4. If step 3 fails, MME selects S-GW/P-GW without +nr or +ue service.

- Handover Statistics:
  - Bearer Statistics
    - ERAB Modification Indication
      - Attempted — The number of bearers for which the E-RAB Modification Indication procedure is attempted (bearer level stats).
      - Success — The number of bearers for which the E-RAB Modification Indication procedure has succeeded (bearer level stats).
      - Failures — The number of bearers for which the E-RAB Modification Indication procedure has failed (bearer level stats).

- ESM Statistics:

  DCNR User PDN Connections:
  - Attempted — The total number of attempts made for DCNR user PDN connections associated with all MME services on the system.
  - Success — The total number of successful attempts for DCNR user PDN connections associated with all MME services on the system.
  - Failures — The total number of attempts failed for DCNR user PDN connections associated with all MME services on the system.

- DCNR User PDN Statistics:
  - All PDNs — Displays statistics for all DCNR user PDNs, connected and idle, through the MME service(s) on the system.

- Connected PDNs — Displays statistics for connected DCNR user PDNs through the MME service(s) on the system.
- Idle PDNs — Displays statistics for idle DCNR user PDNs through the MME service(s) on the system.

- Paging Initiation for PS QCI-80, QCI 82, and QCI 83 Events:
  - Attempted — The total number of ECM statistics related to PS paging initiation events attempted for QCI 80, QCI 82, and QCI 83.
  - Success — The total number of ECM statistics related to PS paging initiation events successful for QCI 80, QCI 82, and QCI 83.
  - Failures — The total number of ECM statistics related to PS paging initiation events failed for QCI 80, QCI 82, and QCI 83.
    - Success at Last n eNB — The total number of ECM statistics related to PS paging initiation events succeeded at the last known eNodeB for QCI 80, QCI 82, and QCI 83.
    - Success at Last TAI — The total number of ECM statistics related to PS paging initiation events succeeded at the eNodeB in the TAI from which the UE was last heard for QCI 80, QCI 82, and QCI 83.
    - Success at TAI List — The total number of ECM statistics related PS paging initiation events succeeded at the eNodeB in all TAIs present in the TAI list assigned to the UE for QCI 80, QCI 82, and QCI 83.

show mme-service statistics dcnr

The output of this command includes the following fields:

Secondary RAT Usage Reports Rx Count

- UE Ctxt Release Req — Indicates the number of secondary RAT data usage reports received in UE context release request message.
- UE Ctxt Release Cmpl — Indicates the number of secondary RAT data usage reports received in UE context release complete message .
- E-RAB Mod Ind — Indicates the number of secondary RAT data usage reports received in eRAB Modification Indication message.
- E-RAB Release Ind — Indicates the number of secondary RAT data usage reports received in eRAB Release Indication message.
- E-RAB Release Resp — Indicates the number of secondary RAT data usage reports received in eRAB Release Response message.
- Secondary RAT Data Usage Report[Periodic] — Indicates the number of secondary RAT data usage reports received in Secondary RAT Data Usage Report message without Handover flag.
- Seccondary RAT Data Usage Report[Handover] — Indicates the number of secondary RAT data usage reports received in Secondary RAT Data Usage Report message with Handover flag.

- S10 Fwd Reloc Cmpl Ack — Indicates the number of secondary RAT data usage reports received in Forward Reloc Complete Ack message from MME to MME.
- Dropped Periodic Report[HO in progress] — Indicates the number of secondary RAT data usage reports dropped when Secondary RAT Data Usage Report message was received without Handover flag during Handover.

Secondary RAT Usage Reports Tx Count:

- Create Session Req — Indicates the number of secondary RAT data usage reports sent in Create Session Request .
- Delete Session Req — Indicates the number of secondary RAT data usage reports sent in Delete Session Request.
- Delete Bearer Rsp — Indicates the number of secondary RAT data usage reports sent in Delete Bearer Response .
- Release Access Brr Req — Indicates the number of secondary RAT data usage reports sent in Release Access Bearer Request.
- Delete Bearer Cmd —Indicates the number of secondary RAT data usage reports sent in Delete Bearer Command.
- Modify Bearer Req — Indicates the number of secondary RAT data usage reports sent in Modify Bearer Request.
- Change Notification — Indicates the number of secondary RAT data usage reports sent in Change Notification.
- S10 Fwd Reloc Cmpl Ack — Indicates the number of secondary RAT data usage reports sent in Forward Reloc Complete Ack.

show mme-service statistics s1ap

The output of this command includes the following fields:

S1AP Statistics:

Transmitted S1AP Data:

- E-RAB Modification Cfm — Indicates the number of E-RAB Modification Confirm messages sent by MME upon successful E-RAB modification procedure.

Received S1AP Data

- E-RAB Mod Ind — Indicates the number of E-RAB Modification Indication messages received from the master eNodeB.

Received S1AP Data:

- Secondary RAT Data Usage Report — Indicates the number of Secondary RAT Data Usage Report messages received from eNodeB.

show subscribers mme-service

The output of this command includes the "DCNR Devices" field to indicate the number of DCNR devices that are attached to the MME.

show call-control-profile full all

The output of this command includes the following fields:

- DCNR
- Secondary RAT Usage Report

show mme-service all

The output of this command includes the following fields:

- DCNR
- Secondary RAT Usage Report

Bulk Statistics

This section provides information on the bulk statistics for the 5G NSA feature on MME.

MME Schema

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

Bulk Statistics	Description
attached-dcnr-subscriber	The current total number of attached subscribers capable of operating in DCNR.
connected-dcnr-subscriber	The current total number of subscribers capable of operating in DCNR and in connected state.
idle-dcnr-subscriber	The current total number of subscribers capable of operating in DCNR and in idle state.
dcnr-attach-req	The total number of Attach Request messages that are received with DCNR supported.
dcnr-attach-acc-allowed	The total number of Attach Accept messages that are sent with DCNR allowed.
dcnr-attach-acc-denied	The total number of Attach Accept messages that are sent with DCNR denied.
dcnr-attach-rej	The total number of DCNR requested Attach Rejected messages.
dcnr-attach-comp	The total number of Attach Complete messages that are received for DCNR supported attaches.

Bulk Statistics	Description
dcnr-intra-tau-req	The total number of Intra-TAU Request messages that are received with DCNR supported.
dcnr-intra-tau-acc-allowed	The total number of Intra-TAU Accept messages that are sent with DCNR allowed.
dcnr-intra-tau-acc-denied	The total number of Intra-TAU Accept messages that are sent with DCNR denied.
dcnr-intra-tau-comp	The total number of Intra-TAU Complete messages that are received for DCNR supported requests.
dcnr-inter-tau-req	The total number of Inter-TAU Request messages that are received with DCNR supported.
dcnr-inter-tau-acc-allowed	The total number of Inter-TAU Accept messages that are sent with DCNR allowed.
dcnr-inter-tau-acc-denied	The total number of Inter-TAU Accept messages that are sent with DCNR denied.
dcnr-inter-tau-rej	The total number of DCNR requested Inter-TAU Request messages that are rejected.
dcnr-inter-tau-comp	The total number of Inter-TAU Complete messages that are received for DCNR supported requests.
s1ap-recdata-eRabModInd	The total number of S1 Application Protocol - E-RAB Modification Indication messages received from all eNodeBs.
s1ap-transdata-eRabModCfm	The total number of E-RAB Modification Confirmation messages sent by the MME to the eNodeB.
erab-modification-indication-attempted	The total number of bearers for which E-RAB Modification Indication messages were sent.
erab-modification-indication-success	The total number of bearers for which E-RAB Modification Indication messages were sent.
erab-modification-indication-failures	The total number of bearers for which E-RAB Modification Indication failed as shown in E-RAB Modification Indication Confirm message.
emmevent-path-update-attempt	The total number of EPS Mobility Management events - Path Update attempted.
emmevent-path-update-success	The total number of EPS Mobility Management events - Path Update successes.
emmevent-path-update-failure	The total number of EPS Mobility Management events - Path Update failures.

Bulk Statistics	Description
dcnr-dns-sgw-selection-common	The total number of times S-GW DNS selection procedures are performed with DNS RR excluding NR network capability.
dcnr-dns-sgw-selection-nr	The total number of times S-GW DNS selection procedures were performed with DNS RR including NR network capability.
dcnr-dns-sgw-selection-local	The total number of times S-GW selection procedures were performed with locally configured S-GW address, without considering the NR network capability.
dcnr-dns-pgw-selection-common	The total number of times P-GW DNS selection procedures were performed with DNS RR excluding NR network capability.
dcnr-dns-pgw-selection-nr	The total number of times P-GW DNS selection procedures were performed with DNS RR including NR network capability.
dcnr-dns-pgw-selection-local	The total number of times P-GW selection procedures were performed with locally configured P-GW address, without considering the NR network capability.
esmevent-dcnr-user-pdncon-attempt	The total number of EPS Session Management events - DCNR User PDN connections - attempted.
esmevent-dcnr-user-pdncon-success	The total number of EPS Session Management events - DCNR User PDN connections - successes.
esmevent-dcnr-user-pdncon-failure	The total number of EPS Session Management events - DCNR User PDN connections - failures.
pdn-dcnr-user-all	The current total number of DCNR user PDN connections in any state.
pdn-dcnr-user-connected	The current total number of DCNR user connected PDNs.
pdn-dcnr-user-idle	The current total number of DCNR user idle PDNs.
ps-qci-80-paging-init-events-attempted	The total number of ECM statistics related to PS paging initiation events attempted for QCI 80.
ps-qci-80-paging-init-events-success	The total number of ECM statistics related to PS paging initiation events successful for QCI 80.
ps-qci-80-paging-init-events-failures	The total number of ECM statistics related to PS paging initiation events failed for QCI 80.

Bulk Statistics	Description
ps-qci-80-paging-last-enb-success	The total number of ECM statistics related to PS paging initiation events succeeded at the last known eNodeB for QCI 80.
ps-qci-80-paging-last-tai-success	The total number of ECM statistics related to PS paging initiation events succeeded at an eNodeB in the TAI from which the UE was last heard for QCI 80.
ps-qci-80-paging-tai-list-success	The total number of ECM statistics related to PS paging initiation events succeeded at an eNodeB in all TAIs present in the TAI list assigned to the UE for QCI 80.
ps-qci-82-paging-init-events-attempted	The total number of ECM statistics related to PS paging initiation events attempted for QCI 82.
ps-qci-82-paging-init-events-success	The total number of ECM statistics related to PS paging initiation events successful for QCI 82.
ps-qci-82-paging-init-events-failures	The total number of ECM statistics related to PS paging initiation events failed for QCI 82.
ps-qci-82-paging-last-enb-success	The total number of ECM statistics related to PS paging initiation events succeeded at the last known eNodeB for QCI 82.
ps-qci-82-paging-last-tai-success	The total number of ECM statistics related to PS paging initiation events succeeded at an eNodeB in the TAI from which the UE was last heard for QCI 82.
ps-qci-82-paging-tai-list-success	The total number of ECM statistics related to PS paging initiation events succeeded at an eNodeB in all TAIs present in the TAI list assigned to the UE for QCI 82.
ps-qci-83-paging-init-events-attempted	The total number of ECM statistics related to PS paging initiation events attempted for QCI 83.
ps-qci-83-paging-init-events-success	The total number of ECM statistics related to PS paging initiation events successful for QCI 83.
ps-qci-83-paging-init-events-failures	The total number of ECM statistics related to PS paging initiation events failed for QCI 83.
ps-qci-83-paging-last-enb-success	The total number of ECM statistics related to PS paging initiation events succeeded at the last known eNodeB for QCI 83.

Bulk Statistics	Description
ps-qci-83-paging-last-tai-success	The total number of ECM statistics related to PS paging initiation events succeeded at an eNodeB in the TAI from which the UE was last heard for QCI 83.
ps-qci-83-paging-tai-list-success	The total number of ECM statistics related to PS paging initiation events succeeded at an eNodeB in all TAIs present in the TAI list assigned to the UE for QCI 83.
s1ap-recdata-secratdatausagerep	Total number of Secondary RAT Data Usage Report messages received by MME.
dcnr-s1ap-rx-srur-uectxtrelreq	Total number of reports received in UE Context Release Request.
dcnr-s1ap-rx-srur-uectxtrelcmpl	Total number of reports received in UE Context Release Complete.
dcnr-s1ap-rx-srur-erabmodind	Total number of reports received in eRAB Modification Indication.
dcnr-s1ap-rx-srur-erabrelind	Total number of reports received in eRAB Release Indication.
dcnr-s1ap-rx-srur-erabrelres	Total number of reports received in eRAB Release Response.
dcnr-s10-rx-srur-fwdrelcmpack	Total number of reports received in Forward Relocation Complete Ack.
dcnr-s11-tx-srur-csreq	Total number of reports sent in Create Session Request.
dcnr-s11-tx-srur-dsreq	Total number of reports sent in Delete Session Request.
dcnr-s11-tx-srur-dbrsp	Total number of reports sent in Delete Bearer Response.
dcnr-s11-tx-srur-rabreq	Total number of reports sent in Release Access bearer Request.
dcnr-s11-tx-srur-dbcmd	Total number of reports sent in Delete Bearer Command.
dcnr-s11-tx-srur-mbreq	Total number of reports sent in Modify Bearer Request.
dcnr-s11-tx-srur-chngnot	Total number of reports sent in Change Notification.
dcnr-s10-tx-srur-fwdrelcmpack	Total number of reports sent in Forward Relocation Complete Ack.

Bulk Statistics	Description
dcnr-s1ap-rx-srur-periodicdropped	Total number of reports dropped when Secondary RAT Data Usage Report message was received without Handover flag during Handover.
dcnr-s1ap-rx-srdur-periodic	Total number of reports received in Secondary RAT Data Usage Report message without Handover flag.
dcnr-s1ap-rx-srdur-ho	Total number of reports received in Secondary RAT Data Usage Report message with Handover flag.

TAI Schema

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

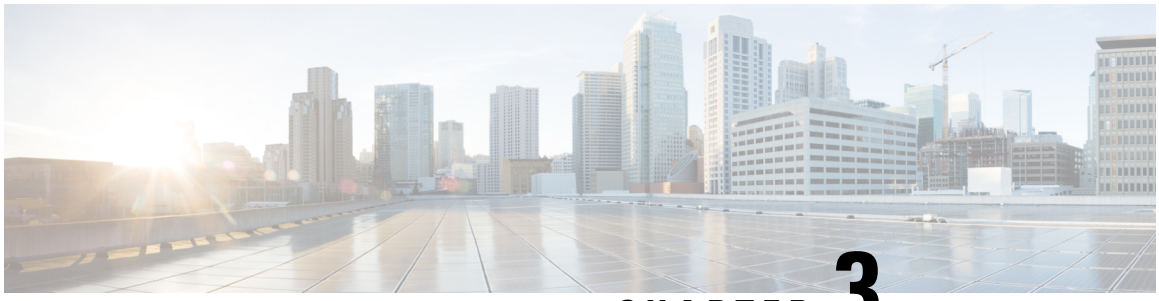
Bulk Statistics	Description
tai-esmevent-dcnr-user-pdncon-attempt	The total number of DCNR User PDN connection EPS Session Management events attempted per TAI.
tai-esmevent-dcnr-user-pdncon-success	The total number of successful DCNR User PDN connection EPS Session Management events per TAI.
tai-esmevent-dcnr-user-pdncon-failure	The total number of failed DCNR User PDN connection EPS Session Management events per TAI.



PART II

SAEGW: 5G Non Standalone Solution

- 5G NSA for SAEGW, on page 35



CHAPTER 3

5G NSA for SAEGW

- Feature Summary and Revision History, on page 35
- Feature Description, on page 37
- How It Works, on page 40
- Configuring 5G NSA for SAEGW, on page 44
- Monitoring and Troubleshooting, on page 48

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-custom1, dcca-custom7 and dcca-custom8 dictionaries additionally.	21.11
The 5G NSA solution for SAEGW supports the following functionality in this release: • 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 in this release: • 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 in this release: • 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.

- **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, dictionarie 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 and dcca-custom13 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 and standard dcca-custom13 dictionaries.

Gz (P-GW)

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

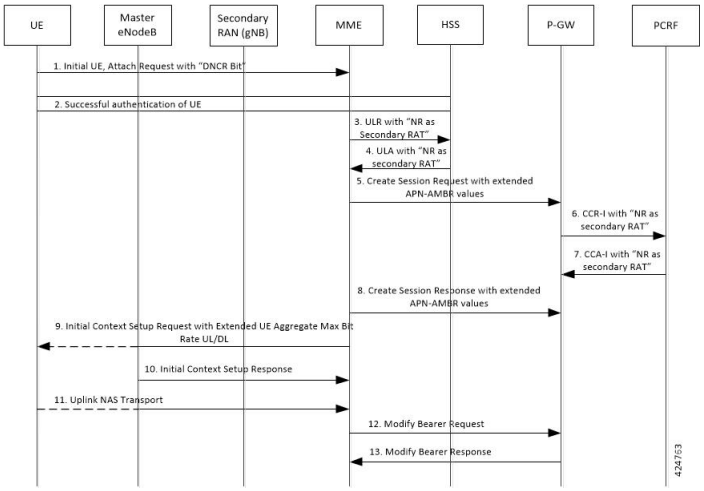
This section describes the known limitations for 5G NSA feature

- 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 and standard dcca-custom13. 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".
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".

Step	Description
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.
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 44
- Configuring Bearer Duration Statistics for URLLC QCI, on page 45
- Configuring EGTPC QCI Statistics for URLLC QCI, on page 45
- Configuring Extended Bandwidth with New Radio, on page 46
- Configuring Network-Initiated Setup/Teardown Events for URLLC QCI, on page 46
- Configuring URLLC QCI in APN Configuration, on page 47
- Configuring URLCC QCI In Charging Action, on page 47
- Configuring URLCC QCI in QCI QOS Mapping Table , on page 48

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.

Bulk Statistics	Description
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.
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.

Bulk Statistics	Description
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.
qci80-uplinkbyte-drop-mbrexcd	The total number of QCI80 uplink bytes dropped due to MBR being exceeded.
qci82-uplinkbyte-drop-mbrexcd	The total number of QCI82 uplink bytes dropped due to MBR being exceeded.
qci83-uplinkbyte-drop-mbrexcd	The total number of QCI83 uplink bytes dropped due to MBR being exceeded.
qci80-dwlinkbyte-drop-mbrexcd	The total number of QCI80 uplink bytes dropped due to MBR being exceeded.
qci82-dwlinkbyte-drop-mbrexcd	The total number of QCI82 uplink bytes dropped due to MBR being exceeded.
qci83-dwlinkbyte-drop-mbrexcd	The total number of QCI83 uplink bytes dropped due to MBR being exceeded.
qci80-rejbearer	The total number of QCI80 rejected bearers.
qci82-rejbearer	The total number of QCI82 rejected bearers.
qci83-rejbearer	The total number of QCI83 rejected bearers.
sessstat-bearrel-ded-admin-clear-qci80	The total number dedicated bearers released due to admin clear from P-GW for QCI80.
sessstat-bearrel-ded-admin-clear-qci82	The total number dedicated bearers released due to admin clear from P-GW for QCI82.
sessstat-bearrel-ded-admin-clear-qci83	The total number dedicated bearers released due to admin clear from P-GW for QCI83.

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.

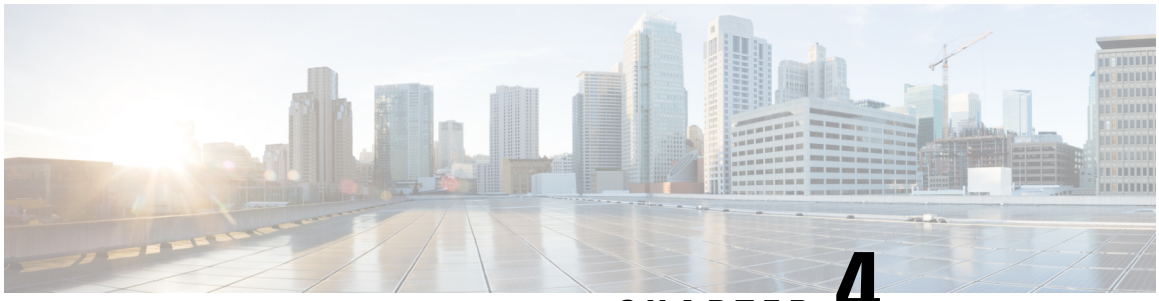
Bulk Statistics	Description
sess-bearerdur-12hr-qci83	The current number of bearer sessions with a duration of 12 hours and having a QCI of 83.
sess-bearerdur-24hr-qci80	The current number of bearer sessions with a duration of 24 hours and having a QCI of 80.
sess-bearerdur-24hr-qci82	The current number 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.



PART III

SGSN: 5G Non Standalone Solution

- 5G NSA for SGSN, on page 63



CHAPTER 4

5G NSA for SGSN

- Feature Summary and Revision History, on page 63
- Feature Description, on page 64
- How It Works, on page 65
- Configuring 5G NSA for SGSN, on page 68
- Monitoring and Troubleshooting, on page 69

Feature Summary and Revision History

Summary Data

Applicable Product(s) or Functional Area	SGSN
Applicable Platform(s)	ASR 5000
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* • *SGSN Administration Guide* • *Statistics and Counters Reference*

Revision History

Revision Details	Release
First introduced.	21.5

Feature Description

The 5G NSA solution for SGSN supports the following functionalities:

- **Dual Connectivity with New Radio (DCNR):**

  The UE supporting dual connectivity with New Radio (NR) sets the DCNR bit to "dual connectivity with NR supported" in the MS network capability IE of the "Attach Request" or "Routing Area Update Request" message.

  If the MS supports dual connectivity of E-UTRA with New Radio (NR), then the MS sets the Dual connectivity of E-UTRA with NR capability bit to "Mobile station supports dual connectivity of E-UTRA with NR" in the MS network capability IE of the "Attach Request" or "Routing Area Update Request" message.

  SGSN informs DCNR support to GGSN by setting the DCNR bit in the UP Function Selection Indication Flags IE of the Create PDP Context Request message.

  If all the conditions (UE DCNR capable, SGSN 5G-NSA support) are met, SGSN sends the GPRS Location Update Request with “nrAsSecondaryRAT” bit set in the Supported Features IE in MAP Interface Gr.

- **Dynamic Gateway Selection:**

  When DCNR capable UE attempts to register in SGSN and all DCNR validations are successful (for example, DCNR feature configuration on SGSN, HLR not sending "access-restriction" for NR, and so on) for dynamic gateway selection, SGSN uses the following service parameters received from DNS server (in NAPTR response) over other service parameters to select NR capable gateway:

  - x-3gpp-pgw:x-gn+nc-nr
  - x-3gpp-pgw:x-gp+nc-nr

  In order to select a network node with a particular network capability, the character string "+nc-<network capability>" must be appended to the "app-protocol" name where "nc" indicates "network capability", "nr" indicates "new radio", "x-gn" is "app protocol" and "x-3gpp-ggsn/pgw" are app services.

  For a DCNR capable UE, when the service parameters are received without network capability and new radio character string "+nc-nr", SGSN uses other service parameters to perform dynamic gateway selection.

  When the dynamic selection of gateway fails for any other reasons, SGSN fallbacks and selects the locally configured gateway.

- **DCNR Support to GGSN:**

  SGSN advertises the DCNR feature support by sending "NR as Secondary RAT" feature bit in "Supported Features" towards HLR, if DCNR feature is configured at SGSN and UE advertises DCNR capability in NAS.

  When DCNR capable UE attempts to register in SGSN and when all DCNR validations are successful (for example, DCNR feature configuration on SGSN, HLR not sending access-restriction for NR, and so on), the SGSN sets the UP Function Selection Indication Flags IE with DCNR flag set to 1 in the Create PDP Context Request message. This flag enables the selection of a PGW-U optimized for NR, when the UE establishes the PDN connection first through Gn-SGSN and the Gn-SGSN will pass a corresponding indication over Gn/Gp to the GGSN/P-GW.

- **Subscription Control:**

SGSN handles the reception of “NR as Secondary RAT Not Allowed” bit in Extended-Access Restriction Data IE in “Insert Subscriber Data” message from HLR.

- **Extended Bandwith:**

  SGSN handles the reception of "Extended Maximum Bit rate DL" and "Extended Maximum Bit rate UL" in AMBR IE received in the "Insert Subscriber Data" message from HLR.

- **Access Restriction Data:**

  SGSN supports Access Restriction data information in MM Context IE while receiving/sending from/to peer SGSN during ISRAU and SRNS Relocation procedures.

How It Works

Limitations

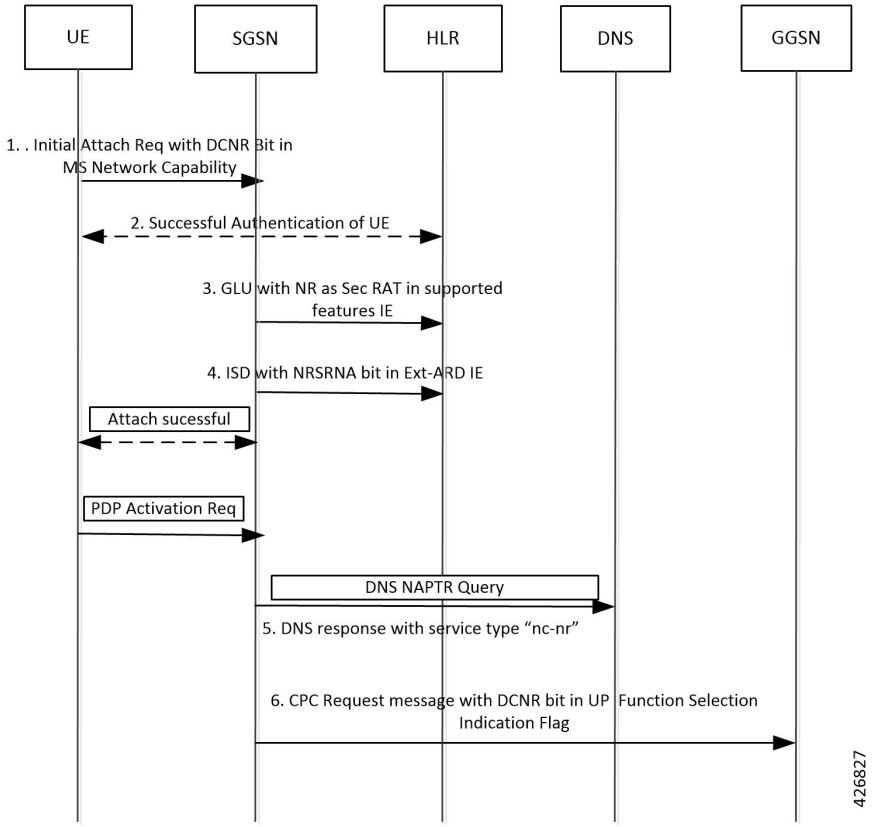
This section describes the known limitations for 5G NSA feature:

- To support EPC QOS parameters like "APN-AMBR", "E-ARP" and "UE-AMBR", “Support for EPC QoS Attributes on SGSN” feature must be enabled. Currently this feature is supported only on 3G not on 2G. So Extended Bandwidth support is only on 3G-SGSN.
- 5G-NSA enabled SGSN uses only MAP Protocol on the Gr Interface, Diameter Protocol on the s6d Interface is not supported.
- If HLR does not send "Extended-Access Restriction" data IE in Insert Subscribe Data message, SGSN assumes that NR as secondary RAT is allowed and it processes the UE request as DCNR enabled.
- When SGSN cannot find a collocated PGW/GGSN which “+nc-nr” in DNS response, SGSN falls back and triggers "A" query to get the normal GGSN information.
- SGSN with 5G-NSA feature enabled selects only the collocated PGW/GGSN in DNS response, for example “*x-3gpp-pgw x-gn+nc-nr/ x-3gpp-pgw x-gp+nc-nr.*”

Flows

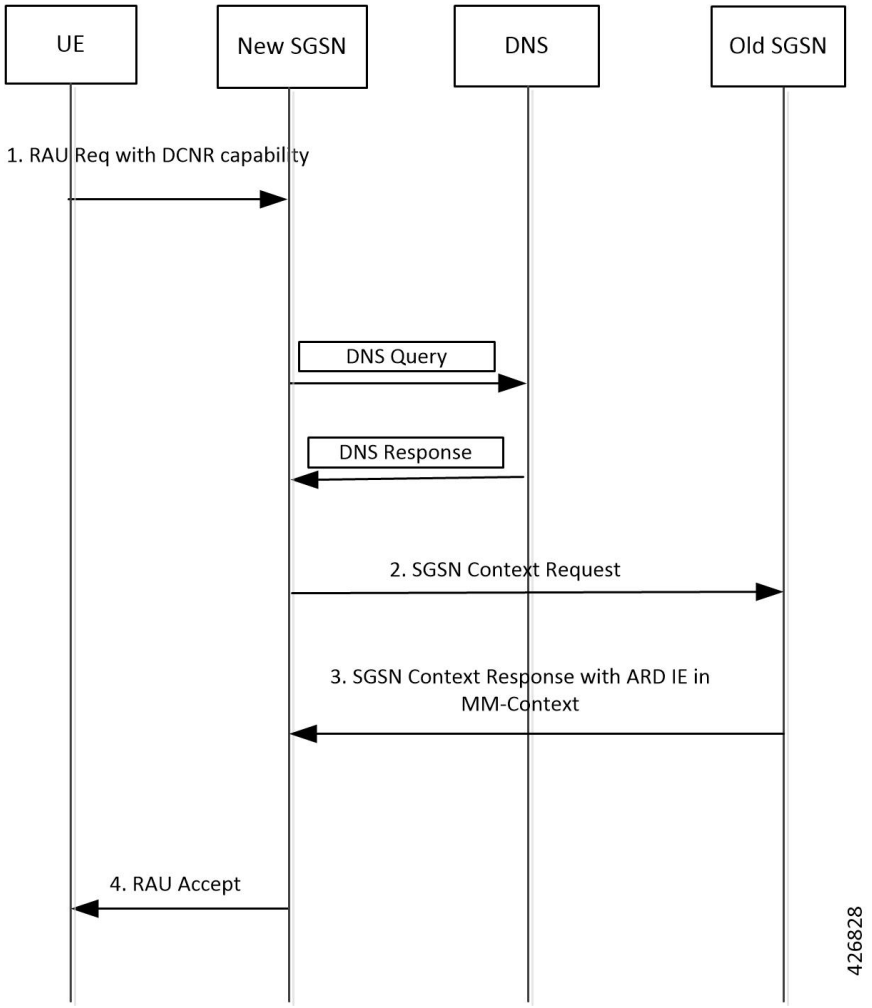
This section describes the call flow procedures related to SGSN for 5G NSA.

Figure 4: Initial Attach Request with DCNR



1. DCNR capable UE sends “DCNR bit” in NAS message “Attach Request” in “MS Network Capability” IE.
2. SGSN successfully authenticates the UE.
3. SGSN advertises the DCNR feature support by sending “NR as Secondary RAT” feature bit in “Supported Features”.
4. If HLR determines that the UE is not authorized for DCNR services, HLR sends Subscription-Data with “Extended Access-Restriction” carrying “NR as Secondary RAT Not Allowed”.
5. SGSN determines the Gateway which is NR capable from the DNS response.
6. SGSN sends Create PDP Context Request with the UP Function Selection Indication Flags coded with DCNR bit to the selected gateway.

Figure 5: Inter SGSN RAU



1. DCNR capable UE sets “DCNR bit” in NAS message “RAU Request” in “MS Network Capability” IE.
2. New-SGSN triggers SGSN Context Request message to OLD-SGSN where the UE is previously attached to get UE context.
3. OLD-SGSN fills the MM-Context with Access-Restriction Data IE with NRSRNA in SGSN Context Response message.
4. After Authentication and verifying subscription information, NEW SGSN sends RAU Accept message to UE.

Standards Compliance

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

- 3GPP 23.003 Release 15.2.0 - 3rd Generation Partnership Project; Technical Specification Group Core Network and Terminals; Numbering, addressing and identification.

- 3GPP 23.401 Release 15.2.0 - General Packet Radio Service (GPRS) enhancements for Evolved Universal Terrestrial Radio Access Network (E-UTRAN) access.
- 3GPP 29.002 Release 15.2.0 - 3rd Generation Partnership Project; Technical Specification Group Core Networkand Terminals; Mobile Application Part (MAP) specification.
- 3GPP 24.008 Release 15.1.0 - 3rd Generation Partnership Project; Technical Specification Group Core Networkand Terminals; Mobile radio interfaceLayer3 specification; Core network protocols; Stage3.
- 3GPP 29.060 Release 15.1.0 - 3rd GenerationPartnershipProject Technical Specification Group Core Network; General Packet Radio Service (GPRS); GPRS Tunnelling Protocol (GTP)acrossthe Gn and Gp interface.
- 3GPP 29.303 Release 15.1.0 - 3rd Generation Partnership Project; Technical Specification Group Core Networkand Terminals; Domain Name System Procedures; Stage3.
- 3GPP 29.303 Release 15.2.0 - 3rd Generation Partnership Project; Technical Specification Group Core Networkand Terminals; Domain Name System Procedures; Stage3.

Configuring 5G NSA for SGSN

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

Configuring 5G NSA involves:

Enabling DCNR in Call Control Profile

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

```
configure
  call-control-profile profile_name
    [ no | remove ] dcnr
    end
```

NOTES:

- **call-control-profile** *profile_name*: Creates an instance of a call control profile. *profile_name* specifies the name of the call control profile as an alphanumeric string of 1 to 64 characters.
- **no**: Disables the DCNR configuration in the call control profile.
- **remove**: Removes the DCNR configuration from the call control profile.

  Removes existing configuration related to DCNR at Call-Control-Profile level (either ‘dcnr’ or ’ no dcnr’), and behaviour depends on the configuration at sgsn-global level.

Configuring DCNR in SGSN Global Configuration

Use the following configuration to enable Dual Connectivity with New Radio (DCNR) for 5G NSA support in the SGSN Global Configuration mode.

With this configuration, SGSN processes the UEs with 5G capability and selects the gateways that are NR capable to inform the peer MME/SGSN nodes.

```
config
  sgsn-global
    [ no ] dcnr
    end
```

NOTES:

- **dcnr**: Configures DCNR to support 5G NSA.
- **no**: Disables the DCNR support.
- This feature is applicable only to Gn-SGSN.

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

show sgsn-mode

The output of this command includes the following fields:

SGSN Global Configuration:

- Dual Connectivity Support with NR capability

show subscribers sgsn-only/gprs-only full

The output of this command includes the following fields:

MS Network Capability:

- DCNR capability: Indicates MS is capable of DCNR or not.

Subscription Data:

Extended ARD:

- NR-As-Secondary-RAT-Not-Allowed - Advertises the DCNR feature support by sending “NR as Secondary RAT” feature bit towards HLR provided DCNR feature is configured at SGSN and UE advertises DCNR capability in NAS.

show gmm-sm statistics

The output of this command includes the following fields:

Session Statistics:

Attached Subscribers:

- 3G-with-DCNR-Attached - The total number of subscribers with DCNR allowed for 3G service.
- 2G-with-DCNR-Attached - The total number of subscribers with DCNR allowed for 2G service.

Activated Subscribers:

- 3G Activated with DCNR - Total number of activated subscribers with DCNR capable allowed for 2g service.
- 2G Activated with DCNR - Total number of activated subscribers with DCNR capable allowed for 2g service.

Activate PDP Contexts:

Total Actv PDP Ctx:

- 3G-Actv Pdp CTx with DCNR - The total number of active PDP contexts established with NR capable P-GW/GGSN.
- 2G-Actv Pdp Ctx with DCNR - The total number of active PDP contexts established with NR capable P-GW/GGSN.

Message Statistics:

Specific Procedures:

Attach Request:

- 3G-with-DCNR-Cap-Attached - Total number of 3G Attach Requests received from DCNR capable UEs.
- 2G-with-DCNR-Cap-Attached - Total number of 2G Attach Requests received from DCNR capable UEs.

Attach Accept:

Total-Attach-Accept:

- 3G-Attach-Accept-with-DCNR - Total number of 3G Attach Requests accepted with DCNR allowed for DCNR capable UEs.
- 2G-Attach-Accept-with-DCNR - Total number of 2G Attach Requests accepted with DCNR allowed for DCNR capable UEs.

Attach Complete:

- 3G-Att-Comp-with-DCNR-Cap - Total number of attach complete received for DCNR allowed UEs for 3G service.
- 2G-Att-Comp-with-DCNR-Cap - Total number of attach complete received for DCNR allowed UEs for 2G service.

Attach Reject:

- 3G-Attach-Reject-with-DCNR - Total number of 3G Attach Requests Rejected for DCNR capable UEs.
- 2G-Attach-Reject-with-DCNR - Total number of 2G Attach Requests Rejected for DCNR capable UEs.

Routing Area Update Request:

- 3G-RAU-Req-with-DCNR-Cap - Total number of 3G RAU Requests received from DCNR capable UEs.
- 2G-RAU-Req-with-DCNR-Cap - Total number of 2G RAU Requests received from DCNR capable UEs.

Routing Area Update Accept:

- 3G-RAU-Acc-with-DCNR-Cap - Total number of 3G RAU Requests accepted with DCNR allowed for DCNR capable UEs.
- 2G-RAU-Acc-with-DCNR-Cap - Total number of 2G RAU Requests accepted with DCNR allowed for DCNR capable UEs.

Routing Area Update Complete:

- 3G-RAU-Comp-with-DCNR-Cap - Total number of 3G RAU complete received for DCNR allowed UEs.
- 2G-RAU-Comp-with-DCNR-Cap - Total number of 2G RAU complete received for DCNR allowed UEs.

Routing Area Update Reject:

- 3G-RAU-Rej-with-DCNR-Cap - Total number of 3G RAU Requests Rejected for DCNR capable UEs.
- 2G-RAU-Rej-with-DCNR-Cap - Total number of 2G RAU Requests Rejected for DCNR capable UEs.

Session Management Messages Statistics:

- 3G-Actv-Request-with-DCNR-Capability - Total number of 3G Activation Requests received for DCNR allowed UEs.
- 2G-Actv-Request-with-DCNR-Capability - Total number of 2G Activation Requests received for DCNR allowed UEs.

Primary-Actv-Request:

- 3G-Primary-Actv-Request-with-DCNR-Capability - Total number of 3G primary Activation Requests received for DCNR allowed UEs.
- 2G-Primary-Actv-Request-with-DCNR-Capability - Total number of 2G primary Activation Requests received for DCNR allowed UEs

Activate Context Accept:

- 3G-Acvt-Accept-with-DCNR - Total number of 3G Primary Activation Accepted with PDP context established with NR capable P-GW/GGSN.
- 2G-Acvt-Accept-with-DCNR - Total number of 2G Primary Activation Accepted with PDP context established with NR capable P-GW/GGSN.

Activate Context Reject:

- 3G-Acvt-Reject-with-DCNR - Total number of 3G Primary Activation Rejected for DCNR allowed UEs
- 2G-Acvt-Reject-with-DCNR - Total number of 2G Primary Activation Rejected for DCNR. allowed UEs.

SRNS statistics:

Attempted

Inter-SRNS UE involved Inter-SRNS UE not involved (new SGSN with MME) -

- Inter-SRNS NRSRNA UE involved Inter-SRNS NRSRNA UE not involved (old SGSN) - Inter-SGSN SRNS from the local SGSN to the peer SGSN is attempted with relocation type 'UE not involved' and DCNR allowed.
- Inter-SRNS NRSRNA UE involved Inter-SRNS NRSRNA UE not involved (new SGSN) - Inter-SGSN SRNS to the local SGSN from the peer SGSN is attempted with relocation type 'UE not involved and DCNR allowed

Inter-SRNS UE not involved (new SGSN with MME):

- Inter-SRNS NRSRNA UE not involved (old SGSN) - Inter-SGSN SRNS from the local SGSN to the peer SGSN is attempted with relocation type 'UE not involved' and DCNR allowed
- Inter-SRNS NRSRNA UE not involved (new SGSN) – Inter-SGSN SRNS from the local SGSN to the peer SGSN is attempted with relocation type 'UE not involved' and DCNR allowed.

Sucessful:

Total SRNS:

- Intra-SGSN SRNS (new SGSN with MME) - Intra SGSN from local SGSN to peer MME is attempted with relocation type UE not Involved /Involved and DCNR allowed.
- Inter-SRNS NRSRNA UE involved (old SGSN) - Inter-SGSN SRNS to the peer SGSN from the local SGSN with dcnr is attempted with relocation type 'UE involved' and DCNR allowed.
- Inter-SRNS NRSRNA UE involved (new SGSN) - Inter-SGSN SRNS to the peer SGSN from the local SGSN with DCNR is attempted with relocation type 'UE involved’ and DCNR allowed.

Bulk Statistics

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

Bulk Statistics	Description
2G-attached-with-dcnr	The total number of subscribers with DCNR allowed for 2G service.
2G-attached-pdp-with-dcnr	the total number of subscribers attached having PDF established with NR capable P-GW/GGSN.
2G-activated-pdp-with-dcnr	The total number of active PDP contexts established with NR capable P-GW/GGSN.
2G-attach-req-with-dcnr	The total number of 2G Attach Requests received from DCNR capable UEs.
2G-attach-accept-with-dcnr	The total number of 2G Attach Requests accepted with DCNR allowed for DCNR capable UEs.
2G-attach-reject-with-dcnr	The total number of 2G Attach Requests Rejected for DCNR capable UEs.

Bulk Statistics	Description
2G-rau-with-dcnr	The total number of 2G RAU Requests received from DCNR capable UEs.
2G-rau-accept-with-dcnr	The total number of 2G RAU Requests accepted with DCNR allowed for DCNR capable UEs.
2G-rau-complete-with-dcnr	The total number of 2G RAU complete received for DCNR allowed UEs.
2G-rau-reject-with-dcnr	The total number of 2G RAU Requests Rejected for DCNR capable UEs.
2G-total-active-with-dcnr	The total number of 2G Activation Requests received for DCNR allowed UEs.
2G-total-primary-active-with-dcnr	The total number of 2G primary Activation Requests received for DCNR allowed UEs.
2G-total-primary-active-accept-with-dcnr	The total number of 2G Primary Activation Accepted with PDP context established with NR capable P-GW/GGSN.
2G-total-primary-active-reject-with-dcnr	The total number of 2G Primary Activation Rejected for DCNR.allowed UEs.
3G-attach-complete-with-dcnr	The total number of attach complete received for DCNR allowed UEs.
2G-attach-complete-with-dcnr	The total number of attach complete received for DCNR allowed UEs.
3G-attached-with-dcnr	The total number of subscribers with DCNR allowed for 3G service.
3G-attached-pdp-with-dcnr	The total number of subscribers attached having pdp established with NR capable P-GW/GGSN.
3G-activated-pdp-with-dcnr	The total number of active PDP contexts established with NR capable P-GW/GGSN.
3G-attach-req-with-dcnr	The total number of 3G Attach Requests received from DCNR capable UEs.
3G-attach-accept-with-dcnr	The total number of 3G Attach Requests accepted with DCNR allowed for DCNR capable UEs.
3G-attach-reject-with-dcnr	The total number of 3G Attach Requests Rejected for DCNR capable UEs.
3G-rau-with-dcnr	The total number of 3G RAU Requests received from DCNR capable UEs.

Bulk Statistics	Description
3G-rau-accept-with-dcnr	The total number of 3G RAU Requests accepted with DCNR allowed for DCNR capable UEs.
3G-rau-complete-with-dcnr	The total number of 3G RAU complete received for DCNR allowed UEs.
3G-rau-reject-with-dcnr	The total number of 3G RAU Requests Rejected for DCNR capable UEs.
3G-total-active-with-dcnr	The total number of 3G Activation Requests received for DCNR allowed UEs.
3G-total-primary-active-with-dcnr	The total number of 3G primary Activation Requests received for DCNR allowed UEs.
3G-total-primary-active-accept-with-dcnr	The total number of 3G Primary Activation Accepted with PDP context established with NR capable P-GW/GGSN.
3G-total-primary-active-reject-with-dcnr	The total number of 3G Primary Activation Rejected for DCNR.allowed UEs.
Important It is an assumed that all the UEs are DCNR capable for the below mentioned counters.	
att_old_sgsn_inter_srns_dcnr_ue_involved	Inter-SGSN is attempted with relocation type 'UE involved' and DCNR allowed.
att_old_sgsn_inter_srns_dcnr_ue_not_involved	Inter-SGSN SRNS from the local SGSN to the peer SGSN is attempted with relocation type 'UE not involved' and DCNR allowed.
att_new_sgsn_inter_srns_dcnr_ue_involved	Inter-SGSN SRNS to the local SGSN from the peer SGSN is attempted with relocation type 'UE involved' and DCNR allowed.
att_new_sgsn_inter_srns_dcnr_ue_not_involved	Inter-SGSN SRNS to the local SGSN from the peer SGSN is attempted with relocation type 'UE not involved and DCNR allowed.
suc_old_sgsn_inter_srns_dcnr_ue_involved	Inter-SGSN SRNS to the peer SGSN from the local SGSN with DCNR is attempted with relocation type 'UE involved' and DCNR allowed.
suc_old_sgsn_inter_srns_dcnr_ue_not_involved	Inter-SGSN SRNS from the local SGSN to the peer SGSN is attempted with relocation type 'UE not involved' and DCNR allowed.
suc_new_sgsn_inter_srns_dcnr_ue_involved	Inter-SGSN SRNS to the peer SGSN from the local SGSN with DCNR is attempted with relocation type 'UE involved’ and DCNR allowed.

Bulk Statistics	Description
suc_new_sgsn_inter_srns_dcnr_ue_not_involved	Inter-SGSN SRNS from the local SGSN to the peer SGSN is attempted with relocation type 'UE not involved' and DCNR allowed.