# Release Change Reference, StarOS Release 21.16/Ultra Services Platform Release 6.10

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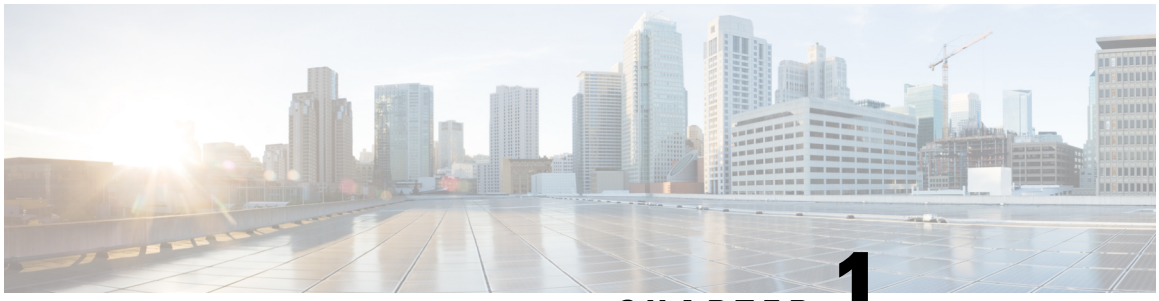


CHAPTER 1

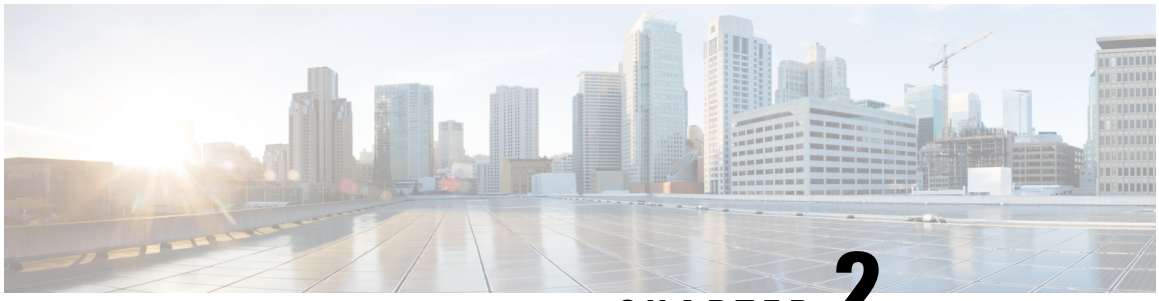
# Release 21.16/6.10 Features and Changes Quick Reference



## Release 21.16/6.10 Features and Changes

| Features / Behavior Changes | Applicable Product(s) / Functional Area | Release Introduced / Modified |
|---|---|---|
| 5G NSA for MME, on page 11 | MME | 21.16 |
| Dedicated Core Networks on MME, on page 39 | MME | 21.16 |
| Dedicated Bearer Establishment without PCRF , on page 73 | P-GW | 21.16.9 |
| Default APN Selection Based on Context ID, on page 77 | SGSN | 21.16 |
| Deprecation of Manual Scaling, on page 95 | UAS | 6.0 |
| Discontinuation of ORBEM Configuration Support, on page 97 | All | 21.16 |
| Enhanced Whitelisting in MME, on page 79 | MME | 21.16 |
| Enhanced Whitelisting in SGSN, on page 87 | SGSN | 21.16 |
| Handling Call Drop in Smart Watch and Multi-SIM Devices, on page 99 | MME | 21.16 |
| Handling Core Dump, on page 103 | All | 21.16.5 |
| Implicit Update Location to HSS, on page 107 | MME | 21.16.6 |
| MEC Location Management, on page 111 | MME | 21.16 |
| MO Voice Call and MO Exception Data Support, on page 121 | MME | 21.16 |

| Features / Behavior Changes | Applicable Product(s) / Functional Area | Release Introduced / Modified |
|---|---|---|
| Merging of afrecordinfo under Custom24 Dictionary, on page 125 | GTPP | 21.16.7 |
| Password Strengthening Requirements for UAS Components, on page 129 | UAS | 6.10 |
| Skip APN Redirection for IMS APN, on page 131 | MME | 21.16 |
| UE IP and UDP Source Port in CDR and Gy CCRU for Dedicated Bearer of WiFi Calls, on page 135 | P-GW | 21.16.9 |
| Upgrade and Migration of Open SSH to Cisco SSH, on page 137 | All | 21.16 |



CHAPTER 2

# Feature Defaults Quick Reference

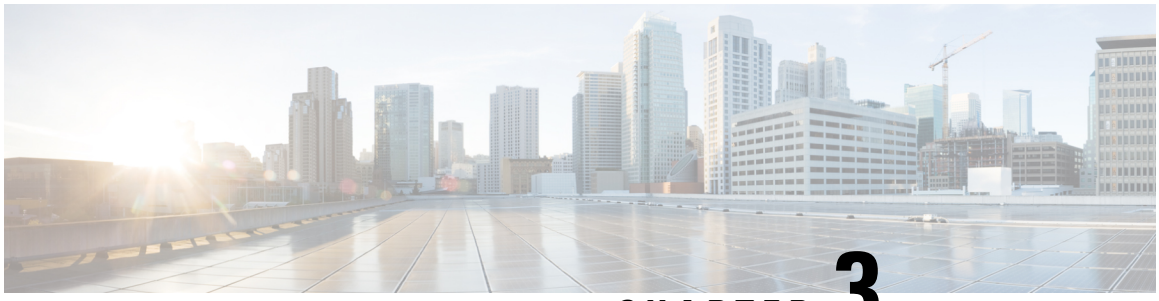


## Feature Defaults

The following table indicates what features are enabled or disabled by default.

| Feature | Default |
|---|---|
| 5G NSA for MME | Disabled - Configuration Required |
| Dedicated Core Networks on MME | Disabled - Configuration Required |
| Dedicated Bearer Establishment without PCRF | Disabled - Configuration Required |
| Default APN Selection Based on Context ID | Disabled - Configuration Required |
| Deprecation of Manual Scaling | Disabled - Configuration Required |
| Discontinuation of ORBEM Configuration Support | Enabled - Always-on |
| Enhanced Whitelisting in MME | Disabled - Configuration Required |
| Enhanced Whitelisting in SGSN | Disabled - Configuration Required |
| Handling Call Drop in Smart Watch and Multi-SIM Devices | Disabled - Configuration Required |
| Handling Core Dump | Enabled - Always-on |
| Implicit Update Location to HSS | Disabled-Configuration Required |
| MEC Location Management | Enabled - Always-on |
| MO Voice Call and MO Exception Data Support | Disabled - Configuration Required |
| Merging of afrecordinfo under Custom24 Dictionary | Disabled - Configuration Required |
| Password Strengthening Requirements for UAS Components | Enabled - Always-on |
| Skip APN Redirection for IMS APN | Enabled - Always-on |

| Feature | Default |
|---|---|
| UE IP and UDP Source Port in CDR and Gy CCRU for Dedicated Bearer of WiFi Calls | Disabled - Configuration Required |
| Upgrade and Migration of Open SSH to Cisco SSH | Enabled - Always-on |



CHAPTER 3

# Bulk Statistics Changes Quick Reference

This chapter identifies bulk statistics changes added to, modified for, or deprecated from the StarOS 21.16 software release.

**Important** For more information regarding bulk statistics identified in this section, see the latest version of the *BulkstatStatistics_document.xls* spreadsheet supplied with the release.

Bulk statistics changes for 21.16 include:



# New Bulk Statistics

This section identifies new bulk statistics and new bulk statistic schemas introduced in release 21.16.

### MME Schema

The following bulk statistics are added in the MME schema in support of the Secondary RAT Usage Reporting feature.

| Bulk Statistics | Description |
|---|---|
| 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. |

| Bulk Statistics | Description |
|---|---|
| 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 Acknowledgement. |
| 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 Acknowledgement. |
| 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. |

### HSS Schema

The following bulk statistics are included in the HSS peer service statistics to track overall statistics

***Table 1: Bulk Statistics Counters in the HSS Peer Service Statistics***

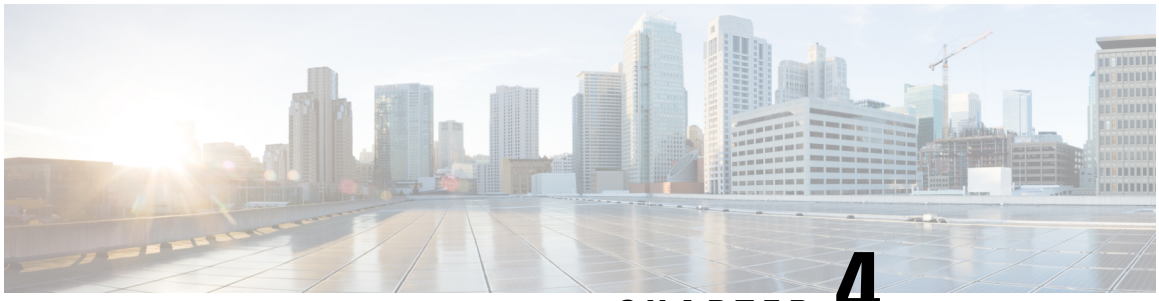
| Counters | Description |
|---|---|
| UL Request | The total number of Update Location Request messages containing the result code "Other Errors"received by the HSS peer service from the HSS. |
| UL Answer | The total number of Update Location Answer messages containing the result code "Other Errors"received by the HSS peer service from the HSS. |

# Modified Bulk Statistics

None in this release.

# Deprecated Bulk Statistics

None in this release.



CHAPTER 4

# SNMP MIB Changes in StarOS 21.16 and USP 6.10

This chapter identifies SNMP MIB objects, alarms and conformance statements added to, modified for, or deprecated from the StarOS 21.16 and Ultra Services Platform (USP) 6.10 software releases.



# SNMP MIB Object Changes for 21.16

This section provides information on SNMP MIB alarm changes in release 21.16.

**Important** For more information regarding SNMP MIB alarms in this section, see the *SNMP MIB Reference* for this release.

### New SNMP MIB Object

This section identifies new SNMP MIB alarms available in release 21.16.

The following alarms are new in this release:

- starMonSubProcessInitFailure
- starMonSubPcapWriteFailure
- starMonSubProcessConnectFailure
- starBulkStatisticsTaiTimeOut
- starUPlaneSelfOverload
- starUPlaneSelfOverloadClear

### Modified SNMP MIB Object

None in this release.

### Deprecated SNMP MIB Object

None in this release.

# SNMP MIB Alarm Changes for 21.16

There are no new, modified, or deprecated SNMP MIB alrm changes in this release.

# SNMP MIB Conformance Changes for 21.16

This section provides information on SNMP MIB alarm changes in release 21.16.

**Important** For more information regarding SNMP MIB alarms in this section, see the *SNMP MIB Reference* for this release.

### New SNMP MIB Conformance

None in the release.

### Modified SNMP MIB Conformance

None in the release.

### Deprecated SNMP MIB Conformance

None in the release.

# SNMP MIB Object Changes for 6.10

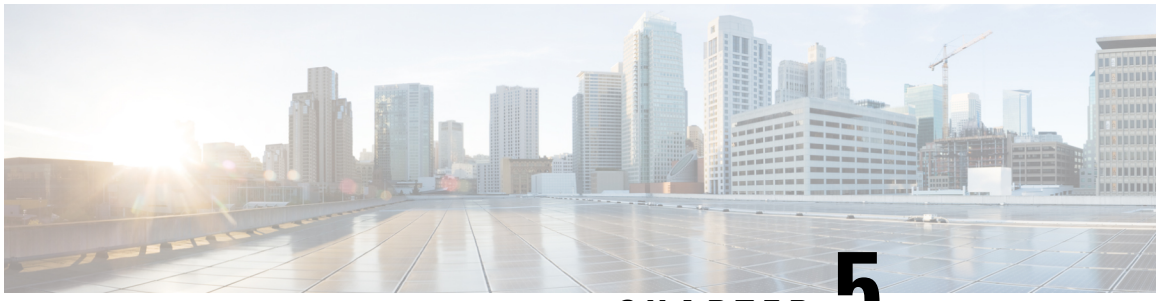
There are no new, modified, or deprecated SNMP MIB object changes in this release.

# SNMP MIB Alarm Changes for 6.10

There are no new, modified, or deprecated SNMP MIB alarm changes in this release.

# SNMP MIB Conformance Changes for 6.10

There are no new, modified, or deprecated SNMP MIB conformance changes in this release.



CHAPTER 5

# 5G NSA for MME



## Feature Summary and Revision History

### Summary Data

| | |
|---|---|
| Applicable Product(s) or Functional Area | MME |
| Applicable Platform(s) | • ASR 5000<br>• ASR 5500<br>• VPC-DI<br>• VPC-SI |
| Feature Default | Disabled - Configuration Required |
| Related Changes in This Release | Not applicable |
| Related Documentation | • *5G Non Standalone Solution Guide*<br>• *AAA Interface Administration and Reference*<br>• *Command Line Interface Reference*<br>• *MME Administration Guide*<br>• *Statistics and Counters Reference* |

### Revision History

| Revision Details | Release |
|---|---|

| | |
|---|---|
| The 5G NSA supports Secondary RAT Usage Reporting.<br>**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:<br>• Ultra-Low Latency QCI bearers handover from MME to Gn-SGSN<br>• 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:<br>• DCNR capability exchange with peer SGSN in MM context over S3 interface<br>• MME support of statistics for DCNR PDNs<br>• NR security algorithms for DCNR capable UEs to support 5G security<br>**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

Cisco 5G Non Standalone (NSA) solution leverages the existing LTE radio access and core network (EPC) as an anchor for mobility management and coverage. This solution enables operators using the Cisco EPC Packet Core to launch 5G services in shorter time and leverage existing infrastructure. Thus, NSA provides a seamless option to deploy 5G services with very less disruption in the network.

### Overview

5G is the next generation of 3GPP technology, after 4G/LTE, defined for wireless mobile data communication. The 5G standards are introduced in 3GPP Release 15 to cater to the needs of 5G networks.

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

- 5G Non Standalone (NSA): The existing LTE radio access and core network (EPC) is leveraged to anchor the 5G NR using the Dual Connectivity feature. 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).

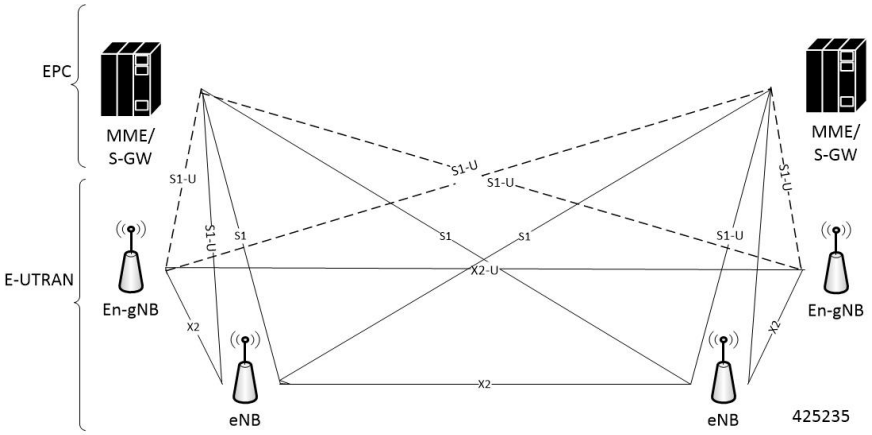
  Network Slicing, CUPS, Virtualization, Multi-Gbps support, Ultra low latency, and other such aspects will be natively built into the 5G SA Packet Core architecture.

### 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 1: 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.

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.

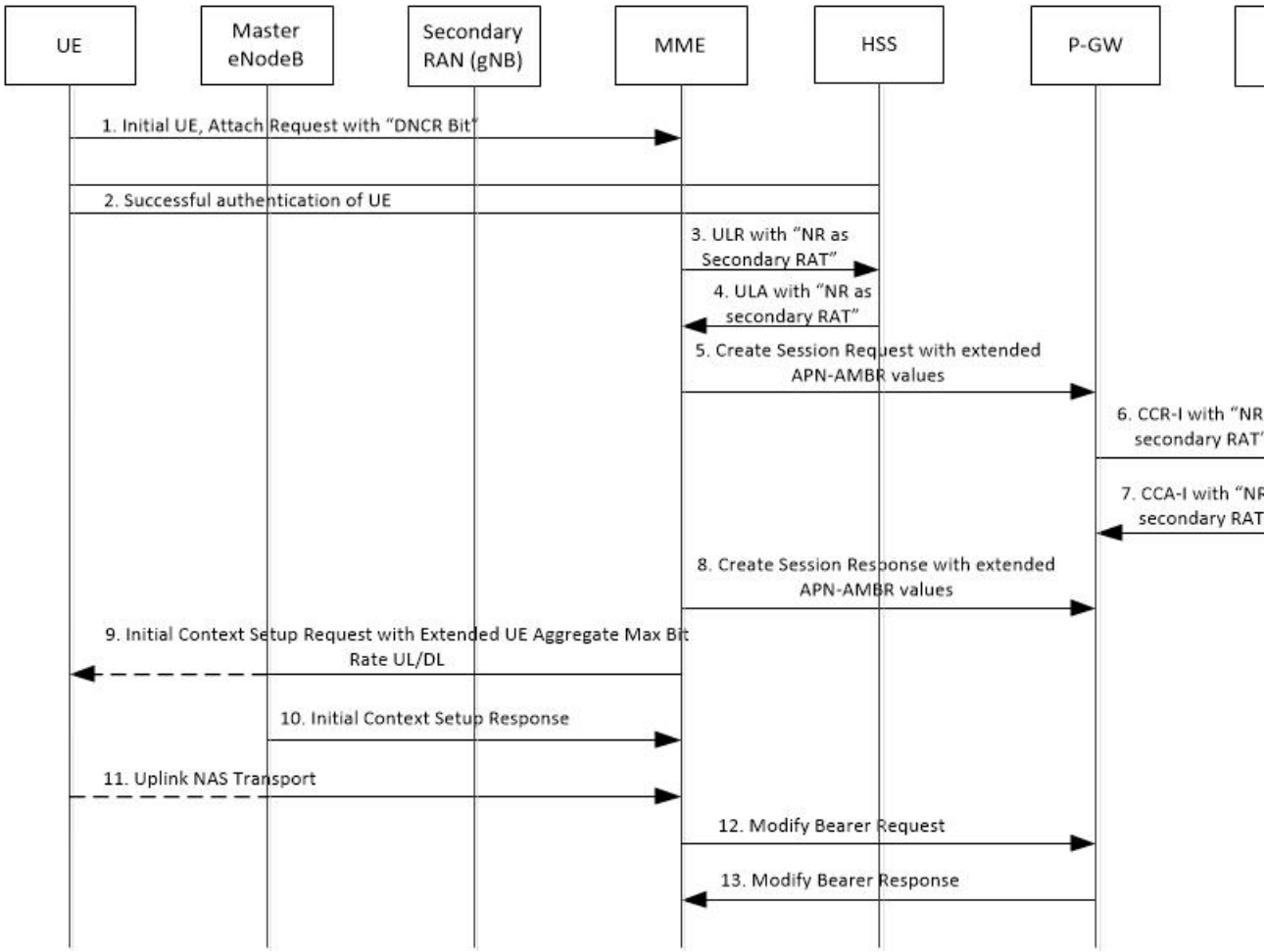
# Flows

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.<br>DCNR must be enabled at MME service or call control profile depending upon the operator requirement. |
| 2 | MME successfully authenticates the UE. |

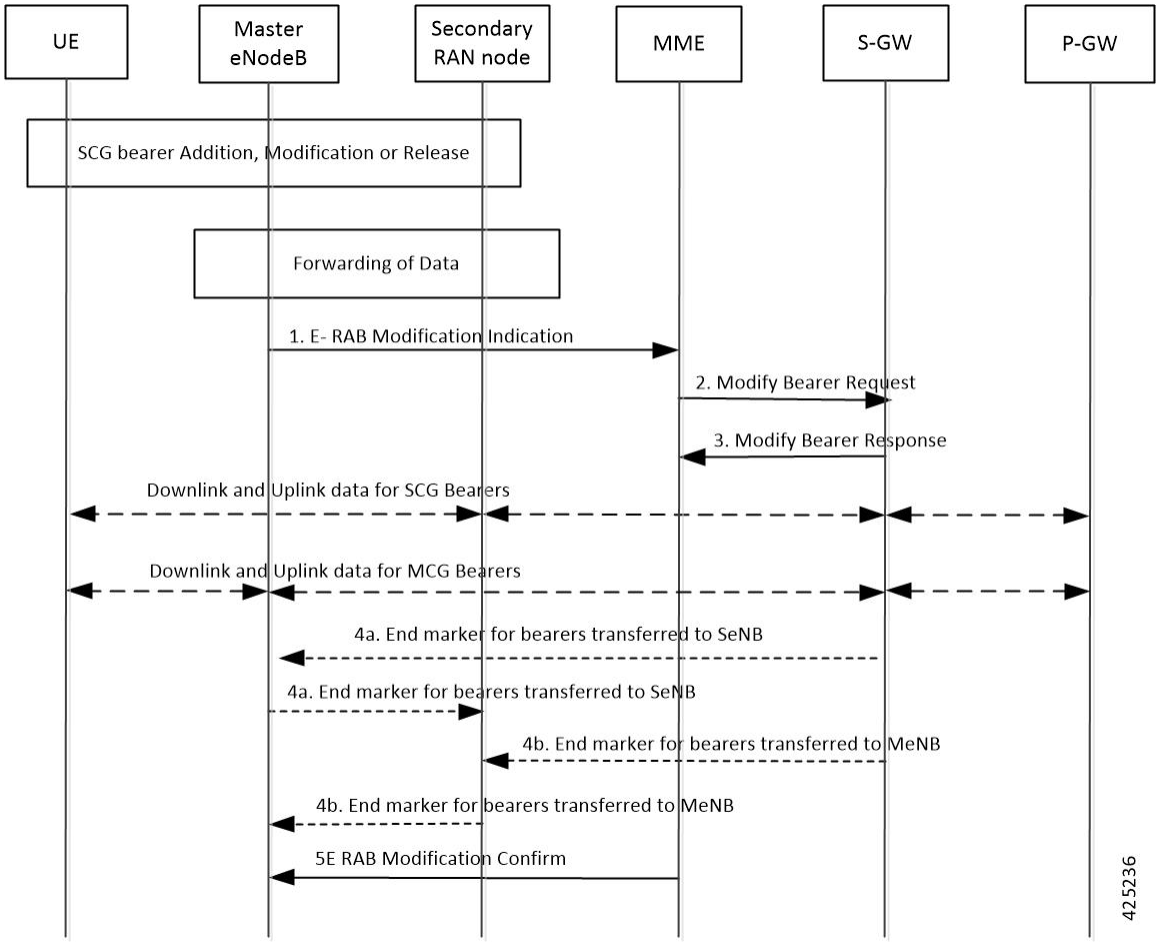
| Step | Description |
|---|---|
| 3 | As part of the authorization process, while sending ULR to HSS, MME advertises the DCNR support by sending the "NR as Secondary RAT" feature bit in "Feature-List-ID-2". |
| 4 | HSS sends ULA by advertising the DCNR by sending "NR as Secondary RAT" feature bit in "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".<br>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. |
| 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. |

| Step | Description |
|---|---|
| 9 | MME computes the UE-AMBR values and sends the extended UE-AMBR values in new IEs "Extended UE Aggregate Maximum Bit Rate Downlink" and "Extended UE Aggregate Maximum Bit Rate Uplink" by setting the legacy "UE AMBR Uplink" and "UE AMBR Downlink" values to the maximum allowed value 10000000000 bps (10 Gbps) in the "Initial Context Setup Request" message.<br><br>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.<br><br>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.<br><br>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". |
| 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 2: 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. |

| Step | Description |
|---|---|
| 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 22
- Enabling DCNR in Call Control Profile, on page 23
- Configuring APN AMBR Values, on page 23
- Configuring Dedicated Bearer MBR Values, on page 26
- Configuring UE AMBR Values , on page 27

## 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. |
| 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. |

| Bulk Statistics | Description |
|---|---|
| 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. |
| 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. |

| Bulk Statistics | Description |
|---|---|
| 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. |
| 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. |

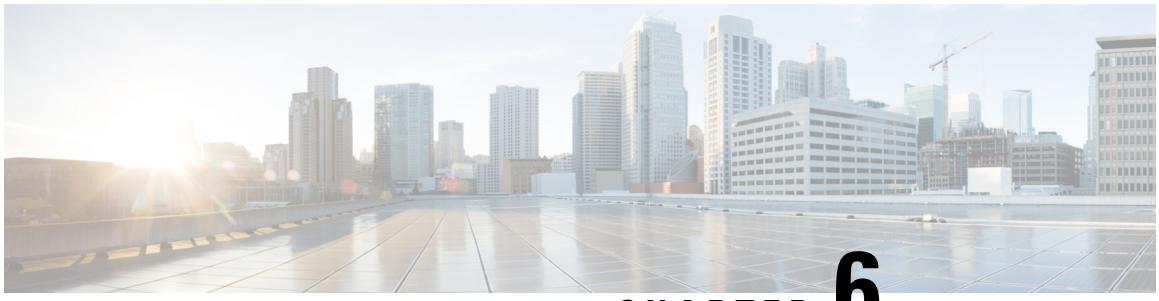
| Bulk Statistics | Description |
|---|---|
| ps-qci-80-paging-tai-list-success | The total number of ECM statistics related to PS paging initiation events succeeded at an eNodeB in all TAIs present in the TAI list assigned to the UE for QCI 80. |
| ps-qci-82-paging-init-events-attempted | The total 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. |
| 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. |

| Bulk Statistics | Description |
|---|---|
| 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. |
| 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. |



CHAPTER 6

# Dedicated Core Networks on MME

This chapter describes the Dedicated Core Networks feature in the following sections:



## Feature Summary and Revision History

### Summary Data

| | |
|---|---|
| Applicable Product(s) or Functional Area | MME |
| Applicable Platform(s) | • ASR 5500<br>• VPC-DI<br>• VPC-SI |
| Feature Default | Enabled - Configuration Required |
| Related Changes in This Release | Not Applicable |
| Related Documentation | • *Command Line Interface Reference*<br>• *MME Administration Guide*<br>• *Statistics and Counters Reference* |

### Revision History

| Revision Details | Release |
|---|---|
| In release 21.16, the DECOR feature is enhanced to support UE Usage type updated by ULA. | 21.16 |

| Revision Details | Release |
|---|---|
| In release 21.14, the DECOR feature is enhanced to support:<br>• P-GW Selection based on ULAs UE Usage Type<br>• Usage Type Deletion by DSR flag support added. | 21.14 |
| In release 21.8, the DECOR feature is enhanced to support:<br>• Association of DCNs to a specific RAT Type under call-control-profile<br>• Association of multiple DCN profiles (to designate dedicated or default core network) under call-control-profile<br>• DNS selection of S-GW / P-GW / MME / S4-SGSN/ MMEGI lookup for specified UE Usage Type or DCN-ID<br>• DIAMETER_AUTHENTICATION_DATA_UNAVAILABLE result code for the S6a (HSS) interface<br>• When UE moves from a service area where DCN is not used to another area where DCN is supported, then MME does not receive the UE-Usage-Type from peer. In this case, MME will do an explicit AIR towards HSS for UE-Usage lookup. | 21.8 |
| The enhancements to the DECOR feature in release 21.6 are fully qualified. | 21.7 |
| The enhancements to the DECOR feature in release 21.6 are not fully qualified and are available only for testing purposes.<br>In release 21.6, the DECOR feature is enhanced to support:<br>• DNS based MMEGI selection<br>• DCN-ID IE in Attach/TAU Accept and GUTI Reallocation Command message towards UE<br>• DCN-ID IE in INITIAL UE MESSAGE from eNodeB<br>• HSS initiated DCN reselection<br>• MME initiated DCN reselection<br>• Network sharing with same MMEGI for different PLMNs<br>• Network sharing with different MMEGIs for different PLMNs<br>• Served DCNs Items IE in S1 Setup Response and MME Configuration Update messages towards eNodeBs | 21.6 |
| First introduced. | 21.4 |

# Feature Description

The Dedicated Core (DECOR) Networks feature allows an operator to deploy one or more dedicated core network within a PLMN, with each core network dedicated for a specific type of subscriber. The specific dedicated core network that serves a UE is selected based on subscription information and operator configuration, without requiring the UEs to be modified. This feature aims to route and maintain UEs in their respective DCNs.

The DECOR feature can either provide specific characteristics and functions to the UE or subscriber, or isolate them to a UE or subscriber. For example, Machine-to-Machine (M2M) subscribers, subscribers belonging to a specific enterprise or separate administrative domain, and so on.

### UE Usage type Update by ULA command

Dedicated Core selection for UE usage type can be delivered either by Subscription Data of ULA or in AIA according to 3GPP TS 23.401. MME processes the UE Usage Type only in AIA, with release 21.16 re-routing the NAS message by UE Usage Type from ULA is supported. This feature is CLI controlled and disabled by default.

# Overview

Dedicated Core Networks (DCN) enable operators to deploy multiple core networks consisting of one or more MME/SGSN and optionally one or more S-GW/P-GW/PCRF.

If a network deploys a DCN selection based on both LAPI indication and subscription information (MME/SGSN), then DCN selection based on the subscription information provided by MME/SGSN overrides the selection based on the Low Access Priority Indication (LAPI) by RAN.

A new optional subscription information parameter, **UE Usage Type**, stored in the HSS, is used by the serving network to select the DCNs that must serve the UE. The operator can configure DCNs and its serving UE Usage Type as required. Multiple UE Usage Types can be served by the same DCN. The HSS provides the UE Usage Type value in the subscription information of the UE to the MME/SGSN/MSC. The serving network chooses the DCN based on the operator configured (UE Usage Type to DCN) mapping, other locally configured operator's policies, and the UE related context information available at the serving network.

**Note** One UE subscription can be associated only with a single UE Usage Type, which describes its characteristics and functions.

# External Interfaces

The following components are enhanced to support the DECOR feature on the MME:

## DNS

### S-GW or P-GW Selection

MME performs S-GW or P-GW selection from DCNs serving UE Usage Type or DCN-ID, based on the configuration in the decor profile.

The existing service parameters of the SNAPTR records are enhanced by appending the character string "+ue-<ue usage type>" or "+ue-<dcn-id>" to the "app-protocol" name identifying the UE usage type(s) or DCN-ID for which the record applies.

For example: S-GW service parameter — x-3gpp-sgw:x-s11+ue-1.10.20 will represent the S-GW which is part of a DCN serving UE usage types or DCN-ID 1, 10, and 20.

For example: P-GW service parameter — x-3gpp-pgw:x-s5-gtp+ue-1.10.20:x-s8-gtp+ue-1.10.20 will represent the P-GW which is part of a DCN serving UE usage types or DCN-ID 1, 10, and 20.

### MMEGI Retrieval

MME uses local configuration for MMEGI corresponding to the UE Usage Type and DNS SNAPTR procedures.

The configuration options for static (local) or DNS or both are provided under decor-profile. If both options are enabled, then DNS is given preference. When DNS lookup fails, static (local) value is used as fallback.

To retrieve the MMEGI identifying the DCN serving a particular UE usage type, the SNAPTR procedure uses the Application-Unique String set to the TAI FQDN. The existing service parameters are enhanced by appending the character string "+ue-<ue usage type>" or "+ue-<dcn-id>" to the "app-protocol" name identifying the UE usage type for which the discovery and selection procedures are performed.

For example: MME will discover the MMEGI for a particular UE usage type or DCN-ID by using the "Service Parameters" of "x-3gpp-mme:x-s10+ue-<ue usage type>" or "x-3gpp-mme:x-s10+ue-<dcn-id>". The service parameters are enhanced to identify the UE usage type(s) for which the record applies. The MMEGI will be provisioned in the host name of the records and MMEGI will be retrieved from the host name.

### MME or S4-SGSN Selection

To perform MME/S4-SGSN selection from the same DCN during handovers, the existing service parameters are enhanced by appending the character string "+ue-<ue usage type>" or "+ue-<dcn-id>" to the "app-protocol" name identifying the UE usage type.

If the MME fails to find a candidate list for the specific UE Usage Type, it falls back to the legacy DNS selection procedure.

For example:

For an MME to find a candidate set of target MMEs — "x-3gpp-mme:x-s10+ue-<ue usage type>" or "x-3gpp-mme:x-s10+ue-<dcn-id>"

For an MME to find a candidate set of target SGSNs — "x-3gpp-sgsn:x-s3+ue-<ue usage type>" or "x-3gpp-sgsn:x-s3+ue-<dcn-id>"

**Note** I-RAT handovers between MME and Gn-SGSN is not supported.

## S6a (HSS) Interface

To request the UE Usage Type from HSS, MME sets the "Send UE Usage Type" flag in the AIR-Flags AVP, in the AIR command.

The AIR-Flag is set only if the **decor s6a ue-usage-type** CLI command is enabled under MME-service or Call-Control-Profile.

HSS may include the UE-Usage-Type AVP in the AIA response command in the case of DIAMETER_SUCCESS or DIAMETER_AUTHENTICATION_DATA_UNAVAILABLE result code. MME will store the UE Usage Type in the UE context for both the result codes.

## GTPv2 (MME or S4-SGSN)

MME supports the UE Usage Type IE in Identification Response, Forward Relocation Request, and Context Response Messages. If the subscribed UE Usage Type is available, it will be set to the available value, otherwise the MME encodes the length field of this IE with 0.

Similarly, MME will parse and store the UE Usage Type value when received from the peer node.

# How It Works

MME obtains the UE Usage type and determines the MMEGI that serves the corresponding DCN.

The MME then compares this MMEGI with its own MMEGI to perform a reroute or process further. In case of reroute, the request message is redirected to the appropriate MME. Refer to the ATTACH/TAU Procedure, on page 45 call flow for more information.

The following deployment scenarios are supported when DECOR is enabled on the MME:

- MME can be deployed where the initial request is sent by RAN (eNodeB) when sufficient information is not available to select a specific DCN.
- MME can be deployed as a part of DCN to serve one or more UE Usage Types.
- MME can be deployed as part of a Common Core Network (CCN) or Default Core Network, to serve UE Usage Types for which specific DCN is not available.

**Note** An MME can service initial RAN requests and also be a part of a DCN or a CCN. However, a particular MME service can only belong to one DCN or CCN within a PLMN domain.

The Dedicated Core Network implements the following functionalities on the MME:

- NAS Message Redirection
- ATTACH and TAU and Handover Procedures
- UE Usage Type support on S6a and GTPv2 interfaces
- S-GW/P-GW DNS selection procedures with UE Usage Type or DCN-ID
- MME/S4-SGSN selection procedures with UE Usage Type or DCN-ID during handovers
- Roaming
- Network Sharing
- DNS based MMEGI selection with UE-Usage-Type or DCN-ID
- DCN ID Support
- HSS/MME initiated DCN reselection

- When UE moves from a service area where DCN is not used to another area where DCN is supported, then MME does not receive the UE-Usage-Type from peer. In this case, MME will do an explicit AIR towards HSS for UE-Usage lookup.

# Flows

This section describes the call flows related to the DECOR feature.



## P-GW Selection based on ULAs UE Usage Type

MME considers only the UE Usage Type received in ULA for gateway selection and UUT (UE Usage Type) received from peer MME/SGSN including reroute scenarios or in AIA message from HSS or locally configured UUT will not be considered. This feature can disabled or enabled by CLI, It is disabled by default.

## UE Assisted Dedicated Core Network Selection

The UE assisted Dedicated Core Network Selection feature selects the correct DCN by reducing the need for DECOR reroute by using DCN-ID sent from the UE and DCN-ID used by RAN.

1. The DCN-ID will be assigned to the UE by the serving PLMN and is stored in the UE per PLMN-ID. Both standardized and operator specific values for DCN-ID are acceptable. The UE will use the PLMN specific DCN-ID whenever it is stored for the target PLMN.
2. The HPLMN may provision the UE with a single default standardized DCN-ID that will be used by the UE only if the UE has no PLMN specific DCN-ID of the target PLMN. When a UE configuration is changed with a new default standardized DCN-ID, the UE will delete all stored PLMN specific DCN-IDs.
3. The UE provides the DCN-ID to RAN at registration to a new location in the network, that is, in Attach, TAU, and RAU procedures.
4. RAN selects the serving node MME based on the DCN-ID provided by UE and configuration in RAN. For E-UTRAN, the eNodeB is conveyed with DCNs supported by the MME during setup of the S1 connection in S1 Setup Response.

## UE Usage Type Deletion by DSR Flag

MME processes the User Equipment (UE) Usage Type if it is set in Dynamic Source Routing flag in the Delete Subscriber data at the Home Subscriber Server. MME initiates the 3GPP standard( 23.401 section 5.19.3) procedure to redirect Network Access Storage (NAS)/UE if necessary.

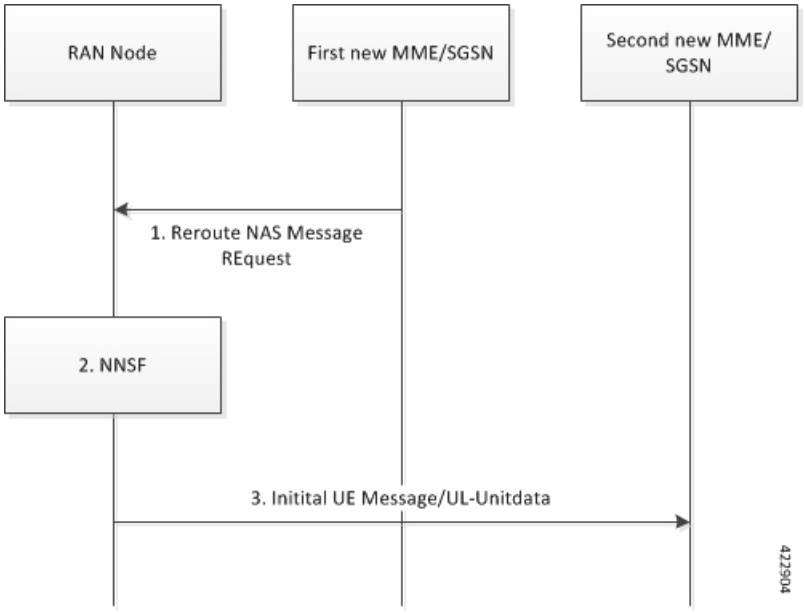
## NAS Message Redirection Procedure

Reroute NAS message is used to reroute a UE from one CN node to another CN node during Attach, TAU, or RAU procedure. This is also used by the MME/SGSN or HSS initiated Dedicated Core Network Reselection procedure.

When the first MME determines the UE Usage Type, it fetches the DCN configuration serving the UE and the corresponding MMEGI (from configuration or DNS). If the MME's MMEGI is not the same as the MMEGI of the DCN, MME moves the UE to another MME using the NAS messaging redirection procedure.

The following call flow illustrates the NAS Message Redirection procedure:

***Figure 3: NAS Message Redirection Procedure***

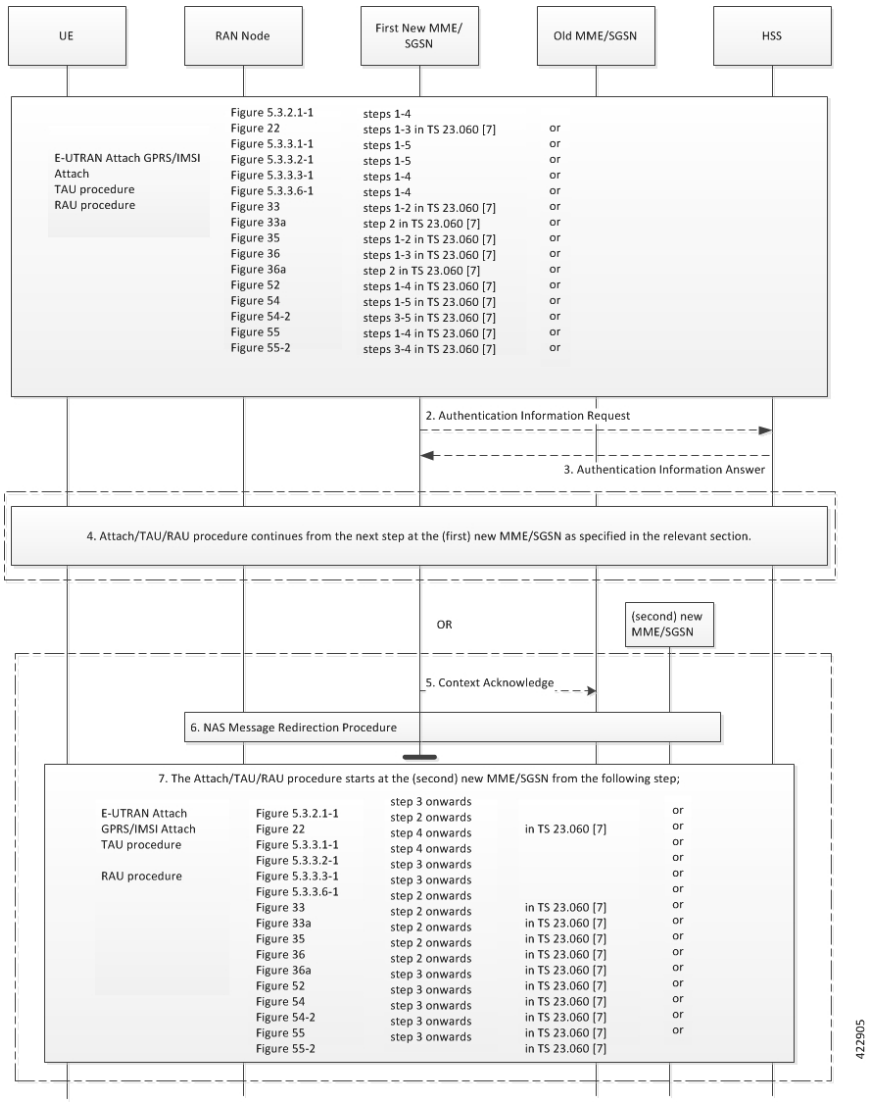



| Step | Description |
|---|---|
| 1 | The first new MME sends a Reroute NAS Message Request to eNodeB including UE Usage Type and MMEGI among other parameters. |
| 2 | RAN selects a new MME based on MMEGI. If no valid MME can be obtained from MMEGI, it selects MME from the CCN or forwards to the same first MME. |
| 3 | The second new MME determines from the MMEGI field if the incoming request is a re-routed NAS request or not. Now, if the received MMEGI belongs to the second MME, the call is serviced, else the call is rejected. No further rerouting is performed.<br>If the UE Usage Type is received by the second MME, it is used for S-GW/P-GW selection. |

## ATTACH/TAU Procedure

The following figure illustrates a detailed flow of the ATTACH or TAU procedure.

*Figure 4: ATTACH and TAU Procedure*




| Step | Description |
|---|---|
| 1 | In the RRC Connection Complete message transferring the NAS Request message, the UE provides the DCN-ID, if available. If the UE has a PLMN specific DCN-ID. the UE provides this value and if no PLMN specific DCN-ID exists, then the pre-provisioned default standardized DCN-ID will be provided, if pre-provisioned in the UE.<br><br>The RAN node selects a DCN and a serving MME/SGSN within the network of the selected core network operator based on the DCN-ID and configuration in the RAN node. The NAS Request message is sent to the selected node. The DCN-ID is provided by the RAN to the MME/SGSN together with the NAS Request message. |

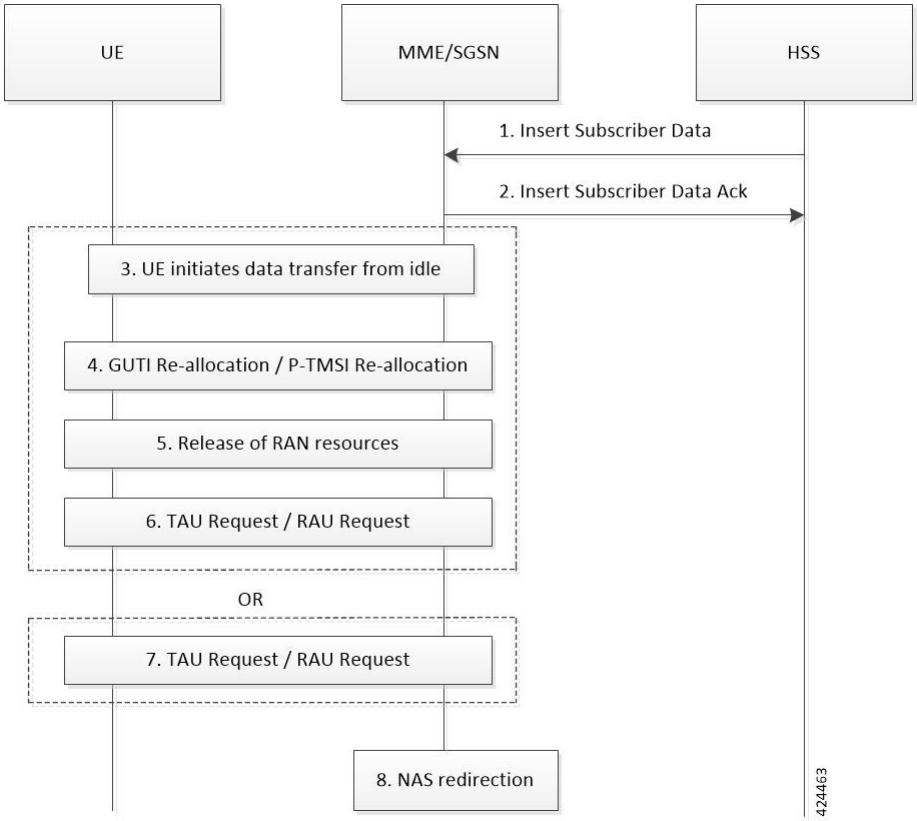
| Step | Description |
|---|---|
| 2 | The first new MME does not receive the MMEGI from eNodeB. The MME determines the UE Usage Type as follows:<br>**1.** It may receive the UE Usage Type from the peer MME/S4-SGSN.<br>**2.** It may determine from the locally available UE context information.<br>**3.** It sends an AIR message to the HSS requesting the UE Usage Type by adding the parameter "Send UE Usage Type" flag in the message. If authentication vectors are available in the database or received from peer, MME will not send the Immediate-Response-Preferred flag in the AIR message.<br>**4.** It may determine from the local configuration. |
| 3 | When UE Usage Type is available, and if the MME has to send an AIR message to the HSS to fetch authentication vectors, then the “Send UE Usage Type” flag is not set in the AIR message. |
| 4 | The first new MME determines to handle the UE:<br>**1.** When there is a configured DCN and the first new MME belongs to the MMEGI serving the DCN.<br>**2.** It will continue with the call flow.<br>**3.** The MME/SGSN sends the DCN-ID, if available, for the new DCN to the UE in the NAS Accept message. The UE updates its stored DCN-ID parameter for the serving PLMN if DCN-ID for serving PLMN is changed. |
| 5 | The first new MME determines to reject the UE:<br>**1.** When UE Usage Type is available but without a matching DCN.<br>**2.** The NAS message is rejected with parameters (for example: T3346 backoff timer) such that the UE does not immediately re-initiate the NAS procedure. |
| 6 | The first new MME determines to reroute the UE:<br>**1.** When there is a configured DCN and the first new MME does not belong to the MMEGI.<br>**2.** The first new MME sends a Context Acknowledge message with cause code indicating that the procedure is not successful. The old MME/SGSN will continue as if Context Request was never received.<br>**3.** The first new MME performs the NAS redirection procedure and the request may be routed by RAN to a second new MME. |
| 7 | The second new MME determines to handle the UE or reject it; the MME does not perform another re-route. The process of handling the UE or rejecting the UE is similar to the procedure used in the case of the first new MME.<br>The second new MME does not fetch the UE Usage Type from HSS. It is received either from the RAN node or the old MME. |

# HSS Initiated Dedicated Core Network Reselection

This procedure is used by the HSS to update (add, modify, or delete) the UE Usage Type subscription parameter in the serving node. This procedure may result in change of serving node of the UE.

The following call flow illustrates the HSS Initiated DCN Reselection procedure.

***Figure 5: HSS Initiated Dedicated Core Network Reselection Procedure***




| Step | Description |
|---|---|
| 1 | The HSS sends an Insert Subscriber Data Request (IMSI, Subscription Data) message to the MME. The Subscription Data includes the UE Usage Type information. |
| 2 | The MME updates the stored Subscription Data and acknowledges the Insert Subscriber Data Request message by returning an Insert Subscriber Data Answer (IMSI) message to the HSS. The procedure ends if the MME/SGSN continues to serve the UE. |
| As per this callflow, one of the following steps occur:<br>• Steps 3 through 6 occur in case the UE is already in connected mode or UE enters connected mode by initiating data transfer.<br>• Step 7 occurs in case the UE is in idle mode and performs a TAU/RAU procedure.<br>**Important** Paging is not supported. If the UE is in idle mode, MME waits until the UE becomes active. | |

| Step | Description |
|---|---|
| 3 | The UE initiates NAS connection establishment either by uplink data or by sending a TAU/RAU Request. |
| 4 | The MME triggers the GUTI re-allocation procedure and includes a non-broadcast TAI. |
| 5 | The MME releases RAN resources and UE is moved to idle mode. |
| 6 | The non-broadcast TAI triggers the UE to immediately start the TAU procedure. The MME receives the TAU Request message. |
| 7 | The UE performs a TAU request. The MME receives the TAU Request message |
| 8 | The MME triggers the NAS Message redirection procedure to redirect the UE if:<br>• the UE Usage Type for the UE has been added or modified and if it is not served by the MME<br>• the UE Usage Type has been withdrawn from the HSS subscription data and subscriptions without UE Usage Type are not served by the MME<br>**Note** HSS Initiated UE Usage Type withdrawal is not supported. The addition or change in usage type is supported. |

## Impact to Handover Procedures

This section describes the impact during handover procedures:

- In a forward relocation request, the source MME includes the UE-Usage-Type, if available.
- If an S-GW needs to be relocated, MME applies the UE-Usage-Type or DCN-ID based DNS selection, that is similar to the Attach/TAU procedure.
- MME or S4-SGSN selection during handover considers UE-Usage-Type or DCN-ID.
- The following two scenarios apply to DCNs deployed partially or heterogeneously:
  - Handover from service area where DCN is not used to an area where DCN is supported. In this case, MME does not receive the UE-Usage-Type from peer and MME does an Explicit AIR towards HSS for UE-Usage lookup.
  - The target MME or SGSN obtains the UE-Usage-Type information from the HSS during the subsequent TAU or RAU procedure.
    - If the target MME/SGSN determines that the S-GW does not support the UE-Usage-Type, the target MME/SGSN must trigger the S-GW relocation as part of the handover procedure. S-GW relocation is not supported.
    - If the target MME/SGSN does not serve the UE-Usage-Type, the handover procedure must complete successfully and the target MME initiates the GUTI re-allocation procedure with non-broadcast TAI to change the serving DCN of the UE.

## Roaming

MME in the visited PLMN provides an operator policy that allows to serve a UE whose home PLMN does not support DCNs. MME also provides operator policies that support the UE Usage Type parameter received from the HPLMN HSS.

## Network Sharing

MME supports DCN selection based on the selected PLMN information received from the UE.

## Limitations

The DECOR feature has the following limitations:

- Only one MMEGI can be configured per DCN.
- DCN deployments as part of a PLMN is not supported. The ability to configure DCN for a set of TAI/TAC is not supported.
- HSS Initiated UE usage type withdrawal is not supported. Only change in UE usage type is supported.
- DCNs can be deployed partially or heterogeneously.
  - The target MME or SGSN obtains the UE Usage Type information from the HSS during the subsequent TAU or RAU procedure. If the target MME/SGSN determines that the S-GW does not support the UE Usage Type, the target MME/SGSN must trigger the S-GW relocation as part of the handover procedures.

    S-GW relocation is not supported.

## Standards Compliance

The DECOR feature complies with the following standards:

- 3GPP 23.401 Release 14.5.0 - General Packet Radio Service (GPRS) enhancements for Evolved Universal Terrestrial Radio Access Network (E-UTRAN) access
- 3GPP 29.272 Release 14.6.0 - Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); LTE; Diameter applications; 3GPP specific codes and identifiers
- 3GPP 29.274 Release 14.5.0 - Universal Mobile Telecommunications System (UMTS); LTE; 3GPP Evolved Packet System (EPS); Evolved General Packet Radio Service (GPRS) Tunnelling Protocol for Control plane (GTPv2-C); Stage 3
- 3GPP 29.303 Release 14.3.0 - Universal Mobile Telecommunications System (UMTS); LTE; Domain Name System Procedures; Stage 3

# Configuring DECOR on MME

This section describes the CLI commands to configure the DECOR feature.

This feature supports the following configurations:

- DCN profile with
  - UE-Usage-Type
  - Static MMEGI
  - DNS lookup for MMEGI
  - PLMN
  - DCN-ID
  - Relative Capacity for the served DCN
  - DNS Service parameters using UE Usage Type or DCN-ID for S-GW / P-GW / MME / S4-SGSN selection / MMEGI lookup using DNS
- Associate DCNs to a specific RAT Type under MME service
- Associate multiple DCN profiles (to designate dedicated or default core network) under MME service
- Associate DCNs to a specific RAT Type under Call-Control-Profile
- Associate multiple DCN profiles (to designate dedicated or default core network) under Call-Control-Profile
- Non-broadcast TAI
- Request UE-Usage-Type from HSS on S6a interface
- UE-Usage-Type per IMSI/IMEI range

# Configuring custom-actions ula gw-selection

Use the following configuration to enable GW selection based on UUT received in ULA.

```
configure
  mme-service mme_service_name
     [ no ] decor custom-actions ula gw-selection
     end
```

**NOTES:**

- **no**: Removes the DECOR configuration.
- **decor**: Specifies the DECOR configuration.
- **custom-actions** : Configures specific decor actions.
- **ula** :Configure UUT actions in ULA message
- **gw-selection**: Enables GW selection based on UUT received in ULA.

# Configuring DECOR Profile

Use the following configuration to create and configure a DECOR profile by specifying the MMEGI hosting the DCN and the associated UE usage type using that DCN.

```
configure
   [ no ] decor-profile profile_name [ -noconfirm ]
     dcn-id dcn_id
     dns service-param ue-usage-type
     [ no ] mmegi { mmegi_value | dns }
     plmn-id mcc mcc_id mnc mnc_id
     served-dcn [ relative-capacity capacity ]
     [ no ] ue-usage-types num_ue_usage_types
     no { dcn-id | dns service-param | plmn-id | served-dcn }
     end
```

**NOTES:**

- **decor-profile** *profile_name*: Configures the DECOR feature as deployed by operator. A DECOR profile without any UE Usage Types configuration is treated as a Common Core Network. *profile_name* must be an alphanumeric string of 1 through 63 characters.

  Entering the **decor-profile** *profile_name* command results in the following prompt and changes to the Decor Profile Configuration mode:

  ```
  [context_name]host_name(config-decor-profile-<profile_name>)#
  ```

- **dns service-param ue-usage-type**: Configures the service parameter to select peer nodes using UE Usage Type or DCN-ID for S-GW / P-GW / MME / S4-SGSN / MMEGI lookup using DNS.
  - **service-param**: Configures the service parameter types used for DNS peer lookup.
  - **ue-usage-type**: Configures the UE Usage type that will be used for DNS service parameter.
  - For UE Usage Type based DECOR configuration:
    - If only UE-USAGE-TYPE is configured, DNS lookup uses UE-USAGE-TYPE.
    - If only DCN-ID is configured, DNS lookup uses DCN-ID without **dns service-param ue-usage-type** CLI command or UE-USAGE-TYPE with **dns service-param ue-usage-type** CLI (default profile).
    - If both UE-USAGE-TYPE and DCN-ID are configured, DCN-ID is used without **dns service-param ue-usage-type** CLI command or UE-USAGE-TYPE with **dns service-param ue-usage-type** CLI command.
    - If both UE-USAGE-TYPE and DCN-ID are not configured, DNS lookup uses UE-USAGE-TYPE (default profile).

- **dcn-id** *dcn_id*: Configures the DCN identifier for the specified DECOR profile. *dcn_id* must be an integer from 0 to 65535.
- **mmegi {** *mmegi_value* **|** **dns }**: Identifies the MME Group Identifier (MMEGI) of the configured DCN. *mmegi_value* must be an integer from 32768 to 65535.

  **dns**: Enables DNS for MMEGI retrieval using UE Usage Type.

The **mmegi dns** command will work only when the **dns peer-mme** command is enabled under MME-service.

- **plmn-id mcc** *mcc_id* **mnc** *mnc_id*: Configures the PLMN identifier for the specified DECOR profile. This supports network sharing with different MMEGIs for different PLMNs.

  **mcc** *mcc_id*: Configures the mobile country code (MCC) for the specified DECOR profile. *mcc_id* must be a 3-digit number between 000 to 999.

  **mnc** *mnc_id*: Configures the mobile network code (MNC) for the specified DECOR profile. *mnc_id* must be a 2- or 3-digit number between 00 to 999.

- **served-dcn [ relative-capacity** *capacity* **]**: Configures the MME that is serving the DCN and its relative capacity. These values are sent by MME to eNodeB during S1 Setup Response to indicate DCN-IDs served by the MME and their relative capacity.

  **relative-capacity** *capacity*: Set the relative capacity of this DCN. *capacity* must be an integer from 0 to 255. The default relative-capacity is 255.

- **ue-usage-types** *num_ue_usage_types*: Specifies the number of UE Usage Types in the dedicated core network. *num_ue_usage_types* is an integer from 0 to 255.

  A maximum number of 20 UE Usage Types are supported per DCN.

- **no**: Removes the specified DECOR parameters from the Global Configuration.
- MME will send the "MME CONFIGURATION UPDATE" message to all connected eNodeBs when a new DECOR profile is created with **served-dcn relative-capacity** and **dcn-id** CLI commands.
- MME will send the "MME CONFIGURATION UPDATE" message to all connected eNodeBs whenever there is a change in **served-dcn relative-capacity** or **dcn-id** CLI commands in a DECOR profile.

# Associating a DECOR Profile under MME Service

Use the following configuration to associate a DECOR profile with an MME service.

```
configure
  context context_name
    mme-service service_name
      [ no ] associate decor-profile profile_name access-type { all | eutran
 | nb-iot }
       end
```

**NOTES:**

- **associate**: Associates a DECOR profile with an MME service.
- **decor-profile** *profile_name*: Specifies the DECOR profile that is associated with the MME Service.
- **access-type**: Configures the type of network access — E-UTRAN, NB-IoT, or both.
  - **all** : Specifies to allow all access types.
  - **eutran**: Specifies the access type as E-UTRAN.
  - **nb-iot**: Specifies the access-type as NB-IoT.
- **no**: Removes the specified DECOR profile from the configuration.

- A maximum number of 16 DECOR profiles can be associated to an MME service.

# Associating a DECOR Profile under Call Control Profile

Use the following configuration to associate a DECOR profile under call control profile.

```
configure
   call-control-profile profile_name
      [ remove ] associate decor-profile profile_name [ access-type { all |
eutran | nb-iot } ]
      end
```

**NOTES:**

- **associate**: Associates a DECOR profile under call control profile.
- **decor-profile** *profile_name*: Specifies the DECOR profile that is associated with the call control profile. *profile_name* must be an alphanumeric string of 1 through 63 characters.
- **access-type**: Configures the type of network access for the DECOR profile — E-UTRAN, NB-IoT, or both.
  - **all** : Specifies allows all access types.
  - **eutran**: Specifies the access type as E-UTRAN.
  - **nb-iot**: Specifies the access-type as NB-IoT.
- **remove**: Removes the specified DECOR profile from the configuration.
- A maximum number of 16 DECOR profile associations can be configured for the call control profile.

# Configuring nas-reroute reject

Use the following configuration to configure NAS re-route reject.

```
configure
   context context_name
      mme-service service_name
         [ no ] decor custom-actions ula nas-reroute [ reject ]
         end
```

**NOTES:**

- **no**: Removes the configuration of NAS re-route reject.
- **decor**: Specifies the Dedicated Core Network Configuration.
- **custom-actions**: Configures specific decor actions.
- **ula**: Configures the UUT actions in ULA message.
- **nas-reroute**: Enables NAS re-route based on Ue-Usage-Type received in ULA.
- **reject**: Rejects the rerouted call based on Ue-Usage-Type received in ULA.

# Configuring UE Usage Type over S6a Interface under MME Service

Use the following configuration to advertise or request UE Usage Type over S6a interface.

```
configure
  context context_name
    mme-service service_name
      [ no ] decor s6a ue-usage-type
      end
```

**NOTES:**

- **decor**: Specifies the DECOR configuration.
- **s6a**: Configures the S6a interface.
- **ue-usage-type**: Specifies the UE Usage Type that needs to be sent in the Authentication-Information-Request message over S6a interface.
- **no**: Disables the specified configuration.

# Configuring UE Usage Type over S6a Interface under Call Control Profile

Use the following configuration to disable UE Usage Type requests over the S6a interface.

```
configure
  call-control-profile profile_name
    decor s6a ue-usage-type [ suppress ]
    remove decor s6a ue-usage-type
    end
```

**NOTES:**

- **decor**: Specifies the DECOR configuration.
- **s6a**: Enables the DECOR S6a configuration.
- **ue-usage-type**: Requests the UE Usage Type in S6a Authentication-Information-Request message.
- **suppress**: Suppresses sending the UE Usage Type in S6a Authentication-Information-Request message.
- **remove**: Removes the DECOR configuration.
- The configuration under call control profile overrides the MME service configuration.

# Configuring UE Usage Type under Call Control Profile

Use the following configuration to locally configure the UE Usage Types for UEs matching the Call Control Profile criteria.

```
configure
  call-control-profile profile_name
    decor ue-usage-type usage_type_value
    remove decor ue-usage-type
    end
```

**NOTES:**

- **decor**: Specifies the DECOR configuration.
- **ue-usage-type** *usage_type_value*: Configures a UE Usage Type locally. *usage_type_value* must be an integer from 0 to 255.
- **remove**: Removes the specified configuration.

## Configuring Non-Broadcast TAI

Use the following configuration to configure non-broadcast TAI. The configuration is added in support of HSS Initiated Dedicated Core Network Reselection.

When HSS sends ISDR with different UE-Usage-Type value other than what is already used by the subscriber and MME decides to move that UE to a new DCN, MME will send the GUTI Reallocation command with unchanged GUTI and non-broadcast TAI.

```
configure
  context context_name
    mme-service service_name
      tai non-broadcast mcc mcc_id mnc mnc_id tac tac_id
      no tai non-broadcast
      end
```

**NOTES:**

- **tai non-broadcast mcc** *mcc_id* **mnc** *mnc_id* **tac** *tac_id*: Specifies the Tracking Area Identity (TAI) which is not assigned to any area.

  **mcc** *mcc_id*: Configures the mobile country code (MCC) for the specified decor profile. *mcc_id* must be a 3-digit number between 000 to 999.

  **mnc** *mnc_id*: Configures the mobile network code (MNC) for the specified decor profile. *mnc_id* must be a 2- or 3-digit number between 00 to 999.

  **tac** *tac_id*: Configures the tracking area code (TAC) for the specified decor profile. *tac_id* must be an integer from 0 to 65535.

- **no**: Deletes the specified configuration.

# Monitoring and Troubleshooting

This section provides information on the show commands available to support DECOR on MME.

## Show Commands and/or Outputs

This section provides information regarding show commands and/or their outputs in support of the DECOR feature.

### show decor-profile full all

The output of this command includes the following information

- Decor Profile Name — Displays the configured decor-profile name.
- UE Usage Types — Displays the configured UE usage types.
- MMEGI — Displays the MMEGI value.
- DNS — Indicates whether DNS is enabled or disabled.
- DCN Id — Displays the configured DCN identifier. Displays "Not Defined" if not configured.
- PLMN Id — Displays the configured PLMN identifier. Displays "Not Defined" if not configured.
- Serving DCN — Indicates whether MME is serving the DCN. Displays "Not Defined" if not configured.
  - Relative capacity — Indicates the configured relative capacity.
- DNS Service Param — Displays the configured DNS service parameter.

## show mme-service all

The output of this command includes the following DECOR information:

- GW selection based on ULA - UUT - indicates if the GW selection based on ULA - UUT is enabled or disabled.
- NAS reroute based on ULA-UeUsageType - indicates if the NAS reroute based on ULA-UeUsageType is enabled or disabled.
- Reject the rerouted call in ULA - indicates if the Reject the rerouted call in ULA is enabled or disabled.

## show mme-service name <mme_svc_name>

The output of this command includes the following information:

- Non-Broadcast TAI — Displays the configured values for MCC, MNC, and TAC.

## show mme-service session full all

The output of this command includes the following DECOR information:

- DECOR Information:
  - UE Usage type
  - DCN Id

## show mme-service statistics decor decor-profile <decor_profile_name>

This show command displays the DECOR statistics for a specified DECOR profile. The DECOR profile level statistics are pegged only if a DECOR profile is configured.

The output of this command includes the following information:

- Decor Statistics
  - Attached Calls

- Initial Requests
  - ATTACH
    - Accepts
    - Reroutes
    - Rejects
- TAU
  - Accepts
  - Reroutes
  - Rejects
- Rerouted Requests
  - ATTACH
    - Accepts
    - Rejects
  - TAU
    - Accepts
    - Rejects
- UE-Usage-Type Source
  - HSS
  - UE Context
  - Peer MME
  - Peer SGSN
  - Config
  - eNB
- GUTI Reallocation Cmd due to UE-Usage-Type Change
  - Attempted
  - Success
  - Failures
- Handover from service area
  - DCN
  - Non DCN

- Explicit AIR
  - Attach
  - Inbound relocation
  - Inbound relocation using TAU procedure
- ISDR UE-Usage-Type Change
- MMEGI Selection
  - DNS
  - Local
  - Failure
- Node Selection
  - SGW DNS
    - Common
    - Dedicated
  - SGW Local Config
    - Common
  - PGW DNS
    - Common
    - Dedicated
  - PGW Local Config
    - Common
  - MME DNS
    - Common
    - Dedicated
  - MME Local Config
    - Common
  - SGSN DNS
    - Common
    - Dedicated
  - SGSN Local Config
    - Common

## show mme-service statistics decor

The output of this command includes the following information:

- Decor Statistics
  - Attached Calls
  - Initial Requests
    - ATTACH
      - Accepts
      - Reroutes
      - Rejects
    - TAU
      - Accepts
      - Reroutes
      - Rejects
  - Rerouted Requests
    - ATTACH
      - Accepts
      - Rejects
    - TAU
      - Accepts
      - Rejects
  - UE-Usage-Type Source
    - HSS
    - UE Context
    - Peer MME
    - Peer SGSN
    - Config
    - eNodeB
  - GUTI Reallocation Cmd due to UE-Usage-Type Change
    - Attempted
    - Success

- Failures

- Handover from service area
  - DCN
  - Non DCN
- Explicit AIR
  - Attach
  - Inbound relocation
  - Inbound relocation using TAU procedure
- ISDR UE-Usage-Type Change
- MMEGI Selection
  - DNS
  - Local
  - Failure
- Node Selection
  - SGW DNS
    - Common
    - Dedicated
  - SGW Local Config
    - Common
  - PGW DNS
    - Common
    - Dedicated
  - PGW Local Config
    - Common
  - MME DNS
    - Common
    - Dedicated
  - MME Local Config
    - Common

- SGSN DNS
  - Common
  - Dedicated
- SGSN Local Config
  - Common

## show mme-service statistics

The output of this command includes the following information at an MME service level:

- S1AP Statistics
  - Reroute NAS Requests
- Decor Statistics
  - Attached Calls
  - Initial Requests
    - ATTACH
      - Accepts
      - Reroutes
      - Rejects
    - TAU
      - Accepts
      - Reroutes
      - Rejects
  - Rerouted Requests
    - ATTACH
      - Accepts
      - Rejects
    - TAU
      - Accepts
      - Rejects
  - UE-Usage-Type Source
    - HSS

    - UE Context
    - Peer MME
    - Peer SGSN
    - Config
    - eNodeB
- GUTI Reallocation Cmd due to UE-Usage-Type Change
    - Attempted
    - Success
    - Failures
- Handover from service area
    - DCN
    - Non DCN
- Explicit AIR
    - Attach
    - Inbound relocation
    - Inbound relocation using TAU procedure
- ISDR UE-Usage-Type Change
- MMEGI Selection
    - DNS
    - Local
    - Failure
- Node Selection
    - SGW DNS
        - Common
        - Dedicated
    - SGW Local Config
        - Common
    - PGW DNS
        - Common
        - Dedicated

- PGW Local Config
  - Common
- MME DNS
  - Common
  - Dedicated
- MME Local Config
  - Common
- SGSN DNS
  - Common
  - Dedicated
- SGSN Local Config
  - Common

## show mme-service statistics recovered-values

The output of this command includes the following information:

Decor Statistics:

- Initial Requests
  - ATTACH
    - Accepts
    - Reroutes
    - Rejects
  - TAU
    - Accepts
    - Reroutes
    - Rejects
- Rerouted Requests
  - ATTACH
    - Accepts
    - Rejects
  - TAU

- Accepts
- Rejects

# Bulk Statistics

The MME schema and MME Decor schema include the supported bulk statistics for the DECOR feature.

## MME Schema

The following bulk statistics are added in the MME schema:

| Bulk Statistics | Description |
|---|---|
| mme-decor-attached-subscriber | Indicates the number of MME sessions attached that have an associated UE usage type. |
| mme-decor-initial-attach-req-accept | Indicates the total number of Initial Attach Requests accepted by the MME, which functions as a DCN. |
| mme-decor-initial-attach-req-reroute | Indicates the total number of Initial Attach Requests which are rerouted by the MME, which functions as a DCN. |
| mme-decor-initial-attach-req-reject | Indicates the total number of Initial Attach Rejects due to No Reroute data and not handled by the MME, which functions as a DCN. |
| mme-decor-reroute-attach-req-accept | Indicates the total number of Rerouted Attach Requests which are accepted by the MME, which functions as a DCN. |
| mme-decor-reroute-attach-req-reject | Indicates the total number of Rerouted Attach Requests which are rejected by the MME, which functions as a DCN. |
| mme-decor-initial-tau-req-accept | Indicates the total number of Initial TAU Requests accepted by the MME, which functions as a DCN. |
| mme-decor-initial-tau-req-reroute | Indicates the total number of Initial TAU Requests which are rerouted by the MME, which functions as a DCN. |
| mme-decor-initial-tau-req-reject | Indicates the total number of Initial TAU Rejects due to No Reroute data and not handled by the MME, which functions as a DCN. |
| mme-decor-reroute-tau-req-accept | Indicates the total number of Rerouted TAU Requests which are accepted by the MME, which functions as a DCN. |
| mme-decor-reroute-tau-req-reject | Indicates the total number of Rerouted TAU Requests which are rejected by the MME, which functions as a DCN. |
| mme-decor-ue-usage-type-src-hss | Indicates the number of MME subscriber sessions, where UE usage type was obtained from HSS/AUC. |

| Bulk Statistics | Description |
|---|---|
| mme-decor-ue-usage-type-src-ue-ctxt | Indicates the number of MME subscriber sessions, where UE usage type was obtained from MME DB record. |
| mme-decor-ue-usage-type-src-peer-mme | Indicates the number of MME subscriber sessions, where UE usage type was obtained from peer MME as part of handover. |
| mme-decor-ue-usage-type-src-peer-sgsn | Indicates the number of MME subscriber sessions, where UE usage type was obtained from peer SGSN as part of handover. |
| mme-decor-ue-usage-type-src-cfg | Indicates the number of MME subscriber sessions, where UE usage type was obtained from local configuration. |
| mme-decor-ue-usage-type-src-enb | Indicates the number of MME subscriber sessions, where UE usage type was obtained from the eNodeB, in the S1 message as part of reroute. |
| mme-decor-sgw-sel-dns-common | Indicates the number of times S-GW DNS selection procedures were performed with DNS RR excluding UE usage type.<br>This counter increments only when the DNS RR with UE usage type is absent. |
| mme-decor-sgw-sel-dns-dedicated | Indicates the number of times S-GW DNS selection procedures were performed with DNS RR including UE usage type parameter(s).<br>This counter increments only when the DNS RR with UE usage type is present. |
| mme-decor-sgw-sel-local-cfg-common | Indicates the number of times S-GW selection procedures were performed with locally configured S-GW address, without considering the UE usage type. |
| mme-decor-pgw-sel-dns-common | Indicates the number of times PGW DNS selection procedures were performed with DNS RR excluding UE usage type.<br>This counter increments only when the DNS RR with UE usage type is absent. |
| mme-decor-pgw-sel-dns-dedicated | Indicates the number of times S-GW DNS selection procedures were performed with DNS RR including UE usage type parameter(s).<br>This counter increments only when the DNS RR with UE usage type is present. |
| mme-decor-pgw-sel-local-cfg-common | Indicates the number of times P-GW selection procedures were performed with locally configured P-GW address without considering the UE usage type. |

| Bulk Statistics | Description |
|---|---|
| mme-decor-mme-sel-dns-common | Indicates the number of times MME DNS selection procedures were performed with DNS RR excluding UE usage type.<br>This counter increments only when the DNS RR with UE usage type is absent. |
| mme-decor-mme-sel-dns-dedicated | Indicates the number of times MME DNS selection procedures were performed with DNS RR including UE usage type parameter(s).<br>This counter increments only when the DNS RR with UE usage type is present. |
| mme-decor-mme-sel-local-cfg-common | Indicates the number of times MME selection procedures were performed with locally configured MME address without considering the UE usage type. |
| mme-decor-sgsn-sel-dns-common | Indicates the number of times SGSN DNS selection procedures were performed with DNS RR excluding UE usage type.<br>This counter increments only when the DNS RR with UE usage type is absent. |
| mme-decor-sgsn-sel-dns-dedicated | Indicates the number of times SGSN DNS selection procedures were performed with DNS RR including UE usage type parameter(s).<br>This counter increments only when the DNS RR with UE usage type is present. |
| mme-decor-handover-srv-area-dcn | Indicates the total number of inbound handovers from the service area where DCN is supported.<br>This counter increments for every inbound handover from DCN service area. |
| mme-decor-handover-srv-area-non-dcn | Indicates the total number of inbound handovers from the service area where DCN is not supported.<br>This counter increments for every inbound handover from non DCN service area. |
| mme-decor-explicit-air-attach | Indicates the number of explicit AIR messages during Attach.<br>This counter increments when MME triggers an explicit AIR during Attach. |
| mme-decor-explicit-air-in-reallocation | Indicates the number of explicit AIR messages during inbound relocation.<br>This counter increments when MME triggers explicit an AIR during inbound relocation. |

| Bulk Statistics | Description |
|---|---|
| mme-decor-explicit-air-tau-in-reallocation | Indicates the number of explicit AIR messages during inbound relocation using TAU.<br>This counter increments when MME triggers an explicit AIR during inbound relocation using TAU. |
| mme-decor-sgsn-sel-local-cfg-common | Indicates the number of times SGSN selection procedures were performed with locally configured SGSN address without considering the UE usage type. |
| s1ap-transdata-reroutenasreq | Indicates the number of S1 Reroute NAS Request Message sent by MME. |
| mme-decor-mmegi-sel-dns | Indicates the total number of times MMEGI is selected through DNS from a dedicated pool (DNS records having UE Usage Type which is matching). |
| mme-decor-mmegi-sel-local-cfg | Indicates the total number of times MMEGI is selected from local configuration. |
| mme-decor-mmegi-sel-fail | Indicates the total number of times MMEGI is selected from failure. |
| mme-decor-guti-reallocation-attempted | This proprietary counter tracks the number of GUTI Reallocation procedures attempted due to UE-Usage-Type Change from HSS through ISDR OR after connected mode handover and UE-Usage-Type not served by the MME (NAS GUTI Reallocation Command message was sent by MME). |
| mme-decor-guti-reallocation-success | Tracks the number of GUTI Reallocation procedures successful. |
| mme-decor-guti-reallocation-failures | Tracks the number of GUTI Reallocation procedure failures. |
| mme-decor-isdr-ue-usage-type-change | Tracks the number of ISDR Messages received with different UE-Usage-Type from the HSS. |
| recovered-mme-decor-initial-attach-req-accept | Indicates the total number of Initial Attach Requests accepted by the MME, which functions as a DCN. |
| recovered-mme-decor-initial-attach-req-reroute | Indicates the total number of Initial Attach Requests which are rerouted by the MME, which functions as a DCN. |
| recovered-mme-decor-initial-attach-req-reject | Indicates the total number of Initial Attach Rejects without the reroute data and that are not handled by the MME, which functions as a DCN. |
| recovered-mme-decor-reroute-attach-req-accept | Indicates the total number of Rerouted Attach Requests which are accepted by the MME, which functions as a DCN. |
| recovered-mme-decor-reroute-attach-req-reject | Indicates the total number of Rerouted Attach Requests which are rejected by the MME, which functions as a DCN. |

| Bulk Statistics | Description |
|---|---|
| recovered-mme-decor-initial-tau-req-accept | Indicates the total number of Initial TAU Requests accepted by the MME, which functions as a DCN. |
| recovered-mme-decor-initial-tau-req-reroute | Indicates the total number of Initial TAU Requests which are rerouted by the MME, which functions as a DCN. |
| recovered-mme-decor-initial-tau-req-reject | Indicates the total number of Initial TAU Rejects due to No Reroute data and not handled by the MME, which functions as a DCN. |
| recovered-mme-decor-reroute-tau-req-accept | Indicates the total number of Rerouted TAU Requests which are accepted by the MME, which functions as a DCN. |
| recovered-mme-decor-reroute-tau-req-accept | Indicates the total number of Rerouted TAU Requests which are rejected by the MME, which functions as a DCN. |

## MME Decor Schema

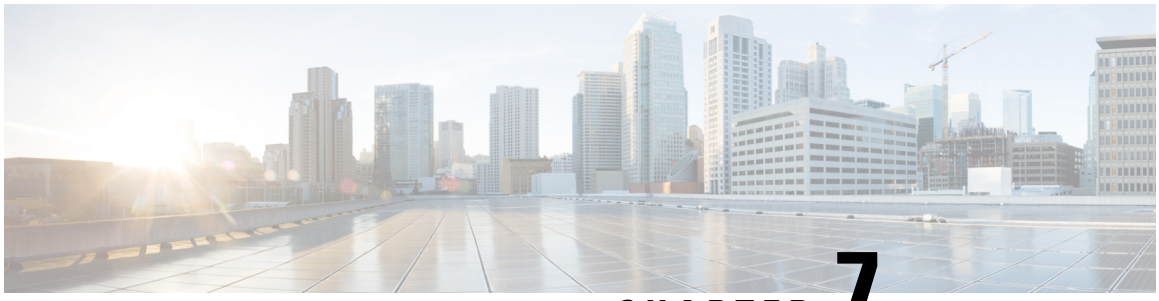
The following bulk statistics for a specific decor-profile are added in the MME Decor schema:

| Bulk Statistics | Description |
|---|---|
| mme-decor-profile-name | Indicates the name of the DECOR profile. |
| mme-decor-profile-attached-subscriber | Indicates the total number of subscribers on the MME which is acting as a DCN. |
| mme-decor-profile-initial-attach-req-accept | Indicates the total number of Initial Attach Requests accepted by the MME that is acting as a DCN. |
| mme-decor-profile-initial-attach-req-reroute | Indicates the total number of Initial Attach Requests which are rerouted by the MME that is acting as a DCN. |
| mme-decor-profile-initial-attach-req-reject | Indicates the total number of Initial Attach Rejects due to No Reroute Data and not handled by the MME that is acting as a DCN. |
| mme-decor-profile-reroute-attach-req-accept | Indicates the total number of Rerouted Attach Requests which are accepted by the MME that is acting as a DCN. |
| mme-decor-profile-reroute-attach-req-reject | Indicates the total number of Rerouted Attach Requests which are rejected by the MME that is acting as a DCN. |
| mme-decor-profile-initial-tau-req-accept | Indicates the total number of Initial TAU Reuquests accepted by the MME that is acting as a DCN. |
| mme-decor-profile-initial-tau-req-reroute | Indicates the total number of Initial TAU Reuquests which are rerouted by the MME that is acting as a DCN. |
| mme-decor-profile-initial-tau-req-reject | Indicates the total number of Initial TAU Rejects due to No Reroute Data and not handled by the MME that is acting as a DCN. |

| Bulk Statistics | Description |
|---|---|
| mme-decor-profile-reroute-tau-req-accept | Indicates the total number of Rerouted TAU Requests which are accepted by the MME that is acting as a DCN. |
| mme-decor-profile-reroute-tau-req-reject | Indicates the total number of Rerouted TAU Requests which are rejected by the MME that is acting as a DCN. |
| mme-decor-profile-ue-usage-type-src-hss | Indicates the total number of times UE Usage Type is received from the HSS and used by the MME. |
| mme-decor-profile-ue-usage-type-src-ue-ctxt | Indicates the total number of times UE Usage Type is fetched from the local DB Record and used by the MME. |
| mme-decor-profile-ue-usage-type-src-peer-mme | Indicates the total number of times UE Usage Type is received from the peer MME and used by the MME. |
| mme-decor-profile-ue-usage-type-src-peer-sgsn | Indicates the total number of times UE Usage Type is received from the peer SGSN and used by the MME. |
| mme-decor-profile-ue-usage-type-src-cfg | Indicates the total number of times UE Usage Type is fetched from the local configuration and used by the MME. |
| mme-decor-profile-ue-usage-type-src-enb | Indicates the total number of times UE Usage Type is received from the eNodeB and used by the MME. |
| mme-decor-profile-sgw-sel-dns-common | Indicates the total number of times S-GW is selected through DNS from a common pool (DNS records without UE Usage Type). |
| mme-decor-profile-sgw-sel-dns-dedicated | Indicates the total number of times S-GW is selected through DNS from a dedicated pool (DNS records with matching UE Usage Type). |
| mme-decor-profile-sgw-sel-local-cfg-common | Indicates the total number of times S-GW is selected from the local configuration without UE Usage Type. |
| mme-decor-profile-pgw-sel-dns-common | Indicates the total number of times P-GW is selected through DNS from a common pool (DNS records without UE Usage Type). |
| mme-decor-profile-pgw-sel-dns-dedicated | Indicates the total number of times P-GW is selected through DNS from a dedicated pool (DNS records with matching UE Usage Type). |
| mme-decor-profile-pgw-sel-local-cfg-common | Indicates the total number of times P-GW is selected from the local configuration without UE Usage Type. |
| mme-decor-profile-mme-sel-dns-common | Indicates the total number of times MME is selected through DNS from a common pool (DNS records without UE Usage Type). |

| Bulk Statistics | Description |
|---|---|
| mme-decor-profile-mme-sel-dns-dedicated | Indicates the total number of times MME is selected through DNS from a dedicated pool (DNS records with matching UE Usage Type). |
| mme-decor-profile-mme-sel-local-cfg-common | Indicates the total number of times MME is selected from the local configuration without UE Usage Type. |
| mme-decor-profile-sgsn-sel-dns-common | Indicates the total number of times SGSN is selected through DNS from a common pool (DNS records without UE Usage Type). |
| mme-decor-profile-sgsn-sel-dns-dedicated | Indicates the total number of times SGSN is selected through DNS from a dedicated pool (DNS records with matching UE Usage Type). |
| mme-decor-profile-sgsn-sel-local-cfg-common | Indicates the total number of times SGSN is selected from the local configuration without UE Usage Type. |
| mme-decor-profile-mmegi-sel-dns | Indicates the total number of times MMEGI is selected through DNS from a dedicated pool (DNS records with matching UE Usage Type). |
| mme-decor-profile-mmegi-sel-local-cfg | Indicates the total number of times MMEGI is selected from the local configuration. |
| mme-decor-profile-mmegi-sel-fail | Indicates the total number of times MMEGI selection failed. |
| mme-decor-profile-guti-reallocation-attempted | Indicates the number of GUTI Reallocation procedures attempted due to UE-Usage-Type Change from HSS through ISDR OR after connected mode handover and UE-Usage-Type not served by this MME (NAS GUTI Reallocation Command message was sent by MME). |
| mme-decor-profile-guti-reallocation-success | Indicates the number of successful GUTI Reallocation procedures. |
| mme-decor-profile-guti-reallocation-failures | Indicates the number of failed GUTI Reallocation procedures. |
| mme-decor-profile-isdr-ue-usage-type-change | Indicates the number of ISDR Messages received with different UE-Usage-Type from the HSS. |
| mme-decor-profile-explicit-air-attach | Indicates the number of explicit AIR messages during Attach. |
| mme-decor-profile-explicit-air-in-relocation | Indicates the number of explicit AIR messages during inbound relocation. |
| mme-decor-profile-explicit-air-tau-in-relocation | Indicates the number of explicit AIR messages during inbound relocation using TAU. |
| mme-decor-profile-handover-srv-area-dcn | Indicates the total number of inbound handovers from the service area where DCN is supported. |

| Bulk Statistics | Description |
|---|---|
| mme-decor-profile-handover-srv-area-non-dcn | Indicates the total number of inbound handovers from the service area where DCN is not supported. |



CHAPTER 7

# Dedicated Bearer Establishment without PCRF



## Feature Summary and Revision History

**Summary Data**

| | |
|---|---|
| Applicable Product(s) or Functional Area | P-GW |
| Applicable Platform(s) | • ASR 5500<br>• VPC-DI<br>• VPC-SI |
| Feature Default | Disabled - Configuration Required |
| Related Changes in This Release | Not Applicable |
| Related Documentation | *P-GW Administration Guide* |

**Revision History**

| Revision Details | Release |
|---|---|
| First Introduced<br>**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. | 21.16.9 |

# Feature Description

In P-GW, you can create a Dedicated Bearer with the help of local-policy when the Gx connection is down and a specific User Location Information (ULI) set matches during the session in the local-policy along with a configured predefined rule match in the service schema. However, in the StarOS 21.16.9 release, to provide IMS services to the UE that are not VOLTE capable, P-GW uses the deep packet inspection (DPI) functionality to create Dedicated Bearers without interaction with PCRF. This is to maintain high QoS of the voice service although the default bearer gets created with interaction with PCRF for the internet APN.

To detect voice services, SBC IP address (IPv4 or IPv6) and protocol RTP/RTCP is configured in ruledef and a Dedicated Bearer is created when a subscriber traffic matches with the ruledef without interaction with PCRF. If no data flows, then Dedicated Bearer interacts with PCRF over Gx normally and removed after the configured time limit.

# How it Works

This section describes call flow and procedure on how the Dedicated Bearer is established without involving PCRF.

***Figure 6: Call Flow***

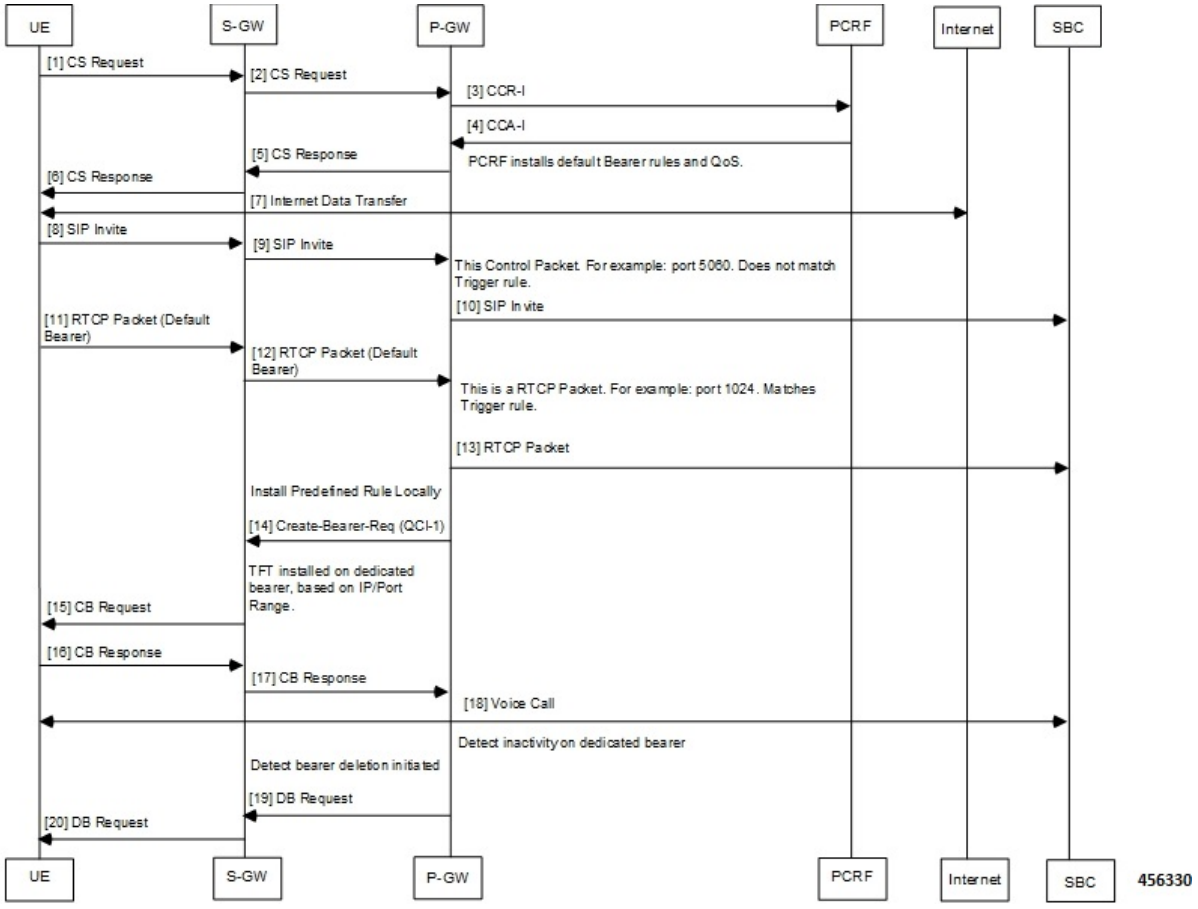


*Table 2: Procedure*

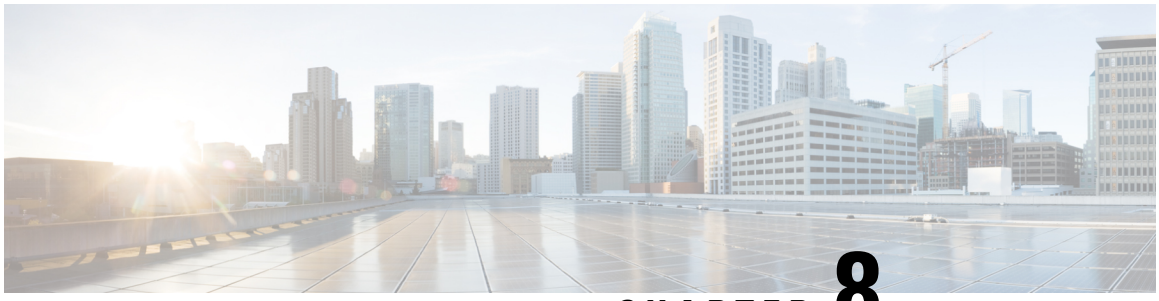
| Step | Description |
|---|---|
| 1 | Establish Default Bearer with internet APN with PCRF. |
| 2 | Default Bearer receives a SIP invite and forwards to SBC.<br>**Note** SIP invite will be received on port 5060/5061, which is outside the port range for dedicated bearer. |
| 3 | An RTCP packet is received matching the SBC address and port-range that matches to the trigger rule. |
| 4 | A dedicated bearer is created with predefined **Audio_dedicated_rule** and TFT with multiple ranges of port as defined by packet-filters tft1 and tft2.<br>**Note** The charging-action for such rule should have **billing-action egcdr** and **content-id** configured. |
| 5 | UE pushes any packets for the specified port ranges to the dedicated bearer and matches with the Audio_dedicated_rule. |
| 6 | After 300 seconds, or configured timeout value of inactivity, and according to the threshold configuration, the Bearer is deleted and P-GWCDR gets generated for a Bearer with corresponding data counts.<br>• You can adjust the threshold based on the keep-alive/watchdog messages.<br>• The SIP control messages after voice call flows on the ports that are outside the port-range defined for Dedicated Bearer TFT.<br>**Note** As SIP control messages are sent by UE on the Default Bearer, it will not be considered under Dedicated Bearer activity. |

# Configuring active-charging-services

Use the following example configuration to establish a dedicated bearer without interaction with PCRF.

```
configure
  active-charging service acs
    ruledef Audio_dedicated_rule
      ip dst-address = 1.1.1.1/32
    #exit
    ruledef trigger_rule
      ip dst-address = 1.1.1.1/32
      udp either-port range 1024 to 5059
      udp either-port range 5062 to 43672
    #exit
    packet-filter tft1
      ip remote-port range 1024 to 5059
      ip remote-address = 1.1.1.1/32
    #exit
    packet-filter tft2
```

```
      ip remote-port range 5062 to 43672
      ip remote-address = 1.1.1.1/32
    #exit
    charging-action no_charge
    #exit
    charging-action ca_audio
      content-id 2
      billing-action egcdr
      qos-class-identifier 1
      flow limit-for-bandwidth direction downlink peak-data-rate 256000 peak-burst-size
32000 violate-action discard
     flow limit-for-bandwidth direction uplink peak-data-rate 256000 peak-burst-size 300000
 violate-action discard
      allocation-retention-priority 4 pvi 1 pci 1
      tft packet-filter tft1
      tft packet-filter tft2
    #exit
    rulebase prepaid
       billing-records egcdr
 #Install Audio_dedicated_rule on dedicated bearer to cater to VoLTE traffic
      action priority 1 dynamic-only ruledef Audio_dedicated_rule charging-action ca_audio
 #Use traffic matching to trigger_rule on default bearer as trigger condition
      action priority 2 ruledef trigger_rule charging-action no_charge
    #exit
    trigger-action TA1
      activate-predef-rule Audio_dedicated_rule
    #exit
    trigger-condition TC1
      rule-name = trigger_rule
    #exit
    trigger-condition tc
      rulebase = prepaid
    #exit
    service-scheme SS
      trigger flow-create
        priority 1 trigger-condition TC1 trigger-action TA1
      #exit
    subs-class SC1
      rulebase = prepaid
    #exit
    subscriber-base sb
      priority 1 subs-class SC1 bind service-scheme SS
    #exit
  #exit
  context egress
    apn internet
 #Remove dedicated bearer after 300 seconds of inactivity
      timeout bearer-inactivity gbr 300 volume-threshold total 1
 active-charging rulebase prepaid
    exit
  exit
end
```



CHAPTER 8

# Default APN Selection Based on Context ID

This chapter describes the following topics:



## 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 | • *Command Line Interface Reference*<br>• *SGSN Administration Guide* |

### Revision History

| | |
|---|---|
| First Introduced. | 21.16 |

## Feature Description

Default APN Selection Based on Context ID feature adds the flexibility to select the subscription APN with given context ID when requested APN is not found in subscription. The default APN feature is invoked and is used to determine if the activation can be allowed by substituting the requested APN for one in subscription. The SGSN uses the subscribed APN which matches the configured context id.

Multiple Trigger Feature supports multiple instances of same of cli “apn-selection-default” where we can configure multiple default APNs based on different configuration. SGSN selects the first matched instance

and CLI instance's will be Stored in the same order in which it is defined during the configuration. The "apn-selection-default" and the order of cli "apn-selection-default" decides the priority. The context ID feature should be configured first to take the highest priority. This feature can be used with other features like first-subscription and lowest-context-id. This feature is CLI controlled.

# Configuring Default APN Selection Based on Context ID

This section provides information on the CLI commands to configure Default APN Selection Based on Context ID.

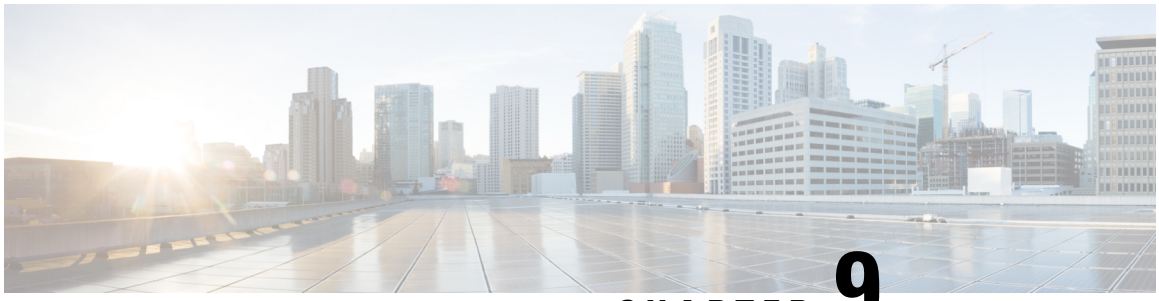
## Configuring APN Selection Default

Use the following configuration to enable APN Selection Default.

```
configure
  apn-remap-table remap_table_name
    apn-selection-default context-id context_id_value [ orig-apn ]
    no apn-selection-default context-id context_id_value
    end
```

**NOTES:**

- **no** : Removes the subscription of APN based on context id.
- **apn-selection-default context-id** : Specifies that the APN will be used as the Default APN.
- **context-id** *context_id_value*: Specifies the usage of APN in subscription record with context ID matching the PDN type if normal APN selection fails. *context_id_value* must be an integer between 1 and 15.
- **orig-apn**: Sends the original APN in the ACTIVATE_DEFAULT_BEARER_REQUEST message to the UE.



CHAPTER 9

# Enhanced Whitelisting in MME



## Feature Summary and Revision History

### Summary Data

| | |
|---|---|
| Applicable Product(s) or Functional Area | MME |
| Applicable Platform(s) | • ASR 5500<br>• VPC-DI<br>• VPC-SI |
| Default Setting | Disabled - Configuration Required |
| Related Changes in This Release | Not Applicable |
| Related Documentation | • *Command Line Interface Reference*<br>• *MME Administration Guide*<br>• *Statistics and Counters Reference* |

### Revision History

| Revision Details | Release |
|---|---|
| First introduced. | 21.16 |

# Feature Description

Enhancement to the whitelisting feature enables the MME to use IMSI or MSISDN subscriber identity to restrict network access to group of subscribers. This feature caters to operator requirements of more than 10000 subscriber identities (IMSI/MSISDN) configuration.

Subscriber whitelisting is done in one of the following ways:

- Whitelist based on IMSI in TAC level.
- Whitelist based on MSISDN in TAC level.

This feature supports both IMSI group and MSISDN group configurations which can contain discrete and range of IMSI and MSISDN.

# How it Works

This section describes how this feature works.

## IMSI Group

IMSI-based configuration supports IMSI groups. An IMSI group can contain upto 500 elements of either individual IMSI or range of IMSI.

Up to 50 IMSI groups can be configured per MME and once an IMSI group is created, each group can be configured with up to 500 unique IMSI values and/or up to 20 IMSI ranges, which can overlap.

The operator policy to whitelist or blacklist IMSI is configured using MME. The restriction considers the handover (TAU) process as well as the attach process.

The IMSI group or IMSI+IMEI-TAC groups are created and associated with operator policies in the CLI.

## MSISDN Group

Whitelisting in MME is enhanced to support specific MSISDN and ranges of MSISDN. The operator policy to whitelist or blacklist MSISDN is configured using MME. The restriction considers the handover (TAU) process as well as the attach process.

MSISDN-based configuration supports MSISDN groups. An MSISDN group can contain upto 500 elements of either individual MSISDN or range of MSISDN. Up to 50 MSISDN groups can be configured per MME and once an MSISDN group is created, each group can be configured with up to 500 unique MSISDN values and/or up to 20 MSISDN ranges, which can overlap.

The MSISDN group or MSISDN+IMEI-TAC groups are created and associated with operator policies in the CLI.

The following table lists the whitelist enhancement for MME.

***Table 3: Whitelist Enhancement***

| White List | TAC |
|---|---|

| | |
|---|---|
| Specific IMSI | Supported |
| Range of IMSI | Supported |
| Group of IMSI (discrete + range) | Supported from Release 21.16 onwards |
| Group of MSISDN (discrete + range) | Supported from Release 21.16 onwards |

# Configuring IMSI Group

Use the following configuration to create the IMSI group.

```
configure
  lte-policy
    imsi-group group_name
    end
```

**NOTES**:

- 50 IMSI groups and a combination of discrete IMSI and range of IMSIs with a maximum of 500 IMSI values and 20 lines per group are supported.

# Configuring Discrete IMSI Numbers

Use the following configuration to configure discrete IMSI numbers.

```
configure
  lte-policy
    imsi-group group_name
      imsi mcc mcc_value mnc mnc_value msin msin_value
      exit
```

**NOTES**:

- **mcc** *mcc_value*: Specifies the mobile country code (MCC) portion of the IMSI identifier.
- **mnc** *mnc_value*: Specifies the mobile network code (MNC) portion of the IMSI identifier.
- **msin** *msin_value*: Specifies the Mobile Subscriber Identification Number of the IMSI identifier.
- If previously configured, use the **no imsi mcc** *mcc_value* **mnc mnc_value msin** *msin_value* CLI command to delete the discrete IMSI values.

# Configuring IMSI Range

Use the following configuration to configure IMSI range.

```
configure
  lte-policy
    imsi-group group_name
      range mcc mcc_value mnc mnc_value msin first start_range last end_range
      exit
```

**NOTES**:

- **mcc** *mcc_value*: Specifies the mobile country code (MCC) portion of the IMSI identifier.
- **mnc** *mnc_value*: Specifies the mobile network code (MNC) portion of the IMSI identifier.
- **msin first** *start_range* **last** *end_range*: Specifies the range of Mobile Subscriber Identification Number of the IMSI identifier.
- If previously configured, use the **no range mcc** *mcc_value* **mnc** *mnc_value* **msin first** *start_range* **last** *end_range* CLI command to delete the IMSI range.

## Associating IMSI Group and IMEI-TAC Group with Operator Policy

Use the following configuration to associate IMSI-group and IMEI-TAC group with operator policy.

```
configure
  lte-policy
    subscriber-map subscriber_map_name
      precedence number match-criteria imei-tac group imeitac_group_name
imsi-group imsi_group_name operator-policy-name op_name
      end
```

**NOTES**:

- *number*: Specifies the order of precedence for the subscriber map. 1 (the lowest number) takes the highest precedence.
- **match-criteria** : Specifies that the keyword following this keyword is the criteria to be used to match a UE.
- **imei-tac group** *imeitac_group_name*: Identifies a previously configured IMEI-TAC group (with imei-tac-group command LTE-Policy configuration mode) to associate with this precedence definition.
- **operator-policy-name** *op_name*: Sets the operator policy with which the matching criteria is associated.

## Verifying IMSI Group Configuration

Use the following show commands to display details related to IMSI group.

- **show lte-policy imsi-group name** *group_name*
- **show lte-policy imsi-group summary**

# Configuring MSISDN Group

Use the following configuration to create a new MSISDN group.

```
configure
  msisdn-group group_name
  end
```

**NOTE**:

- MSISDN is a subscriber number which provides the functionality with TAC and it decides whether to allow or block the subscribers based on the subscriber number. The MSISDN group name is used to create a new MSISDN group and it can have a maximum of 50 groups.

# Configuring Discrete MSISDN Numbers

Use the following configuration to configure discrete MSISDN numbers.

```
configure
  msisdn-group group_name
    msisdn cc cc_value number value
    exit
```

**NOTES**:

- **msisdn** : Specifies the discrete list of MSISDN numbers (Combination of discrete and range line is 20 per group).

# Configuring MSISDN Range

Use the following configuration to configure MSISDN range.

```
configure
  msisdn-group group_name
    range cc cc_value number first start_range last end_range
    exit
```

**NOTES**:

- **number first** *start_range* **last** *end_range*: Specifies the MSISDN range.

# Associating MSISDN Group and IMEI-TAC Group with Operator Policy

Use the following configuration to associate MSISDN group and IMEI-TAC group with operator policy.

```
configure
  lte-policy
    subscriber-map subscriber_map_name
      precedence number match-criteria msisdn-group namemsisdn_group name
operator-policy-name op_name
      end
```

**NOTES**:

- *number*: Specifies the order of precedence for the subscriber map. 1 (the lowest number) takes the highest precedence.
- **match-criteria** : Specifies that the keyword following this keyword is the criteria to be used to match a UE.
- **msisdn-group name** *msisdn_group_name*: Identifies a previously configured IMEI-TAC group (with imei-tac-group command LTE-Policy configuration mode) to associate with this precedence definition.
- **operator-policy-name** *op_name*: Sets the operator policy with which the matching criteria is associated.

## Verifying MSISDN Group Configuration

Use the following show commands to display details related to MSISDN group.

- **show config msisdn-group name** *group_name*
- **show config msisdn-group summary**

# Configuring Operator Policy based on IMSI Group and MSISDN Group

The match-criteria in precedence command is enhanced to take parameter that is "matched-to" the configure selection based on IMSI group and MSISDN group. It supports the selection of operator policy based on a combination of IMEI-TAC group and IMSI group (IMEI-TAC + IMSI group) or of IMEI-TAC group and MSISDN group (IMEI-TAC + MSISDN group). The configuration involves:

- IMSI-group
- MSISDN group
- IMEI-TAC + IMSI-group
- IMEI-TAC + MSISDN group

## Associating IMSI Group with Operator Policy

Use the following configuration to associate IMSI group with operator policy.

```
configure
  lte-policy
    subscriber-map map_name
      precedence precedence_number match-criteria [ imsi-group group_name ]
 [ operator-policy-name policy_name ]
      end
```

For information about these commands and keywords, refer to the *Command Line Interface Reference*.

## Associating IMSI Group in Combination with IMEI-TAC with Operator Policy

Use the following configuration to associate IMSI group in combination with IMEI-TAC with operator policy.

```
configure
  lte-policy
    subscriber-map map_name
      precedence precedence_number match-criteria imei-tac group group_name
[ imsi-group group_name ]  [ operator-policy-name policy_name ]
      end
```

For information about these commands and keywords, refer to the *Command Line Interface Reference*.

# Associating MSISDN Group with Operator Policy

Use the following configuration to associate MSISDN group with operator policy.

```
configure
  lte-policy
    subscriber-map map_name
      precedence precedence_number match-criteria [ msisdn-group group_name
]  [ operator-policy-name policy_name ]
      end
```

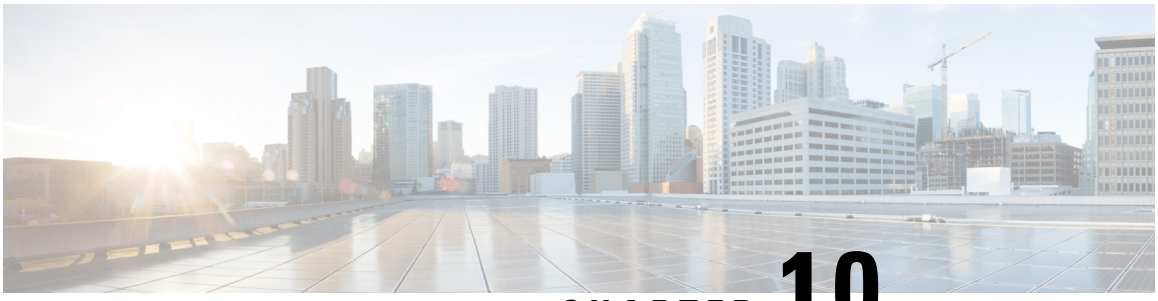
For information about these commands and keywords, refer to the *Command Line Interface Reference*.

# Associating MSISDN Group in Combination with IMEI-TAC with Operator Policy

Use the following configuration to associate IMSI group in combination with IMEI-TAC with operator policy.

```
configure
  lte-policy
    subscriber-map map_name
      precedence precedence_number match-criteria imei-tac group group_name
[ msisdn-group group_name ]  [ operator-policy-name policy_name ]
      end
```

For information about these commands and keywords, refer to the *Command Line Interface Reference*.



CHAPTER 10

# Enhanced Whitelisting in SGSN



## Feature Summary and Revision History

### Summary Data

| | |
|---|---|
| Applicable Product(s) or Functional Area | SGSN |
| Applicable Platform(s) | • ASR 5500<br>• VPC-DI<br>• VPC-SI |
| Feature Default | Disabled - Configuration Required |
| Related Changes in This Release | Not Applicable |
| Related Documentation | • *Command Line Interface Reference*<br>• *SGSN Administration Guide*<br>• *Statistics and Counters Reference* |

### Revision History

| Revision Details | Release |
|---|---|
| First introduced. | 21.16 |

# Feature Description

SGSN is enhanced to support whitelisting based on IMSI and MSISDN in LAC/RAC in addition to the HSS-based Regional Zone Code Restriction. This SGSN feature allows specific subscribers to connect to the network.

Operator policy based support is extended to support up to 10000 subscribers identies (IMSI/MSISDN) configuration. Subscribers are configured based on Routing Areas to enable subscriber whitelisting depending on its current Routing Area Identifier (RAI). A maximum of 10000 IMSI/MSISDN are allowed by LAC/RAC.

The following table lists the whitelist enhancement for SGSN.

***Table 4: Whitelist Enhancement***

| | **LAC** | **RAC** |
|---|---|---|
| Specific IMSI | Supported | Supported from Release 21.16 |
| Range of IMSI | Supported | Supported from Release 21.16 |
| Group of IMSI (discrete + range) | Supported from Release 21.16 | Supported from Release 21.16 |
| Specific MSISDN | Supported from Release 21.16 | Supported from Release 21.16 |
| Range MSISDN | Supported from Release 21.16 | Supported from Release 21.16 |
| Group of MSISDN (discrete + range) | Supported from Release 21.16 | Supported from Release 21.16 |

# How it Works

## Architecture

### IMSI Group

The SGSN retrieves IMSI for the relevant operator policy, both by IMSI range and IMSI group. After retrieving the operator policy, the active Routing Area Identifier (RAI) with LAC/RAC information in the UE is verified against the operator policy routing-area-list by LAC/RAC combinations. If the RAI isn't available in the operator policy Routing Area List, the UE is rejected using the specific configured cause value.

The IMSI configuration supports up to 50 IMSI groups per SGSN. After creating IMSI groups, combination of IMSI and IMSI range together provide up to 500 unique IMSI values. Combination of discrete IMSI and IMSI range line are 20 per group. The IMSI group allows to configure multiple IMSIs and IMSI ranges per group to associates it to operator policy.

### MSISDN Group

MSISDN group allows to configure multiple MSISDN and MSISDN ranges per group and associate the MSISDN group to an operator policy. The SGSN retrieves MSISDN for the relevant operator policy, both by MSISDN range and MSISDN group.

SGSN retrieving the operator policy, the active RAI with LAC/RAC information in the UE is verified against the operator policy routing-area-list by LAC/RAC combinations. If the RAI isn't available in the operator policy routing-area-list, the UE is rejected using the specific configured cause value.

The MSISDN configuration supports up to 50 MSISDN groups per SGSN. After creating MSISDN groups, combination of MSISDN and range together can be 500 unique MSISDN values. Combination of discrete MSISDN and range line are 20 per group.

### MSIDSN Range

An MSISDN range allows associating a range of MSISDNs to an operator policy. The SGSN searches for operator policy based on the areas in which the MSISDN is retrieved (either through MAP/Diameter/GTP-C message or stored in existing UE context), both by MSISDN range and MSISDN group.

After retrieving a relevant operator policy, the SGSN verifies the active RAI which contains LAC/RAC in which the UE is in against the operator policy routing area list LAC/RAC combinations. If the active RAI is not confirmed, the UE is rejected using the specific configured cause value.

### SRNS

The Gn/Gp SGSN and S4-SGSN support inter-SGSN and intra-SGSN Serving Radio Network Subsystem (SRNS) relocation. On the Gn/Gp SGSN, the SRNS relocation is triggered by subscribers (MS/UE) moving from one RNS to another. If the originating RNS and destination RNS are connected to the same SGSN but are in different routing areas, the behavior triggers an intra-SGSN Routing Area Update (RAU). If the RNSs are connected to different SGSNs, the relocation is by an inter-SGSN RAU.

# Configuring Enhanced Whitelisting in SGSN

This section describes how to configure Enhanced Whitelisting in SGSN.

## Configuring Discrete IMSI Numbers

Use the following configuration to configure discrete IMSI numbers.

```
configure
   imsi-group group_name
      [ no ] imsi mcc mcc mnc mnc msin msin
      end
```

**NOTES:**

- **mcc** *mcc*: Mobile Country Code of IMSI. *mcc* must be a three digit integer in the range of 000-999.
- **mnc** *mnc*: Mobile Network Code of IMSI. *mnc* must be a two or three digit integer in the range of 00-999.
- **msin** *msin*: 9/10 digit MSIN numbers, maximum of 500 per group.
- **no**: Disables the configured options.

## Configuring IMSI Range

Use the following configuration to configure IMSI range.

```
configure
  imsi-group group_name
    [ no ] range mcc mcc mnc mnc msin first msin_first last msin_last
    end
```

**NOTES:**

- **range**: Range of MSIN numbers (Maximum 20 per group).
- **mcc** *mcc*: Mobile Country Code of IMSI. *mcc* must be a three digit integer in the range of 000-999.
- **mnc** *mnc*: Mobile Network Code of IMSI. *mnc* must be a two or three digit integer in the range of 00-999.
- **msin**: Mobile Subscriber International Number. Must be a maximun of 9 or 10 digit MSIN numbers. Maximum 500 per group.
- **first** *msin_first* : Start of Mobile Subscriber International Number Range. Must be a maximun of 9 or 10 digit MSIN numbers.
- **last** *msin_last*: End of Mobile Subscriber International Number Range. Must be a maximun of 9 or 10 digit MSIN numbers.
- **no**: Disables the configured options.

# Configuring Discrete MSISDN Numbers

Use the following configuration to configure discrete list of MSISDN numbers.

```
configure
  msisdn-group group_name
    [ no ] msisdn cc cc number number
    end
```

**NOTES:**

- **msisdn** *cc*: Discrete list of MSISDN numbers (Combination of discrete and range lines is 20 per group).
- **cc** *cc*: Country Code of subscriber. Maximum 500 per group.

  *cc* must be three digit number between 1 to 999.
- **number** *number*: MSISDN number. Maximum 500 per group.

  *number* must be 1 to 14 digit number.

# Associating MSISDN Range with Operator Policy

Use the following configuration to associate MSISDN range with Operator Policy.

```
configure
  sgsn-global
    msisdn-range cc cc number first start_range last last_range operator-policy
 policy_name
    no msisdn-range cc cc number first start_range last last_range
    end
```

**NOTES:**

- **msisdn-range** : MSISDN Range to which Operator Policy should be associated.
- **cc** *cc*: Country Code of MSISDN.

  *cc* must be three digit number between 1 to 999.
- **number** : Subscriber Number (and optional NDC/NPA) of MSISDN.
- **first** *start_range* : Starting range of MSISDN NDC/NPA/Subscriber Number Prefix. *start_range* must be a number up to 15 digits length.
- **last***last_range*: End range of MSISDN NDC/NPA/Subscriber Number Prefix. *last_range* must be a number up to 15 digits length.
- **operator-policy***policy_name*: MSISDN Operator Policy name.
- **no**: Disables the configured options.

# Configuring MSISDN Range

Use the following configuration to configure MSISDN range of numbers .

```
configure
  msisdn-group group_name
    [ no ] range cc cc number first number_first last number_last
    end
```

**NOTES:**

- **range** : Range of MSISDN numbers (Combination of discrete and range lines is 20 per group).
- **cc** *cc*: Country Code of subscriber. *cc* must be a three digit number between 1 to 999.
- **number** : Specifies 1 to 14 digit. (Maximum 500 per group).
- **first** *number_first*: Starting value of MSISDN number. *number_first* must be a number from 1 to 14 digits.
- **last** *number_last*: Last value of MSISDN number. *number_last* must be a number from 1 to 14 digits.
- **no**: Disables the configured options.

# Configuring Routing Area List

Use the following configuration to configure Routing Area List.

```
configure
  call-control-profile profile_name
    routing-area-list instance instance lac lac rac rac
    no routing-area-list instance instance
    end
```

**NOTES:**

- **routing-area-list instance** *instance*: Configure one particular instance. Instance number will be valid only if area code is configured for this instance. *instance* must be an integer in the range of 1-5.
- **lac** *lac*: Specifies the LAC value. *lac* must be an integer from 1 to 65535.

- **rac** *rac*: Specifies the RAC value. *rac* must be an integer from 0 to 255.
- **no**: Disables the configured options.

# Configuring RAU-inter Restrict for SGSN

Use the following configuration to configure RAU inter-restrict for 2G and 3G.

```
configure
   call-control-profile profile_name
      [ no ] rau-inter restrict access-type { gprs routing-area-list
instance instance | umts routing-area-list instance instance  }
      end
```

**NOTES:**

- **rau-inter**: (SGSN) Inter SGSN Routing Area Update.
- **restrict**: Specifies restrict.
- **access-type**: Specifies the inclusion of Access Type Extension.
- **gprs**: Specifies the General Packet Radio Service
- **rau-inter**: (SGSN) Inter SGSN Routing Area Update.
- **routing-area-list** : (SGSN) RAC List to set allow/restrict of services in this routing area. Configure the area codes to define the service.
- **instance** *instance*: Configures one particular instance. *instance* must be an integer in the range of 1-5.
- **no**: Disables the configured options.

# Configuring RAU-intra Allow for SGSN

Use the following configuration to configure RAU inter-allow for 2G and 3G.

```
configure
   call-control-profile profile_name
      [ no ] rau-intra allow access-type { gprs routing-area-list instance
 instance | umts routing-area-list instance instance }
      end
```

**NOTES:**

- **rau-intra**: (SGSN) Intra SGSN Routing Area Update.
- **allow**: Specifies allow.
- **access-type**: Specifies the inclusion of Access Type Extension.
- **gprs**: Specifies the General Packet Radio Service
- **rau-inter**: (SGSN) Inter SGSN Routing Area Update.
- **routing-area-list** : (SGSN) RAC List to set allow/restrict of services in this routing area. Configure the area codes to define the service.

- **instance** *instance*: Configures one particular instance. *instance* must be an integer in the range of 1-5.
- **no**: Disables the configured options.

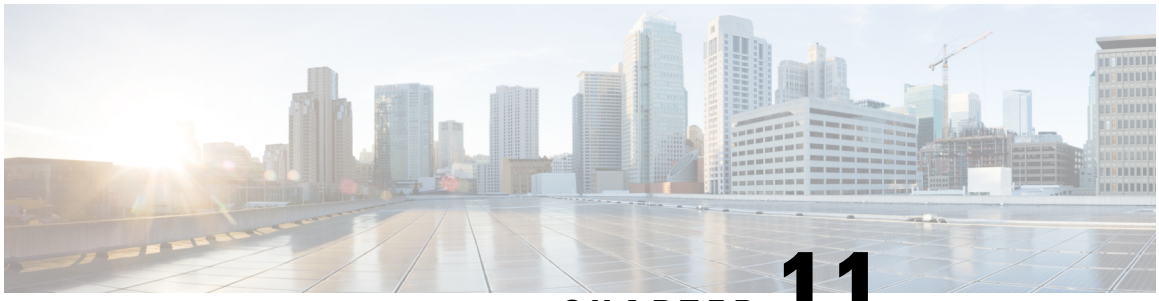
# Configuring SRNS Intra

Use the following configuration to configure SRNS.

```
configure
   call-control-profile profile_name
      [ no ] srns-intra { allow location-area-list instance instance  |
restrict { all | location-area-list instance  instance}
     end
```

**NOTES:**

- **srns-intra**: (SGSN) SRNS Intra SGSN.
- **allow**: Specifies allow.
- **restrict**: Specifies restrict.
- **location-area-list** : (SGSN) LAC List to set allow/restrict of services in this location area. Configures the area codes to define the service.
- **instance** *instance*: Configures one particular instance. *instance* must be an integer in the range of 1-5.
- **no**: Disables the configured options.



CHAPTER 11

# Deprecation of Manual Scaling



## Feature Summary and Revision History

### Summary Data

| | |
|---|---|
| Applicable Product(s) or Functional Area | UAS |
| Applicable Platform(s) | UGP |
| Feature Default | Disabled - Configuration Required |
| Related Changes in This Release | Not applicable |
| Related Documentation | • *Ultra M Solutions Guide*<br>• *Ultra Services Platform Deployment Automation Guide* |

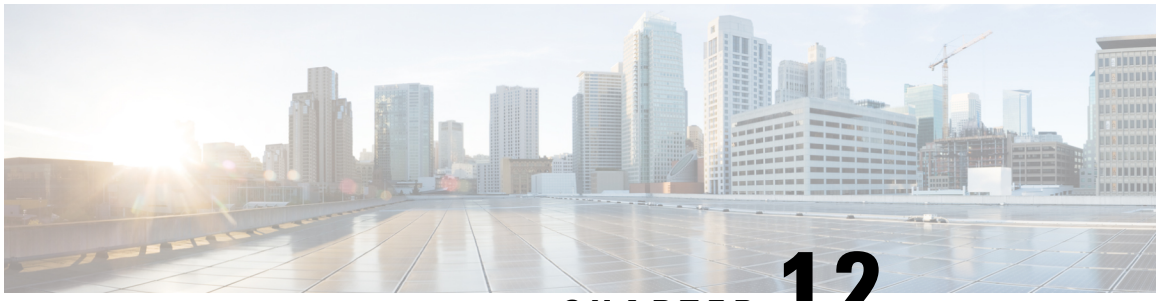
### Revision History

| Revision Details | Release |
|---|---|
| The support for manual scale-in and scale-out functionality has been deprecated in this release. | 6.0 through 6.14 |
| First introduced | 6.0 |

## Feature Changes

**Previous Behavior**: In previous releases, the Service Function (SF) scaling (including the manual scale-in and scale-out) feature was supported.

**New Behavior**: In this release, the manual scale-out and scale-in functionalities have been deprecated. For more information, contact your Cisco account representative.



CHAPTER 12

# Discontinuation of ORBEM Configuration Support



## Feature Summary and Revision History

### Summary Data

| | |
|---|---|
| Applicable Product(s) or Functional Area | All |
| Applicable Platform(s) | • ASR 5500<br>• VPC-DI<br>• VPC-SI |
| Feature Default | Disabled – Configuration Required |
| Related Changes in This Release | Not applicable |
| Related Documentation | • *ASR 5500 System Administration Guide*<br>• *Command Line Interface Reference*<br>• *Ultra Gateway Platform System Administration Guide*<br>• *VPC-DI System Administration Guide*<br>• *VPC-SI System Administration Guide* |

### Revision History

**Important** Revision history details are not provided for features introduced before releases 21.2 and N5.1.

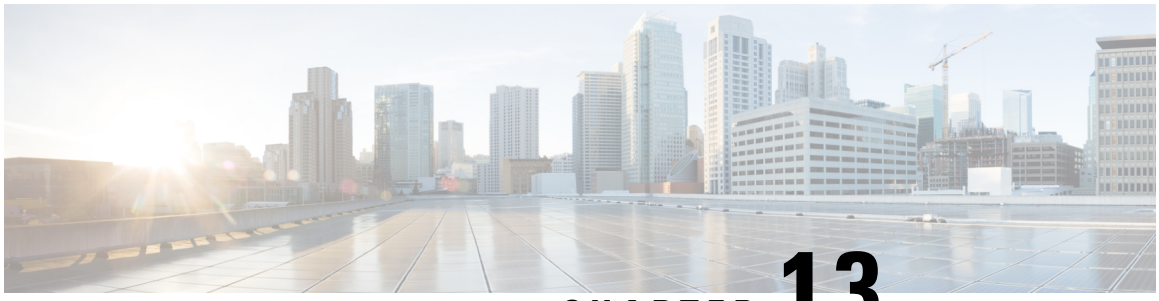
| Revision Details | Release |
|---|---|
| With this release onwards, the **orbem** CLI command is discontinued and no longer recommended for use. | 21.16 |
| First introduced. | Pre 21.2 |

# Feature Changes

**Previous Behavior**: In releases earlier to 21.16, the **orbem** CLI command was supported.

**New Behavior**: With Release 21.16 onwards, the **force** keyword has to be appended to the **orbem** CLI command to enter the ORBEM mode and enable the feature. The **orbem** keyword is now hidden.

**Note** Support for the end-of-life ORBEM/WEM feature will be fully discontinued in future releases.



CHAPTER 13

# Handling Call Drop in Smart Watch and Multi-SIM Devices



## Feature Summary and Revision History

### Summary Data

| | |
|---|---|
| Applicable Product(s) or Functional Area | MME |
| Applicable Platform(s) | • ASR 5500<br>• VPC-DI<br>• VPC-SI |
| Default Setting | Disabled - Configuration Required |
| Related Changes in This Release | Not Applicable |
| Related Documentation | • *Command Line Interface Reference*<br>• *MME Administration Guide* |

### Revision History

| Revision Details | Release |
|---|---|
| Enhanced Feature Description | 21.17.6 |
| First introduced. | 21.16 |

# Feature Description

When the user manually switches the VoLTE option from “Data + Voice” to “4G Data Only”, it triggers the handset to detach and re-attach again instead of the standard Tracking Area Update (TAU) this resulted in Mobile Terminated (MT) call failure on a VoLTE capable handset that was IMS VoPS domain registered.

In the subsequent Attach Request the combination of “MS Network Capability” , “Voice Domain Preference and UE's Usage Setting” (that is “SRVCC from UTRAN HSPA or E-UTRAN to GERAN/UTRAN supported”, and “CS Voice Only”), in conjunction with IMS VoPS which is already configured as “Supported”, causes the current MME functionality to return IMS VoPS to “Supported” in all relevant NAS and HSS Diameter based message responses.

By returning IMS VoPS “Supported” back to the HSS (in this case via the Insert Subscriber Data Answer message) resulted in the handset failing the MT forked call, as it did not initiate a PDN connectivity request for the IMS APN.

To overcome this issue, a new configuration feature has been implemented which (when enabled in conjunction with IMS VoPS set to “Supported”) ensures the IMS VoPS settings are returned as “Not Supported”, in all subsequent NAS and diameter based messages, if the Attach or TAU request “Voice Domain Preference and UE's Usage Setting” is “CS Voice Only”.

# Configuring Call Drop Handling in Smart Watch and Multi-SIM Devices

This section describes how to configure this feature.

## Enabling Multi-SIM

Use the following configuration to enable Multi-SIM customization feature.

```
configure
   call-control-profile call_control_profile_name
     network-feature-support-ie ims-voice-over-ps supported
srvcc-ue-with-voice-domain-pref
     remove network-feature-support-ie
     end
```

**NOTES:**

- **srvcc-ue-with-voice-domain-pref**: The MME sets IMS VoPS flag based on the voice-over domain preference and unsets VoPS in the case of CS voice only.
- **remove**: Removes the configuration.

# Monitoring and Troubleshooting

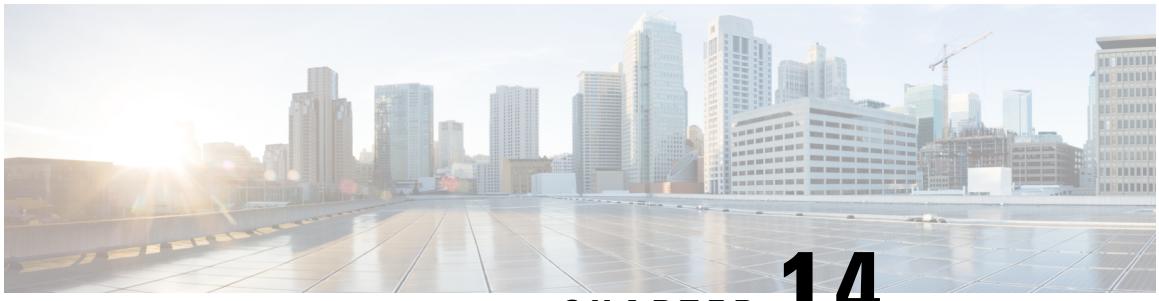
This section provides information regarding show commands available to monitor and troubleshoot this feature.

# Show Commands and Outputs

**show call-control-profile full name <profile_name>**

The output of this command includes the following fields:

- Network Feature Support
- IMS Voice Over PS



CHAPTER 14

# Handling Core Dump



## Feature Summary and Revision History

### Summary Data

| | |
|---|---|
| Applicable Product(s) or Functional Area | All |
| Applicable Platform(s) | • ASR 5500<br>• VPC-DI<br>• VPC-SI |
| Feature Default | Enabled - Always-on |
| Related Changes in This Release | Not Applicable |
| Related Documentation | • *ASR 5500 System Administration Guide*<br>• *Command Line Interface Reference*<br>• *VPC-DI System Administration Guide*<br>• *VPC-SI System Administration Guide* |

### Revision History

**Important** Revision history details are not provided for features introduced before releases 21.2 and N5.1.

| Revision Details | Release |
|---|---|
| With this release, changes are made to the maximum number of core transfers and the format of the core filename. | 21.20 |
| First introduced. | Pre 21.2 |

# Feature Changes

**Previous Behavior:**

- Maximum number of core transfers:

  When more than one process crashes, the simultaneous core file transfer was limited to a maximum of two at any given point of time and based on first come first serve basis.

  The maximum simultaneous core file transfer was increased from one to two cores as VPP crashes could induce simultaneous crashes in the boxer. Atleast one VPP full core has to be transferred at any time for debugging.

  Issue: When the process crashes in the 1st non-VPP -> 2nd non-VPP -> 3rd VPP sequence, the VPP core is discarded, transfer is based on first come first serve basis, and maximum of two cores are transferred.

- Core Filename:

  When the process crashes, the core file is transferred and stored with the filename compiled by its card number, CPU number, and hextime to make it unique and identifiable.

  Format: **crash-<cardno>-<cpuno>-<hextime>-core**

  Issue: When two or more processes crash at the same hextime along with the same card and CPU number, the generated cores are written to the same core filename causing corruption.

**New Behavior:**

- Maximum number of core transfers:

  The maximum number of core transfers are restricted to two in case of [1] and one in case of [2] with one non-VPP and one VPP always at any given point of time.

  1. Maximum core transfer to two: For cores generated in the below sequences, both 1st and 2nd cores are transferred.

     1st non-VPP -> 2nd VPP core

     1st VPP + 2nd non-VPP core

  2. Maximum core transfer to one: For cores generated in the below sequences, the 1st core is transferred and the 2nd core is discarded.

     1st VPP -> 2nd VPP core

     1st non-VPP -> 2nd non-VPP core

- Core File Name:

  For all cores, the filename is extended by adding the PID of the process to make it unique, even when two or more processes crash at the same hextime along with the same card and CPU number.

Format: **crash-<cardno>-<cpuno>-<pid>-<hextime>-core**

**Customer Impact:**

The scripts must be updated to the new format, if the coded core filename is in the old format.

Old format for core file: **crash-<cardno>-<cpuno>-<hextime>-core**

New format for core file: **crash-<cardno>-<cpuno>-<pid>-<hextime>-core**

# Command Changes

### Configuring VPP Core Transfer

Use the following configuration to enable or disable mandating VPP core transfer along with non-VPP.

```
configure
   [ no ] crash enable vpp-core-transfer
   exit
```

**NOTES:**

- **crash enable vpp-core-transfer**: Enables mandating VPP core transfer.
- **no crash enable vpp-core-transfer**: Disables mandating VPP core transfer.
- Default: Enabled

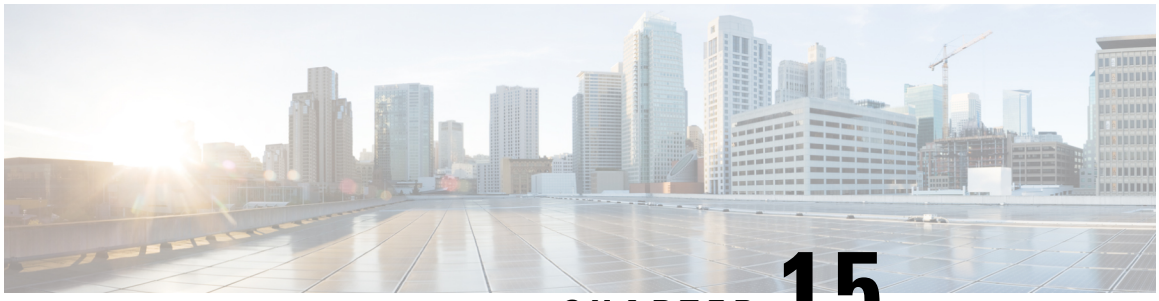
# Performance Indicator Changes

### show crash config

The existing **show crash config** command is enhanced to display the VPP core transfer status. The **Mandatory VPP Core Transfer** field displays whether VPP core transfer is enabled or disabled.

Sample Output:

```
# show crash config
URL                          : /hd-raid/cores
Disk Space Limit             : Not Configured
Rotate Core Files Limit      : 15 (default)
Core File Max-Size           : 4096 MB
Core File Compression        : gzip
Core Transmit Timeout        : 120 seconds
Core Obfuscation             : disabled
Async Core Transfer          : enabled
Mandatory VPP Core Transfer  : enabled
Critical Task                : enabled
#
```



CHAPTER 15

# Implicit Update Location to HSS



## Feature Summary and Revision History

### Summary Data

| | |
|---|---|
| Applicable Product(s) or Functional Area | MME |
| Applicable Platform(s) | • ASR 5500<br>• VPC-DI<br>• VPC-SI |
| Default Setting | Disabled - Configuration required |
| Related Changes in This Release | Not Applicable |
| Related Documentation | • Command Line Interface Reference<br>• MME Administration Guide |

### Revision History

| Revision Details | Release |
|---|---|
| In this release, Initial-Attach-Indicator flag is set in the Implicit ULR. | 21.16.6 |
| First introduced. | 21.14 |

# Feature Description

When the attach has a Globally Unique Temporary ID (GUTI), then MME queries for the subscriber information. If it has the subscriber information, then the Update Location Request (ULR) will not be executed because the UE information is updated already. Some of the customer devices cannot reset the old GUTI after returning to Home network from the visited network. This causes mismatch between Home Subscriber Server (HSS) and MME. Hence MME is expected to send ULR to HSS even when the subscriber Database(dB record) is present at the MME so that the HSS and the MME are in the sync.

**Setup Initial-Attach-Indicator Flag Enhancement:** In StarOS 21.16.6 release, the MME supports Initial-Attach-Indicator bit in the implicit ULR with the configuration enabled through CLI. You can set the initial attach indication flag during local GUTI attach with the available subscriber DB.

# Configuring Implicit Update Location to HSS

## Enabling Implicit Update Location to HSS

Use the following commands to send Implicit ULR without setting initial attach indication flag.

```
configure
     call-control-profile call_control_profile_name
        [ no ] attach implicit-ulr
        end
```

**NOTES:**

- **attach implicit-ulr**: Attaches the implicit ULR. By default implicit-ulr is disabled.
- **no**: Removes the configuration to implicitly send the ULR for local GUTI reattach.

Use the following command to send Implicit ULR with initial attach indication flag set.

```
configure
     call-control-profile call_control_profile_name
        attach implicit-ulr initial-attach-flag
        end
```

**NOTES:**

- **attach implicit-ulr**: Attaches the implicit ULR. By default implicit-ulr is disabled.
- **initial-attach-flag**: Enables Initial-attach-indication flag in Implicit-ULR.

### Reset Initial-Attach-Indication flag in Implicit ULR

To reset, configure **attach implicit-ulr** under call-control-profile configuration mode as below.

```
configure
     call-control-profile call_control_profile_name
         attach implicit-ulr
        end
```

Disable sending of Implicit ULR.

```
configure
     call-control-profile call_control_profile_name
        no attach implicit-ulr
       end
```

# Monitoring and Troubleshooting

This section provides information regarding show commands available to monitor and troubleshoot the MME Minimization Drive Test feature.

## Show Commands and Outputs

### show call-control-profile full all

A new show command out put "Implicit Sending of ULR during local GUTI attach" is added to indicate configured value (Enabled/Disabled).

## show call-control-profile full all

The output of this command includes the following fields:

| Field | Description |
|---|---|
| Implicit Sending of ULR during local GUTI attach | Shows whether implicit sending of ULR messages during local GUTI attach is enabled or disabled. |
| Set Initial-Attach-Indication flag in Implicit ULR | Shows whether initial attach flag is enabled or disabled. |

# Bulk Statistics

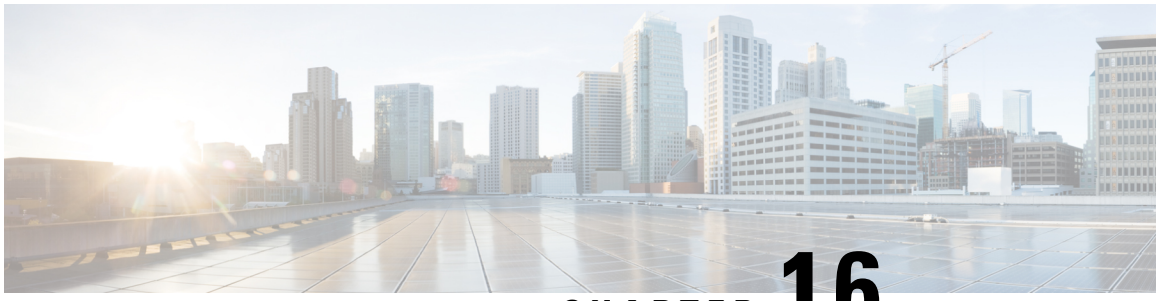
This section provides information on the bulk statistics for the Implicit update to HSS on MME.

## HSS Schema Statistics

The following bulk statistics are included in the HSS peer service statistics to track overall statistics.

*Table 5: Bulk Statistics Counters in the HSS Peer Service Statistics*

| Counters | Description |
|---|---|
| UL Request | The total number of Update Location Request messages containing the result code "Other Errors" received by the HSS peer service from the HSS. |
| UL Answer | The total number of Update Location Answer messages containing the result code "Other Errors" received by the HSS peer service from the HSS. |



CHAPTER 16

# MEC Location Management



## Feature Summary and Revision History

### Summary Data

| | |
|---|---|
| Applicable Product(s) or Functional Area | MME |
| Applicable Platform(s) | • ASR 5500<br>• VPC-DI<br>• VPC-SI |
| Default Setting | Enabled - Always-on |
| Related Changes in This Release | Not Applicable |
| Related Documentation | • *Command Line Interface Reference*<br>• *MME Administration Guide*<br>• *Statistics and Counters Reference* |

### Revision History

| Revision Details | Release |
|---|---|
| MEC UP configuration enhancement. | 21.16 |
| PGW-U IP address is used for User Plane address. | 21.15 |
| First introduced. | 21.14 |

# Feature Description

Mobile Edge Computing (MEC) Support is used to bring application with low latency requirements and capabilities to the carrier's network in order to explore a wide range of new use cases and applications. This feature enables selection of proper Edge User Plane nodes for MEC user sessions.

With release 21.16, MEC UP configuration is enhanced to configure multiple TALs under a MEC group. MME allows to mix and match the TALs under a MEC group.

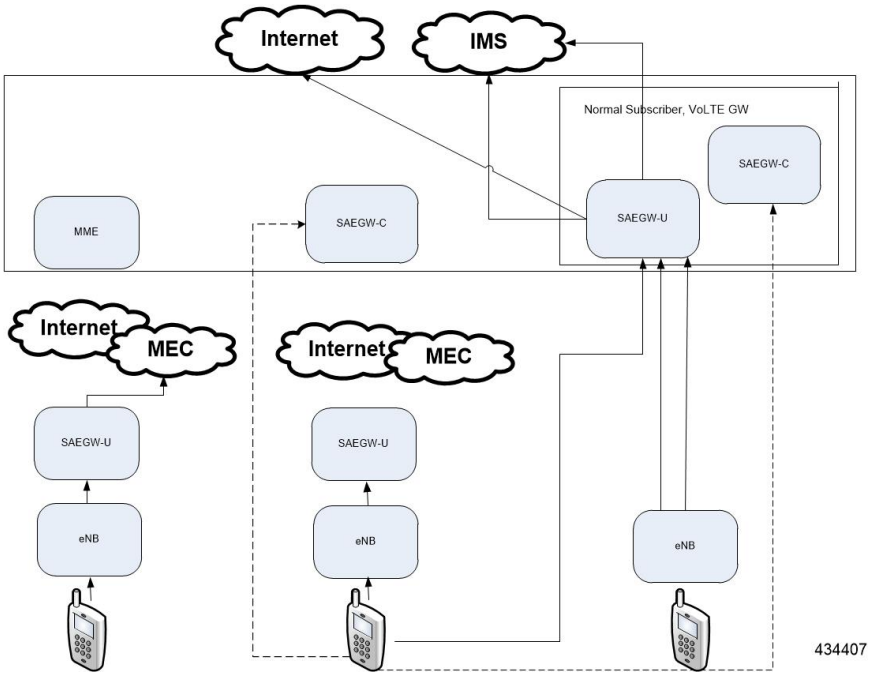
**Note** TAI List and UP address for MEC group can be configured either in TAI Management DB or MEC TAI Group. It is recommended to configure using only one option.

# How It Works

## Architecture

This section describes the MEC architecture.

***Figure 7: MEC Architecture***




## Flows

This section describes the call flow procedures related to MEC support.

Whenever the user moves to idle mode, each PDN's default bearer is checked to see if the GW-U IP address matches the TAI List. If a mismatch is found, paging is initiated.

When the user connects back again either by TAU or Service Request based on the new tracking area from where the TAU or Service Request is received, each PDN's default bearer is checked to see if the GW-U IP address matches the TAI List. If mismatch is found and if the PDN and UE Usage is marked Re-connect in APN Profile, the PDNs are deleted with Re-Activation cause code. TAI List will be taken from TAI Management DB or MEC TAI Group based on the configuration of TAI List and UP address".

*Figure 8: Attach in TA-1, TAU from TA-2, IDLE Mode and SR in TA-2*

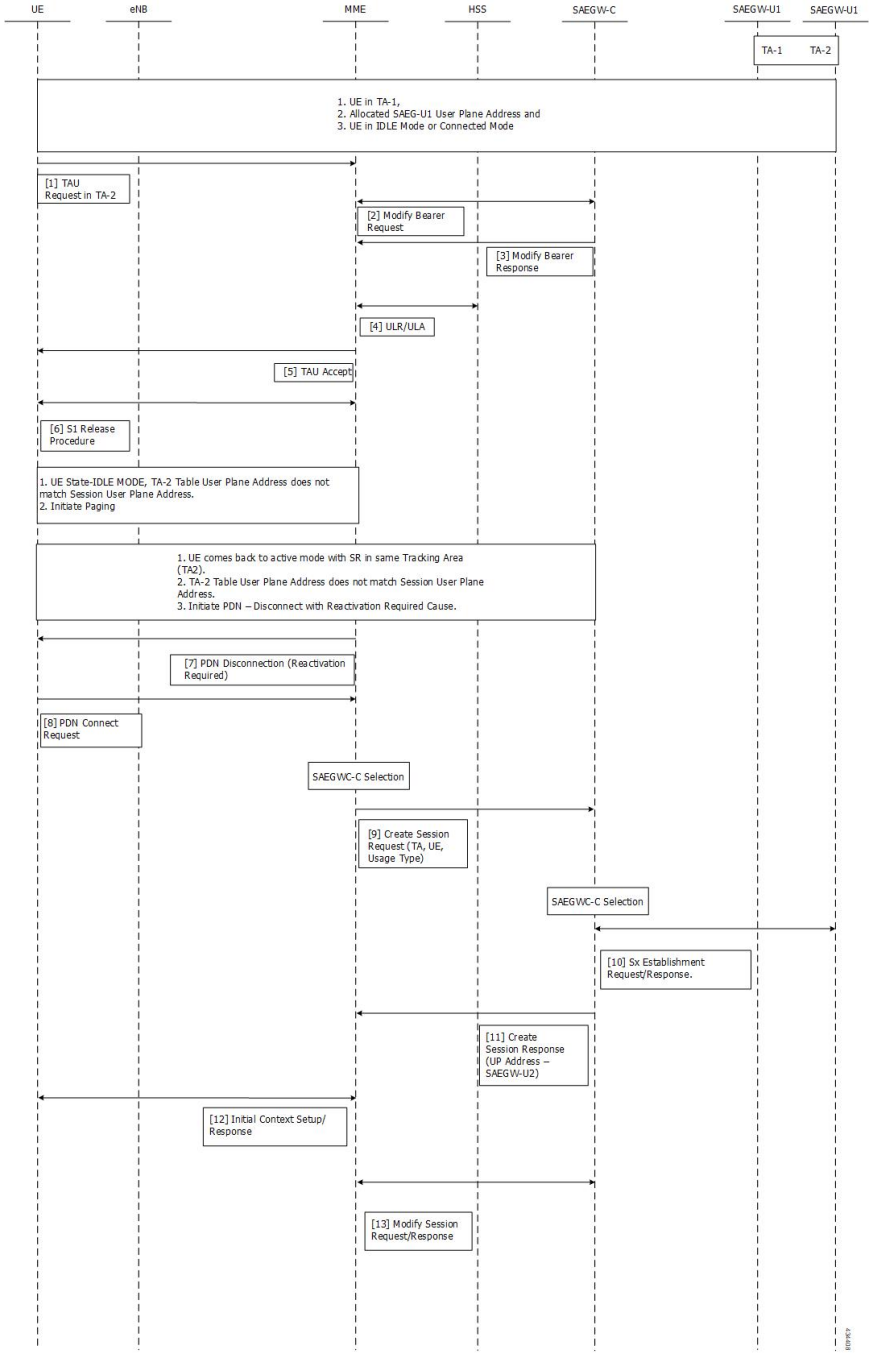
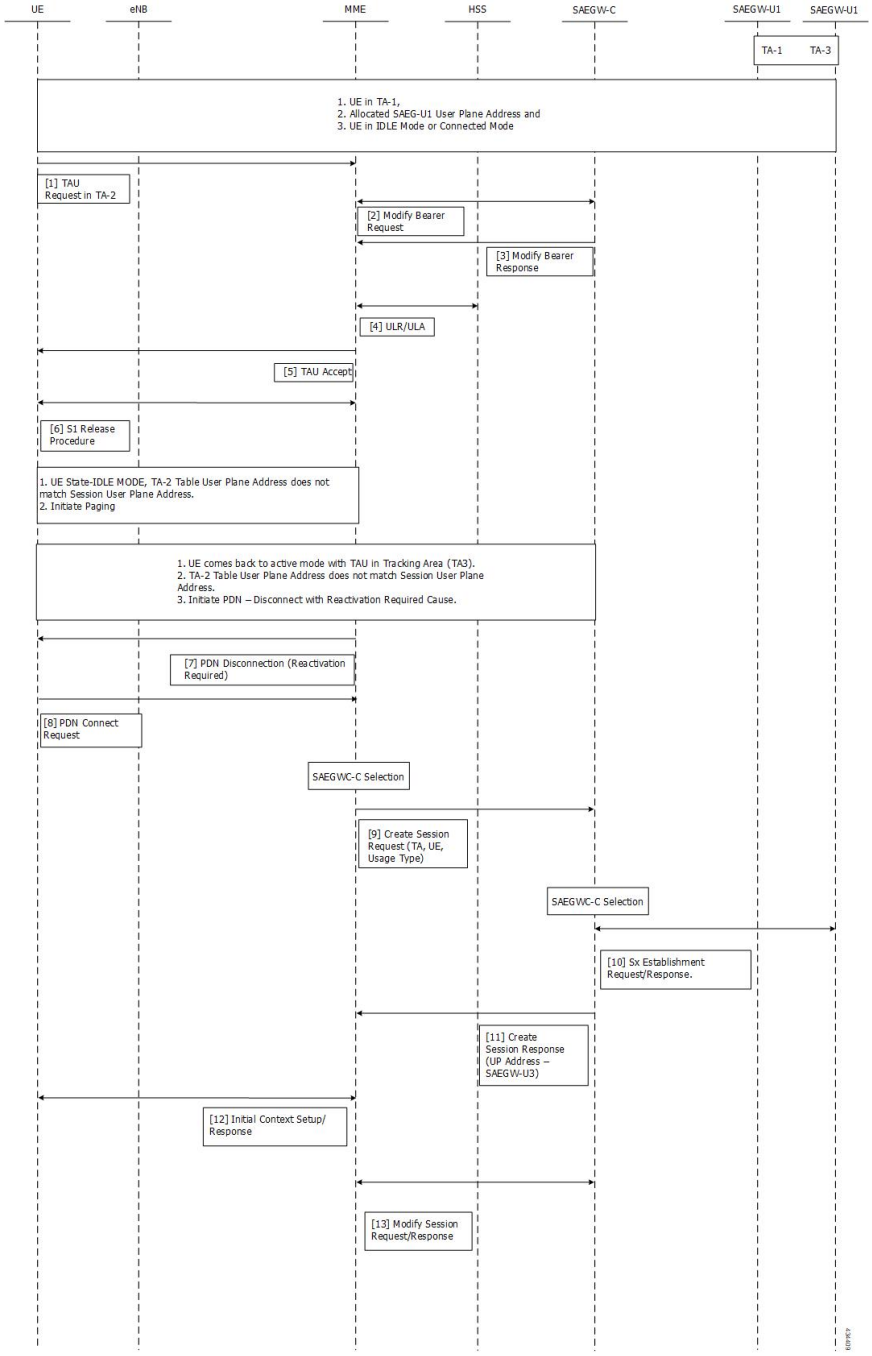


*Figure 9: Attach in TA-1, TAU from TA-2, IDLE Mode and TAU in TA-3*




# Configuring MEC Support

This section provides information on the CLI commands to configure MEC Support in the MME.

# Configureing up-address in TAI Management DB

Use the following configuration to configure the addresses of User Plane Nodes Serving all TAIs in this object.

```
configure
  lte-policy
    tai-mgmt-db tai_mgmt_db_name
      tai-mgmt-obj tai_mgmt_obj_name
        [ no ] up-address ( IP-ADDRESS | IP-ADDRESS/MASK }
        end
```

**NOTES:**

- **no**: Removes the addresses of User Plane Nodes Serving all TAIs in this object.
- **[ no ] up-address ( IP-ADDRESS | IP-ADDRESS/MASK }** Configures the addresses of User Plane Nodes Serving all TAIs in this Object. **IP-ADDRESS** must be an IPV4 ##.##.##.## or IPV6 ####:####:####:####:####:####:####:####. Also supports :: notation **IP-ADDRESS/MASK** must be an IPV4 ##.##.##.##/x or IPV6 ####:####:####:####:####:####:####:####/x.

# Configuring up-address in MEC TAI Group

Use the following configuration to configure the up-address of User Plane Nodes Serving all TAIs in this object.

```
configure
  lte-policy
    mec-tai-grp mec_tai_grp_name
        [ no ] up-address ( IP-ADDRESS | IP-ADDRESS/MASK } mef-address
 iPV4/iPV6_address
        end
```

**NOTES:**

- **no**: Removes the addresses of User Plane Nodes Serving all TAIs in this object.
- **up-address ( IP-ADDRESS | IP-ADDRESS/MASK }** Configures the addresses of User Plane Nodes Serving all TAIs in this Object. **IP-ADDRESS** must be an IPV4 ##.##.##.## or IPV6 ####:####:####:####:####:####:####:####. Also supports :: notation **IP-ADDRESS/MASK** must be an IPV4 ##.##.##.##/x or IPV6 ####:####:####:####:####:####:####:####/x.
- **mef-address** *iPV4/iPV6_address*: Configures the peer MEF server address for MEF signalling.*iPV4/iPV6_address* must be IPV4 ##.##.##.## or IPV6 ####:####:####:####:####:####:####:#### (IPV6 also supports :: notation).

# Configuring tai in MEC TAI Group

Use the following configuration to configure the Tracking Area Identity.

```
configure
  lte-policy
    mec-tai-grp mec_tai_grp_name
      [ no ] tai mcc mcc_value mnc mnc_value { tac value1... value20  | tac-range
```

```
from tac_value_from to tac_value_to }
        [ no ] up-address ( IP-ADDRESS | IP-ADDRESS/MASK }
        end
```

**NOTES:**

- **no**: Removes the configuration of tai.
- **mec-tai-grp** *mec_tai_grp_name*: Configures MEC TAI Group.*mec_tai_grp_name* must be a string between 1 to 64. Maximum of 50 MEC TAI Groups can be configured.
- **tai**: Specifies the Tracking Area Identity.
- **mcc** *mcc_value*: Specifies the Mobile Country Code.*mcc_value* must be a three digit integer between 0 to 999.
- **mnc** *mnc_value*: Specifies the Mobile National Code.*mnc_value* must be a two / three digit integer between 00 to 999.
- **tac** *value1... value20*: Specifies the Tracking Area Code. Upto 20 Tracking Area Codes can be entered on one line. It can be configured by entering TAC directly or using range. *value1... value20* must be an integer between 0 to 65535.
- **tac-range from** *tac_value_from* **to** *tac_value_to* : Specifies the Range of Tracking Area Code. Maximum of 5 ranges in a MEC TAI group can be configured. *tac_value_from* and *tac_value_to* must be an integer between 0 to 65535.

# Configuring up-service-area-change

Use the following configuration to configure action for User-Plane Service Area Change for MME.

```
configure
   context context_name
     apn-profile apn_profile_name
       up-service-area-change disconnect-pdn [ ue-usage-type ]
ue_usage_type_values
       end
```

**NOTES:**

- **up-service-area-change**: Configures action for User-Plane Service Area Change for MME.
- **disconnect-pdn**: Enables reselection of User Plane Node by PDN disconnection.
- **ue-usage-type** *ue_usage_type_values*: Configures UE usage type for disconnecting PDN for UP service area. *ue_usage_type_values* must be an integer 1 through 255.

**Important** Release 21.15 onwards, PGW-U IP address is used for User Plane address.

# Monitoring and Troubleshooting

This section provides information regarding show commands available to monitor this feature.

# Show Commands and Outputs

### show mme-service statistics

The output of this command includes the following fields:

Paging Initiation for SIGNALING PDN RECONN Events:

- Attempted
- Success
- Failures
  - Success at Last n eNB
  - Success at TAI List
  - Success at Last TAI

### show lte-policy mec-tai-grp name <grp_name>

The output of this command includes the following fields:

MEC TAI Group group grp_name

- TAI mcc 123 mnc 45 tac 2010 2011 2457
- TAI mcc 123 mnc 456 tac
- UP-address 192.80.80.10 MEF-ADDRESS 192.80.80.175

### show lte-policy mec-tai-grp summary

- MEC TAI Group group1
- MEC TAI Group group2

# Bulk Statistics

The following statistics are added in support of the MEC Location Management feature:

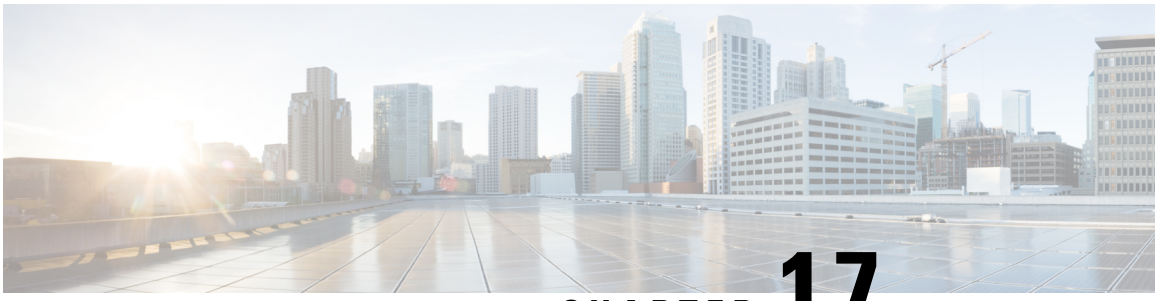
***Table 6: MME Schema***

| Bulk Statistics | Description |
|---|---|
| signalling-pdn-reconn-paging-init-events-attempted | The total number of ECM Statistics-related Paging requests to UE, to reconnect PDN, that were attempted. |
| signalling-pdn-reconn-paging-init-events-success | The total number of ECM Statistics-related Paging requests to UE, to reconnect PDN, that were successful. |

| Bulk Statistics | Description |
|---|---|
| signalling-pdn-reconn-paging-init-events-failures | The total number of ECM Statistics-related Paging requests to UE, to reconnect PDN, that failed. |
| signalling-pdn-reconn-paging-last-enb-success | The total number of ECM Statistics-related Paging requests to UE to reconnect PDN that succeeded at the last known eNodeB. |
| signalling-pdn-reconn-paging-last-tai-success | The total number of ECM Statistics-related Paging requests to UE to reconnect PDN that succeeded at the last known Tracking Area Identifier. |
| signalling-pdn-reconn-paging-tai-list-success | The total number of ECM Statistics-related Paging requests to UE to reconnect PDN that succeeded at an eNodeB in all TAIs present in the TAI list assigned to the UE. |

***Table 7: TAI Schema***

| Bulk Statistics | Description |
|---|---|
| tai-signalling-pdn-reconn-paging-init-events-attempted | The total number of ECM Statistics-related Paging requests to UE, to reconnect PDN, that were attempted. |
| tai-signalling-pdn-reconn-paging-init-events-success | The total number of ECM Statistics-related Paging requests to UE, to reconnect PDN, that were successful. |
| tai-signalling-pdn-reconn-paging-init-events-failures | The total number of ECM Statistics-related Paging requests to UE, to reconnect PDN, that failed. |
| tai-signalling-pdn-reconn-paging-last-enb-success | The total number of ECM Statistics-related Paging requests to UE to reconnect PDN that succeeded at the last known eNodeB. |
| tai-signalling-pdn-reconn-paging-last-tai-success | The total number of ECM Statistics-related Paging requests to UE to reconnect PDN that succeeded at the last known Tracking Area Identifier. |
| tai-signalling-pdn-reconn-paging-tai-list-success | The total number of ECM Statistics-related Paging requests to UE to reconnect PDN that succeeded at an eNodeB in all TAIs present in the TAI list assigned to the UE. |



CHAPTER 17

# MO Voice Call and MO Exception Data Support



## Feature Summary and Revision History

### Summary Data

| | |
|---|---|
| Applicable Product(s) or Functional Area | MME |
| Applicable Platform(s) | • ASR 5500<br>• VPC-DI<br>• VPC-SI |
| Default Setting | Disabled - Configuration Required |
| Related Changes in This Release | Not Applicable |
| Related Documentation | • *Command Line Interface Reference*<br>• *MME Administration Guide*<br>• *Statistics and Counters Reference* |

### Revision History

| Revision Details | Release |
|---|---|
| First Introduced. | 21.16 |

# Feature Description

eNodeB forwards the Attach Request message to MME contained in a S1-MME control message (Initial UE message) together with the Selected Network and an indication of the E-UTRAN Area identity, a globally unique E-UTRAN ID of the cell, RRC establishment cause and GUMMEI ID. MME handles the ASN encoding and decoding of RRC establishment causes for emergency, HighPriorityAccess, mt-Access, mo-Signalling, mo-Data. The ASN encoding and decoding of RRC establishment cause mo-voicecall and mo-exceptiondata is not supported and responds with an error "Transfer Syntax Error". For MME to be in compliant with release 13 handset, it needs to handle both the new cause values, and for mo-exepctiondata MME has to maintain the MO Exception Data Counter for Serving PLMN Rate Control purposes. Mo-exceptiondata arrives for NB-IoT RAT type.

mo-exceptiondata counter: MME allows operator to configure the MO Exception Data counter and threshold value for reporting the counter values to S-GW. On configuring, MME maintains UE specific mo_exceptiondata counter and timestamp in UE subscriber DB and will remains until purge occurs. This data once allocated is retained until the DB associated with the UE is purged. When RRC establishment cause arrives for first time, MME increments the counter by 1 and updates the creation timestamp. On subsequent arrivals, MME will just increment the counter value.

The counter with timestamps is included in create session request message for TAU with MME and SGW change, Modify bearer request for UE triggered service request and Change notification request message when there is a change in the ECGI or TAI. If the counters are already reported, then MME does not send the counters in subsequent modify bearer message of UE Triggered Service Request or Notification of ECGI and/or TAI changes.

# How It Works

## Limitations

This section describes the known limitations for the MME MO Voice Call and MO Exception Data Support feature:

- MME maintains the UE specific mo-exceptiondata counter values in subscriber DB. The data once allocated will be retained until the DB is associated with the UE. On purge timeout the nonreported counter values are lost as the subscriber DB is flushed. If the operators configure mo-exception-data reporting-threshold-value to 1, on receiving RRC establishment cause mo-exceptiondata then MME reports the counter changes to SGW.

# Configuring MO Voice and MO Exception Data Support

This section provides information on the CLI commands to configure exception data reporting.

## Configuring MO Exception Data Reporting Threshold Value

Use the following configuration to configure NBIOT RRC Cause MO exception data reporting threshold value.

```
configure
  call-control-profile profile_name
    nb-iot mo-exception-data reporting-threshold-value value
    remove nb-iot mo-exception-data
    end
```

**NOTES:**

- **remove** : Removes the configuration of NBIOT RRC Cause MO exception data.
- **nb-iot** : Enables configuration for NB-IoT Access Type.
- **mo-exception-data**: Configures NBIOT RRC Cause MO Exception Data counter.
- **reporting-threshold-value** *value* : Specifies reporting threshold value. *value* Must be an integer from 1 to 50.

# Monitoring and Troubleshooting

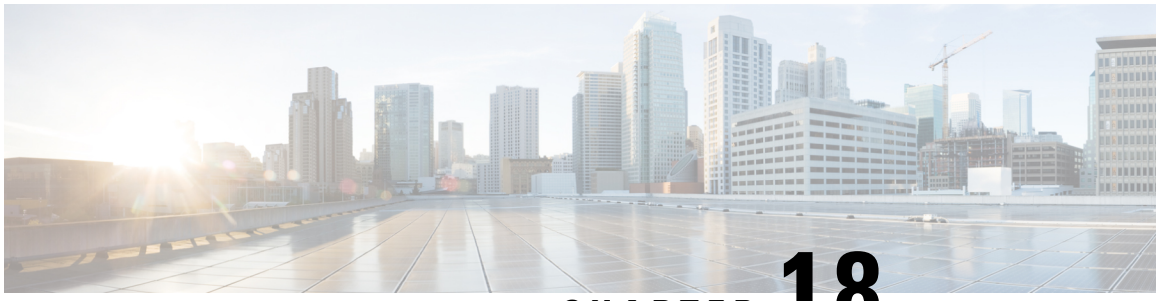
This section provides information regarding show commands available to monitor and troubleshoot the MO Voice and MO Exception Data Support.

## Show Commands and Outputs

### show call-control-profile full all

The output of this command includes the following fields:

- NBIOT RRC Cause MO Exception Data counter
- NBIOT MO Exception Data counter reporting threshold value



CHAPTER 18

# Merging of afrecordinfo under Custom24 Dictionary



## Feature Summary and Revision History

| | |
|---|---|
| Applicable Product(s) or Functional Area | P-GW |
| Applicable Platform(s) | • ASR 5500<br>• VPC - DI<br>• VPC-SI |
| Feature Default | Disabled - Configuration Required |
| Related Changes in This Release | Not Applicable |
| Related Documentation | • *GTPP Interface Administration and Reference Guide*<br>• *Command Line Interface Reference, Modes G - H* |

### Revision History

| Revision Details | Release |
|---|---|
| In this release, P-GW supports merging of afrecordinfo attribute in custom24 dictionary for generating IMS APN charging data record. | 21.16.7 |

# Feature Description

GTPP interface supports ICID – IMS Charging ID attribute in the Charging Data Record (CDR). The **afChargingIdentifier** attribute is added to the Custom 24 dictionary and gttp_attribute_afrecordinfo() CLI configuration function is supported under show different modes such as, CLI_CMD_SET, CLI_CMD_NO and CLI_CMD_DEFAULT. The existing two attributes are also supported in custom24 dictionary:

- UE Tunnel Info (UE-IP-Address and PORT) for VoWiFi calls available in custom24.
- QCI information for the dedicated bearer available in custom24.

# Enabling afrecordinfo under Custom24 Dictionary

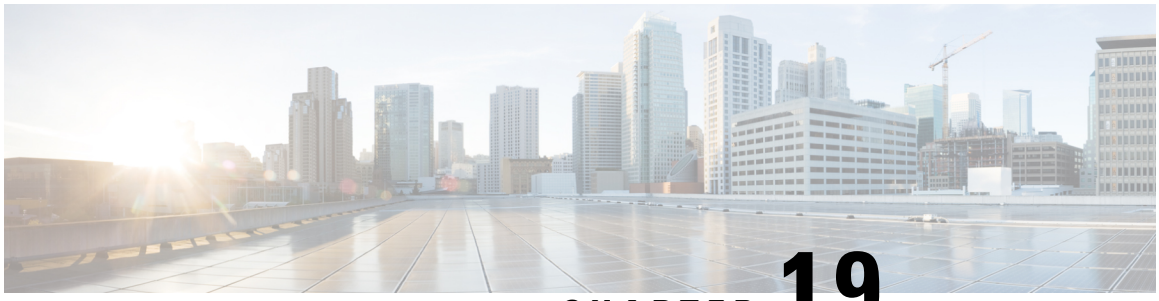
Use the following configuration to enable **afrecordinfo** attribute in Custom24 dictionary.

```
configure
  context context_name
    gtpp group default
      gtpp charging-agent address IP adress
      no gtpp source-port-validation
      gtpp max-cdrs value wait-time value
      gtpp attribute diagnostics
      gtpp attribute  local-record-sequence-number
      gtpp attribute node-id-suffix  value
      no gtpp attribute node-id  string
      gtpp served-pdp-pdn-address-extension ipv4 address  |ipv6 address
      gtpp attribute af-record-info
      gttp attribute ue-tun-ip-port
      gtpp dictionary custom24
    exit
```

**Notes**:

- **gtpp group** <*name*>: The GTPP group name under which the **afrecordinfo** attribute is configured by default.
- **gtpp attribute diagnostics**: Includes the **Diagnostic** field in the CDR that is created when PDP contexts are released.
- **gtpp attribute local-record- sequence- number**: Includes the optional **Local Record Sequence Number** and **Node-ID** fields in the CDR.
- **gtpp attribute node-id-suffix** <*string*> : Specifies the suffix to use in the **Node-ID** field of PGW-CDRs. With the default setting of "no", the P-GW uses the active-charging service name for the **Node-ID** field.
- **no gtpp attribute af-record-info** : **no gtpp attribute af-record-info** will disable the inclusion of **afrecordinfo** in the custom24 dictionary.
- **gtpp attribute node-id**: Enables the **Node-ID** field in the CDR.

- **af-record-info** : Enable this attribute to include the **AF Charging Identifier** keyword and associated flow identifiers generated by the AF and received by the P-GW over Gx interfaces. This keyword is applicable to custom24 GTPP dictionary.
- **ue-tun-ip-port** : Specifies S2b (VoWifi) call/subscriber parameter in CDR. This keyword is applicable to custom24 GTPP dictionary.



CHAPTER 19

# Password Strengthening Requirements for UAS Components



## Feature Summary and Revision History

### Summary Data

| | |
|---|---|
| Applicable Product(s) or Functional Area | UAS |
| Applicable Platform(s) | UGP |
| Feature Default | Enabled - Always-on |
| Related Changes in This Release | Not applicable |
| Related Documentation | • *Ultra Services Platform Deployment Automation Guide*<br>• *Ultra M Solutions Guide* |

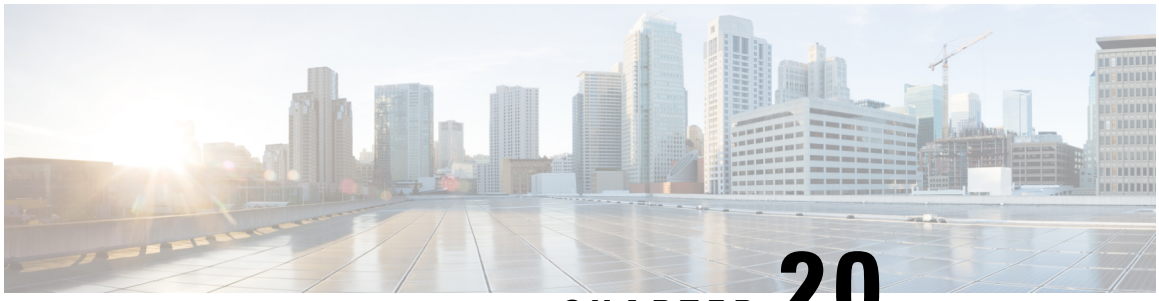
### Revision History

| Revision Details | Release |
|---|---|
| First introduced. | 6.10 |

## Feature Description

This feature imposes these additional regulations for the passwords of all user, local, administrative, and system accounts to improve the security.

- The passwords configured for UAS components and UEM must not contain any repetitive alphabets or digits (for example, aaaa, 1111).
- The passwords must not contain any dictionary words.



CHAPTER 20

# Skip APN Redirection for IMS APN



## Feature Summary and Revision History

### Summary Data

| | |
|---|---|
| Applicable Product(s) or Functional Area | MME |
| Applicable Platform(s) | • ASR 5500<br>• VPC-DI<br>• VPC-SI |
| Default Setting | Enabled - Always on |
| Related Changes in This Release | Not Applicable |
| Related Documentation | • *Command Line Interface Reference*<br>• *MME Administration Guide* |

### Revision History

| Revision Details | Release |
|---|---|
| First introduced. | 21.16 |

# Feature Description

with release 21.16, when IMS APN is not available under subscription information, MME will not redirect it to the APN available under first in subscription/lowest context id, instead the PDN CONNECTIVITY REQUEST is rejected with cause code 27(Unknown or Missing APN). This feature is CLI controlled, and it is disabled by default.

# Configuring Skip APN Redirection for IMS APN

This section provides information on the CLI commands to configure Configuring Skip APN Redirection for IMS APN the in MME.

## Configuring Subscription Failure

Use the following configuration to configure Subscription Failure.

```
configure
   apn-remap-table apn_remap_table_name
      apn-remap network-identifiernetwork_identifier_name new-ni  new_ni_name
subscription-failure reject
        no apn-remap network-identifiernetwork_identifier_name
        end
```

**NOTES:**

- **no**: Removes the apn-remap network identifier.
- **apn-remap**: Creates a Remap Entry.
- **network-identifier** *network_identifier_name*: Specifies the Network Identifier part of the APN. *network_identifier_name* must be a string of size 1 to 63 that include alphabetic characters (A-Z and a-z), one *, and digits.
- **new-ni** *new_ni_name*: Specifies the Remapped Network Identifier part of the APN. *new_ni_name* must be a string of size 1 to 62 that include alphabetic characters (A-Z and a-z), digits.
- **subscription-failure**: Subscription failure for requested APN.
- **reject**: Specifies the rejection with cause code Unknown or Missing APN.

# Monitoring and Troubleshooting

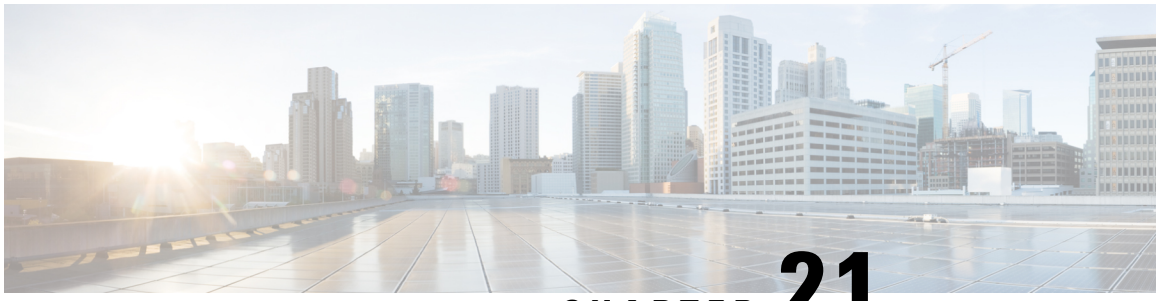
This section provides information regarding show commands available to monitor and troubleshoot the Skip APN Redirection for IMS APN.

# Show Commands and Outputs

### show apn-remap-table full all

The output of this command includes the following fields:

- Do not Redirect if Subscription is not available - Indicates "Do not Redirect if Subscription" is enabled or disabled.



CHAPTER 21

# UE IP and UDP Source Port in CDR and Gy CCRU for Dedicated Bearer of WiFi Calls



## Feature Summary and Revision History

### Summary Data

| | |
|---|---|
| Applicable Product(s) or Functional Area | P-GW |
| Applicable Platform(s) | • VPC-DI<br>• VPC-SI |
| Feature Default | Disabled - Configuration Required |
| Related Changes in This Release | Not Applicable |
| Related Documentation | Not Applicable |

### Revision History

| Revision Details | Release |
|---|---|
| First Introduced | 21.16.9 |

## Feature Changes

**Previous Behavior:** UDP Source port was not written in QCI1 CDR for VoWIFI calls when UDP Source port and UE IP received in Create Bearer Response was the same as received in Create Session Request.

**New Behavior:** Effective with StarOS21.16 release,a new CLI **netloc-s2b-ue-ip-udp-port-always** can be configured in APN to write UE IP and UDP Source Port in Gy Messages and CDR for the Dedicated Bearer of WiFi call, even if values of these IEs are unchanged in CBRsp,UBRsp,or DBRsp.

For changes in UE IP and/or UDP port, the behavior remains the same as existing behavior without the CLI configured.

**Customer Impact**: Not applicable.

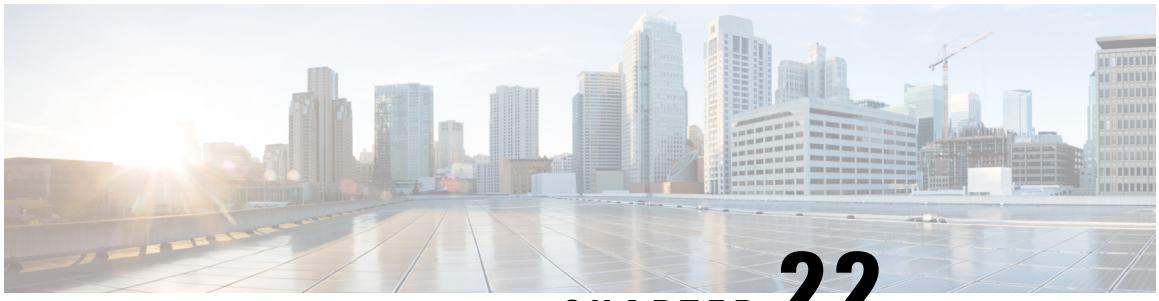
# Command Changes

Use the following CLI configuration to write uELocalIPAddress and uDPSourcePort in Gy Messages and CDR for dedicated bearer.

```
configure
   context context_name
     apn apn_name
        [ no ] netloc-s2b-ue-ip-udp-port-always
        end
```

**NOTES**:

- **netloc-s2b-ue-ip-udp-port-always**: Writes uELocalIPAddress and uDPSourcePort in Gy Messages and CDR for dedicated bearer always. This option is disabled by default.
- **no**: Disables the feature and its the default configuration.



CHAPTER 22

# Upgrade and Migration of Open SSH to Cisco SSH



## Feature Summary and Revision History

### Summary Data

| | |
|---|---|
| Applicable Product(s) or Functional Area | All |
| Applicable Platform(s) | • ASR 5500<br>• VPC-DI<br>• VPC-SI |
| Feature Default | Enabled - Always-on |
| Related Changes in This Release | Not applicable |
| Related Documentation | • *ASR 5500 System Administration Guide*<br>• *Command Line Interface Reference*<br>• *VPC-DI System Administration Guide*<br>• *VPC-SI System Administration Guide* |

### Revision History

**Important** Revision history details are not provided for features introduced before releases 21.2 and N5.1.

| Revision Details | Release |
|---|---|
| With this release, the algorithm values of Ciphers and MACs are modified based on the upgrade and migration of OpenSSH to CiscoSSH. | 21.16 |
| First introduced. | Pre 21.2 |

# Feature Changes

As a security measure for Cisco ASR 5500 and VPC products, the Ciphers and MACs algorithm values are modified to support the upgrade and migration of the Open SSH to Cisco SSH versions.

**Previous Behavior**: In releases earlier to 21.16, the **default** algorithm values of the **cipher** and **macs** commands were as follows:

- **Cipher**

  **21.15 (Normal build only)**

  Resets the value of *algorithm* in a Normal build to:

  `blowfish-cbc,3des-cbc,aes128-cbc,aes128-ctr,aes192-ctr,aes256-ctr,aes128-gcm@openssh.com,aes256-gcm@openssh.com,chacha20-poly1305@openssh.com`

- **MACs**

  **21.15 (Trusted build only)**

  Resets the value of *algorithm* in a Trusted build to:

  `hmac-sha2-512-etm@openssh.com,hmac-sha2-256-etm@openssh.com,hmac-sha1-etm@openssh.com,hmac-sha2-512,hmac-sha2-256,hmac-sha1`

- **KEX Algorithms**

  **21.15**

  **Available Algorithms in Normal and Trusted Builds:**

  `diffie-hellman-group1-sha1,diffie-hellman-group14-sha1`

**New Behavior**: In this release, the **default** algorithm values of the **cipher** and **macs** commands are as follows:

- **Cipher**

  **Release 21.16 onwards: Post OpenSSH to CiscoSSH Upgrade and Migration**

  **Default Algorithms in a Normal Build:**

  `aes256-ctr,aes192-ctr,aes128-ctr,aes256-gcm@openssh.com,aes128-gcm@openssh.com,chacha20-poly1305@openssh.com`

  **Available Algorithms in a Normal Build:**

  `aes256-ctr,aes192-ctr,aes128-ctr,aes256-gcm@openssh.com,aes128-gcm@openssh.com,chacha20-poly1305@openssh.com,aes128-cbc`

  **Default and Available Algorithms in Trusted Builds:**

  `aes256-ctr,aes192-ctr,aes128-ctr`

**Note** There is no change in the default and configurable Ciphers for Trusted builds.

- **MACs**

  **Release 21.16 onwards: Post OpenSSH to CiscoSSH Upgrade and Migration**

  **Default and Available Algorithms in Normal Builds:**

  ```
  hmac-sha2-512-etm@openssh.com,hmac-sha2-256-etm@openssh.com,hmac-sha1-etm@openssh.com,hmac-sha2-512,
  hmac-sha2-256,hmac-sha1
  ```

  **Default Algorithms in Trusted Builds:**

  ```
  hmac-sha2-512,hmac-sha2-256,hmac-sha1
  ```

  **Available Algorithms in Trusted Builds:**

  ```
  hmac-sha2-512,hmac-sha2-256,hmac-sha1
  ```

  **Note** hmac-sha2-512-etm@openssh.com,hmac-sha2-256-etm@openssh.com,hmac-sha1-etm@openssh.com are removed from the Trusted builds.

- **KEX Algorithms**

  **Release 21.16 onwards: Post OpenSSH to CiscoSSH Upgrade and Migration**

  **Available Algorithms in Normal and Trusted Builds:**

  ```
  diffie-hellman-group14-sha1
  ```

  **Note** KEX algorithms are not configurable in StarOS. Therefore, there are no CLI changes.