

Events Monitoring

- Feature Summary and Revision History, on page 1
- Feature Description, on page 2
- How it Works, on page 9
- Configuring MME Services and Call Control Profiles , on page 21
- Configuring Monitoring Events Profile , on page 23
- Configuring External-identifier in lte-policy, on page 27
- Configuring congestion-action-profile for Monitoring Events , on page 27
- Monitoring and Troubleshooting, on page 28

Feature Summary and Revision History

Summary Data

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

Revision History

Revision Details	Release
This releae supports communicatation of monitoring information from MME to SCEF through Interworking(IWK) SCEF.	21.20
The Events Monitoring and External-Identifer features are fully qualified in this release.	21.19.1
This release supports: • Monitoring Event configuration request and response over S6a and T6a interfaces. • External-identifier support on MME for Monitoring Events feature. **Important** Monitoring Events and External-identifier features are not fully qualified in this release and are available only for testing purposes. For more information, contact your Cisco Account Representative.	21.19
First introduced.	21.18

Feature Description

The Event Monitoring functionality allows monitoring of specific events in the 3GPP system and makes the event information available through either Service Capability Exposure Function (SCEF) or Home Subscriber Server (HSS). Allows the identification of the 3GPP network elements that are suitable for configuring specific events, detecting events, and reporting events to the authorized users. MME supports Roaming functionality for monitoring events through Interworking (IWK) SCEF by communicating the monitoring information to SCEF.

The following example explains a specific use case for an individual subscriber.

A subscriber can track the following events:

- Loss of Connectivity
- UE Reachability
- Location Reporting
- Communication Failure
- Availability after DDN Failure
- Number of UEs Present in a Geographical Area

Note This is a node level event unlike other events that are specific to a subscriber.

- UE Reachability and Idle Status Indication

- Availability after DDN Failure and Idle Status Indication
- PDN Connectivity Status

In StarOS 21.19 and later releases, MME supports monitoring events on s6a and t6a interfaces for monitoring the following events:

- **Loss of Connectivity**–Event is triggered when UE's radio connectivity is lost. HSS configures the Loss of Connectivity event through ULA/ISDR messages. Event reporting happens through RIR with event-specific parameters. The following AVPs are supported.

Table 1: Supported AVPs

AVPs	Parameters
Loss-Of-Connectivity-Reason - Identifies the reason of loss of connectivity	**UE_DETACHED_MME (0)** **UE_PURGED_MME (4)**

- **UE Reachability**–Monitoring Events reports when UE transitions to ECM-CONNECTED mode (for a UE using Power-Saving Mode or extended idle mode DRX) or when the UE reaches for paging (for a UE using extended idle mode DRX).

Table 2: Supported AVPs

AVPs	Parameters
UE-Reachability-Configuration	**[Reachability-Type]** **[Maximum-Response-Time** MME uses the Maximum Response Time as the Active Time for PSM UEs only if the configuration is enabled as part of Monitoring Events Profile.
Event Reporting	**Reachability-Information** **Maximum-UE-Availability-Time**

- **Location Reporting**–Monitoring Events sends report when the MME detects that the UE changed location with the granularity as requested by the monitoring event configuration. If there is Minimum Reporting Interval, while the timer is running, the MME suppresses sending consecutive Location Reporting notification. On timer expiry MME sends location information that was contained in the latest suppressed Location Reporting notification and restarts the timer. The supported Accuracy in the network is at either cell level (ECGI), eNodeB, or Tracking Area (TA) level.

  Location Reporting is supported for Current Location or the Last Known Location of a UE. One-time and Continuous Location Reportings are supported for the Current Location. The Location Reporting type allows:

  - One Time Reporting: If the requested location type is "Last known location", it is one time reporting only.
  - Continuous Location Reporting: If a Minimum Reporting Interval is not available, the serving node sends a notification every time it becomes aware of a location change. If periodic time was provided as part of the configuration, MME starts the periodic timer, after sending the first location report.

Table 3: Supported and Unsupported AVPs

AVPs	Parameters
Location-Information-Configuration	**[MONTE-Location-Type]** **[Accuracy]** **[Periodic-Time]**
MONTE-Location-Type	**CURRENT_LOCATION (0)** **LAST_KNOWN_LOCATION (1)** **Note** The default value, when this AVP is not included, is LAST_KNOWN_LOCATION (1).
Common Parameter	Maximum number of reports should not be greater than one if Monitoring-Type is **Location Reporting (2)** and MONTE-Location-Type is **Last Known Location (1)**
MME Location Information	**[E-UTRAN-Cell-Global-Identity]** **[Tracking-Area-Identity]** **[eNodeB-ID]**
Unsupported AVP	
MME Location Information	**[Geographical-Information]** **[Geodetic-Information]** **[Current-Location-Retrieved]** **[Age-Of-Location-Information]** **[User-CSG-Information]** **[Extended-eNodeB-ID]**

- **Communication Failure** –Event is triggered when the MME becomes aware of a RAN or NAS failure event. Event configuration by HSS through ULA/ISDR messages.

Table 4: Supported AVPs

AVPs	Parameters
Communication-Failure-Information	**[Cause-Type]** **[S1AP-Cause]**

- **Availability after DDN Failure**–MME triggers this event when the UE contacts the network, for example, to perform a TAU, or to execute a service request after DDN Failure.

Note Not every DDN failure triggers this event. This event is triggered only when DDN failure had occurred due to UE being in PSM or Extended idle mode DRX.

- Maximum number of Reports is not applicable for this event.

Table 5: Supported AVPs

AVPs	Parameters
Event configuration	**Monitoring -Type: AVAILABILITY_AFTER_DDN_FAILURE (6)**
Event Reporting	**Monitoring-Type set to AVAILABILITY_AFTER_DDN_FAILURE (6)**

- **Number of UEs Present in a Geographical Area**–This is triggered from SCEF to MME in the Configuration Information Request (CIR) message. MME responds with a Configuration Information Answer (CIA) message with the reports, status, and supported Attribute-Value Pair (AVPs). From SCEF, MME processes EUTRAN, TAI, enodeB as hex values based on the 3GPP specifications 29.272, and 29.274.

The following table describes the supported feature AVPs.

Table 6: Supported and Unsupported AVPs

AVPs	Parameters
Number-of-UE-Per-Location-Configuration	**{ EPS-Location-Information }** **[IMSI-Group-Id]** MME supports parsing of one Monitoring-Event-configuration with a maximum of three Number-of-UE-Per-Location-Configurations (in CIR). It responds with a CIA message with Monitoring-Event-Config-Status and one Monitoring-Event-Report.
MME-Location-Information	**[E-UTRAN-Cell-Global-Identity]** **[Tracking-Area-Identity]** **[User-CSG-Information]** **[eNodeB-ID]** For the above mentioned Location Information criteria, MME counts the number of UEs matching the criteria and sets the UE count in the CIA.

AVPs	Parameters
Number-of-UE-Per-Location-Report	**{ EPS-Location-Information }** **{ UE-Count }** **IMSI-Group-Id** **{ Group-Service-Id }** **{ Group-PLMN-Id }** **{ Local-Group-Id }**
IMSI-Group-Id	**{ Group-Service-Id }** **{ Group-PLMN-Id }** **{ Local-Group-Id }**
Unsupported AVP	
Location Information	**[Geographical-Information]** **[Geodetic-Information]** **[Current-Location-Retrieved]** **[Age-Of-Location-Information]** **[Extended-eNodeB-ID]** For the above mentioned criteria, MME sets UE count as 0 in the CIA.

Limitations: The Monitoring-Event-configuration AVPs have the following limitations:

- If the Number of UE events is unsupported, then MME responds with a Result-Code set to DIAMETER_UNABLE_TO_COMPLY.
- If the Monitoring Event type is other than seven (Number-of-UE-Per-Location-Configuration) or Number-of-UE-Per-Location-Configuration AVP is empty, then MME responds with a Result-Code set to DIAMETER_UNABLE_TO_COMPLY.
- If the TA/ECGI location requested by the SCEF is not served by the MME, then the MME sets UE count as 0 in the CIA.
- CIR sent from SCEF within three seconds from previous CIR gets queued in MME with the maximum queue size of five.
- **PDN Connectivity Status**–Supports the following AVPs.

Table 7: Supported AVPs

AVPs	Parameters
PDN-Connectivity-Status-Event configuration	HSS to MME: ULA / ISDRA Monitoring Event Type is set to PDN-Connectivity-Status-Configuration **[Service-Selection]** If the Service-Selection AVP is available, then the monitoring applies to that specific APN. If the Service-Selection is not available the monitoring request applies to all APNs.
PDN-Connectivity-Status-Report	**{ Service-Selection }** **{ PDN-Connectivity-Status-Type }** **[PDN-Type]** **[Non-IP-PDN-Type-Indicator]** **[Non-IP-Data-Delivery-Mechanism]** **[Served-Party-IP-Address]**

- **Idle Status Indication for Availability after DDN failure and UE reachability** – MME supports Idle Status Indication when the UE transitions into idle mode. The MME includes the time at which the UE transitioned into idle mode, the active time, and the periodic TAU/RAU time granted to the UE by the MME in the notification sent towards the SCEF, the eDRX cycle length, and the suggested number of downlink packets if a value is provided to the S-GW.

Table 8: Supported AVPs

AVPs	Parameters
Idle-Status-Indication	**[Idle-Status-Timestamp]**–Time at which the UE transitioned into idle mode. **[Active-Time] d**– The active time if PSM is enabled. **[Subscribed-Periodic-RAU-TAU-Timer]**–The periodic TAU/RAU time granted to the UE by the MME. **[eDRX-Cycle-Length]**–The eDRX cycle length if eDRX is enabled. **[DL-Buffering-Suggested-Packet-Count]** –The Suggested number of downlink packets sent to the S-GW.

- **External-identifier on MME for Monitoring Events**– The External-identifier feature is applicable for the ULR/ULA, DSR/DSA, and IDR/IDA command pairs over S6a (and S6d), when the MME supports the External-identifier.

- MME includes the External-identifier or the MSISDN if present in the subscription data received from the HSS in the User Identifier AVP towards SCEF in RIR.

Note If the MME does not support External-identifier, MME will not process the External-Identifier if received in the subscription data.

- When you receive External Identifier AVP as part of Monitoring Event Configuration AVP, it has higher precedence than the same AVP received under Subscription Data AVP of ULA/ISDR.

- **Gtpv2 (S10 and S3 Interfaces)**–Monitoring Event information IE and Monitoring Event Extension Information IE are supported and filled as applicable.
- **Tracking Area Code in RIR**–MME includes the following AVP in every RIR Monitoring Event Report Message towards SCEF (except when the monitoring type is Location Reporting) to report UE location (TAC) when the event report is generated. MME supports enabling and disabling configuration at CallControlProfile level (Monte profile) and MME service (Monte profile). By default, it is disabled.

```
Monitoring-Event-Report
 [ EPS-Location-Information ]
         [MME-Location-Information]
              [ Tracking-Area-Identity ]
```

Rat-Type and IMSI-Group-Id Filters

The following method describes how to configure Rat-Type and IMSI-Group-Id filters for the operators:

- By default the Rat-Type Filter is configured to all.
- For the Number of UEs requested location criterion, MME matches the requested location criteria for each UE.
  - If IMSI-Group filtering is requested, then the exact count of the number of UEs belonging to the provided IMSI Group that are known to be at the requested location is included in the CIA.
  - If IMSI-Group filtering is not requested, then the exact count of the number of UEs belonging to the provided requested location is calculated and included in the CIA.

To calculate the number of UEs count belonging to a requested location, MME does number of UEs filtering based on the Rat-Type and IMSI-Group-ID:

By default, the Rat-Type Filter is configured to access type 'all' for number of UE events under *monitoring-event* profile.

- MME checks if a subscriber Rat-Type matches with the configured RAT-Type.
- If the Rat-Type configured does not match, MME will not do further location search for that subscriber.
- If Rat-Type matches, it proceeds to check if the IMSI-Group-Id is present in CIR request message.

If the IMSI-Group-Id filtering is requested:

- MME checks to match with any of the subscribers configured IMSI-Group-Id (each subscriber can have maximum of five IMSI-Group-ID configured). If a match is found, then the UE/subscriber location is matched with the requested location criteria and only then number of UEs count is incremented.

If the IMSI-Group-Id filtering is not requested:

- UE location is matched with the requested location criteria. If match is found only, then number of UEs count is incremented. This is performed for all the UEs located at MME.

Session Recovery Support

MME supports the recovery of monitoring events configurations when there is a session manager task failure. Following are the post recovery functions:

- If the periodic time is present as part of the location reporting configuration, the same gets restarted only after sending the report for first location change.
- UE reachability reporting related to paging occasions for UEs in idle mode gets resumed only when the UE moves again to the idle state.



Note Monitoring events-related statistics are not recovered as part of recovery mechanism.

How it Works

This section describes how monitoring events work for the following events:

- **Number of UEs Present in a Geographical Area** –MME and SCEF exchanges the UE information based on the location information through Configuration Information Request (CIR) and Configuration Information Answer (CIA) messages
- **Communication Failure**–The communication failure events that happen between MME and HSS can be monitored, when HSS sends a communication failure message in the monitoring event configuration. MME receives the message through Insert Subscriber Data Request (ISDR) or Update Location Answer (ULA) on s6a interface. The MME sends the Monitoring Event Report for the communication failure event to SCEF over t6a interface through RIR (Reporting-Information-Request) messages.
- **External-identifier**–MME supports the following External-identifier functions:
  - If enabled in CLI, updates HSS on External-identifier support.
  - If MME receives external identifier as part of Monitoring Event Configuration Grouped AVP, this external identifier is sent in RIR to SCEF.
  - If external identifier AVP is NOT received as part of Monitoring Event Configuration AVP but, received in Subscription Data AVP, the same is updated in RIR to SCEF.
- **IMSI-Group**–MME supports following IMSI-Group-Id functions:
  - Updates HSS through ULA, ISDR, and DSDR.
  - MME replaces stored IMSI-Group Ids, if any, with the received information on receiving IMSI-Group-Id AVP(s) within the Subscription-Data AVP.
  - Supports maximum of five IMSI-Group-ID for each UE.

- **UE Reachability**–MME uses the timer values sent by HSS for PSM enabled UEs when configured through cli. By default, it is disabled.

Table 9: MME behavior when PSM or eDRX or both are enabled

If Only PSM is Enabled	If Only eDRX is Enabled	If Both PSM and eDRX is Enabled
• RIR is sent when UE gets connected without Maximum-UE-Availability-Time. • If idle indication is enabled, RIR is sent when UE moves to idle.	• RIR is sent when UE gets connected without Maximum-UE-Availability-Time. • RIR is sent before every paging occasion with PTW as Maximum-UE-Availability-Time. • If idle indication is enabled, RIR is sent when UE moves to idle.	• RIR is sent when UE gets connected without Maximum-UE-Availability-Time. • If idle indication is enabled, RIR is sent when UE moves to idle. • RIR is sent before every paging occasion with PTW as Maximum-UE-Availability-Time.

Monitoring Events WorkFlow

This section describes the call flows in which the monitoring events procedures are performed.

Figure 1: Call Flow from SCEF to MME

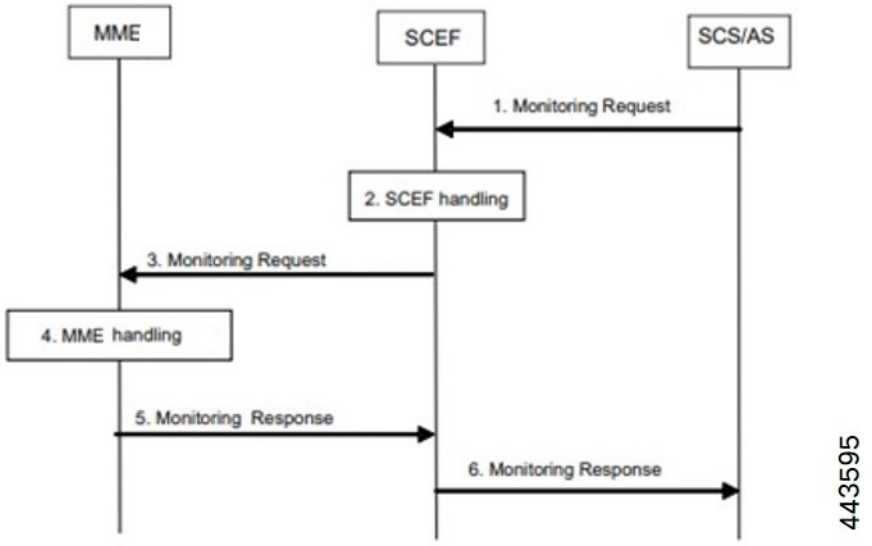


Figure 2: Call Flow from SCEF to MME

Table 10: Monitoring Event Configuration and Deletion through MME Procedure

Step	Description
1	The SCS/AS sends a Monitoring Request (SCS/AS Identifier, Monitoring Type, Monitoring Duration, Maximum Number of Reports, T8 Destination Address, T8 Long-Term Transaction Reference ID (TLTRI) for Deletion message to the SCEF. The SCEF assigns a TLTRI that identifies the Monitoring Request.
2	The SCEF stores the TLTRI, and also assigns it to an SCEF Reference ID.
3	The SCEF sends Monitoring Request such as SCEF ID, SCEF Reference ID, Monitoring Type, Monitoring Duration, Maximum Number of Reports and SCEF Reference ID for Deletion message to the MME.
4	• The MME examines whether to accept the request from the SCEF based on operator configuration or whether it serves the SCEF Reference ID for Deletion and can delete it. • If acceptable, the MME stores SCEF ID, SCEF Reference ID, Monitoring Duration, Maximum Number of Reports and other relevant parameters, unless it is a One-time request, and the Monitoring Event is available to the MME currently. • The MME deletes the monitoring configuration identified by the SCEF Reference ID for Deletion, if provided.
5	The MME sends a Monitoring Response (SCEF Reference ID, Cause) message to the SCEF to acknowledge acceptance of the Monitoring Request and to provide the requested monitoring information or to acknowledge the deletion of the identified monitoring event configuration, if it was requested.
6	The SCEF sends a Monitoring Response (TLTRI, Cause, Monitoring Event Report) message to the SCS/AS to acknowledge acceptance of the Monitoring Request and to provide the requested monitoring information in Monitoring Event Report parameter or to acknowledge the deletion of the identified monitoring event configuration at the time of request.

Figure 3: Monitoring Event Configuration and Deletion through HSS Call Flow

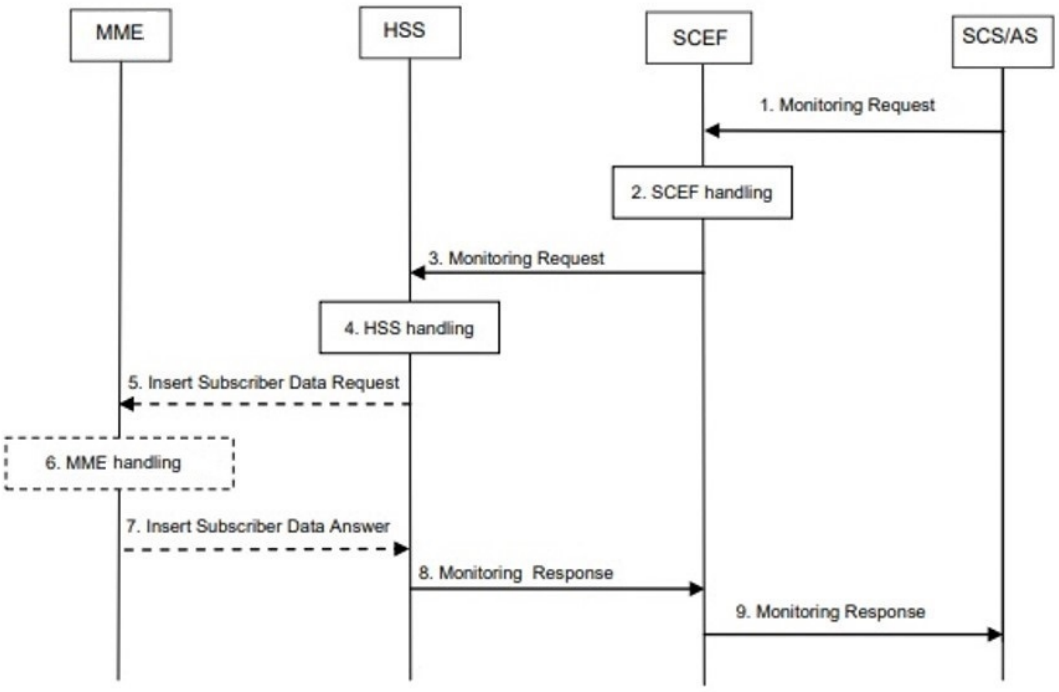


Table 11: Monitoring Event Configuration and Deletion through HSS Procedure

Step	Description
1	The SCS/AS sends a Monitoring Request message to the SCEF with necessary parameters. The request can be for both configuring and deleting any existing configuration..
2	The SCEF stores parameters provided and takes actions based on operator policies. The SCEF stores the T8 Long-Term Transaction Reference ID (TLTRI) and also assigns to an SCEF Reference ID.
3	The SCEF sends a Monitoring Request message to the HSS to configure the given Monitoring Event on the HSS/MME.
4	The HSS examines the Monitoring Request message, stores the parameter, and takes action based on operator policies.
5	HSS sends an Insert Subscriber Data Request (Monitoring Type, SCEF ID, SCEF Reference ID, Maximum Number of Reports, Monitoring Duration, SCEF Reference ID for Deletion, and so on) message to the MME for each individual UE. **Note** Monitoring Event Configuration can also be sent over ULA.

Step	Description
6	The MME stores the received parameters and starts to watch for the indicated Monitoring Event unless, it is a One-time request, and the Monitoring Event is available to the MME at the time of sending Insert Subscriber Data Answer. The MME deletes the monitoring configuration identified by the SCEF Reference ID for Deletion, if provided. MME does not perform any duplication checks regarding SCEF-Ref-id. To know more about MME handling refer the *MME Handling of Configuration and Deletion* section.
7	If the monitoring configuration is successful, the MME sends an Insert Subscriber Data Answer (Cause) message to the HSS. If the requested Monitoring Event is available to the MME at the time of sending Insert Subscriber Data Answer, then the MME includes the Monitoring Event Report in the Insert Subscriber Data Answer message. **Note** If configuration was received over ULA, reports will be sent over RIR towards SCEF
8	HSS sends a Monitoring Response message to the SCEF to acknowledge acceptance of the Monitoring Request.
9	SCEF sends a Monitoring Response message to the SCS/AS to acknowledge acceptance of the Monitoring Request.

MME Handling of Configuration and Deletion:

- The Diamproxy client, which is running on the StarOS device receives Monitoring Event Configuration Requests from the HSS through s6a interface under Subscription data grouped AVP or from the SCEF through t6a in Configuration Information Request message.
- AVP information received from the device is parsed and the message is sent to corresponding Session Manager for further handling.
- The Session Manager parses the event message and decodes the appropriate event.

Important MME running as part of Session Manager identifies if the message is synchronous and responds immediately or asynchronously. Requests from HSS are received in the Update Location Answer(ULA)/Insert Subscriber Data Request(ISDR).

If the response is determined as asynchronous, then the response is notified through t6a to SCEF directly.

- Event handling routine invokes handler for appropriate events.
- After the event handling, the report is sent through Monitoring Event Report message on s6a and t6a interface. Based on the event type, MME chooses to dispatch the report on S6a interface.
- If available, the HSS S6a Insert Subscriber Data Answer can contain the report for the Monitoring event (s). Configuration Information Answer and Reporting Information Request message can contain the report on t6a interface.

Limitation: After session manager recovery the Diamproxy client continues to send CIR to the same cached session manager instance until the next CMR is triggered from any of the active session manager instances. During this period MME will not handle the CIR message.

Figure 4: Monitoring Events Call Flow through Interworking (IWK) SCEF

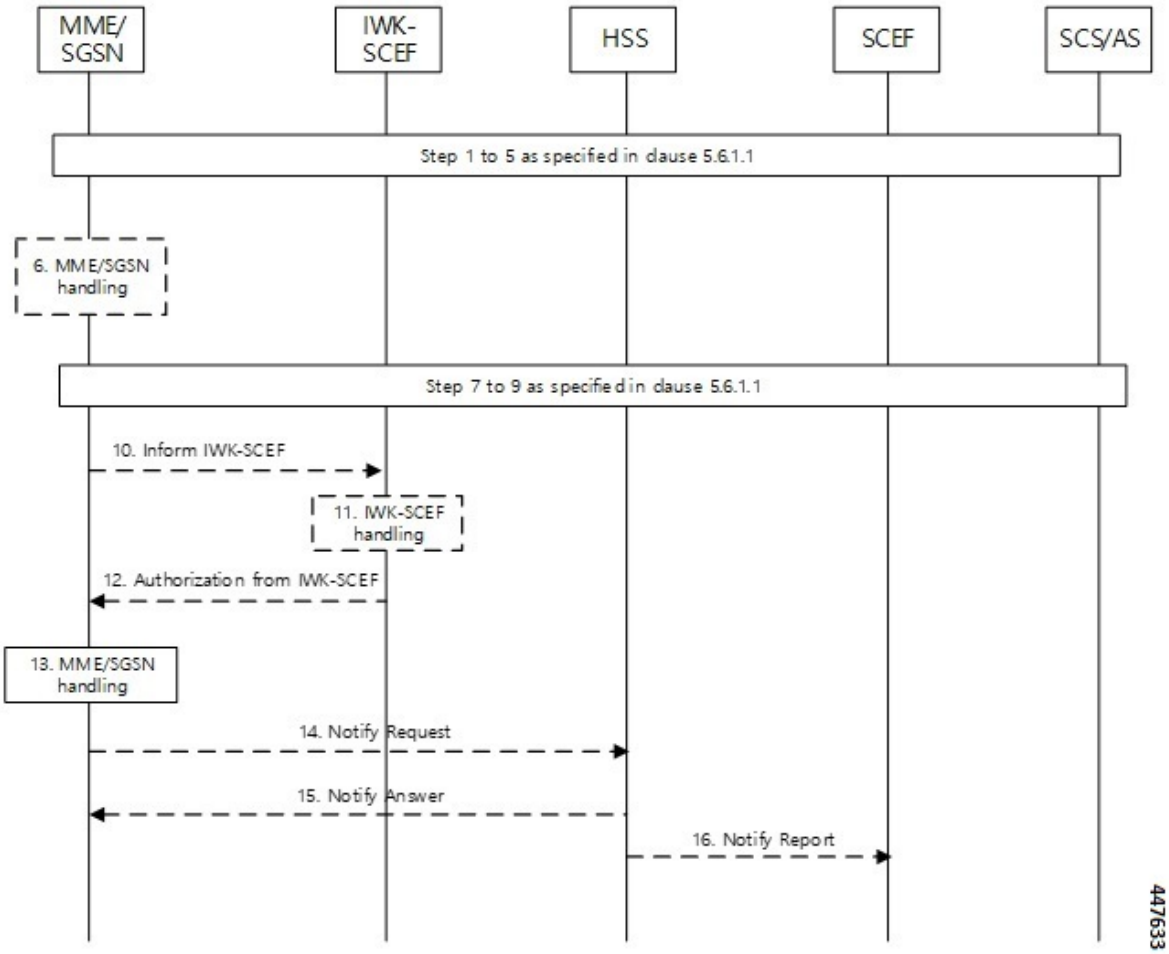


Table 12: Monitoring Event Configuration through IWK-SCEF Procedure

Step	Description
1 through 9	MME establishes a UE connection and learns the monitoring event configuration parameters from HSS through S6a interface. **Note** HSS S6a subscription data contains Monitoring event configuration AVPs that MME need to parse to learn the event.

Step	Description
10	MME checks: • for the roaming subscribers who have received monitoring event configuration in ULA/ISDR from HSS • whether roaming support and IWK SCEF details are configured as part of monitoring event profile. MME then constructs a Configuration Information Request message (CIR), which includes monitoring event configuration as received from HSS and Supported Features AVP. MME starts a timer for 6 seconds after sending CIR. When DSDR / ISDR with 'scef ref id for deletion' is received, MME deletes the respective config locally and also sends CIR with details of events to be deleted, with corresponding scef reference id filled as part of "SCEF-Reference-ID-for-Deletion" AVP.
11	IWK-SCEF either accepts or rejects events.

Step	Description
12 through 15	

Step	Description

	• If there is no response, MME considers timeout as failures and does not apply new monitoring configurations and for each rejected events MME sends NOR towards HSS separately.
	• If CIA is received from MME, MME passes through the message and checks if IWK-SCEF has sent any of the below failure causes and it takes necessary action accordingly.
	`At Message level ,`
	`Experimental code AVP :`
	`DIAMETER_ERROR_UNAUTHORIZED_REQUESTING_ENTITY (5510)`
	`DIAMETER_ERROR_UNAUTHORIZED_SERVICE (5511)`
	• If Experimental code AVP is not present, MME checks for Result code AVP.
	• If MME receives any of the above failure causes or result code is not success, MME does not apply any of the new monitoring events configuration sent in CIR and for each rejected events MME sends NOR towards HSS separately.
	• If message level IWK SCEF responds as success, MME checks for contents filled with Service-result-code AVP for every configuration sent.
	• If **Service-result-code** AVP is filled with Experimental Result Code values, MME checks for below causes, else MME considers it as Result-code values and takes action accordingly:
	`Experimental code values checked by MME:`
	`DIAMETER_ERROR_UNAUTHORIZED_REQUESTING_ENTITY (5510)`
	`DIAMETER_ERROR_UNAUTHORIZED_SERVICE (5511)`
	`DIAMETER_ERROR_CONFIGURATION_EVENT_STORAGE_NOT_SUCCESSFUL (5513)`
	`DIAMETER_ERROR_CONFIGURATION_EVENT_NON_EXISTANT (5514)`
	• If MME receives any of the above failure causes or result code is not success, MME does not apply those failed monitoring events configuration and for each rejected events MME sends NOR towards HSS separately. MME applies for the monitoring configurations which IWK SCEF had returned success and start reporting.
	• MME applies the monitoring events configuration that is accepted by IWK-SCEF.
	• MME continues to monitor for the events, triggers events, and sends the report to IWK-SCEF through Reporting Information Request (RIR).
	Important

Step	Description
	Unless IWK-SCEF rejects with any of the above failure causes, MME considers the same as success and monitoring events configuration are applied for subscribers.

Note

- MME does not include Monitoring Event Report as part of CIR to IWK SCEF. Instead, MME sends the available reports as part of RIR No reports are filled in ISDA for roaming subscribers.
- When current location is requested in ISDR as part of monitoring events configuration, paging or location reporting control gets triggered based on UE state. RIR with location report is sent only after receiving response for paging or location reporting and CIA from IWK SCEF.
- Number of UEs in geographical area is a node level messages and behavior will be the same for both roaming and home subscribers.

Monitoring Events Report Call Flow and Procedure

The following section describes call flows and procedures of monitoring events report.

Figure 5: Call Flow

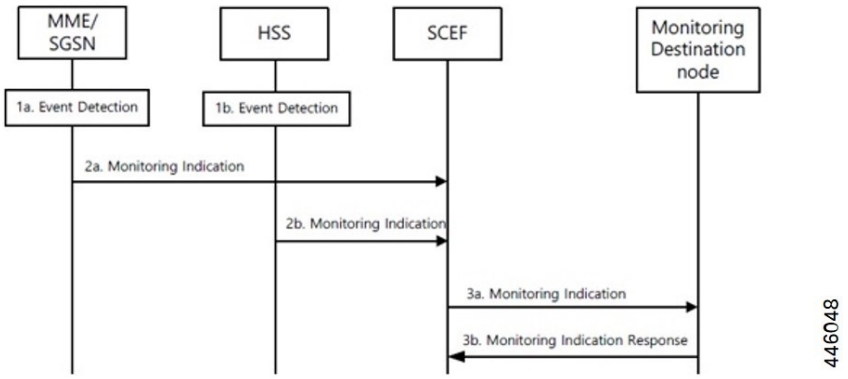


Table 13: Monitoring Event Report Procedure

Step	Description
1	MME detects events.
2	Report is sent through Monitoring Event Report message on s6a and t6a interface. For roaming subscribers, the report is sent through t6ai interface.

Configuring, monitoring, and reporting of new messages and AVPs for subscribers are supported by following mechanisms:

- Monitoring Event Configuration AVP in CIR message from SCEF over t6a interface.

- Monitoring Event Configuration in ULA/ISDR from HSS over s6a interface.
- Monitoring Event Report AVP from MME over t6a interface through CIA for the number of UE in a geographical area event.
- Monitoring Event Report AVP to HSS over S6a interface through ISDA message.
- Monitoring Event Report AVP to SCEF over t6a interface through RIR message.

Limitations

Following limitations are applicable for monitoring events functionality:

- Maximum of one Monitoring Event Configuration for each event for the UE is supported in MME. If MME receives same monitoring event configuration for same UE and Type, MME replaces the existing configuration and starts monitoring event reporting based on the new configuration.

  For Number of UEs in Geographic area, maximum of one Monitoring-Event-Configuration for each CIR message is supported.
- We recommend limiting the maximum number of UE with monitoring events enabled and active up to 50 percent of the maximum sessions for each session manager instance. Beyond this limit, there might be an impact on memory and CPU resources. There are no hard limits restricted within MME.
- Maximum of five IMSI-Group-Ids for each UE or subscriber is configured and maintained.
- If SCEF does not respond, MME does not retry the Reporting Information Request.
- Maximum range of Monitoring-Duration supported is limited to 30 days.
- The maximum length of SCEF-Id, SCEF-Realm, External-Identifier, Service-Selection AVP, and Local_Group_id AVP is 128 characters.
- T6a interface messages are not supported in mon sub (monitor subscriber).

Supported Standards

The Monitoring Events feature complies with the following 3GPP Release 16.0.0 specification standards:

- 3GPP TS 23.682
- 3GPP TS 29.128
- 3GPP TS 29.272
- 3GPP TS 29.274
- 3GPP TS 29.128
- 3GPP 23.401

Common Procedures and Parameters for Monitoring Events

Following procedures, messages and common parameters are supported for Monitoring Events.

Table 14: Supported Interfaces and Procedures

Interface	Description
S6a	Update Location Request Update Location Answer Insert Subscriber Data Request Insert Subscriber Data Answer Delete Subscriber Data Request Delete Subscriber Data Answer Notification Request Notification Answer
T6a	Reporting Information Request Reporting Information Answer Configuration Information Request Configuration Information Answer

Following table lists common AVPs on T6a and S6a interfaces.

Table 15: Common Procedures and AVPs

Procedure	Common AVPs
Monitoring-Event-Configuration	**[SCEF-Reference-ID]** **{ SCEF-ID }** **{ Monitoring-Type }** **[SCEF-Reference-ID-for-Deletion]** **[Maximum-Number-of-Reports]** **[Monitoring-Duration]** **[UE-Reachability-Configuration]** **[Location-Information-Configuration]** **[Number-Of-UE-Per-Location-Configuration]** **Note** Allows Maximum of 3 AVPs for each MONTE configuration. **PDN-Connectivity-Status-Configuration**
Monitoring-Event-Status	**[Service-Report],{ SCEF-Reference-ID }, [SCEF-ID]**

Procedure	Common AVPs
Monitoring-Event-Report	**SCEF-Reference-ID },[SCEF-ID], [Monitoring-Type], [Reachability-Information], [EPS-Location-Information],[Communication-Failure-Information],[Number-Of-UE-Per-Location-Report] , [Loss-Of-Connectivity-Reason], [Idle-Status-Indication], [Reporting-Time-Stamp], [Maximum-UE-Availability-Time], Maximum-UE-Availability-Time], [PDN-Connectivity-Status-Report]**

Following lists of GTPv2 IEs (S10 and S3) are supported for monitoring events:

- Monitoring Event Information
- Monitoring Event Extension Information

Configuring MME Services and Call Control Profiles

This section describes how to configure monitoring events for a call control profile.

Important When you configure MME service for users, monitoring-events is disabled by default. Whenever the operator enables the **MONTE** feature in a call control profile or mme-service, it is mandatory to associate a monitoring-event-profile.

Enabling the CLI monitoring-events in a Call Control Profile

Use the following configuration to enable CLI monitoring-events for all users in a call control profile.

```
configure
  call-control-profile profile_name
    [ no | remove ] monitoring-events
    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 and must be a string of 1-64 characters.

- **monitoring-events**: Enables the monitoring events under the call control profile mode.
- **no**: Disables CLI monitoring events in a call-control-profile for an MME service.
- **remove**: Removes the event configuration from the call-control-profile.

  :

Associating Monitoring Events Profile under Call Control Profile

Use the following configuration to associate a monitoring-event-profile CLI for all users in a call control profile. For the number-of-ue-events profile, the operator should enable the CLI and must associate at mme-service level. If the operator enables it at CCP level, then there will not be any effect as the configuration is a node-level message.

```
configure
   call-control-profile  profile_name
      associate monitoring-event-profile profile_monte
      end
```

NOTES:

- **call-control-profile** *profile_name*: Creates an instance of a call control profile. *profile_name* specifies the call control profile name, and must be an alphanumeric string of 1-64 characters.
- **associate monitoring-event-profile** *profile_monte*: Associates monitoring profiles in a call control profile whenever MONTE feature is enabled.

Configuring Monitoring Events for an MME Service

Use the following configuration to monitor events for an MME service:

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

NOTES:

- **mme-service** *service_name*: Specifies the name of the MME service and and must be a string of 1-63 characters.
- **monitoring-events**: Enables monitoring events for MME service users.
- **no**: Disables CLI monitoring-events in an MME Service.

Associating Monitoring Events Profile under MME Service

Use the following configuration to associate a monitoring-event-profile CLI for all users in an MME service.



Important monitoring-event-profile is mandatory for MME to start event monitoring.

```
configure
   context context_name
      mme-service service_name
         associate monitoring-event-profile  profile_monte
         end
```

NOTES:

- **mme-service** *service_name*: *service_name* specifies the MME service name, and must be a string of 1 to 63 characters.
- **monitoring-events**: Configures monitoring events for MME service users.
- **associate monitoring-event-profile** *profile_monte*: Associates monitoing profiles in an mme-service whenever MONTE feature is enabled.

Verifying the CLI monitoring-events in an MME Service

The following command is used to verify the parameters for Event Monitoring in an MME service:

- **show mme-service all | grep Monitor**

Sample Output Configuration:

```
[ingress]asr5500# show mme-service all | grep Moni
Tuesday April 28 20:31:23 IST 2020
Monitoring Event Profile : test
Monitoring Events : Enabled
```

Configuring Monitoring Events Profile

This section describes how to configure monitoring events profile in a lte-policy mode.

Configuring monitoring-event-profiles

Use the following command to configure monitoring event profiles to enable list of event types that MME can support.

```
configure
  lte-policy
    monitoring-event-profile  profile_monte
      events
      end
```

NOTES:

- **lte-policy** *profile_name*: Creates an instance of the lte-policy for monitoring events configuration.
- **monitoring-event-profile** *profile_monte profile_name*: Creates a monitoring events profile name under the lte-policy mode.
- **events** : Specifies the event types that MME supports. Options include:
  - loss-of-connectivity
  - ue-reachability
  - location-reporting
  - communication-failure
  - availability-after-ddn-failure

- idle-status-indication
- pdn-connectivity-status
- number-of-ue-in-geo-area
- Roaming Support



Note If the user configures with Idle Status Indication under the monitoring event profile, then it allows enabling of the following events:

- If UE Reachability (1) is configured, enables UE Reachability and Idle Status Indication(8) events.
- If Availability after DDN failure (6) is configured, enables Availability after DDN Failure and Idle Status Indication (9) events.

Enabling Additional CLI Parameters under number-of-ue-in-geo-area

Use the following CLI configuration to enable or disable SCEF IDs to list authorized SCEFs that can request number of UEs present in a geographical area:



Note Since this a node-level message, ensure to enable this CLI command and associate at mme-service level as number of UE events.

```
configure
  lte-policy
    monitoring-event-profile profile_monte
      [ no ] events number-of-ue-in-geo-area  authorized-scef-id  scef_id

      end
```

NOTES:

- **lte-policy** : Creates an instance of a lte-policy for monitoring events configuration.
- **monitoring-event-profile** *profile_monte* : Creates a monitoring events profile name under the lte-policy mode.
- **events number-of-ue-in-geo-area** : Lists the event type instance to enable the authorized SCEFs.
- **authorized-scef-id**: Enables SCEF IDs to list authorized SCEFs who can request this events.
- **[no]**: Disables authorized SCEF ID.

Configure RAT-Type Filter

Use the following CLI configuration to list number of UEs that are calculated based on access types.

```
configure
  lte-policy
    monitoring-event-profile profile_monte
      events number-of-ue-in-geo-area { nb-iot | wb-eutran }
      default events number-of-ue-in-geo-area
      end
```

NOTES:

- **lte-policy** : Creates an instance of a lte-policy for monitoring events configuration.
- **monitoring-event-profile***profile_monte* : Creates a monitoring events profile name under the lte-policy mode.
- **events number-of-ue-in-geo-area** : Lists the event type instance to enable the access type.
- **nb-iot**: Counts only UEs with Access type as NB-IOT.
- **wb-eutran**: Counts only UEs with Access type as EUTRAN.

Enabling Additional CLI Parameters under ue-reachability

Use the following CLI configuration to enable or disable the HSS provided values for active timer t3224 and subscribed periodic time t3412_E.

```
configure
  lte-policy
    monitoring-event-profile profile_monte
      [ no ] events ue-reachability hss-requested-psm-timers
      end
```

NOTES:

- **lte-policy** *profile_name*: Creates an instance of a lte-policy for monitoring events configuration.
- **monitoring-event-profile***profile_monte* : Creates a monitoring events profile name under the lte-policy mode.
- **no events ue-reachability**: Disables UE reachability events.
- **hss-requested-psm-timers**: MME applies t3324 and t3412_e timers from subscription data received from HSS. Overrides values defined in PSM policy.

edrx-reporting-occasions

Use the following LTE policy configuration to send the UE Reachability report on every paging occasions.

```
configure
  lte-policy
    monitoring-event-profile profile_monte
      events ue-reachability edrx-reporting-occasions
      minimum-cycle-value value reporting-offsetvalue
      end
```

NOTES:

- **lte-policy** *profile_name*: Creates an instance of a lte-policy for monitoring events configuration.

- **monitoring-event-profile***profile_monte* : Creates a monitoring events profile name under the lte-policy mode.
- **events ue-reachability** : Creates an instance of ue-reachability events.
- **edrx-reporting-occasions**: Triggers report on paging occasion for eDRX enabled UEs.



Note By default, the minimum-edrx-value is 13 and the reporting offset is 2 seconds.

- **minimum-cycle-value**: The minimum eDRX cycle value, above which the UE reachability reporting on paging occasions gets triggered.
- **reporting-offset**: Indicates how early the report will be sent before eDRX paging window occurs in seconds.

Track Area Code in Reporting Information Request

Use the following command to fill the Tracking Area Code (tac) value in every event reporting (RIR message) that is sent to SCEF. By default, the TAC in RIR feature is disabled..

```
configure
  lte-policy
    monitoring-event-profile profile_monte
      no events tac-in-rir
      end
```

NOTES:

- **lte-policy** *profile_name*: Creates an instance of a lte-policy for monitoring events configuration.
- **monitoring-event-profile***profile_monte* : Creates a monitoring events profile name under the lte-policy mode.
- **no events tac-in-rir**: Disables or fills TAC in all RIR messages sent to SCEF.

Enabling Roaming Support

Use the following CLI configuration to enable Roaming support:



Note It is mandatory to configure both host and realm of IWK-SCEF for roaming subscribers. Otherwise, MME considers roaming subscribers as home subsribers and routing of messages will happen accordingly.

```
configure
  lte-policy
    monitoring-event-profile map
      [no]roaming-support  dest host  scef_id
      [no]roaming-support   dest realm realm.com
      end
```

NOTES:

- **lte-policy** : Creates an instance of a lte-policy for monitoring events configuration.
- **monitoring-event-profile** *map* : Creates a monitoring events profile name under the lte-policy mode.
- **[no]roaming-support dest host** : Enables roaming support destination host name to communicate to SCEF through Interworking (IWK).
- **[no]roaming-support dest realm**: Enables roaming support destination realm name to communicate to SCEF through Interworking (IWK).
- **no** : Removes roaming support destination host or destination realm.



Note Make sure to configure both the parameters for roaming subscribers. Otherwise, routing happens like home subscribers.

Configuring External-identifier in lte-policy

This section describes how to configure External-identifiers in a lte-policy CLI.

Enabling external-identifier

Use the following configuration to enable the external-identier CLI in the LTE policy mode.

```
configure
     lte-policy
     monitoring-event-profile  profile_monte  profile_name
     external-identifier
       end
```

NOTES:

- **lte-policy** *profile_name*: Creates an instance of an lte-policy for monitoring events configuration.
- **monitoring-event-profile** *profile_monte profile_name*: Creates a monitoring events profile name under the lte-policy mode.
- **external-identifier**: Enables external-identifier feature support for monitoring-events.

Configuring congestion-action-profile for Monitoring Events

This section describes how to configure congestion action profile for monitoring events.

Enabling a congestion-action-profile Condition for Monitoring Events

Use the following configuration to enable CLI for congestion condition to drop or reject the monitoring-event-config requests in the LTE policy mode.

```
configure
     lte-policy
        [ no ] congestion-action-profile profile_name
          {drop | reject  monitoring-event-config-request}
            end
```

NOTES:

- **lte-policy** : Creates an instance of an lte-policy for monitoring events configuration.
- **[no] congestion-action-profile** : Removes the specified profile from the system.
- **congestion-action-profile** *profile_name* : Creates an instance of congestion profile for monitoring-events.
- **drop | reject monitoring-event-config-request** : Drops or rejects every new incoming Monitoring Event configuration without any reply.

Monitoring and Troubleshooting

This section provides information regarding show commands and bulk statistics available to monitor and troubleshoot the Monitoring Events feature.

Show Commands and Outputs

show mme-service statistics

show mme-service statistics

The output of this command includes the following fields:

- Loss of connectivity—Indicates the current session statistics of Loss of connectivity event configuration.
- UE Reachability—Indicates the current session statistics of UE Reachability event configurations.
- Location Reporting—Indicates the current session statistics of reporting location event configurations.
- Communication Failure—Indicates the current session statistics of Radio connection status failure events.
- Availability after DDN Failure—Indicates the current session statistics of Availability after DDN Failure event configuration.
- UE Reachability and Idle status indication—Indicates the current session statistics of UE Reachability and Idle status indication event configurations.
- Availability after DDN Failure and Idle Status indication—Indicates the current session statistics of Availability after DDN Failure and Idle Status indication event configuration.
- PDN connectivity status—Indicates that the current session statistics of PDN connectivity status event configuration.

Note In the StarOS 21.20 and later releases, After the UE Detach procedure, **Total Terminated** and **Total Current Sessions** counters in Statistics are updated only after purge timeout (purge time out + 10% of purge timeout) seconds. Whereas for releases on or before StarOS 21.19, **Total Terminated** and **Total Current Sessions** counters are updated immediately after the successful UE Detach Procedure.

show mme-service statistics-monte

The output of this command includes the following fields:

Monitoring Report Config Rx Count

- Loss of connectivity—Indicates that the number of Loss of connectivity event configuration received.
- UE Reachability—Indicates that the number of UE reachability event configurations received
- Location Reporting—Indicates that the number of reporting location event configurations received.
- Communication Failure—Indicates that the number of Radio connection status failure events received.
- Availability after DDN Failure—Indicates that the number of Availability after DDN Failure event configuration received.
- Number of UE in a geographic area—Indicates the received Number of UEs present in a geographic area event configuration.
  - Progress—Indicates the number of 'Number of UE in a geographic area' events under progress.
  - Pending—Indicates the number of 'Number of UE in a geographic area' events queued.
  - Drop— Indicates the number of 'Number of UE in a geographic area' events dropped.
- Idle status indication—Indicates that the number of Idle status event configurations received.
- PDN connectivity status—Indicates that the PDN connectivity status event configuration received.

Monitoring Report Config Tx Count: The output includes the following fields:

- Loss of connectivity—Indicates the number of loss of connectivity reports sent.
- UE Reachability—Indicates the number of UE reachability reports sent.
- Location Reporting—Indicates that the number of Location reports sent.
- Communication Failure—Indicates that the number of communication failure reports sent.
- Availability after DDN Failure—Indicates that the number of Availability after DDN Failure reports sent.
- Number of UE in a geographic area—Indicates that the number of UE in a geographical area report responded.
  - Success—Indicates the number of Number of UE in a geographic area event success responses.
  - Failure—Indicates the number of Number of UE in a geographic area event failure responses.
  - Drops—Indicates the number of 'Number of UE in a geographic area' event responses dropped

- UE Reachability and idle status indication—Indicates that the number of UE Reachability and idle status indication report sent.
- Availability after DDN Failure and idle status indication—Indicates that the Availability after DDN Failure and idle status indication report sent.
- PDN connectivity status—Indicates that the number of PDN connectivity statuses report sent.

Monitoring Event Configuration Deleted Count: The output includes the following fields:

- Loss of connectivity—Indicates the number of deleted loss of connectivity monitoring events.
- UE Reachability—Indicates the number of deleted UE Reachability monitoring events.
- Location Reporting—Indicates the number of deleted location reporting monitoring events.
- Communication Failure—Indicates the number of deleted communication failure monitoring events.
- Availability after DDN Failure—Indicates number of deleted availability after DDN failure monitoring events.
- UE Reachability and idle status indication—Indicates the number of deleted UE reachability and idle status indication monitoring events.
- PDN connectivity status—Indicates the number of deleted pdn connectivity status monitoring events.
- ULA received without monte cfg—Indicates the number of deleted monitoring events configurations when ULA received with updated set of configurations.
- HSS update received with different scef ref id—Indicates the number of deleted monitoring events with HSS update received with different SCEF Reference Id.
- HSS update received with same scef ref id—Indicates the number of deleted monitoring events with HSS update received with same SCEF Reference Id.

Monitoring Event Roaming statistics: The output includes the following fields:

- CIR sent —Indicates the number of CIR messages sent for roaming subscribers.
- CIA received—Indicates the number of CIA message received from roaming subscribers.
- CIR timeout—Indicates the CIR timeout value if there is no response for the CIR messages sent.
- RIR sent—Indicates the number of RIR messages sent for roaming subscribers.
- CIR denied by IWK-SCEF—Indicates the number of CIR messages denied through IWK-SCEF.

show lte-policy monitoring-event-profile

Monitoring Event Profile mon

The output of this command includes the following fields:

- Loss of connectivity—Indicates the enabled events of Loss of connectivity event configuration.
- UE Reachability—Indicates the enabled events of UE Reachability event configurations.
- Location Reporting—Indicates the enabled events of reporting location event configurations.

- Communication Failure—Indicates the current session statistics of Radio connection status failure events.
- Availability after DDN Failure—Indicates the current session statistics of Availability after DDN Failure event configuration.
- Idle Status Indication Failure—Indicates the enabled events of Idle status indication event configurations.
- PDN Connectivity Status Report—Indicates that the enabled events of PDN connectivity status event configuration.
- Number Of UE's in Geo Area—Indicates the received Number of UEs present in a geographic area event configuration
- Roaming Support—Indicates whether roaming support is enabled or disabled for Interworking SCEF destination host or realm.

Bulk Statistics

This section provides information on the bulk statistics for the Monitoring Events feature on MME.

MME Schema

The following bulk statistics are included in the MME Schema to track overall statistics:

Counters	Description
monitored-subscribers	The current total number of monitored subscribers for monitoring events.
monitored-loss-of-connectivity	The current total number of loss of connectivity events configured.
monitored-ue-reachability	The current total number of UE reachability events configured.
monitored-location-reporting	The current total number of location reporting events configured.
monitored-communication-failure	The current total number of communication failure events configured.
monitored-availability-after-ddn-failure	The current total number of availability after DDN failure events configured.
monitored-availability-after-ddn-failure-idleind	The current total number of availability after DDN failure and idle status indication events configured.
monitored-ue-reachability-idleind	The current total number of UE reachability and idle status indication events configured.
monitored-pdn-connecitivty-status	The current total number of PDN connectivity status events configured.
monte-rx-loss-of-connectivity	The total number of loss of connectivity monitoring events configured.
monte-rx-ue-reachability	The total number of UE reachability monitoring events configured.
monte-rx-location-reporting	The total number of location reporting monitoring events configured.

Counters	Description
monte-rx-communication-failure	The total number of communication failure monitoring events configured.
monte-rx-availability-after-ddnfailure	The total number of availability after DDN failure monitoring events configured.
monte-rx-number-of-ue-geoarea	The total number of UEs present in a geographical area monitoring events configured.
monte-rx-uereachability-idleind	The total number of UE reachability and idle status indication monitoring events configured.
monte-rx-availability-ddnfailure-idleind	The total number of availability after DDN failure and idle status indication monitoring events configured.
monte-rx-pdn-connectivity-status	The total number of PDN connectivity status monitoring events configured.
monte-tx-loss-of-connectivity	The total number of loss of connectivity monitoring reports sent.
monte-tx-ue-reachability	The total number of UE Reachability monitoring reports sent.
monte-tx-location-reporting	The total number of location reporting monitoring reports sent.
monte-tx-communication-failure	The total number of communication failure monitoring reports sent.
monte-tx-availability-after-ddnfailure	The total number of availability after DDN failure monitoring reports sent.
monte-tx-number-of-ue-geoarea	The total number of number of UEs present in a geographical area monitoring reports sent.
monte-tx-uereachability-idleind	The total number of UE reachability and idle status indication monitoring reports sent.
monte-tx-availability-ddnfailure-idleind	The total number of availability after DDN failure and idle status indication monitoring reports sent.
monte-tx-pdn-connectivity-status	The total number of PDN connectivity status monitoring reports sent.
monte-del-ue-reachability	The total number of deleted UE Reachability monitoring events.
monte-del-location-reporting	The total number of deleted location reporting monitoring events.
monte-del-communication-failure	The total number of deleted communication failure monitoring events.
monte-del-availability-after-ddn-failure	The total number of deleted availability after DDN failure monitoring events.
monte-del-uereachability-idleind	The total number of deleted UE reachability and idle status indication monitoring events.

Counters	Description
monte-del-availability-ddnfailure-idleind	The total number of deleted availability after DDN failure and idle status indication monitoring events.
monte-del-pdn-connectivity-status	The total number of deleted PDN connectivity status monitoring events.
monte-del-loss-of-connectivity	The total number of deleted loss of connectivity monitoring events.