ERICSSON

Event-Based Monitoring

TECHNICAL PRODUCT DESCRIPTION

9/221 02-AXB 250 12-V3 Uen DA

Contents

1 Introduction

This document describes the Event-Based Monitoring (EBM) in the EPG.

For more information on networks and nodes that can be used with EBM, refer to EPG Features.

1.1 Scope

This document covers an EBM overview, working principles and supported EBM events, and event information.

For information on the configuration of EBM in the EPG, refer to Event-Based Monitoring Configuration.

For a list of alarms related to EBM, see Fault Management Description.

For information about the EBM-related counters, refer to Counters and Gauges for the GGSN and PGW and Counters and Gauges for the SGW.

For a list of EBM supported events, refer to Event-Based Monitoring Events and Parameters.

For a list of cause codes, sub-cause codes and bearer cause codes, refer to Event-Based Monitoring Cause Codes.

1.2 Target Groups

This document is an introduction to EBM for the following personnel:

— Network operators

— Network and service planners

— System engineers

— System administrators

It requires a basic knowledge of data communications and telecommunications.

2 Overview

EBM is developed to support the real-time monitoring of signaling and payload (statistics) for reporting. The basic architecture of EBM in the EPG is illustrated in Figure 1.

A mobility or session management message used in a procedure triggers an event. EBM enables the EPG to record the event information in a formatted report. The formatted event report is then streamed in real-time or near-real-time to an external post-processing system. The external post-processing system is also referred to as the EBM server. Depending on whether the monitoring is for signaling or payload, different events are monitored.

EPG supports to configure up to three EBM servers. There is no load sharing or active-standby mechanism among the configured EBM servers. EPG streams the same EBM events to the configured EBM servers simultaneously. For each configured EBM server, each CPB has a buffer with a maximum size of 100 MB for sending EBM events. The number of EBM events that can be stored in the EBM buffer depends on the size of the events. When the EBM buffer becomes full, as a result of either excessive number of generated EBM events or loss of connections to all the configured EBM servers, the latest events are dropped. The number of dropped events is reported in the next stream error record that is sent to the EBM servers.

When any of the EBM connections are recovered, or the buffer becomes available, the EPG sends all the buffered events to one or more available EBM servers.

Note: If more than one EBM server is configured, after one connection failure, the EPG keeps sending buffered events to the rest of the available EBM servers.

It is configurable whether to keep or suspend monitoring when the PGW is in an overload situation. For more information about the EBM overload protection configuration, refer to Event-Based Monitoring Configuration.

For more information on the supported events, see Section 3 on page 3. For more information on the formatted reports, refer toEvent-Based Monitoring Output.

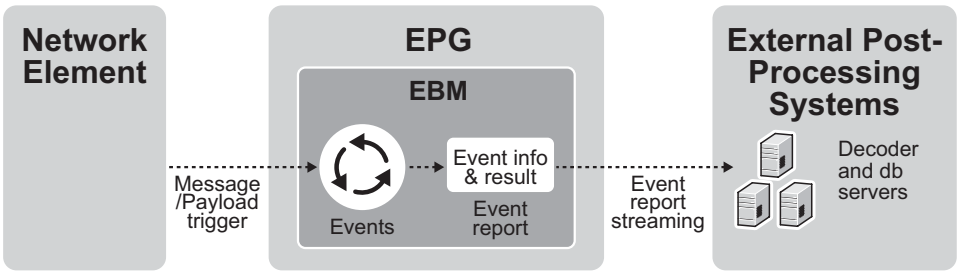

Figure 1 EBM Overview

The EBM reporting can be enabled for the following applications:

— SGW only

— GGSN/PGW only

— Combined SGW and PGW

An example of EBM for SGW only is as follows:

The `Create Session Request` message used in the `Initial Attach` procedure triggers the `SESSION_CREATION` event. The EPG records the information on the `SESSION_CREATION` event, and then streams the event information to the EBM server in real-time or near-real-time.

3 Supported Events

This section describes the working principle with supported events for different EBM applications.

— For SGW only, see Section 3.1 on page 3.

— For GGSN/PGW only, see Section 3.2 on page 13.

— EBM on the PGW can work independently or together with EBM on the SGW, depending on the configuration. For combined SGW and PGW, see Section 3.1 on page 3 and Section 3.2 on page 13.

For a list of EBM supported events, refer to Event-Based Monitoring Events and Parameters.

3.1 SGW-Supported Events

EBM reporting on the SGW is shown in Figure 2.

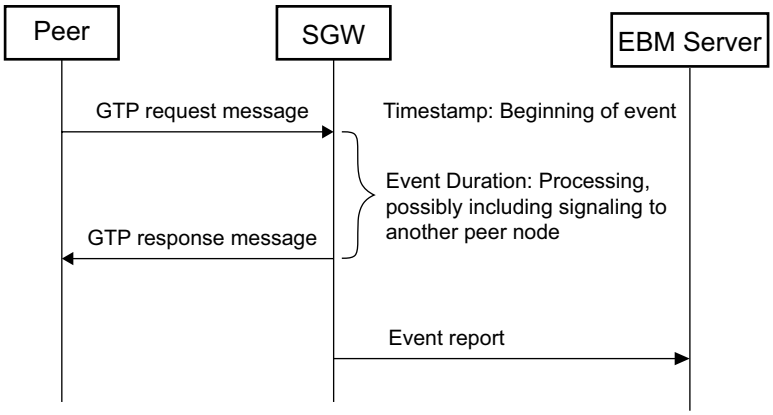

Figure 2 EBM Reporting on the SGW

An event is normally triggered when the SGW receives a GTP message in a procedure. Events can also be triggered because of other reasons, for example, internally triggered events or during a Network Triggered Service Restoration procedure. An event ends when the SGW sends a response to the GTP message that triggered the event. The EPG then reports the event information to the EBM server.

For more information about the message flow between the Network Elements, see SoC with 3GPP TS 23.401, and Session Management.

For more information about the GTPv2 messages that trigger events, see SoC with 3GPP TS 29.274.

— SESSION_CREATION

— SESSION_SUSPENSION

— SESSION_RESUME

— SESSION_DELETION

— BEARER_CREATION

— BEARER_MODIFICATION

— BEARER_UPDATE

— BEARER_DELETION

— DOWNLINK_DATA_NOTIFICATION

— CHANGE_NOTIFICATION

The following subsections detail the format of the events supported by the SGW.

3.1.1 SESSION_CREATION

The SESSION_CREATION event has the following characteristics:

— Provides information about session creation.

— Is triggered when a Create Session Request message is received at the S4 or S11 GTP-C interface.

— Ends when the SGW sends the corresponding Create Session Response message.

The SESSION_CREATION event includes one of the following values of the EVENT_TRIGGER parameter:

CREATE_NEW_PDN_CONNECTION
The default bearer is created.

MOBILITY_WITH_SGW_CHANGE
The default and dedicated bearers are created.

HANDOVER_FROM_NON_3GPP
The UE moves from Non-3GPP access to a 3GPP Access Network.

NO_INFORMATION
The SGW does not have enough information about the reason for the event trigger.

3.1.2 SESSION_SUSPENSION

The SESSION_SUSPENSION event has the following characteristics:

— Provides information about session suspension.

— Is triggered when a Suspend Notification message is received on the S11 interface.

— Ends when the SGW sends the corresponding Suspend Acknowledge message.

The SESSION_SUSPENSION event includes the following value of the EVENT_TRIGGER parameter:

CS_FALLBACK_OR_SRVCC
The PDN connection is suspended because of a CS fallback or SRVCC procedure.

NO_INFORMATION
The SGW does not have enough information about the reason for the event trigger.

3.1.3 SESSION_RESUME

The SESSION_RESUME event has the following characteristics:

— Provides information about session resume.

— Is triggered when a Resume Notification message is received on the S11 interface.

— Ends when the SGW sends a Resume Acknowledge message in response to a Resume Notification message.

The SESSION_RESUME event includes the following value of the EVENT_TRIGGER parameter:

CS_FALLBACK_OR_SRVCC
The PDN connection is resumed when the CS fallback or SRVCC procedure ends.

NO_INFORMATION
The SGW does not have enough information about the reason for the event trigger.

3.1.4 SESSION_DELETION

The SESSION_DELETION event has the following characteristics:

— Provides information about session deletion.

— Is triggered when any of the following scenarios occur:

- A Delete Session Request message is received on the S4 or S11 GTP-C interface.
- A Delete Bearer Request message that includes the default bearer is received on the S5/S8 SGW GTP-C interface.
- A user issues a CLI command to terminate a session for an IMSI.
- An internal decision is made by the SGW or EPG to delete a PDN connection.

— Ends when any of the following scenarios occur:

- The SGW sends a Delete Session Response message in response to a Delete Session Request message.
- The SGW sends a Delete Bearer Response message for a default bearer in response to a Delete Bearer Request message.
- A PDN connection is closed as a result of an internal decision made by the SGW or EPG to delete a PDN connection.

The SESSION_DELETION event includes one of the following values of the EVENT_TRIGGER parameter:

DELETE_PDN_CONNECTION
The default and any dedicated bearers are deleted.

MOBILITY_WITH_SGW_CHANGE
The default and any dedicated bearers are deleted.

EVENT_TRIGGERED_INTERNALLY
The SGW responds to an internal error.

HANDOVER_TO_NON_3GPP
The UE moves from a 3GPP access to a Non-3GPP Access Network.

NO_INFORMATION
The SGW does not have enough information about the reason for the event trigger.

EVENT_INVOKED_BY_MANAGEMENT
Set when the user issues a CLI command to terminate a session for an IMSI

Note: The Delete Bearer Request message that triggers the SESSION_DELETION event includes the default bearer, but possibly also dedicated bearers.
However, the Delete Bearer Request message that triggers the BEARER_DELETION event includes only dedicated bearers. There can be more than one dedicated bearer in the messages. See Section 3.1.8 on page 10 for more information about the BEARER_DELETION event.

Note: A successful SESSION_DELETION event reports all the user volumes for each default bearer and dedicated bearer of the session.
For secondary RAT usage data report, the SESSION_DELETION event only reports the Secondary RAT Usage Data Report IE in a Delete Session Request message.
In some exceptional scenarios, for example in the Interchassis Redundancy (ICR) scenario or in the User Plane rebuild scenario, the six user volumes can be reported with partial user data in the SESSION_DELETION events.

3.1.5 BEARER_CREATION

The BEARER_CREATION event has the following characteristics:

— Provides information about the creation of dedicated bearers or secondary PDP contexts.

— Is triggered when any of the following scenarios occur:

- A `Create Bearer Request` message is received at the S5/S8 SGW GTP-C interface.
- A `Bearer Resource Command` message is received by the SGW.

— Ends when any of the following scenarios occur:

- The SGW sends the corresponding `Create Bearer Response` message.
- The SGW sends the corresponding `Bearer Resource Failure Indication` message.

The `BEARER_CREATION` event includes one of the following values of the `EVENT_TRIGGER` parameter:

BEARER_ACTIVATION
Dedicated bearers or secondary PDP contexts are activated.

UE_REQUESTED_BEARER_RESOURCE_ALLOCATION
The UE requests bearer resource allocation procedure.

NO_INFORMATION
The SGW does not have enough information about the reason for the event trigger.

3.1.6 BEARER_MODIFICATION

The `BEARER_MODIFICATION` event has the following characteristics:

— Provides information about bearer modification.

— Is triggered when any of the following scenarios occur:

- A `Modify Bearer Request` message is received on the S4 or S11 GTP-C interface.
- A `Modify Access Bearers Request` message is received on the S4 or S11 GTP-C interface.
- One of the pause charging thresholds is exceeded.

— Ends when any of the following scenarios occur:

- The SGW sends the corresponding `Modify Bearer Response` message.
- The SGW sends the corresponding `Modify Access Bearers Response` message.
- The `Modify Bearer Response` message is received from the PGW, if the event was triggered because of a pause charging threshold being exceeded.

The BEARER_MODIFICATION event includes one of the following values of the EVENT_TRIGGER parameter:

MOBILITY_OR_SERVICE_REQUEST
TAU, RAU, Handover, or when the UE goes from ECM-IDLE to ECM-CONNECTED.

HANDOVER_FROM_NON_3GPP
The UE moves from Non-3GPP access to a 3GPP Access Network.

RELOCATION_TO_OTHER_MME_OR_SGSN_IN_POOL
The UE relocates to another MME or SGSN in the pool.

NO_INFORMATION
The SGW does not have enough information about the reason for the event trigger.

3.1.7 BEARER_UPDATE

The BEARER_UPDATE event has the following characteristics:

— Provides information about bearer update.

— Is triggered when any of the following scenarios occur:

- An `Update Bearer Request` message is received on the S5/S8 SGW GTP-C interface.
- A `Modify Bearer Command` message received on the S4 or S11 GTP-C interface is rejected.
- A `Modify Bearer Command` message is received from the SGW.

— Ends when any of the following scenarios occur:

- The SGW sends the corresponding `Update Bearer Response` message.
- The SGW sends the corresponding `Modify Bearer Failure Indication` message.

The BEARER_UPDATE event includes one of the following values of the EVENT_TRIGGER parameter:

PGW_INITIATED_BEARER_MODIFICATION
The PGW initiates a bearer modification.

MME_INITIATED_MODIFY_BEARER_COMMAND
The SGW responds to a `Modify Bearer Command` message from the MME.

NO_INFORMATION

The SGW does not have enough information about the reason for the event trigger.

3.1.8 BEARER_DELETION

The BEARER_DELETION event has the following characteristics:

— Provides information about the deletion of dedicated bearers or secondary PDP contexts.

— Is triggered when any of the following scenarios occur:

- A Delete Bearer Request message is received on the S5/S8 SGW GTP-C interface to delete the dedicated bearer within a PDN connection.
- A Delete Bearer Command message is received by the SGW.

— Ends when any of the following scenarios occur:

- The SGW sends the corresponding Delete Bearer Response message.
- The SGW sends the corresponding Delete Bearer Failure Indication message.

The BEARER_DELETION event includes one of the following values of the EVENT_TRIGGER parameter:

BEARER_DEACTIVATION

Dedicated bearers or secondary PDP contexts are deleted.

NO_INFORMATION

The SGW does not have enough information about the reason for the event trigger.

Note: A successful BEARER_DELETION event reports all the user volumes for each dedicated bearer.
For secondary RAT usage data report, the BEARER_DELETION event only reports the Secondary RAT Usage Data Report IE in a Delete Bearer Request message.
In some exceptional scenarios, for example in the ICR scenario or in the User Plane rebuild scenario, the six user volumes can be reported with partial user data in the BEARER_DELETION events.

3.1.9 DOWNLINK_DATA_NOTIFICATION

The DOWNLINK_DATA_NOTIFICATION event has the following characteristics:

— Provides information about Downlink Data Notification messages, including failure messages.

— Is triggered when any of the following scenarios occur:

- The SGW receives downlink data from the PGW and a Downlink Data Notification message is sent to either an MME or an SGSN.
- The SGW receives a Downlink Data Notification Failure Indication message from the MME or SGSN.
- The SGW receives an Error Indication from an eNodeB, SGSN, or RNC and the SGW responds with sending a Downlink Data Notification message to the MME or SGSN.

— Ends when any of the following scenarios occur:

- The SGW receives a Downlink Data Notification Acknowledge message in response to the Downlink Data Notification message.
- Immediately when the SGW has received the Downlink Data Notification Failure Indication message.

The DOWNLINK_DATA_NOTIFICATION event includes one of the following values of the EVENT_TRIGGER parameter:

SERVICE_REQUEST_DUE_TO_DOWNLINK_DATA_RECEIVED
A Downlink Data Notification message was sent because downlink data was received from the PGW.

SERVICE_REQUEST_DUE_TO_SERVICE_AWARE_SMART_PAGING
A Downlink Data Notification message was sent because a service identifier with high service priority is detected, or a Differentiated Services Code Point (DSCP) value was detected after inspection in a downlink packet, or both of them are detected. This event trigger is only set because of service-aware smart paging.

ERROR_INDICATION_RECEIVED
A Downlink Data Notification message was sent because an Error Indication message was received from the eNodeB, RNC, or SGSN.

DDN_FAILURE_INDICATION_RECEIVED
A Downlink Data Notification Failure Indication message was received from the MME or SGSN.

SERVICE_RESTORATION_DUE_TO_DOWNLINK_DATA_RECEIVED
A Downlink Data Notification message was sent because downlink data was received from the PGW. This event trigger is only set for network-triggered restoration procedures.

SERVICE_RESTORATION_DUE_TO_ERROR_INDICATION_RECEIVED

A `Downlink Data Notification` message was sent because an Error Indication message was received from the eNodeB, RNC, or SGSN. This event trigger is only set for network-triggered restoration procedures.

SERVICE_RESTORATION_DUE_TO_MESSAGE_RECEIVED

A `Downlink Data Notification` message was sent because a GTPv2 message was received from the PGW. This event trigger is only set for network-triggered restoration procedures.

SERVICE_RESTORATION_BY_TRYING_ANOTHER_MME_OR_SGSN

A `Downlink Data Notification` message was sent to another MME or SGSN in the pool because no response was received from the contacted MME or SGSN. This event trigger is only set for network-triggered restoration procedures.

RESENDING_DUE_TO_INTER_MME_PAGING

EBM trigger for resending the `Downlink Data Notification` EBM event.

3.1.10 INDIRECT_DATA_FORWARDING_CREATION

The `INDIRECT_DATA_FORWARDING_CREATION` event has the following characteristics:

— Provides information when indirect data forward tunnel is created.

— Is triggered when the following occur:

- A `Create Indirect Data Forwarding Tunnel Request` message is received on the S11 or S4 interface to create an indirect data forward tunnel during the S1-based handover.

— Ends when the following occur:

- The SGW sends the corresponding `Create Indirect Data Forwarding Tunnel Response` message.

The `INDIRECT_DATA_FORWARDING_CREATION` event includes the following value of the `EVENT_TRIGGER` parameter:

EUTRAN_S1_BASE D_HANDOVER

E-UTRAN S1-based handover.

3.1.11 INDIRECT_DATA_FORWARDING_DELETION

The `INDIRECT_DATA_FORWARDING_DELETION` event has the following characteristics:

— Provides information when indirect data forward tunnel is deleted.

— Is triggered when the following occur:

  • A `Delete Indirect Data Forwarding Tunnel Request` message is received on the S11 or S4 interface to delete an indirect data forward tunnel during the S1-based handover.

— Ends when the following occur:

  • The SGW sends the corresponding `Delete Indirect Data Forwarding Tunnel Response` message.

The `INDIRECT_DATA_FORWARDING_DELETION` event includes the following value of the `EVENT_TRIGGER` parameter:

EUTRAN_S1_BASE D_HANDOVER
E-UTRAN S1-based handover.

3.1.12 CHANGE_NOTIFICATION

The `CHANGE_NOTIFICATION` event has the following characteristics:

— Is triggered when a `Change Notification Request` message is received on the S11 interface.

— Ends when the SGW sends the corresponding `Change Notification Response` message.

The `CHANGE_NOTIFICATION` event includes one of the following values of the `EVENT_TRIGGER` parameter:

SECONDARY_RAT_USAGE_DATA_REPORT
Secondary RAT usage data report.

NO_INFORMATION
The SGW does not have enough information about the reason for the event trigger.

3.2 GGSN/PGW-Supported Events

EBM reporting on the GGSN/PGW is shown in Figure 3.

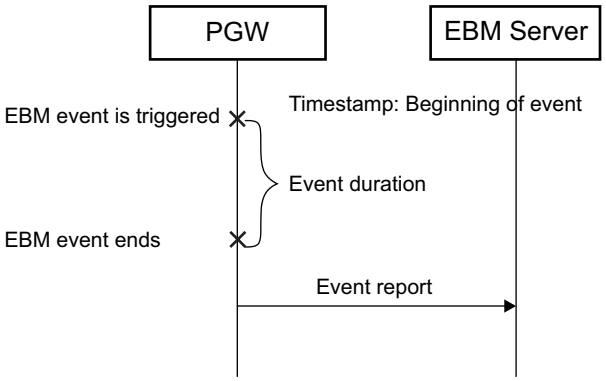

Figure 3 EBM Reporting on the GGSN/PGW

EBM reporting for a PDN connection is identified by the IMSI and PDN identifier. Emergency PDN connections corresponding to unauthenticated users (without IMSI or with unauthenticated IMSI) are identified by the IMEI and a PDN identifier.

The `IMSI_VALIDATION` parameter is used to indicate if an IMSI is authenticated.

The GGSN/PGW starts EBM reporting for a PDN connection by sending an `SESSION_INFO` report that contains static information, such as APN, UE address, and Rule Space when applicable.

The GGSN/PGW reports the usage in `DATA_USAGE` events for bearer level and service level (RG, SI, and URI). Bearer usage is applicable for all users, whereas service usage is applicable only for users belonging to the APNs with Service-Aware Charging and Control (SACC) functionality. For more information on different usage levels, refer to Offline Charging.

On the PGW Control Plane, an event is normally triggered when the PGW receives a request message in a procedure. Events can also be triggered because of other reasons, for example, internally triggered events. An event normally ends when the corresponding procedure is completed. The EPG then reports the event information to the EBM server.

Note: EBM only reports one event for Diameter redirection or failover. If there are multiple Diameter peers involved in the scenario, only the last session is recorded in EBM event.

For more information about the message flow between the Network Elements, see SoC with 3GPP TS 23.401, and Session Management.

For more information about the GTPv2 messages that trigger events, see SoC with 3GPP TS 29.274.

The following GGSN/PGW events are supported:

— `SESSION_INFO`

— `DATA_USAGE`

- P_SESSION_CREATION
- P_SESSION_DELETION
- P_BEARER_CREATION
- P_BEARER_MODIFICATION
- P_BEARER_UPDATE
- P_BEARER_DELETION
- PDP_CONTEXT_CREATION
- PDP_CONTEXT_DELETION
- PDP_CONTEXT_UPDATE
- SECONDARY_PDP_CONTEXT_ACTIVATION
- S6B_AUTHORIZATION

  Note: This event is only applicable for the S6bAuth interface.

- S6B_TERMINATION

  Note: This event is only applicable for the S6bAuth interface.

- GX_INIT
- GX_UPDATE
- GX_TERMINATE
- GX_REAUTHORIZE
- GY_CC_INIT
- GY_CC_UPDATE
- GY_CC_TERMINATE
- GY_CC_EVENT
- P_CHANGE_NOTIFICATION

The following subsections detail the format of the events supported by the GGSN/PGW.

3.2.1 SESSION_INFO

The SESSION_INFO event has the following characteristics:

— Provides static information about a user, such as APN, UE address, and Rule Space when applicable. For detailed information about the SESSION_INFO event, see Event-Based Monitoring Events and Parameters.

— Is triggered when at least one type of EBM event is configured in the corresponding EBM profile, and any of the following scenarios occur:

  • The EPG sets up a new PDN connection, whether the setup is successful or not.

  • The first event is determined to be reported and no SESSION_INFO event was reported before in the life cycle of this PDN connection, for example, EBM is enabled after the PDN connection setup.

  • Handover from untrusted WLAN/CDMA2000 network to LTE network.

  • Handover from LTE network to untrusted WLAN network.

— Ends when the event is sent

3.2.2 DATA_USAGE

The DATA_USAGE event has the following characteristics:

— Provides information about bearer and service usage (RG/SI/URI). Usage can be monitored optionally at the following levels:

  • Bearer level: uplink and downlink volume.

  • RG level: uplink and downlink volume.

  • SI level: uplink and downlink volume.

  • URI level: uplink and downlink volume.

— Is triggered when a change occurs in bearer-related or service-related charging conditions, or the DATA_USAGE time-limit expires.

  For more information about bearer-related and service-related charging conditions, refer to Offline Charging.

— Ends when the following DATA_USAGE event is triggered.

  For information on configuring monitoring level and time-limit for the DATA_USAGE event, refer to Event-Based Monitoring Configuration.

3.2.3 P_SESSION_CREATION

The P_SESSION_CREATION event has the following characteristics:

— Provides information about session creation.

— Is triggered when a `Create Session Request` message is received on the S5/S8 interface or the S2b interface.

— Ends when any of the following scenarios occur:

  • The PGW sends the corresponding `Create Session Response` message.

  • The PGW discards the `Create Session Request` message.

The `P_SESSION_CREATION` event includes the following value of the `EVENT_TRIGGER` parameter:

CREATE_NEW_PDN_CONNECTION
The default bearer is created.

HANDOVER_FROM_CDMA
The UE moves from an eHRPD access to an LTE access.

HANDOVER_FROM_UNTRUSTED_WLAN
The UE moves from an untrusted WLAN access to an LTE access.

HANDOVER_TO_UNTRUSTED_WLAN
The UE moves from an LTE access to an untrusted WLAN access.

HANDOVER_TO_UNTRUSTED_WLAN_TREATED_AS_NEW_SESSION_CREATION
The UE accesses an untrusted WLAN with the `Handover Indication` set to 1 while the UE context does not exist in the PGW.

3.2.4 P_SESSION_SUSPENSION

The `P_SESSION_SUSPENSION` event has the following characteristics:

— Provides information about session suspension.

— Is triggered when a `Suspend Notification` message is received on the S5/S8 interface.

— Ends when the PGW sends the corresponding `Suspend Acknowledge` message.

The `P_SESSION_SUSPENSION` event includes the following value of the `EVENT_TRIGGER` parameter:

CS_FALLBACK_OR_SRVCC
The PDN connection is suspended because of a CS fallback or SRVCC procedure.

NO_INFORMATION

The PGW does not have enough information about the reason for the event trigger.

3.2.5 P_SESSION_RESUME

The P_SESSION_RESUME event has the following characteristics:

— Provides information about session resume.

— Is triggered when an explicit or implicit Resume Notification message is received on the S5/S8, Gn/Gp, S2a, or S2b interface.

— Ends when the PGW sends a Resume Acknowledge message or other response message in response to an explicit or implicit Resume Notification message.

The P_SESSION_RESUME event includes the following value of the EVENT_TRIGGER parameter:

CS_FALLBACK_OR_SRVCC

The PDN connection is resumed when the CS fallback or SRVCC procedure ends.

NO_INFORMATION

The PGW does not have enough information about the reason for the event trigger.

3.2.6 P_SESSION_DELETION

The P_SESSION_DELETION event has the following characteristics:

— Provides information about session deletion.

— Is triggered when any of the following scenarios occur:

- A Delete Session Request message is received on the S5/S8 interface or the S2b interface.
- A Delete Bearer Request message is sent on the S5/S8 interface or the S2b interface with Linked EPS Bearer ID (LBI) when a CLI command is issued to terminate a session.
- The PGW sends a Delete Bearer Request message with cause code Reactivation Requested to the SGW during P-CSCF restoration procedure.
- A Disconnect-Request message is received from the RADIUS server.
- A Re-Auth-Request (RAR) message is received from the PCRF with a Session-Release-Cause AVP included.

- An Abort-Session-Request (ASR) or Abort-Session-Answer (ASA) message is received from the OCS
- An internal decision is made by the SGW or EPG to delete a PDN connection.

— Ends when any of the following scenarios occur:

- The PGW sends a Delete Session Response message in response to a Delete Session Request message.
- A session is successfully terminated after a Delete Bearer Response message is received that includes the LBI.
- The PGW discards the Delete Session Request message, or Delete Bearer Response message, including the LBI.
- The inactivity timer of an emergency PDN connection expires.
- A PDN connection is closed as a result of an internal decision made by the SGW or EPG to delete a PDN connection.

The P_SESSION_DELETION event includes one of the following values of the EVENT_TRIGGER parameter:

DELETE_PDN_CONNECTION
The SGW, RADIUS server, PCRF, or OCS initiates a deletion of the default and any dedicated bearers.

HANDOVER_TO_CDMA
The UE moves from an LTE access to an eHRPD access.

HANDOVER_TO_UNTRUSTED_WLAN
The UE moves from an LTE access to an untrusted WLAN access.

HANDOVER_FROM_UNTRUSTED_WLAN
The UE moves from an untrusted WLAN access to an LTE access.

EVENT_INVOKED_BY_MANAGEMENT
The default bearer and any dedicated bearers are deleted, which is initiated by the bearer termination CLI commands.

Note: This value is supported for two bearer termination CLI commands:

— Terminate all bearers in the GGSN/PGW.

— Terminate all bearers associated with a specific IMSI or an IMSI prefix.

EVENT_TRIGGERED_INTERNALLY

The PGW initiates a default bearer deletion because of the idle bearer timer expiration or if a new session creation collides with an existing default bearer. For more information, refer to Session Management.

PCRF-BASED-PCSCF-RESTORATION

Set when the session is terminated because of the PCRF-based P-CSCF restoration procedure.

PCSCF_RESTORATION

Set when the session is terminated because of PCO-based extension of the HSS-based P-CSCF restoration procedure.

PDN_CONNECTION_INACTIVITY_TIMER_EXPIRES

The emergency PDN connection inactivity timer expires.

Note: The `Delete Bearer Request` message that triggers the `P_SESSION_DELETION` event includes the default bearer, but possibly also dedicated bearers.
However, the `Delete Bearer Request` message that triggers the `P_BEARER_DELETION` event includes only dedicated bearers. There can be more than one dedicated bearer in the messages. See Section 3.2.10 on page 23 for more information about the `P_BEARER_DELETION` event.

For secondary RAT usage data report, the `Secondary RAT Usage Data Report` IE is not included in the `P_SESSION_DELETION` event when a `PGW Delete Session Response` message is received.

3.2.7 P_BEARER_CREATION

The `P_BEARER_CREATION` event has the following characteristics:

— Provides information about the creation of dedicated bearers.

— Is triggered when any of the following scenarios occur:

- A `Credit-Control-Answer` (CCA) or `RAR` message is received from the PCRF. The message contains a dynamic charging rule including the QoS information that is different from the QoS of any already active dedicated bearer.
- A dedicated bearer is determined to be activated based on service detection of a started service.
- The PGW tries to send `Create Bearer Request` during handover from LTE to WLAN.
- The PGW tries to send `Create Bearer Request` during handover from WLAN to LTE.

— Ends when any of the following scenarios occur:

  - The PGW receives the `Create Bearer Response` message from the SGW in response to a sent `Create Bearer Request` message.
  - There is no response received from the SGW/ePDG.
  - The PGW receives the `Create Bearer Response` or no response during handover from LTE to WLAN.
  - The PGW receives the `Create Bearer Response` or no response during handover from WLAN to LTE.

The `P_BEARER_CREATION` event includes one of the following values of the `EVENT_TRIGGER` parameter:

BEARER_ACTIVATION
Dedicated bearers are activated.

HANDOVER_TO_UNTRUSTED_WLAN
The UE moves from an LTE access to an untrusted WLAN access.

HANDOVER_FROM_UNTRUSTED_WLAN
The UE moves from an untrusted WLAN access to an LTE access.

3.2.8 P_BEARER_MODIFICATION

The `P_BEARER_MODIFICATION` event has the following characteristics:

— Provides information about bearer modification.

— Is triggered when a `Modify Bearer Request` message is received from the SGW.

— Ends when any of the following scenarios occur:

  - The PGW sends a `Modify Bearer Response` message in response to a `Modify Bearer Request` message.
  - The PGW discards the `Modify Bearer Request` message.

The `P_BEARER_MODIFICATION` event includes one of the following values of the `EVENT_TRIGGER` parameter:

MOBILITY_OR_SERVICE_REQUEST
The PGW responds to a bearer modification request from SGW in a mobility or a service request scenario without SGW change.

MOBILITY_WITH_SGW_CHANGE

The PGW responds to a bearer modification request from SGW in a mobility scenario with SGW change.

HANDOVER_FROM_CDMA

The UE moves from an eHRPD access to an LTE access.

HANDOVER_FROM_UNTRUSTED_WLAN

The UE moves from an untrusted WLAN access to an LTE access.

NO_INFORMATION

The PGW does not have enough information about the reason for the event trigger.

PCSCF_RESTORATION

Set when the bearer is modified because of PCO-based extension of the HSS-based P-CSCF restoration procedure.

3.2.9 P_BEARER_UPDATE

The P_BEARER_UPDATE event has the following characteristics:

— Provides information about bearer update.

— Is triggered when any of the following scenarios occur:

- A CCA or RAR message is received from PCRF to update a Traffic Flow Template (TFT) for an active default bearer or dedicated bearer.
- A CCA or RAR message is received from PCRF to modify the APN restriction Aggregated Maximum Bit Rate (APN-AMBR).
- A CCA or RAR message is received from PCRF to modify bearer QoS for active default bearers or dedicated bearers.
- A CCA or RAR message is received from PCRF to retrieve User Location from the MME.
- A Modify Bearer Command message is received from the SGW.
- The PGW sends Update Bearer Request during handover from LTE to WLAN.
- The PGW sends Update Bearer Request during handover from WLAN to LTE.

— Ends when any of the following scenarios occur:

- The PGW receives an Update Bearer Response message in response to a sent Update Bearer Request message.

- The PGW discards the Modify Bearer Command message.
- The Modify Bearer Failure Indication message is sent to the SGW.
- There is no response received from the SGW/ePDG.
- The PGW receives the Update Bearer Response or no response during handover from LTE to WLAN.
- The PGW receives the Update Bearer Response or no response during handover from WLAN to LTE.

The P_BEARER_UPDATE event includes one of the following values of the EVENT_TRIGGER parameter:

PCRF_TRIGGERED_UPDATE_BEARER
The PGW responds to a bearer update request from PCRF.

SGW_INITIATED_MODIFY_BEARER_COMMAND
The PGW responds to a Modify Bearer Command message from the SGW.

PCSCF_RESTORATION
Set when the bearer is updated because of PCO-based extension of the HSS-based P-CSCF restoration procedure.

HANDOVER_TO_UNTRUSTED_WLAN
The UE moves from an LTE access to an untrusted WLAN access.

HANDOVER_FROM_UNTRUSTED_WLAN
The UE moves from an untrusted WLAN access to an LTE access.

3.2.10 P_BEARER_DELETION

The P_BEARER_DELETION event has the following characteristics:

— Provides information about the deletion of dedicated bearers.

— Is triggered when any of the following scenarios occur.

- A CCA or RAR message is received from the PCRF to remove the last dynamic charging rule on a dedicated bearer.
- A Delete Bearer Command message is received from the SGW.
- A CLI command to terminate a dedicated bearer.
- A dedicated bearer is determined to be deactivated based on service detection of a stopped service.

— Ends when any of the following scenarios occur:

  - The dedicated bearer is successfully deleted after a `Delete Bearer Response` message is received by the PGW.
  - The PGW discards the `Delete Bearer Command` message.
  - The `Delete Bearer Failure Indication` message is sent to the SGW.
  - There is no response received from the SGW.

The `P_BEARER_DELETION` event includes the following value of the `EVENT_TRIGGER` parameter:

BEARER_DEACTIVATION
: Bearer deletion is triggered by PCRF, SGW, or end of user traffic for a service or application.

EVENT_TRIGGERED_INTERNALLY
: The PGW initiates a dedicated bearer deletion because of the idle bearer timer expiration or if a new session creation collides with an existing dedicated bearer. For more information, refer to Session Management.

Note: For secondary RAT usage data report, the `Secondary RAT Usage Data Report` IE is not included in the `P_BEARER_DELETION` event when a `PGW Delete Bearer Response` message is received.

3.2.11 PDP_CONTEXT_CREATION

The `PDP_CONTEXT_CREATION` event has the following characteristics:

— Provides information about the creation of PDP contexts.

— Is triggered when any of the following scenarios occur:

  - A `Create PDP Context Request` message is received from the SGSN.

— Ends when any of the following scenarios occur:

  - The GGSN sends the corresponding `Create PDP Context Response` message.
  - The PGW discards the `Create PDP Context Request` message.

The `PDP_CONTEXT_CREATION` event includes the following value of the `EVENT_TRIGGER` parameter:

CREATE_NEW_PDP_CONTEXT_CONNECTION
: A primary PDP context is created.

3.2.12 PDP_CONTEXT_DELETION

The PDP_CONTEXT_DELETION event has the following characteristics:

— Provides information about the deletion of PDP contexts.

— Is triggered when any of the following scenarios occur:

- A Delete PDP Context Request message is received from the SGSN.
- The deletion of the PDP context connection is initiated from the RADIUS, PCRF, OCS, or GGSN.

— Ends when any of the following scenarios occur:

- The GGSN sends the corresponding Delete PDP Context Response message to the SGSN.
- The GGSN receives the corresponding Delete PDP Context Response message from the SGSN.

The PDP_CONTEXT_DELETION event includes one of the following values of the EVENT_TRIGGER parameter:

DELETE_PDP_CONTEXT_CONNECTION
The SGSN, GGSN, RADIUS, OCS, or PCRF initiates the deletion of primary and secondary PDP contexts.

SECONDARY_PDP_CONTEXT_DEACTIVATION
The SGSN, GGSN, RADIUS, OCS, or PCRF initiates the deactivation of secondary PDP contexts.

3.2.13 PDP_CONTEXT_UPDATE

The PDP_CONTEXT_UPDATE event has the following characteristics:

— Provides information about the update of PDP contexts.

— Is triggered when any of the following scenarios occur:

- A CCA or RAR message is received from the PCRF to modify the TFT or QoS for primary and secondary PDP contexts.
- The SGSN and the UE initiate PDP context modifications for the TFT or QoS.
- The UE moves from an LTE access to a WCDMA access.
- The UE moves from a GSM access to a GSM access.
- The UE moves from a WCDMA access to a WCDMA access.
- The UE moves from a GSM access to a WCDMA access.

- The UE moves from a WCDMA access to a GSM access.

— Ends when any of the following scenarios occur:

- The GGSN receives the corresponding `Update PDP Context Response` message from the SGSN.
- The GGSN sends the `Update PDP Context Response` message to the SGSN.

The `PDP_CONTEXT_UPDATE` event includes one of the following values of the `EVENT_TRIGGER` parameter:

SGSN_TRIGGERED_UPDATE_BEARER
The SGSN initiates the update of PDP Contexts.

PCRF_TRIGGERED_UPDATE_BEARER
The GGSN or PCRF initiates the update of PDP Contexts.

HANDOVER_FROM_LTE
The UE moves from an LTE access to a Gn/Gp access.

HANDOVER_FROM_GSM_TO_GSM
The UE moves from a GSM access to a GSM access.

HANDOVER_FROM_GSM_TO_WCDMA
The UE moves from a GSM access to a WCDMA access.

HANDOVER_FROM_WCDMA_TO_WCDMA
The UE moves from a WCDMA access to a WCDMA access.

HANDOVER_FROM_WCDMA_TO_GSM
The UE moves from a WCDMA access to a GSM access.

3.2.14 SECONDARY_PDP_CONTEXT_ACTIVATION

Note: This event is triggered only when the activation of secondary contexts is triggered by the PCRF.

The `SECONDARY_PDP_CONTEXT_ACTIVATION` event has the following characteristics:

— Provides information about the activation of secondary PDP contexts.

— Is triggered when any of the following scenarios occur:

- A `CCA` or `RAR` message is received from the PCRF and an `Initiate PDP Context Activation Request` message is sent to the GGSN.

— Ends when any of the following scenarios occur:

- The PGW receives the corresponding `Initiate PDP Context Activation Response` message from the SGSN.
- There is no response received from the SGSN.

The `SECONDARY_PDP_CONTEXT_ACTIVATION` event includes the following value of the `EVENT_TRIGGER` parameter:

SECONDARY_PDP_CONTEXT_ACTIVATION
The PCRF initiates the activation of secondary PDP contexts.

3.2.15 S6B_AUTHORIZATION

The `S6B_AUTHORIZATION` event has the following characteristics:

— Provides information about the PGW-initiated authorization procedure and the PGW-initiated or 3GPP AAA server-initiated reauthorization procedure.

— Is triggered when any of the following scenarios occur:

- An `AA-Request` (AAR) message is sent from the PGW.
- The PGW receives an `RAR` message from the 3GPP AAA server.

— Ends when any of the following scenarios occur:

- The PGW receives the `AA-Answer` (AAA) message from the 3GPP AAA server in response to a sent AAR message.
- The PGW sends the `Re-Auth-Answer` (RAA) message in response to a sent `RAR` message.
- There is no response received from the 3GPP AAA server.

The `S6B_AUTHORIZATION` event includes one of the following values of the `EVENT_TRIGGER` parameter:

CREATE_NEW_PDN_CONNECTION
The default bearer is created.

S6B_SESSION_LIFETIME_EXPIRED
The PGW-initiated reauthorization.

REAUTHORIZATION
The 3GPP AAA server-initiated reauthorization.

HANDOVER_FROM_CDMA
The UE moves from an eHRPD access to an LTE access.

HANDOVER_TO_CDMA
The UE moves from an LTE access to an eHRPD access.

HANDOVER_FROM_UNTRUSTED_WLAN
The UE moves from an untrusted WLAN access to an LTE access.

HANDOVER_TO_UNTRUSTED_WLAN
The UE moves from an LTE access to an untrusted WLAN access.

3.2.16 S6B_TERMINATION

The S6B_TERMINATION event has the following characteristics:

— Provides information about the PGW-initiated or 3GPP AAA server-initiated termination procedure.

— Is triggered when any of the following scenarios occur:

- A Session-Terminate-Request (STR) message is sent from the PGW.
- The PGW receives an ASR message from the 3GPP AAA server.

— Ends when any of the following scenarios occur:

- The PGW receives the Session-Terminate-Answer (STA) message from the DRA/3GPP AAA server in response to a sent STR message.
- The PGW sends the ASA message in response to a sent ASR message.
- There is no response received from the DRA/3GPP AAA server.

The S6B_TERMINATION event includes one of the following values of the EVENT_TRIGGER parameter:

DELETE_PDN_CONNECTION
The PGW initiates a deletion of the default bearer and any dedicated bearers.

PCRF_TRIGGERED_DELETE_PDN_CONNECTION
The default bearer and any dedicated bearers are deleted, which is initiated by the PCRF.

OCS_TRIGGERED_DELETE_PDN_CONNECTION
The default bearer and any dedicated bearers are deleted, which is initiated by the OCS.

ABORT_S6B_SESSION
The 3GPP AAA server-initiated end session without STR/STA.

ABORT_AND_TERMINATE_S6B_SESSION
The 3GPP AAA server-initiated end session with STR/STA.

EVENT_TRIGGERED_INTERNALLY
The PGW responds to an internal error.

3.2.17 GX_INIT

The GX_INIT event has the following characteristics:

— Provides information about the GGSN/PGW-initiated Gx+ PCC session initialization or reestablishment procedure.

— Is triggered when a CCR Initial message is sent from the GGSN/PGW.

— Ends when any of the following scenarios occur:

- The GGSN/PGW receives the CCA-Initial message from the PCRF in response to a sent CCR-I message.
- There is no response received from the PCRF.

The GX_INIT event includes one of the following values of the EVENT_TRIGGER parameter:

CREATE_NEW_PDN_CONNECTION
The default bearer is created.

REATTEMPT The GGSN/PGW-initiated Gx+ PCC session reestablishment.

3.2.18 GX_UPDATE

The GX_UPDATE event has the following characteristics:

— Provides information about the GGSN/PGW-initiated or PCRF-initiated session update procedure.

— Is triggered when a CCR Update message is sent from the GGSN/PGW.

— Ends when any of the following scenarios occur:

- The PGW receives the CCA-Update message from the PCRF in response to a sent CCR-U message.
- There is no response received from the PCRF.

The GX_UPDATE event includes the following value of the EVENT_TRIGGER parameter:

SERVICE_CONDITION_CHANGE

The PGW initiates an IP-CAN Session Modification procedure. For example, the PGW receives a request to establish or terminate an IP-CAN bearer, the PGW receives a request for resource modification, or an event trigger is met. For more information, refer to Event-Based Monitoring Events and Parameters.

3.2.19 GX_TERMINATE

The GX_TERMINATE event has the following characteristics:

— Provides information about the GGSN/PGW-initiated or PCRF-initiated termination procedure.

— Is triggered when a CCR Termination message is sent from the GGSN/PGW.

— Ends when any of the following scenarios occur:

- The GGSN/PGW receives the CCA Termination message from the PCRF in response to a sent CCR-T message.
- There is no response received from the PCRF.

The GX_TERMINATE event includes the following value of the EVENT_TRIGGER parameter:

DELETE_PDN_CONNECTION

The GGSN/PGW or PCRF initiates a deletion of the default and any dedicated bearers.

3.2.20 GX_REAUTHORIZE

The GX_REAUTHORIZE event has the following characteristics:

— Provides information about the PCRF-initiated reauthorization procedure.

— Is triggered when the GGSN/PGW receives an RAR message from the PCRF.

— Ends when any of the following scenarios occur:

- The GGSN/PGW sends the RAA message in response to a sent RAR message.
- There is no response received from the GGSN/PGW.

The GX_REAUTHORIZE event includes one of the following values of the EVENT_TRIGGER parameter:

REAUTHORIZATION_NONOPTIMIZED

The PCRF-Initiated reauthorization with a non-optimized RAR message.

REAUTHORIZATION_OPTIMIZED
The PCRF-Initiated reauthorization with an optimized RAR message.

3.2.21 GY_CC_INIT

The GY_CC_INIT event has the following characteristics:

— Provides information about the GGSN/PGW-initiated Gy+ session initialization procedure.

— Is triggered when a CCR-I message is sent from the GGSN/PGW.

— Ends when any of the following scenarios occur:

- The GGSN/PGW receives the CCA-I message from the OCS in response to a sent CCR-I message.
- There is no response received from the OCS.

The GY_CC_INIT event includes one of the following values of the EVENT_TRIGGER parameter:

CREATE_NEW_PDN_CONNECTION
The default bearer is created.

SERVICE_ACCESS_DETECTED
Service data is detected to create a CC session.

REATTEMPT The GGSN/PGW-initiated Gy+ session initialization reestablishment.

3.2.22 GY_CC_UPDATE

The GY_CC_UPDATE event has the following characteristics:

— Provides information about the GGSN/PGW-initiated or OCS-initiated session update procedure.

— Is triggered when a CCR-U message is sent from the GGSN/PGW.

— Ends when any of the following scenarios occur:

- The PGW receives the CCA-U message from the OCS in response to a sent CCR-U message.
- There is no response received from the OCS.

The GY_CC_UPDATE event includes one of the following values of the EVENT_TRIGGER parameter:

SERVICE_CONDITION_CHANGE

The PGW initiates a credit control session modification procedure. The procedure is triggered by service data container closure. For more information, refer to Offline Charging.

REAUTHORIZATION

The update is triggered by the OCS-initiated reauthorization.

REATTEMPT The GGSN/PGW-initiated or OCS-initiated session update reestablishment.

3.2.23 GY_CC_TERMINATE

The GY_CC_TERMINATE event has the following characteristics:

— Provides information about the GGSN/PGW-initiated or OCS-initiated termination procedure.

— Is triggered when a CCR-T message is sent from the GGSN/PGW.

— Ends when any of the following scenarios occur:

- The GGSN/PGW receives the CCA-T message from the OCS in response to a sent CCR-T message.
- There is no response received from the OCS.

The GY_CC_TERMINATE event includes one of the following values of the EVENT_TRIGGER parameter:

DELETE_PDN_CONNECTION

The GGSN/PGW initiates a deletion of the default and any dedicated bearers.

OCS_TRIGGERED_TERMINATE_GY_SESSION

The OCS initiates a synchronous termination of an ongoing credit control session by including a termination request in a CCA message in response to a CCR message.

The OCS initiates an asynchronous termination of an ongoing credit control session by sending an ASR message to the GGSN/PGW.

OCS_TRIGGERED_ABORT_GY_SESSION

The OCS initiates a synchronous termination of an ongoing credit control session by including a termination request in a CCA message with a result code set to DIAMETER_AUTHORIZATION_REJECTED in response to a CCR message.

The OCS initiates an asynchronous termination of an ongoing credit control session by sending an ASR message to the GGSN/PGW.

REATTEMPT The GGSN/PGW-initiated or OCS-initiated termination reestablishment.

SERVICE_END_DETECTED

Service data is detected to terminate a CC session.

3.2.24 GY_CC_EVENT

The GY_CC_EVENT event has the following characteristics:

— Provides information about reporting rating condition changes from the GGSN/PGW to the OCS without initiating a credit control session. For more information, refer to Credit Control.

— Is triggered when a CCR Event message is sent from the GGSN/PGW.

— Ends when any of the following scenarios occur:

- The GGSN/PGW receives the CCA Event message from the OCS in response to a sent CCR-E message.
- There is no response received from the OCS.

The GY_CC_EVENT event includes one of the following values of the EVENT_TRIGGER parameter:

LOCATION_TRIGGERS_PROVIDED_BY_PCRF

The PCRF arms triggers in the GGSN/PGW at user session establishment, and then the GGSN/PGW sends a location change report to the OCS.

REATTEMPT The GGSN/PGW reports a location change report when a location trigger is met during session establishment.

3.2.25 P_CHANGE_NOTIFICATION

The P_CHANGE_NOTIFICATION event has the following characteristics:

— Is triggered when a Change Notification Request message is received on the S5/S8 interface.

— Ends when the PGW sends the corresponding `Change Notification Response` message.

The `P_CHANGE_NOTIFICATION` event includes one of the following values of the `EVENT_TRIGGER` parameter:

SECONDARY_RAT_USAGE_DATA_REPORT
Secondary RAT usage data report.

NO_INFORMATION
The PGW does not have enough information about the reason for the event trigger.

3.2.26 UE_IP_ADDRESS_ALLOCATION

The `UE_IP_ADDRESS_ALLOCATION` event has the following characteristics:

— Provides information about UE location and the UE IP address when the session is created.

— Is triggered when any of the following scenarios occur:

- A `Create Session Request` message is received on the S5/S8 interface or the S2b interface.
- A `Create PDP Context Request` message is received from the SGSN.

— Ends when any of the following scenarios occur:

- The PGW sends the corresponding `Create Session Response` message.
- The PGW discards the `Create Session Request` message.
- The GGSN sends the corresponding `Create PDP Context Response` message.
- The PGW discards the `Create PDP Context Request` message.

The `UE_IP_ADDRESS_ALLOCATION` event includes the following value of the `EVENT_TRIGGER` parameter:

CREATE_NEW_PDN_CONNECTION
The default bearer is created.

CREATE_NEW_PDP_CONTEXT_CONNECTION
A primary PDP context is created.

HANDOVER_FROM_CDMA
The UE moves from an eHRPD access to an LTE access.

HANDOVER_FROM_UNTRUSTED_WLAN

The UE moves from an untrusted WLAN access to an LTE access.

HANDOVER_TO_UNTRUSTED_WLAN

The UE moves from an LTE access to an untrusted WLAN access.

HANDOVER_TO_UNTRUSTED_WLAN_TREATED_AS_NEW_SESSION_CREATION

The UE accesses an untrusted WLAN with the `Handover Indication` set to 1 while the UE context does not exist in the PGW.

3.2.27 UE_IP_ADDRESS_DEALLOCATION

The `UE_IP_ADDRESS_DEALLOCATION` event has the following characteristics:

— Provides information about UE location and the UE IP address when the session is deleted.

— Is triggered when any of the following scenarios occur:

- A `Delete Session Request` message is received on the S5/S8 interface or the S2b interface.
- A `Delete Bearer Request` message is sent on the S5/S8 interface or the S2b interface with Linked EPS Bearer ID (LBI) when a CLI command is issued to terminate a session.
- The PGW sends a `Delete Bearer Request` message with cause code `Reactivation Requested` to the SGW during the P-CSCF restoration procedure.
- A `Disconnect-Request` message is received from the RADIUS server.
- A `Re-Auth-Request` (RAR) message is received from the PCRF with a `Session-Release-Cause` AVP included.
- An `Abort-Session-Request` (ASR) or an `Abort-Session-Answer` (ASA) message is received from the OCS.
- An internal decision is made by the SGW or EPG to delete a PDN connection.
- A `Delete PDP Context Request` message is received from the SGSN.
- The deletion of the PDP context connection is initiated from the RADIUS, the PCRF, the OCS, or the GGSN.

— Ends when any of the following scenarios occur:

- The PGW sends a `Delete Session Response` message in response to a `Delete Session Request` message.
- A session is successfully terminated after a `Delete Bearer Response` message is received that includes the LBI.
- The inactivity timer of an emergency PDN connection expires.
- A PDN connection is closed as a result of an internal decision made by the SGW or the EPG to delete a PDN connection.
- The GGSN sends the corresponding `Delete PDP Context Response` message to the SGSN.
- The GGSN receives the corresponding `Delete PDP Context Response` message from the SGSN.

The `UE_IP_ADDRESS_DEALLOCATION` event includes one of the following values of the `EVENT_TRIGGER` parameter:

DELETE_PDN_CONNECTION
The SGW, the RADIUS server, the PCRF, or the OCS initiates a deletion of the default and any dedicated bearers.

HANDOVER_TO_CDMA
The UE moves from an LTE access to an eHRPD access.

HANDOVER_TO_UNTRUSTED_WLAN
The UE moves from an LTE access to an untrusted WLAN access.

HANDOVER_FROM_UNTRUSTED_WLAN
The UE moves from an untrusted WLAN access to an LTE access.

EVENT_INVOKED_BY_MANAGEMENT
The default bearer and any dedicated bearers are deleted, which is initiated by the bearer termination CLI commands.

Note: This value is supported for two bearer termination CLI commands:

— Terminate all bearers in the GGSN or the PGW

— Terminate all bearers associated with a specific IMSI or an IMSI prefix

EVENT_TRIGGERED_INTERNALLY
The PGW initiates a default bearer deletion because of the idle bearer timer expiration, or if a new session creation collides with an existing default bearer. For more information, refer to Session Management.

PCRF-BASED-PCSCF-RESTORATION
Set when the session is terminated because of the PCRF-based P-CSCF restoration procedure.

PCSCF_RESTORATION
Set when the session is terminated because of the PCO-based extension of the HSS-based P-CSCF restoration procedure.

PDN_CONNECTION_INACTIVITY_TIMER_EXPIRES
The emergency PDN connection inactivity timer expires.

DELETE_PDP_CONTEXT_CONNECTION
The SGSN, the GGSN, the RADIUS, the OCS, or the PCRF initiates the deletion of primary and secondary PDP contexts.

SECONDARY_PDP_CONTEXT_DEACTIVATION
The SGSN, the GGSN, the RADIUS, the OCS, or the PCRF initiates the deactivation of secondary PDP contexts.

4 Event Outcome

The following subsections describe the event results, event cause codes, sub-cause codes, cause protocols, and bearer causes that are supported by the EPG.

For a list of cause codes, sub-cause codes and bearer cause codes, refer to Event-Based Monitoring Cause Codes.

4.1 Event Result

The EPG sets the `EVENT_RESULT` parameter that corresponds to the result of the event:

— The EPG sets the `EVENT_RESULT` to `SUCCESS`.

- If the cause value that the EPG sets in the response message is an acceptance response (`Request accepted` or `Request accepted partially`)

  This is for the scenario where the event is triggered by a request message from another node and the EPG sends a response message to that node.

- If the cause value that the EPG receives in the response message, is an acceptance response (`Response accepted` or `Response accepted partially`)

  This is for the scenario where the event is triggered by a request message sent from the EPG to another node and the EPG receives a response message from that node.

  This is also for the scenario where the event is triggered by a command message from another node and then EPG sends a request message to and receives a response message from that node.

- If the event is triggered internally (that is, not by external signaling)

— The EPG sets the `EVENT_RESULT` to `REJECT`.

- If the cause value that the EPG sets in the response message is a rejection response

  This is for the scenario where the event is triggered by a request message from another node and the EPG sends a response message to that node.

- If the cause value that the EPG receives in the response message, is a rejection response

  This is for the scenario where the event is triggered by a request message sent from the EPG to another node and the EPG receives a response message from that node.

- If the EPG sends a `Failure Indication` message as the response to the command message received by the EPG

- If the expected response message other than `Delete Bearer Response` is not received by the EPG, then the procedure is implicitly finished

— The EPG sets the `EVENT_RESULT` to `IGNORE` when the received request message or command message is discarded by the EPG.

4.2 Cause Protocol

For the present release, the following cause protocols are used:

— `GTPV2`

  This cause protocol is used when GTPv2 messages trigger EBM events.

— INTERNAL

  This cause protocol is used when the event is not directly triggered by external signaling or the event is ignored because of an internal failure. A possible example of an internally triggered operation is if the MME and SGW lose contact and the UE detaches and reattaches. The SGW then receives a new Create Session Request message along with an EPS Bearer ID (EBI) that the SGW already has a context for. This can result in a SESSION_DELETION event triggered internally and a SESSION_CREATION message triggered by external GTPv2-C messages.

— DIAMETER

  This cause protocol is used when Diameter messages trigger EBM events.

— RADIUS

  This cause protocol is used when RADIUS messages trigger EBM events.

4.3 Cause Code

The value of the CAUSE_CODE parameter provides more information about the reason for the acceptance or the rejection of an event. The cause code information must be analyzed together with the CAUSE_PROTOCOL parameter to come to a meaningful conclusion.

Normally, the CAUSE_CODE is the same as the standard cause code (normally 3GPP) sent to the peer node in the response message as a result of the signaling procedure. If the cause protocol INTERNAL is used, the CAUSE_CODE is internally defined.

Different protocols have different CAUSE_CODE values defined.

For a list of cause codes, refer to Event-Based Monitoring Cause Codes.

4.4 Sub-Cause Code

The SUB_CAUSE_CODE parameter gives information about the reason for failure. The EPG sets a SUB_CAUSE_CODE in the following cases:

— If the EVENT_RESULT parameter of an event is partially successful.

— If the EVENT_TRIGGER parameter of the event is set to EVENT_TRIGGERED_INTERNALLY, that is, if the event is triggered internally.

— If the EVENT_RESULT parameter of an event is set to IGNORE.

The SUB_CAUSE_CODE event parameter must be analyzed together with the CAUSE_CODE and CAUSE_PROTOCOL parameter information.

For a list of sub-cause codes, refer to Event-Based Monitoring Cause Codes.

4.5 Bearer Cause

The value of the BEARER_CAUSE parameter provides more information about each bearer in the bearer list (for example, whether the bearer handling was successful or the underlying reason bearer handling was unsuccessful). The Bearer cause corresponds to a subset of the values present in the table detailing cause values in SoC with 3GPP TS 29.274.

For a list of bearer cause codes, refer to Event-Based Monitoring Cause Codes.

4.6 DIAMETER Cause

The DIAMETER cause codes provide information about the reason for acceptance or rejection of a Diameter message during the interaction with the PCRF and the OCS.

For a list of DIAMETER cause codes, refer to Event-Based Monitoring Cause Codes.

4.7 RADIUS Cause

The RADIUS cause codes provide information about the reason for acceptance or rejection of a RADIUS message during the interaction with the RADIUS server.

For a list of RADIUS cause codes, refer to Event-Based Monitoring Cause Codes.