

# Event-Based Monitoring

## TECHNICAL PRODUCT DESCRIPTION

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# Contents

<b>1</b>	<b>Introduction</b>	<b>1</b>
1.1	Scope	1
1.2	Target Groups	1
<b>2</b>	<b>Overview</b>	<b>2</b>
<b>3</b>	<b>Supported Events</b>	<b>3</b>
3.1	SGW-Supported Events	3
3.1.1	SESSION_CREATION	4
3.1.2	SESSION_SUSPENSION	5
3.1.3	SESSION_RESUME	5
3.1.4	SESSION_DELETION	6
3.1.5	BEARER_CREATION	7
3.1.6	BEARER_MODIFICATION	8
3.1.7	BEARER_UPDATE	9
3.1.8	BEARER_DELETION	9
3.1.9	DOWNLINK_DATA_NOTIFICATION	10
3.1.10	INDIRECT_DATA_FORWARDING_CREATION	12
3.1.11	INDIRECT_DATA_FORWARDING_DELETION	12
3.2	GGSN/PGW-Supported Events	13
3.2.1	SESSION_INFO	14
3.2.2	DATA_USAGE	15
3.2.3	P_SESSION_CREATION	15
3.2.4	P_SESSION_SUSPENSION	16
3.2.5	P_SESSION_RESUME	17
3.2.6	P_SESSION_DELETION	17
3.2.7	P_BEARER_CREATION	19
3.2.8	P_BEARER_MODIFICATION	20
3.2.9	P_BEARER_UPDATE	21
3.2.10	P_BEARER_DELETION	22
3.2.11	S6B_AUTHORIZATION	23
3.2.12	S6B_TERMINATION	24
3.2.13	GX_INIT	25
3.2.14	GX_UPDATE	25
3.2.15	GX_TERMINATE	26
3.2.16	GX_REAUTHORIZE	26
3.2.17	GY_CC_INIT	27
3.2.18	GY_CC_UPDATE	27
3.2.19	GY_CC_TERMINATE	28
3.2.20	GY_CC_EVENT	29
<b>4</b>	<b>Event Outcome</b>	<b>30</b>
4.1	Event Result	30



4.2	Cause Protocol	31
4.3	Cause Code	31
4.4	Sub-Cause Code	32
4.5	Bearer Cause	32
4.6	DIAMETER Cause	32
4.7	RADIUS Cause	32



# 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 amount 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 is 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 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, see [Event-Based Monitoring Output](#).

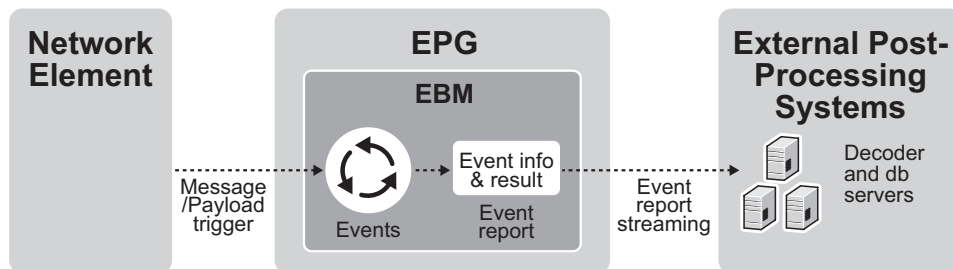


Figure 1 EBM Overview

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 described 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.

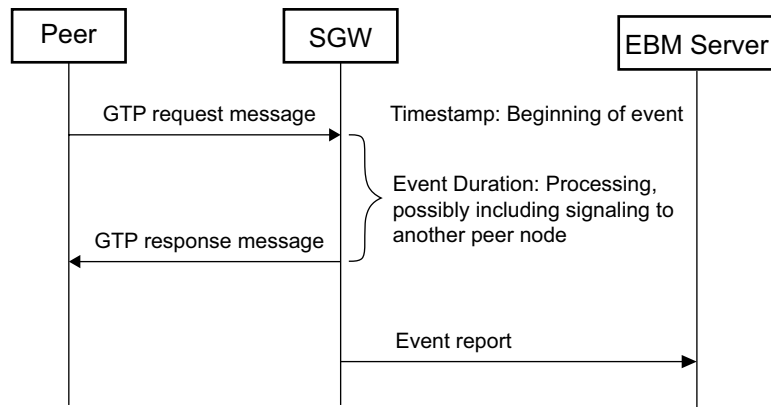


Figure 2 EBM Reporting on the SGW

An event is normally triggered when the SGW receives a GTP message in a procedure. Events may also be triggered due to 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

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 a 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 due to 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 9 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.

In some exceptional scenarios, for example in the Inter-Chassis 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 due to 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 a 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.
  - An 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. 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 due to 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\_RESTITUTION\_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\_RESTITUTION\_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\_RESTITUTION\_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\_RESTITUTION\_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 one of the following values of the `EVENT_TRIGGER` parameter:

### **EUTRAN\_S1\_BASE D\_HANOVER**

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 one of the following values of the `EVENT_TRIGGER` parameter:

#### `EUTRAN_S1_BASE D_HANDOVER`

E-UTRAN S1-based handover.

## 3.2 GGSN/PGW-Supported Events

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

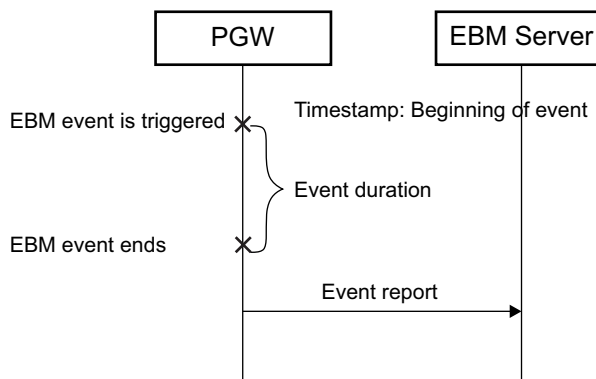


Figure 3 EBM Reporting on the GGSN/PGW

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 may also be triggered due to 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 report 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
- 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

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 corresponding EBM profile, and any of the following scenarios occurs:
  - 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 due to 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 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 due to the idle bearer timer expiration or if a new session creation collides with an existing default bearer. For more information, refer to *Session Management*.

ment

### PCRF-BASED-PCSCF-RESTORATION

Set when the session is terminated due to PCRF based P-CSCF restoration procedure.

### PCSCF\_RESTORATION

Set when the session is terminated due to 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 22 for more information about the *P\_BEARER\_DELETION* event.

## 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 due to 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 due to 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 due to the idle bearer timer expiration or if a new session creation collides with an existing dedicated bearer. For more information, refer to [Session Management](#).

### **3.2.11**

#### **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 re-authorization 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 re-authorization.

#### **REAUTHORIZATION**

The 3GPP AAA server-initiated re-authorization.



#### **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.

### **3.2.12**

#### **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:
  - An 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 and any dedicated bearers.

#### **PCRF\_TRIGGERED\_DELETE\_PDN\_CONNECTION**

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

#### **OCS\_TRIGGERED\_DELETE\_PDN\_CONNECTION**

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



### **ABORT\_S6B\_SESSION**

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

### **ABORT\_AND\_TERMINATE\_S6B\_SESSION**

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

### **EVENT\_TRIGGERED INTERNALLY**

The PGW responds to an internal error.

## **3.2.13**

### **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.

## **3.2.14**

### **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 one of the following values 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*.

### **3.2.15 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 one of the following values of the EVENT\_TRIGGER parameter:

#### **DELETE\_PDN\_CONNECTION**

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

### **3.2.16 GX\_REAUTHORIZE**

The GX\_REAUTHORIZE event has the following characteristics:

- Provides information about the PCRF-initiated re-authorization 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 re-authorization with a non-optimized RAR message.

**REAUTHORIZATION\_OPTIMIZED**

The PCRF-Initiated re-authorization with an optimized RAR message.

**3.2.17****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 new CC session.

**REATTEMPT**

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

**3.2.18****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 re-authorization.

**REATTEMPT**

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

**3.2.19**

**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.

## **3.2.20**

### **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.



## 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.