Multi-Access Gateway – controller

Release 26.10

Per Call Measurement Data Guide

3HE 22206 AAAC TQZZA
Edition: 01
October 2026

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1 Getting started

Find general information about this guide.

1.1 About this guide

This guide describes details pertaining to the Per Call Measurement Data (PCMD) service for the Nokia Multi-Access Gateway – controller (MAG-c) for the BNG CUPS solution.

This guide serves as the specification for the MAG-c PCMD, which is identical between all available product platforms. It provides concepts and descriptions of PCMD record generation, format, information elements and their value tables, Command Line Interface (CLI) syntax, and command usage.

This guide is organized into functional chapters and provides concepts and descriptions of the implementation flow, as well as CLI syntax and command usage.

Command outputs shown in this guide are examples only; actual displays may differ depending on supported functionality and user configuration.

The CLI trees and command descriptions can be found in the *MAG-c CLI Reference Guide*.

Note: This guide generically covers content for the release specified on the title page of the guide, and may also contain some content that will be released in later maintenance loads. See the applicable *MAG-c Release Notes* for information about features supported in each load of the software release.

Note: The information in this guide is intended to be used in conjunction with the SR OS software user guides. The SR OS software user guides describe SR OS service features that are supported by the MAG-c. See the *7450 ESS, 7750 SR, 7950 XRS, and VSR Documentation Suite Overview Card 20.10.R1* for specific guide titles.

1.2 Conventions

This section describes the general conventions used in this guide.

1.2.1 Precautionary and information messages

The following information symbols are used in the documentation.

DANGER: Danger warns that the described activity or situation may result in serious personal injury or death. An electric shock hazard could exist. Before you begin work on this equipment, be aware of hazards involving electrical circuitry, be familiar with networking environments, and implement accident prevention procedures.

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WARNING: Warning indicates that the described activity or situation may, or will, cause equipment damage, serious performance problems, or loss of data.



Caution: Caution indicates that the described activity or situation may reduce your component or system performance.



Note: Note provides additional operational information.



Tip: Tip provides suggestions for use or best practices.

1.2.2 Options or substeps in procedures and sequential workflows

Options in a procedure or a sequential workflow are indicated by a bulleted list. In the following example, at step 1, the user must perform the described action. At step 2, the user must perform one of the listed options to complete the step.

Example: Options in a procedure

1. User must perform this step.
2. This step offers three options. User must perform one option to complete this step.
   - This is one option.
   - This is another option.
   - This is yet another option.

Substeps in a procedure or a sequential workflow are indicated by letters. In the following example, at step 1, the user must perform the described action. At step 2, the user must perform two substeps (a. and b.) to complete the step.

Example: Substeps in a procedure

1. User must perform this step.
2. User must perform all substeps to complete this action.
   a. This is one substep.
   b. This is another substep.

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2 Introduction to PCMD

PCMD provides the ability to conduct per-session performance analysis of MAG-c functions. PCMD supports per-procedure analysis at per-session granularity.

2.1 PCMD overview

PCMD is a real-time diagnostics and troubleshooting tool that provides call-session and connection records for information such as duration, quality, disposition, and other important events that occur during the session, such as setup, failure, handover, and termination.

PCMD is used to evaluate the UE and the network node performance. For example, a call-flow procedure failure for the majority of UEs from a specific vendor can quickly reveal the root cause of a problem at the UE level.

When used for specific scenarios, PCMD provides the ability to perform root-cause analysis of problems caused by non-compliance in the network nodes. PCMD helps determine failure scenarios using end-to-end network-wide per-call measurements from multiple nodes. The end-to-end session data from the live network helps pinpoint the root causes of failures and facilitates quick responses, without recreating the scenarios in a lab environment.

PCMD also supports analysis of the MAG-u traffic volume.

Note:
The MAG-c is the generic converged name for any type of control plane, including the BNG CP, the 4G combined SGW-C + PGW-C, and the 5G CP function (SMF).

The MAG-u is the generic converged name for any type of user plane, including the BNG UP, the 4G combined SGW-u + PGW-u, and the 5G UP function (UPF).

Evaluating the subscriber experience is possible by studying the uplink and downlink traffic patterns for a pool of subscribers or on a per-subscriber basis. PCMD data is generated on the gateway and sent to a data collector node over a User Datagram Protocol (UDP) stream, which facilitates the exchange of datagrams without acknowledgment or guaranteed delivery. Call data streaming enables performance and root-cause analysis of real-time network issues.

PCMD data is generated on the MAG-c control plane (CP) and sent to a data collector node over a UDP stream. The call-data streaming enables performance and root-cause analysis of real-time network issues.

2.2 Feature summary

The MAG-c supports PCMD in the following networks:

- on the CP, in a 4G-CUPS network
- on the SMF, in a 5G network

The MAG-c PCMD features include:

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- performance and fault management, real-time monitoring, and off-line troubleshooting
- detailed call-processing view per procedure and per session
- detailed information about all activities of every user
- optionally enabled by the user using CLI configuration
- data source:
  - external messages
  - session state
  - internal processing logic
  - data digested and enriched with application logic, unlike sniffer tools that operate agnostic of application logic and rely on packet-capture only
- live streaming of PCMD session records
- data records for charging events
- PCMD stream realized as a UDP stream of PCMD records (one PCMD IP/UDP packet may contain 1 to 11 or more PCMD records) in proprietary binary format
- support for FWA control plane functions only (SMF and GW-C)

2.3 Configuration

The MAG-c supports CLI commands to configure streaming of PCMD records. MAG-c supports PCMD record streaming to the provisioned real-time port when the record is created.

See PCMD record format and Generating and transmitting PCMD records for more information about PCMD records.

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3 PCMD record generation

The MAG-c supports PCMD record configuration using CLI commands. A PCMD record is streamed to the provisioned real-time port when the record is created.

3.1 Configuring the destination port for PCMD records

The MAG-c collects and streams session and data PCMD records. Use the following command to configure the destination port for PCMD records:

```
configure mobile-gateway profile pcmd destination port
```

3.2 Session records

Session records overview

The most important entity reported in the PCMD session records is a procedure that describes the event (for example, attach, detach, PDU session create, modify bearer, and QoS flow modification). A procedure contains a set of messages that are reported together. A specific message starts a procedure and another message ends it. However, some exception procedures, such as session deletion because of MME failure, are initiated internally by the system without requiring an external trigger message. A procedure can also be relevant to bearers that are reported with it.

If a procedure starts while another procedure is still ongoing, the procedures are reported together as concurrent procedures. A procedure is concurrent if it is relevant to some bearers in the original procedure.

For example, when DL packets are received for an idle UE for a specific default bearer, a paging procedure is triggered and the DDN is sent to the MME. At the same time, the MME sends a Delete Session Request for this default bearer.

A session PCMD record is created when any of the supported 3GPP procedures are triggered and the call flow of the procedure ends (normally or abnormally).

Each session PCMD record contains fields for subscriber information (IMSI, SUPI, MSISDN, GPSI, IMEI, PEI), procedure ID, procedure result, procedure failure cause, and other data relevant to the procedure, such as bearer ID, QoS flow ID, APN, and slice.

Session record verbosity

The session PCMD can include either of the following records:

- The **standard** record contains only the mandatory and conditional fields.
- The **extended** record contains mandatory and conditional fields plus optional and conditional-optional fields.

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Mandatory fields are always present. Optional fields are present only when an extended record is generated. Conditional (and conditional-optional) fields are filled in the PCMD record if the related information elements (IEs) are present in the signaling messages involved in the procedure. In some cases, a conditional parameter may be filled in the PCMD record even when the IE is not present in any signaling message. This happens when the MAG-c processing function knows the value, for example, through state information kept from previous processing.

The descriptions in the IE indicate the presence or availability of each PCMD IE; see PCMD record IEs for more information about IEs.

The procedure result and the configured verbosity type determine the type of PCMD records that are generated and streamed. Use the following CLI command to configure the verbosity type:

```
configure mobile-gateway profile pcmd session-report verbosity
```

The possible values for the **verbosity** are:

- **failure-only**
- **standard**
- **extended**

The following table lists the triggers for creating PCMD session records.

Table 1: Triggers for the creation of PCMD session records

User setting (CLI) verbosity command	Records		
	Extended session PCMD record for result FAILURE	Standard session PCMD record for result NORMAL	Extended session PCMD record for result NORMAL
failure-only	✓	—	—
standard	✓	✓	—
extended	✓	—	✓

See Session PCMD record format for more information about the container formats that construct the standard and the extended session PCMD records.

See Generating and transmitting PCMD records for more information about generating and transmitting PCMD records.

3.3 Data records

The triggers that generate PCMD data records are the same as those configured for charging on the MAG-c. A PCMD data record is generated whenever there is a charging event from N40 CHF.

For example, if both online and offline charging are enabled, offline-charging events occur after online-charging events. Charging functionality must be enabled on the MAG-c to generate data PCMD records. The data PCMD records contain the following information:

- subscriber identification

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- charging-related information (for example, rating group and service ID)
- MAG-u data volume
- MAG-u data time

The following table lists the triggers for creating Data PCMD records.

Data record selection

The value of the following command controls the generation of data PCMD records.

```
configure mobile-gateway profile pcmd [profile-name] data-report generation
```

Data PCMD records are generated only when any type of charging is enabled on the MAG-c. The possible values for the **generation** command are:

- **no generation** — no data records are generated.
- **generation event-based** — Data PCMD records are generated based on the charging events. Charging functionality must be enabled on the MAG-c.

3.4 PCMD heartbeat messages

The PCMD interface sends periodic heartbeat messages to notify the collector that the MAG-c reporting application is alive. This is especially useful in silent periods, for example, during the integration phase or when traffic is low.

The MAG-c active OAM-VM transmits the heartbeat messages toward the configured PCMD destination, based on the configuration in the PCMD profile. Use the following CLI command to modify the default setting for the heartbeat messages.

```
configure mobile-gateway profile pcmd heartbeat
```

See Generating and transmitting PCMD records for more information about configuring the PCMD profile.

3.5 Generating and transmitting PCMD records

An internal process collects PCMD data and generates the PCMD records. When a user configures a PCMD profile and assigns it to a PDN, the internal process starts generating (not transmitting) PCMD records. To transmit the generated PCMD records, the user must also configure the PCMD profile with a reachable destination IP address and assign it to a PDN that is operationally enabled.

About this task

PCMD records start generating as soon as you associate a PCMD profile with a PDN, regardless of whether you configure a reachable destination IP address.

Note: Generating PCMD records can have a performance impact on the system, regardless of whether the PCMD records are transmitted.

To transmit the generated PCMD records, the following is required:

- Configure the PCMD profile with a reachable destination IP address.

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- Assign the PCMD profile to a PDN that is operationally enabled (**no shutdown** command).

Note:

- Reachability is calculated based on the local routing information and the link status. As a result, the MAG-c starts and stops PCMD record transmission and accordingly updates the PCMD operational state based on network configuration and interface status only.
- The PCMD transmission stops with any of the following events:
  - the user executes the **shutdown** command at the PDN to shutdown the PDN
  - the user executes the **no pcmd** command at the PDN to disable the PCMD profile
  - connectivity to the configured destination IP address fails and the destination becomes unreachable

In the following procedure, the PCMD profile configuration settings are defined as follows:

- The profile name is PCMD-records.
- The PCMD network destination is 192.0.2.2.
- The session report verbosity type is extended.

Procedure

Step 1. Configure a PCMD profile.

Note: If you are modifying the configuration of a PCMD profile that is already assigned to the PDN, remove the profile from the PDN configuration before making the changes. The MAG-c does not support configuration of the PCMD profile while it is assigned to the PDN.

```
configure mobile-gateway profile pcmd
```

Example

```
configure mobile-gateway profile pcmd PCMD-records
```

Step 2. Configure the network destination for the PCMD profile records.

PCMD records generate without a configured network destination, however a reachable destination IP address is required to transmit the generated PCMD records.

```
configure mobile-gateway profile pcmd destination
```

Example

```
configure mobile-gateway profile pcmd PCMD-records destination 192.0.2.2
```

Step 3. Optional: Modify the default report type for the PCMD profile.

```
configure mobile-gateway profile pcmd session-report verbosity
```

Example

```
configure mobile-gateway profile pcmd PCMD-records session-report verbosity extended
```


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Step 4. Optional: Modify the default periodic heartbeat transmission in the PCMD interface.

```
configure mobile-gateway profile pcmd heartbeat
```

Example

```
configure mobile-gateway profile pcmd PCMD-records heartbeat 15
```

Step 5. Optional: Enable PCMD data report generation in the profile.

```
configure mobile-gateway profile pcmd PCMD-records data-report generation event-based
```

Step 6. Assign the PCMD profile to the gateway instance.

```
configure mobile-gateway pdn pcmd profile
```

Example

```
configure mobile-gateway pdn 1 pcmd profile PCMD-records
```

Step 7. Ensure the PDN is in the operationally enabled state.

```
configure mobile-gateway pdn 1 no shutdown
```

Step 8. View the PCMD configuration.

```
show mobile-gateway profile pcmd
```

Example

```
show mobile-gateway profile pcmd PCMD-records
```

Expected outcome

```
A:MAG-c# show mobile-gateway profile pcmd "PCMD-records"
===============================================================================
PCMD profile
===============================================================================
Profile name        : PCMD-records
Description         : none
Destination address : 192.0.2.2
Destination port    : 29780
Destination router  : Base
Heartbeat           : 15

Session Report:
Verbosity           : extended

Data Report:
Generation          : event-based
Destination         : inherit
-------------------------------------------------------------------------------
Number of profiles  : 1
===============================================================================
```


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Step 9. View the PCMD statistics.

```
show mobile-gateway pdn pcmd-stats
```

Expected outcome

```
A:MAG-c# show mobile-gateway pdn pcmd-stats
===============================================================================
PDN gateway PCMD statistics
===============================================================================
VNF/VM           : 1/3                  Gateway          : 1

PDN PCMD Profile name     : PCMD-records
PDN PCMD Profile duration : 0d 00:04:37
PDN PCMD oper. state      : up

Session records                          Data Records
---------------                          ------------
Success records  : 0                     Total records    : 2
Failure records  : 0                     Total bytes      : 168
Success extended : 3                     Total suppressed : 0
Success limited  : 0
Total records    : 3
Total bytes      : 588

---------------------------
Gateway lifetime statistics
---------------------------
Success records  : 3                     Failure records  : 0
-------------------------------------------------------------------------------
Number of cards  : 1
-------------------------------------------------------------------------------
NOTE: Gateway lifetime statistics represent all generated session records count
      since gateway creation regardless profile is assigned to gateway or not.
===============================================================================
```


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4 PCMD record format

Learn about the PCMD record format, which is logically divided into several containers that can be present multiple times.

A PCMD record is logically divided into several parts known as containers. Containers are sorted and can be present multiple times. They can be of fixed or variable size and must be divisible by four. If the size is not divisible by four, padding 0s are appended.

If the system IP address inserted in the PCMD record is IPv6, the maximum session record size is:

- 1248 bytes for standard records
- 1532 bytes for extended records
- 32 bytes for heartbeat records
- 96 bytes for data records

If the system IP address inserted in the PCMD record is IPv4, the sizes are decreased by 12 bytes. The PCMD record size equals the UDP payload length of the IP packet, if there is just one PCMD record present.

Every PCMD record begins with a header as defined in PCMD record header format. The version of the PCMD record conveyed in the PCMD header changes when either of the following occurs:

1. The structure or format of any container changes.
2. A new container type is introduced.

The PCMD version for this release is 6.

The following notation specifies the structure of each container. This notation is similar to the 3GPP specifications, with the left side of a byte holding the most significant bit. Four bytes are shown per table row. The leftmost byte is transmitted first.

bytes:	0	1	2	3
bits:	7 6 5 4 3 2 1 0	7 6 5 4 3 2 1 0	7 6 5 4 3 2 1 0	7 6 5 4 3 2 1 0

When more than one byte is merged in a single information element, the bit numbering is contiguous and the left is the logically more significant. See Table 5: HeaderFlags in PCMD record report header2 for an example.

4.1 PCMD record header format

The PCMD record header is composed of the PCMD record common header, the PCMD record report header, and the SendingNodeIP container.

Table 2: PCMD record header format

PCMD record common header
PCMD record report header2

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SendingNodeIP container

4.1.1 PCMD record common header

Table 3: PCMD record common header

Bytes	0	1	2	3
0	PCMDVersion=6	RecordType	RecordLength	

4.1.2 PCMD record report header2

Table 4: PCMD record report header2

Bytes	0	1	2	3
0	RecordOpeningTime			
4				
8	RecordSequenceNumber			
12	GwId	MscpGroupId	SendingNodeType	HeaderFlags
16	System Load	Reserved		
20	UEid			
24				

Table 5: HeaderFlags

7	6	5	4	3	2	1	0
Sending NodeIpV6	Reserved						

For descriptions of the PCMD record header container information elements, see Header record IEs.

4.1.3 SendingNodeIP container

The length of the SendingNodeIP container depends on the IP address type:

- 4 bytes for IPv4
- 16 bytes for IPv6

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Table 6: SendingNodeIP container (IPv4)

Bytes	0	1	2	3
0	Sending node IPv4			

Table 7: SendingNodeIP container (IPv6)

Bytes	0	1	2	3
0	Sending node IPv6			
4				
8				
12				

4.2 Session PCMD record format

The following tables describe the formats of the Session PCMD and Session Extended PCMD records.

The multiplicity values listed in the tables indicate, at the container level, how often a container may appear in the record:

- 1 – appears exactly one time (always present)
- 0 to 1 – appears one time or not at all (optional)
- 0 to *n* – appears multiple times or not at all (optional)
- 1 to *n* – appears one or more times (mandatory)
- 0 to 40, 1 to 40 – bounded multiplicity ranges with a fixed maximum number of occurrences

Table 8: Session PCMD record

Container	Multiplicity	Information Elements (IEs)
PCMD record common header	1	Common Header IEs
PCMD record report header2		Report Header2 IEs
SendingNodeIP container		Sending Node IP container IEs
Session PCMD Decoding container 2		Session Decoding container IEs
Session3 container		Session3 container IEs
Procedure container Present only one time, except if another procedure or procedures occur before the original procedure completes; see PCMD record generation for information about a concurrent procedure.	1 to 3	Procedure container IEs

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Container	Multiplicity	Information Elements (IEs)
IMEI container Present when the ImeiFlag is set to 1.	1	IMEI container IEs
MSISDN container Present when the MsisdnFlag is set to 1.		MSISDN container IEs
Peer container		Peers container IEs
APN container Present when the ApnFlag is set to 1.		APN container IEs
Message container Message_1 container to Message_*n* container	0 to 40	Message container IEs
MessageAI container MessageAI_1 container to MessageAI_*n* container One MessageAI container is present for every Message container.		MessageAI container IEs
Bearer / QoS Flow container Present only when a bearer is involved in the procedure (bearer creation, modification, and deletion).	0 to 11	Bearer and QoS Flow container IEs
TEID container Present only when a bearer is involved in the procedure (bearer creation, modification, and deletion).		TEID container IEs
FTEID IP container Present only when a bearer is involved in the procedure (bearer creation, modification, and deletion).		FTEID IP container IEs
5G QoS container		5GC QoS container IEs
Charging container Charging_1 to Charging_*n* container One Charging container is present if BLC is 0. One Charging container is present for every Bearer container if BLC is 1.	1 to 11	Charging container IEs
UE IP container	1	UE IP container IEs

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Container	Multiplicity	Information Elements (IEs)
SNSSAI container	0 to 1	SNSSAI container IEs

Table 9: Extended session PCMD record

Container	Multiplicity	Record format and IE
PCMD record common header	1	Common Header IEs
PCMD record report header2		Report Header2 IEs
SendingNodeIP container		Sending Node IP container IEs
Session PCMD Decoding container 2		Session Decoding container IEs
Session3 container		Session3 container IEs
Procedure container Present only one time, except if another procedure or procedures occur before the original procedure completes; see PCMD record generation for information about a concurrent procedure.	1 to 3	Procedure container IEs
IMEI container Present when the ImeiFlag is set to 1.	1	IMEI container IEs
MSISDN container Present when the MsisdnFlag is set to 1.		MSISDN container IEs
Peer container		Peers container IEs
APN container Present when the ApnFlag is set to 1.		APN container IEs
Session Extended container Present when the ExtendedFlag is set to 1.		Session extended container IEs
Message container Message_1 container to Message_*n* container	0 to 40	Message container IEs
MessageAI container MessageAI_1 container to Message AI_*n* container One MessageAI container is present for every Message container.		MessageAI container IEs
Bearer / QoS Flow container	0 to 11	Bearer and QoS Flow container IEs

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Container	Multiplicity	Record format and IE
Present only when a bearer is involved in the procedure (bearer creation, modification, and deletion).		
TEID container Present only when a bearer is involved in the procedure (bearer creation, modification, and deletion).		TEID container IEs
FTEID IP container Present only when a bearer is involved in the procedure (bearer creation, modification, and deletion).		FTEID IP container IEs
Bearer Extended container Present when the ExtendedFlag is set to 1 and when a bearer is involved in the procedure (bearer creation, modification, and deletion).		Bearer extended container IEs
5G QoS container		5GC QoS container IEs
Charging container Charging_1 container to Charging_*n* container One Charging container is present if BLC is 0. One Charging container is present for every Bearer container if BLC is 1.	1 to 11	Charging container IEs
UE IP container	1	UE IP container IEs
SNSSAI container	0 to 1	SNSSAI container IEs

4.2.1 Session PCMD Decoding container 2

Table 10: Session Decoding container 2

Bytes	0	1		2	3
0	MessageNum	ProcNum (4 bits)	PeerNum (4 bits)	Reserved	Session FlagsV2
4	SessionFlags2	Reserved			

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Table 11: SessionFlagsV2

7	6	5	4	3	2	1	0
BrNum				ApnFlag	Extended Flag	ImeiFlag	MsisdnFlag

Table 12: SessionFlags2

7	6	5	4	3	2	1	0
SnssaiFlag	UliType Flag	Reserved					

4.2.2 Session3 container

Table 13: Session3 PCMD container

Bytes	0				1			2		3
0	Rat Type (4 bits)	DT (2 bits)	BLC (1 bit)	CI (1 bit)	PDN Type (3 bits)	Iwki (3 bits)	Reserved (3 bits)	UP Selection (6 bits)	SSCM (2 bits)	Pdu Session Id

In the following table, if the UPSAttributes is 0, the UPSelectionPeer field is not used. The UPSAttributes is always 0 in this release.

Table 14: UPSelection

7	6	5	4	3	2	1	0
UPSAttributes				UPSelectionPeer			

4.2.3 Procedure container

Table 15: Procedure container

Bytes	0	1	2	3
0	ProcedureID	ProcedureResult	ProcedureCause	
4	ProcedureDetailedCause		ProcedureDuration	

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4.2.4 IMEI container

Table 16: IMEI container

Bytes	0	1	2	3
0	IMEI			
4				

4.2.5 MSISDN container

Table 17: MSISDN container

Bytes	0	1	2	3
0	MSISDN			
4				

4.2.6 Peer container

The Peer container contains at least 1 peer and up to 15 peers maximum, as specified by PeerNum in the Session PCMD Decoding container 2.

Each peer is described by a PeerTypeV2 field and a PeerId field. The following apply for the PeerTypeV2 field:

- Length is 1 byte.
- Padding may be added after the PeerTypeV2 fields to align with a 4-byte boundary.
- Total number of bytes depends on the total number of peers in the record:
  - 1 to 4 peers use 4 bytes
  - 5 to 8 peers use 8 bytes
  - 9 to 12 peers use 12 bytes
  - 13 to 15 peers use 16 bytes

In the PeerXTypeV2, the range for X is [5..13]; if x is 13 there is padding (not peer 16).

PeerId field length is 4 bytes (IPv4) or 16 bytes (IPv6 or UUID), as specified by the PeerIdType.

Maximum length of a Peer container is 256 bytes.

In the PeerYId, Y is the PeerNum and the range for Y is [2..15]; if Y is 15 there is padding.

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Table 18: Peer container

Bytes	0	1	2	3
0	Peer1TypeV2	Peer2TypeV2 or padding	Peer3TypeV2 or padding	Peer4TypeV2 or padding
...				
4 - 12	PeerXTypeV2	Peer(X+1)TypeV2 or padding	Peer(X+2)TypeV2 or padding	Peer(X+3)TypeV2 or padding
4 - 16	Peer1Id			
...	...			
... 252	PeerYId			

Table 19: PeerNTypeV2

7	6	5	4	3	2	1	0
PeerIdType		PeerType					

4.2.7 APN container

In the following table, the APN container size is up to 100 bytes, depending on the APN length, and is always a multiple of 4 bytes.

Table 20: APN container

Bytes	0	1	2	3
0	ApnLength	APN (0 – 2 bytes)		
...	APN (continued)			
96	(APN continued)		Padding to 4 bytes if needed	

4.2.8 Session Extended container

The Session Extended container size is up to 20 bytes, depending on the ULI length, and is always a multiple of 4 bytes; for example, for 5G sessions it can be up to 17 bytes.

Table 21: Session Extended container

Bytes	0	1	2	3
0	UliLength	ULI		
...	ULI (continued)			

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Bytes	0	1	2	3
16	ULI (continued)		Padding to 4 bytes if needed	

4.2.9 Message container

There is one Message container for every message that is transmitted or received in the reported procedure. The Message containers are appended in chronological order.

When concurrent procedures are reported, to preserve the chronology the messages of the concurrent procedure are interleaved with the messages of the reported procedure.

Table 22: Message container

Bits	31-22	21-17	16	15-0
0	MessageMarker_n	ReferencePoint_n	Direction_n	timestampMM_n

4.2.10 MessageAI container

There is one MessageAI (additional information) container for each Message container. Matching of the MessageAI container to the Message container is performed in the order that the Message containers appear.

Table 23: MessageAI container

Bytes	0	1	2	3
0	MessageCauseCode		Padding to 4 bytes at the last MessageAI container	

4.2.11 Bearer / QoS Flow container

Table 24: Bearer / QoS Flow container

Bits	31-28	27-24	23-16	15-8	7	6	5- 2	1	0
0	BearerID	LBI	BearerResult	BearerCause					
4	BearerDetailedCause			Bearer QCI	PVI	PCI	PL	is Internal BearerID	5GQos Flag
8	FTeidUIp V4BrIdRef (4 bit)	FTeidUIp V6 BrIdRef (4 bit)	5GTun Ipv4 (1 bit)	5GTun Ipv6 (1 bit)	Reserved				

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4.2.12 TEID container

Table 25: TEID container

Bytes	0	1	2	3
0	TeidU			

4.2.13 FTEID IP container

The length of the FTEID IP container shown in the following tables depends on the IP address type:

- 4 bytes for IPv4
- 16 bytes for IPv6
- 20 bytes for IPv4 followed by IPv6

Table 26: FTEID IP container (IPv4)

Bytes	0	1	2	3
0	FTEID IPv4			

Table 27: FTEID IP container (IPv6)

Bytes	0	1	2	3
0	FTEID IPv6			
4				
8				
12				

Table 28: FTEID IP container (IPv4 and IPv6)

Bytes	0	1	2	3
0	FTEID IPv4 and IPv6			
4				
8				
12				
16				

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4.2.14 Bearer Extended container

Table 29: Bearer Extended container

Bytes	0	1	2	3
0	Uplink APN-AMBR			
4	Downlink APN-AMBR			
8	Uplink MBR			
12	Downlink MBR			
16	Uplink GBR			
20	Downlink GBR			

4.2.15 5G QoS container

Table 30: 5G QoS container

Bytes	0		1		2			3
0	QFI (6bit)	RT (2 bit)	PDB (5 bit)	PEB (3 bit)	QNC (1 bit)	RQI (1 bit)	Reserved	
4	AW (12 bit)		MBV (12 bit)					Reserved

4.2.16 Charging container

There is one Charging container when BLC is 0 and one Charging container for each Bearer container when BLC is 1.

The MAG-c performs the Charging container to Bearer container matching in the order in which the Bearer containers appear.

Table 31: Charging container

Bytes	0	1	2	3
0	GCID			

4.2.17 UE IP container

The length of the UE IP container shown in the following tables depends on the IP address type:

- 4 bytes for IPv4
- 16 bytes for IPv6

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- 20 bytes for IPv4 followed by IPv6

Table 32: UE IP container (IPv4)

Bytes	0	1	2	3
0	UE IPv4			

Table 33: UE IP container (IPv6)

Bytes	0	1	2	3
0	UE IPv6			
4				
8				
12				

Table 34: UE IP container (IPv4 and IPv6)

Bytes	0	1	2	3
0	UE IPv4 and IPv6			
4				
8				
12				
16				

4.2.18 SNSSAI container

Table 35: SNSSAI container

Bytes	0	1	2	3
0	sst	sd		

4.3 Data PCMD record format

The following table lists the data PCMD record formats.

Table 36: Data PCMD record format

Table 3: PCMD record common header
Table 4: PCMD record report header2

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Table 7: SendingNodeIP container (IPv6)
Table 37: Data container

4.3.1 Data container

Table 37: Data container

Bytes	0	1	2	3
0	BearerId	PduSessionId	Charging Type (2 bits)	Reserved
4	RatingGroup			
8	ServiceIdentifier			
12	StartTime			
16	EndTime			
20	TimeUsage			
24	DataVolumeDownlink			
28				
32	DataVolumeUplink			
36				
40	NumberOfPacketsDownlink			
44	NumberOfPacketsUplink			
48	ChargingId			

4.4 PCMD Heartbeat format

The following table describes the PCMD Heartbeat format.

Table 38: PCMD Heartbeat format

PCMD record common header
PCMD Heartbeat container
SendingNodeIP container

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4.4.1 PCMD Heartbeat container

Table 39: PCMD Heartbeat container

Bytes	0	1	2	3
0	HBSequenceNumber		GwId	HBFlags
4	Reserved			
8	HBTxTime			

Table 40: HBFlags

7	6	5	4	3	2	1	0
Sending NodeIpV6	Reserved						

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5 PCMD record IEs

The MAG-c supports PCMD record IEs including header IEs, session IEs, and PCMD heartbeat message IEs.

5.1 Header record IEs

The MAG-c supports Common Header, Report Header2, and Sending Node IP container IEs.

5.1.1 Common Header IEs

Table 41: Common Header IEs

Information element	Description
PCMDVersion	Version of the PCMD feature Current value 6 Version changes whenever there is a modification in the Header structure or there is a non-compatible change in the structure of the containers.
RecordType	Type of record: • 2 – data • 3 – session2 • 4 – heartbeat
RecordLength	Total record length in bytes

5.1.2 Report Header2 IEs

Table 42: Report Header2 IEs

Information element	Description
RecordOpeningTime	Time the record generation started • First 4 bytes – time since 1970-01-01 00:00:00 UTC, in seconds • Second 4 bytes – precision of the procedure start time, in nanoseconds
RecordSequenceNumber	Unique sequence identifier for the record type per card and per record type

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Information element	Description
	Each card generates the RecordSequenceNumber for each record type it transmits. Resets to 1 if: • maximum reached • MSCP-group or MG-Group failover • switchover to a new active card or VM
GwId	Mobile gateway ID Range: 1 to 8
MscpGroupId	MSCP group ID Range: 1 to 15
SendingNodeType	Type of node that sends the PCMD record: • 9 – combined SGW-C + PGW-C • 14 – SMF
System Load	System LCI
UEid	User equipment ID: • IMSI – for combined SGW-C + PGW-C session, encoded in TBCD form • SUPI – for 5G PDU session reporting SUPI for 5G PDU session reporting • 0 – no IMSI or SUPI available, for example, an emergency attach with just the IMEI
SendingNodeIpV6	Sending node IP address type: • 1 – SendingNodeIP contains an IPv6 address • 0 – SendingNodeIP contains an IPv4 address, stored in the first 4 bytes

5.1.3 Sending Node IP container IEs

Table 43: Sending Node IP IEs

Information element	Description
SendingNodeIP	IP address of the sending node, corresponding to the system interface of the base router IP address version used on the network layer, if both IPv4 and IPv6 are configured

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5.2 Session record information elements

The MAG-c supports session PCMD record IEs.

5.2.1 Session Decoding container IEs

Table 44: Session Decoding container IEs

Information element	Description
MessageNum	Number of message containers Range: 0 to 40
ProcNum	Number of procedure containers Range: 1 to 3
PeerNum	Number of peers containers Range: 0 to 15

Table 45: SessionFlags2 IEs

Information element	Description
SnssaiFlag	Presence of the SNSSAI container
UliTypeFlag	Type of ULI in the Session Extended container See the ULI IE description in Table 54: Session extended container IEs

Table 46: SessionFlagsV2 IEs

Information element	Description
BrNum	Number of Bearer containers, or the number of QoS Flow containers for 5G sessions Range: 0 to 11
ApnFlag	Presence of the APN or DNN container
ExtendedFlag	Extended report type flag The report type is extended when set to 1
ImeiFlag	Presence of the IMEI or PEI for 5G Session container
MsisdnFlag	Presence of the MSISDN or GPSI for 5G Session container

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5.2.2 Session3 container IEs

Table 47: Session3 container IEs

Information element	Description
RatType	Radio access technology: • 0 – reserved • 6 – EUTRAN (WB-E-UTRAN) • 14 – NR
DT	Direct tunnel indication: • 0 – undefined (when UE is idle) • 1 – S1-U • 2 – N3 • 3 – Reserved
BLC	Bearer level charging or sessions flag: • 0 – Session level charging is used • 1 – Bearer level charging is used GCID is reported for every bearer 5G sessions only support PDU session-level charging.
CI	Charging indication for the session: • 0 – no charging • 1 – charging enabled Accounts for online and offline charging as configured or imposed by PCF
PDNType	PDN type: • 0 – UE IP container is not present, for example in UE level procedures (see UE-level procedures) • 1 – IPv4 • 2 – IPv6 • 3 – Dual stack
IwkI	Interworking indication for 4G-attached sessions (from the MME) or 5G-attached sessions (from the AMF): • 0 – reserved • 1 – no interworking

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Information element	Description
	• 2 – N26 interworking • 3 – no N26 interworking
UPSelection	Container for UPSelectionAttributes and UPSelectionPeer; see the table User Plane Selection IEs
SSC-Mode	Session and service continuity mode: • 0 – undefined • 1 – SSC Mode 1 • 2 – SSC Mode 2 • 3 – SSC Mode 3
PduSessionId	PDU session ID for the UE Range: 0 to 15

Table 48: User Plane Selection IEs

Information element	Description
UPSelectionAttributes	0 – UPSelection not relevant 0 in the current version
UPSelectionPeer	Present when UPSelectionAttributes is not 0

5.2.3 Procedure container IEs

Table 49: Procedure container IEs

Information element	Description
ProcedureID	ID of the procedure See ProcedureIDs for possible values and meanings.
ProcedureResult	Indicates the outcome of the procedure: • 1 – success • 2 – failure
ProcedureCause	ProcedureCause associated with the Procedure Result See Causes for possible values and meanings. 0 when no value is reported

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Information element	Description
	Cause code matches GTPv2, HTTP2, or PFCP external message causes
ProcedureDetailedCause	ProcedureDetailedCause associated with the current procedure. See Detailed causes for possible values and meanings. Set to 0 when no value is reported Cause code matches internal status events
ProcedureDuration	Elapsed time since start of the procedure, in hundredths of seconds

5.2.4 IMEI container IEs

Table 50: IMEI container IEs

Information element	Description
IMEI	IMEI or PEI (14 decimal digits plus a check digit) or IMEI/SV (16 digits) for the UE IMEI/SV structure specified in 3GPP TS 23.003 Includes device origin, model, and serial number Non-zero if available Encoded in telephony binary-coded decimal (TBCD)

5.2.5 MSISDN container IEs

Table 51: MSISDN container IEs

Information element	Description
MSISDN	MSISDN or GPSI identifying the subscription Non-zero if available Encoded in TBCD

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5.2.6 Peers container IEs

Table 52: PeerNTypeV2 container IEs

Information element	Description
PeerNId	ID of the nth peer IPv4, IPv6, or UUID depending on peerIdType value
PeerIdType	Type of ID used in PeerNId: • 10 – IPv6 • 00 – IPv4 • 01 – UUID
PeerType	Indicates the type of the involved Peer: • 2 – MME • 16 – combined SGW-U + PGW-U • 20 – UPF • 21 – Nsmf_PDUSession consumer • 23 – Namf_Communication service • 25 – Nudm_SubscriberDataManagement service • 26 – Nudm_UEContextManagement service • 27 – Npcf_SMPolicyControl service • 28 – Nchf_ConvergedCharging service

5.2.7 APN container IEs

Table 53: APN container IEs

Information element	Description
ApnLength	Length of the APN in bytes
APN	Access point name APN is not reported in UE level procedures; see UE-level procedures.

5.2.8 Session extended container IEs

The Session extended container presence is indicated by the ExtendedFlag.

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Table 54: Session extended container IEs

Information element	Description
UliLength	Length of the ULI
ULI	If the UliTypeFlag is not set (0), the ULI format is as specified in 3GPP TS 29.274, section 8.21. Bytes defined in the specification from 5 onward are present in this field; the PCMD ULI field omits the first 4 bytes (type, length, spare, instance). If the UliTypeFlag is set (1), the ULI format is as specified in 3GPP TS 29.061, section 16.4.7.2 set. Bytes defined in the specification from 3 onward are present in this field; the PCMD ULI field omits the first 2 bytes (3GPP type and length). The 5G ULI reports the following types: • 137 NrLocation – 5GS TAI and NCGI • 130 EutraLocation – 5GS TAI and ECGI From 3GPP TS 29.571 (5.4.4.3-5): • TAI = PLMN-ID + 5GS TAC • ECGI = PLMN-ID + eutraCellId • NCGI = PLMN-ID + nrCellId • TAC, eutraCellId, and nrCellId encoded as per section 5.4.2 of 3GPP TS 29.571 In 5G, the TAC part of TAI can be a 2- or 3-octet string, however in 2G, 3G, and 4G, it is always 2 octets. MCC and MNC are encoded per 3GPP TS 29.274 for the PLMN-ID part.

5.2.9 Message container IEs

There are 0 to 40 message containers in the Session PCMD record.

Table 55: Message container IEs

Information element	Description
MessageMarker_n	Code defining a specific procedure message when any message is received or sent during the associated procedure.

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Information element	Description
	See Message marker IDs and SBI service operation messages for possible values and meanings.
ReferencePoint_n	Specifies the reference point where the message is received or sent See Reference point and SBI services IDs for possible values and meanings
Direction_n	Specifies the direction of the message See Direction_n IDs for possible values and meanings
TimestampMM_n	Time elapsed since the start of the procedure, in hundredths of seconds

5.2.10 MessageAI container IEs

There are 0 to 40 MessageAI containers in the Session PCMD record.

Table 56: MessageAI container IEs

Information element	Description
MessageCauseCode	Message cause or reason code

5.2.11 Bearer and QoS Flow container IEs

There are 0 to 11 bearer containers in the session PCMD record.

Table 57: Bearer and QoS Flow container IEs

Information element	Description
BearerID	ID of the bearer
LBI	Identifier for the bearer 0 in the default bearer record Unknown in 5GC QoS flow reporting if N26 interface is not used LBI is not a unique identifier of a QoS flow; multiple QoS flows may share the same LBI
BearerResult	Bearer result value See Results for possible values and their meanings.

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Information element	Description
BearerCause	Bearer cause value See Causes for possible values and their meanings. 0 if no value reported Identical to GTPv2 – external causes associated with detailed cause (internal status events)
BearerDetailedCause	Bearer detailed cause value See Detailed causes for possible values and their meanings. 0 if no value reported Identical cause code to internal status events
BearerQCI	Bearer QoS class ID 5QI value of the QoS flow for 5G sessions
PVI	Bearer pre-emption vulnerability indicator
PCI	Bearer pre-emption capability indicator
PL	Bearer priority level
isInternalBearerID	Boolean value • 0 – False, reported bearerID received from external signaling • 1 – True, reported bearerID internally generated **Note:** In some cases, the reported bearerID may be generated internally and not present in any external signaling, for example, in 5G sessions without 4G interworking.
FTeidUIpV4BrIdRef	4G – four-bit indicator: • 0x0 – absence of an IPv4 address **Note:** No FTEID IP address and no TEID containers are present if FTeidUIpV4BrIdRef and FTeidUIpV6BrIdRef are both 0x0. • equal to BearerId – reports an IPv4 address in the FTEID IP container immediately after the TEID container

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Information element	Description
	• X in range 0x5 to 0xF and not equal to the BearerId value – reports an IPv4 address of the bearer FTEID in the same session record with bearer X, serving as a reference to the bearer X FTEID IP (uses the same IP address) 5G – ignored if Tun5GIpv4 is set
FTeidUIpV6BrIdRef	4G – four-bit indicator: • 0x0 – absence of an IPv6 address **Note:** No FTEID IP address or TEID containers are present if FTeidUIpV4BrIdRef and FTeidUIpV6BrIdRef are both 0x0. • equal to BearerId – reports an IPv6 address in the FTEID IP container immediately after the TEID container or the IPv4 FTEID IP container • X in range 0x5 to 0xF and not equal to the BearerId value – reports the IPv6 address of the bearer FTEID in the same session record with bearer X, using the IP address as a reference to the bearer X FTEID IP (uses the same IP address) 5G – ignored if Tun5GIpv6 set For an explicitly reported IPv6 address, the FTEID address reporting follows: • immediately after the IPv6 FTEID IP container, if present • immediately after the TEID container
QosFlag5G	• 0 – reported container for an EPS bearer • 1 – reported container for a 5G QoS flow (5G QoS container is present)
Tun5GIpv4	Uses an IPv4 address for the 5G MAG-u tunnel If this or the Tun5GIpv6 flag is set, reports only one FTEID and ignores TeidUIpV4BrIdRef and TeidUIpV6BrIdRef IEs
Tun5GIpv6	Uses an IPv6 address for the 5G MAG-u tunnel. If this or the Tun5GIpv4 flag is set, reports only one FTEID and ignores TeidUIpV4BrIdRef and TeidUIpV6BrIdRef IEs When explicitly reported, the IPv6 FTEID IP follows: • immediately after the IPv4 FTEID IP, if present

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Information element	Description
	• immediately after the TEID container No FTEID IP address or TEID containers are present for this QoS flow if the following are 0: • Tun5GIpv4 • Tun5GIPv6 • QoSFlag5G Reports FTEID only for the first QoS flow in the PCMD record

5.2.12 TEID container IEs

Table 58: TEID container IEs

Information element	Description
TeidU	TEID value of the S1-U, for combined SGW + PGW sessions TEID of the MAG-u tunnel on the N3 UPF side (shared by all QoS flows), for 5G sessions Reported only for the first QoS flow in the PCMD record

5.2.13 FTEID IP container IEs

Table 59: FTEID IP container IEs

Information element	Description
FTeidUIp	IPv4 or IPv6 address TEID of the MAG-u tunnel on the N3 UPF side (shared by all QoS flows), for 5G sessions

5.2.14 Bearer extended container IEs

Table 60: Bearer extended container IEs

Information element	Description
Uplink APN-AMBR	Uplink aggregate maximum bit rate in kb/s
Downlink APN-AMBR	Downlink aggregate maximum bit rate in kb/s

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Information element	Description
Uplink MBR	Uplink maximum bit rate in kb/s
Downlink MBR	Downlink maximum bit rate in kb/s
Uplink GBR	Uplink guaranteed bit rate in kb/s
Downlink GBR	Downlink guaranteed bit rate in kb/s

5.2.15 5GC QoS container IEs

Table 61: 5G QoS container IEs

Information element	Description
QFI	QFI value of the QoS flow (1 to 63) (6 bits) Mandatory element
RT	Resource type (2 bits): • 1 – GBR • 2 – non-GBR • 3 – delay critical GBR Mandatory field
PDB	Packet delay budget (5 bits): • 0 – undefined • 1 – 5 ms • 2 – 10 ms • 3 – 30 ms • 4 – 50 ms • 5 – 60 ms • 6 – 75 ms • 7 – 100 ms • 9 – 150 ms • 11 – 200 ms • 13 – 300 ms
PER	Packet error rate (3 bits): • 0 – undefined • 1 – 10^{-6} • 2 – 10^{-5}

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Information element	Description
	• $3 – 10^{-4}$ • $4 – 10^{-3}$ • $5 – 10^{-2}$
QNC	QoS control status: • 0 – disabled • 1 – enabled
RQI	Reflective QoS status: • 0 – disabled • 1 – enabled
AW	Averaging window Range: 1 to 4095 ms (12 bits)
MBV	Maximum burst volume Range: 1 to 4095 Bytes (12 bits)

5.2.16 Charging container IEs

There are 1 to 11 Charging containers in the session PCMD record.

Table 62: Charging container IEs

Information element	Description
GCID	Session GCID if BLC is 0 (5G records) Bearer GCID if BLC is 1 (bearer-level charging, one GCID per bearer container)

5.2.17 UE IP container IEs

Table 63: UE IP container IEs

Information element	Description
UeIPs	IP addresses allocated to the UE Present when the PdnType is not 0 **Note:** For UE-level procedures, Pdn Type is set to 0, and the UE IP is not

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Information element	Description
	reported; see UE-level procedures for more information. Length from 4 to 20 bytes, depending on the Pdn Type in the report header: • PdnType = 1 (IPv4) – UeIPs contain the IPv4 allocated to the UE, length is 4 bytes • PdnType = 2 (IPv6) – UeIPs contain the IPv6 allocated to the UE, length is 16 bytes • PdnType = 3 (dual stack) – first 4 bytes of the UeIPs contain the IPv4 allocated to the UE; next 16 bytes contain IPv6; length 20 bytes

5.2.18 SNSSAI container IEs

Table 64: SNSSAI container IEs

Information element	Description
sst	Slice service type Range: 0 to 215
sd	3-byte hex string 6-character hex string (0 to 9 and A to F); for example, 0xD143A5

5.3 Data PCMD record information elements

The MAG-c supports data PCMD record IEs.

5.3.1 Data container IEs

Table 65: Data container information elements

Information element	Description
BearerID	ID of the default bearer for the UE Mandatory field
PduSessionID	PDU Session ID for the UE Mandatory field
Charging Type	Type of the charging service used: 0 – RADIUS

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Information element	Description
	3 – NCHF
RatingGroup	Rating group ID Corresponds to the Charging Key as specified in 3GPP TS 23.203 Mandatory field
ServiceIdentifier	Service identifier Mandatory field **Note:** This information element is not supported yet, and its value is always 0.
StartTime	Time when a service started to be used, indicated in seconds since 1970-01-01 00:00:00 UTC Mandatory field **Note:** This information element is not supported yet, and its value is always 0. Because the time information is not available in the MAG-c, the StartTime information element is empty in the PCMD DATA record.
EndTime	Time when a service stopped being used, indicated in seconds since 1970-01-01 00:00:00 UTC Procedure StartTime in the Header contains the reported time of the PCMD data record Procedure EndTime may be slightly different from StartTime because of the processing delay Mandatory field **Note:** This information element is not supported yet, and its value is always 0. Because the time information is not available in the MAG-c, the EndTime information element is empty in the PCMD DATA record.
TimeUsage	Effective used time within the charging service data container recording interval, indicated in seconds Mandatory field **Note:** This information element is not supported yet, and its value is always 0. Because the time information is not available in the MAG-c, the TimeUsage

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Information element	Description
	information element is empty in the PCMD DATA record.
DataVolumeDownlink	Number of octets transmitted during the service data container recording interval, in one or both of the uplink and downlink directions For GTP-based tunneling, the amount of data counted in the gateway based on the payload of the GTP-U protocol Full payload included as a minimum Mandatory field
DataVolumeUplink	
NumberOfPacketsDownlink	Number of packets transmitted during the service data container recording interval in charging, in one or both of the uplink and downlink directions Mandatory field
NumberOfPacketsUplink	
ChargingID	Charging ID of the session Mandatory Field

5.4 Heartbeat message record IEs

The MAG-c supports Heartbeat container IEs for PCMD.

Table 66: Heartbeat container IE

Information element	Description
HBSequenceNumber	Unique sequence identifier for the Heartbeat Resets to 1: • after reaching the maximum value 65535 • on failover or when PCMD record transmission is enabled
GwId	Mobile gateway ID Range: 1 to 8
HBTxTime	Time the heartbeat message was transmitted Seconds since 1970-01-01 00:00:00 UTC
SendingNodeIpV6	• 1 – SendingNodeIP contains an IPv6 address • 0 – SendingNodeIP contains an IPv4 address stored in the first 4 bytes

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6 Information elements value tables

The MAG-c PCMD supports IEs for procedure IDs, results, success and failure causes, message marker IDs, SBI service IDs and operation messages, and reference points.

6.1 ProcedureIDs

The MAG-c PCMD supports procedure IDs with related causes and responses, for supported MAG-c gateway types.

The following table describes the procedure ID, name, start and end actions, and supported gateway types.

Table 67: ProcedureIDs

ProcedureId	Name	Start of procedure	End of procedure (success)	End of procedure (failure)	Supported gateway type
1	MME-initiated Create Default Bearer	Combined SGW-C + PGW-C receives Create Session Request from MME	Procedure completes successfully in all involved peers (MME, combined SGW-C + PGW-C, combined SGW-U + PGW-U, PCF, UDM, CHF)	Procedure encounters a failure in any of the involved peers	Combined SGW-C + PGW-C
9	MME-initiated Modify Bearer	Combined SGW-C + PGW-C receives Modify Bearer Request from MME	Procedure completes successfully in all involved peers (MME, combined SGW-C + PGW-C, combined SGW-U + PGW-U, and so on)	Procedure encounters a failure in any of the involved peers	Combined SGW-C + PGW-C
16	MME-initiated Modify Default Bearer	Combined SGW-C + PGW-C receives Modify Bearer command from MME	Procedure completes successfully in all involved peers (MME, combined SGW-C + PGW-C, combined SGW-U + PGW-U, PCF)	Procedure encounters a failure in any of the involved peers	Combined SGW-C + PGW-C

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ProcedureId	Name	Start of procedure	End of procedure (success)	End of procedure (failure)	Supported gateway type
20	MME-initiated Delete Session	Combined SGW-C + PGW-C receives Delete Session Request from MME	Procedure completes successfully in all involved peers (MME, combined SGW-C + PGW-C, combined SGW-U + PGW-U, PCF, CHF, UDM)	Procedure encounters a failure in any of the involved peers	Combined SGW-C + PGW-C
26	SGW-initiated Downlink Data Notification to MME	Combined SGW-C + PGW-C sends Downlink Data Notification to MME	MME responds with successful cause	MME responds with a failure cause	Combined SGW-C + PGW-C
32	MME-initiated release of S1U	Combined SGW-C + PGW-C receives Release Access Bearer Request from MME	Procedure completes successfully in all involved peers (MME, combined SGW-C + PGW-C, combined SGW-U + PGW-U)	Procedure encounters a failure in any of the involved peers	Combined SGW-C + PGW-C
80	Delete UE Administrative	Combined SGW-C + PGW-C deletes all sessions for specific UE and may inform its peers if applicable Triggered by delete from CLI, reattach or collision	Procedure completes successfully in all involved peers (MME, combined SGW-C + PGW-C, combined SGW-U + PGW-U, PCF, UDM, CHF)	Procedure encounters a failure in any of the involved peers	Combined SGW-C + PGW-C
81	Delete Session Administrative	Combined SGW-C + PGW-C deletes session with one or several bearers but the UE persists if it has more sessions on the gateway.	Procedure completes successfully in all involved peers (MME, combined SGW-C + PGW-C, combined SGW-U + PGW-U, PCF, UDM, CHF)	Procedure encounters a failure in any of the involved peers	Combined SGW-C + PGW-C

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ProcedureId	Name	Start of procedure	End of procedure (success)	End of procedure (failure)	Supported gateway type
		May inform peers if applicable. Triggered mainly by collision, unsuccessful call-flow or per-bearer delete from CLI			
85	Sx Session Report	Combined SGW-C + PGW-C receives a PFCP Session Report Req from UPF	Combined SGW-C + PGW-C acknowledges the PFCP Session Report Resp with a success cause and initiates the PFCP Session Modification to update or clean up the bearer	Encounters a failure in the combined SGW-C + PGW-C	Combined SGW-C + PGW-C
86	PCF Initiated Modify Default Bearer	Combined SGW-C + PGW-C receives Npcf_SMPolicy Control_update	Procedure completes successfully in all involved peers (MME, combined SGW-C + PGW-C, combined SGW-U + PGW-U, PCF)	Procedure encounters a failure in any of the involved peers	Combined SGW-C + PGW-C
87	PCF Initiated Delete Default Bearer	Combined SGW-C + PGW-C receives Npcf_SMPolicy Control_update terminate	Procedure completes successfully in all involved peers (MME, combined SGW-C + PGW-C, combined SGW-U + PGW-U, PCF, UDM, CHF)	Procedure encounters a failure in any of the involved peers	Combined SGW-C + PGW-C
88	Delete Session because of MME Path failure	Combined SGW-C + PGW-C detects MME Path failure	Procedure completes successfully, all involved peers (combined SGW-C + PGW-C, combined SGW-U	Procedure encounters a failure in any of the involved peers	Combined SGW-C + PGW-C

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ProcedureId	Name	Start of procedure	End of procedure (success)	End of procedure (failure)	Supported gateway type
			+ PGW-U, PCF, UDM, CHF)		
89	Delete Session because of UPF Path failure	Combined SGW-C + PGW-C detects UPF Path failure	Procedure completes successfully in all involved peers (combined SGW-C + PGW-C, PCF, UDM, CHF)	Procedure encounters a failure in any of the involved peers	Combined SGW-C + PGW-C
90	Combined SGW-C + PGW-C receives Error Indication Report	Combined SGW-C + PGW-C receives PFCP Session Report with Error Indication in the message from combined SGW-U + PGW-U	Procedure completes successfully in all involved peers: • SGW-C + PGW-C • combined SGW-U + PGW-U, MME	Procedure encounters a failure in any of the involved peers	Combined SGW-C + PGW-C

The following table describes the 5G PCMD procedure IDs, names, start, and ending of a procedure.

Table 68: 5G PCMD procedures

ProcedureId	Name	Start of procedure	End of procedure (success)	End of procedure (failure)
101	PDU Session Create	SMF receives Nsmf_PDUSession_CreateSMContext service request from AMF	Procedure completes successfully in all involved peers (UE, RAN, AMF, SMF, UPF, PCF, UDM, CHF)	Procedure encounters a failure in any of the involved peers
102	UE-initiated PDU Session Release	SMF receives Nsmf_PDUSession_UpdateSMContext service request from AMF, containing the N1 container for PDU Session Release Request	Session and subscriptions delete successfully in all involved peers (UE, RAN, AMF, SMF, UPF, PCF, UDM, CHF)	Session and subscriptions encounter a failure in any of the involved peers
103	AMF-initiated PDU Session Release	SMF receives Nsmf_PDUSession_ReleaseSMContext	Session and subscriptions delete successfully in all	Session and subscriptions encounter a failure in

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ProcedureId	Name	Start of procedure	End of procedure (success)	End of procedure (failure)
	without N1N2 signaling to the RAN	Post request from AMF	involved peers (AMF, SMF, UPF, PCF, UDM, CHF)	any of the involved peers
104	AMF-initiated PDU Session Release with RAN signaling	SMF receives Nsmf_PDUSession_UpdateSMContext Post request from AMF. The release IE is included indicating that AMF wants to release the session.	Session and subscriptions delete successfully in all involved peers (RAN, AMF, SMF, UPF, PCF, UDM, CHF)	Session and subscriptions encounter a failure in any of the involved peers
105	PCF-initiated PDU Session Release	SMF receives Npcf_SMPolicyControl_UpdateNotify Post request from PCF. The payload identifies the released session.	Session and subscriptions delete successfully in all involved peers (UE, RAN, AMF, SMF, UPF, PCF, UDM, CHF)	Session and subscriptions encounter a failure in any of the involved peers
106	SMF-initiated PDU Session Release	SMF initiates PDU session release	Session and subscriptions delete successfully in all involved peers (UE, RAN, AMF, SMF, UPF, PCF, UDM, CHF)	Session and subscriptions encounter a failure in any of the involved peers
107	UDM-initiated PDU Session Release	SMF receives Nudm_SDM_Notification Request from UDM, indicating the subscription data of the session has been removed	Session and subscriptions delete successfully in all involved peers (UE, RAN, AMF, SMF, UPF, PCF, UDM, CHF)	Session and subscriptions encounter a failure in any of the involved peers
109	UE-triggered Service Request without AMF Change	SMF Receives Nsmf_PDUSession_UpdateSMContext Post request from AMF. The value of up ConnectionState is set to 'ACTIVATING' to indicate that request is about activating the UP.	Procedure completes successfully in all involved peers (UE, RAN, AMF, SMF, UPF, PCF)	Procedure encounters a failure in any of the involved peers

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ProcedureId	Name	Start of procedure	End of procedure (success)	End of procedure (failure)
110	UE-triggered Service Request with AMF Change	SMF receives Nsmf_PDUSession_UpdateSMContext Post request from AMF. Value of up ConnectionState is set to 'ACTIVATING' to indicate that request is about activating the user plane. New AMF-ID is received.	Procedure completes successfully in all involved peers (UE, RAN, New AMF, SMF, UPF, PCF)	Procedure encounters a failure in any of the involved peers
111	5GC Network-initiated Service Request	SMF receives Data Notification from UPF. The session report message may contain also a Usage Report.	Procedure completes successfully in all involved peers (RAN, AMF, SMF, UPF, PCF, CHF)	Procedure encounters a failure in any of the involved peers
112	NR RAN Release	SMF receives Nsmf_PDUSession_UpdateSMContext Post request from AMF. The value of upConnection State is set to 'DEACTIVATED'	Procedure completes successfully in all involved peers (RAN, AMF, SMF, UPF)	Procedure encounters a failure in any of the involved peers
114	SMF-initiated PDU Session Modification	SMF initiates PDU session modification	Procedure completes successfully in all involved peers (UE, RAN, AMF, SMF, UPF, PCF, CHF)	Procedure encounters a failure in any of the involved peers
115	PCF-initiated Session Modification	SMF receives Npcf_SMPolicyControl Update Notify from PCF	Procedure completes successfully in all involved peers (UE, RAN, AMF, SMF, UPF, UDM, PCF, CHF)	Procedure encounters a failure in any of the involved peers

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ProcedureId	Name	Start of procedure	End of procedure (success)	End of procedure (failure)
116	UDM-initiated PDU Session Modification	SMF receives Nudm_SDM Notification from UDM	Procedure completes successfully in all involved peers (UE, RAN, AMF, SMF, UPF, UDM, PCF, CHF)	Procedure encounters a failure in any of the involved peers
119	Xn based handover	SMF receives Nsmf_PDUSession_UpdateSMContext Request from AMF for the PDU session, with Path Switch Request Transfer in the N2 container	Procedure completes successfully in all involved peers (RAN, AMF, SMF, UPF, PCF)	Procedure encounters a failure in any of the involved peers
123	N2-based handover with indirect forwarding with AMF change  **Note:** N2-based handover is not yet supported.	SMF receives Nsmf_PDUSession_UpdateSMContext request from a new AMF. AMF ID of the new AMF is included in the message. The hoState is set to PREPARING. N2 container contains Handover Required Transfer IE, without Direct Forwarding Path Availability IE.	Procedure completes successfully in all involved peers (RAN, AMF, SMF, UPF, PCF)	Procedure encounters a failure in any of the involved peers
124	AMF Change in IDLE state	SMF receives an Nsmf_PDUSession_Update SM Context request from the AMF with a new AMF ID	Procedure completes successfully in all involved peers (new AMF, SMF, PCF)	Procedure encounters a failure in any of the involved peers
127	SMF received Error Indication Report	SMF receives Error indication report from UPF	Procedure completes successfully in all involved peers (RAN, AMF, SMF, UPF)	Procedure encounters a failure in any of the involved peers

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ProcedureId	Name	Start of procedure	End of procedure (success)	End of procedure (failure)
129	SMF received Data Usage Report (as only report in the session report message)	SMF receives only the Usage Data Report from UPF in the session report message	Procedure completes successfully in all involved peers (SMF, UPF, CHF, PCF)	Procedure encounters a failure in any of the involved peers
130	5G to 4G handover during connected state	The combined SGW-C + PGW-C and the SMF receive a Create Session Request from the MME	Procedure completes successfully in all involved peers: • combined SGW-C + PGW-C and SMF • combined SGW-U + PGW-U and AMF, MME, UDM, CHF and PCF	Procedure encounters a failure in any of the involved peers
131	4G to 5G handover during connected state	The combined SGW-C + PGW-C and the SMF receive a Nsmf_PDUSession_CreateSMContext service request from the AMF	Procedure completes successfully in all involved peers: • combined SGW-C + PGW-C and SMF • combined SGW-U + PGW-U and AMF, MME, UDM, CHF and PCF	Procedure encounters a failure in any of the involved peers
132	Idle mode 5G to 4G mobility	The combined SGW-C + PGW-C and the SMF receive a Create Session Request from the MME	Procedure completes successfully in all involved peers: • combined SGW-C + PGW-C and SMF • combined SGW-U + PGW-U and AMF, MME, UDM, CHF and PCF	Procedure encounters a failure in any of the involved peers
133	Idle mode 4G to 5G mobility	The combined SGW-C + PGW-C and	Procedure completes	Procedure encounters a failure

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ProcedureId	Name	Start of procedure	End of procedure (success)	End of procedure (failure)
		the SMF receive a Nsmf_PDUSession_CreateSMContext service request from the AMF	successfully in all involved peers: • combined SGW-C + PGW-C and SMF • combined SGW-U + PGW-U and AMF, MME, UDM, CHF and PCF	in any of the involved peers
134	SM context retrieval by AMF during 5G to 4G handover	The combined SGW-C + PGW-C and the SMF receive a Nsmf_PDUSession_CreateSMContext service request from the AMF	Procedure completes successfully in all involved peers: • combined SGW-C + PGW-C and SMF • AMF	Procedure encounters a failure in any of the involved peers
135	TIME_LIMIT charging event	The combined SGW-C + PGW-C and the SMF sends Nchf_ConvergedCharging_update toward CHF because of TIME_LIMIT expiration	Procedure completes successfully in all involved peers: • combined SGW-C + PGW-C and SMF • CHF • combined SGW-U + PGW-U and UPF	Procedure encounters a failure in any of the involved peers
136	VALIDITY_TIME charging event	The combined SGW-C + PGW-C and the SMF sends Nchf_ConvergedCharging_update toward CHF because of VALIDITY_TIME expiration	Procedure completes successfully in all involved peers: • combined SGW-C + PGW-C and SMF • CHF • combined SGW-U + PGW-U and UPF	Procedure encounters a failure in any of the involved peers

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ProcedureId	Name	Start of procedure	End of procedure (success)	End of procedure (failure)
137	CHF-initiated Reauthorization request	The combined SGW-C + PGW-C and the SMF receives Nchf_Converged Charging_notify with Reauthorization request from CHF	Procedure completes successfully in all involved peers: • combined SGW-C + PGW-C and SMF • CHF • combined SGW-U + PGW-U and UPF	Procedure encounters a failure in any of the involved peers
138	CHF-initiated PDU Session termination	The combined SGW-C + PGW-C and the SMF receives Nchf_Converged Charging_notify with PDU session termination request from CHF	Procedure completes successfully in all involved peers: • combined SGW-C + PGW-C and SMF • CHF, combined SGW-U + PGW-U and UPF, AMF, MME, PCF, UDM	Procedure encounters a failure in any of the involved peers
139	PDU session release because of CP inactivity timeout	Combined SGW-C + PGW-C and SMF deletes PDU or PDN sessions for specific UE and may inform its peers if applicable Triggered by CP inactivity timeout	Procedure completes successfully in all involved peers (MME, AMF, combined SGW-U + PGW-U, PCF, UDM, CHF)	Procedure encounters a failure in any of the involved peers

6.1.1 UE-level procedures

Procedures that are related to a specific session of a UE include the session- and bearer-level characteristics, such as APN, UE IP, PDN type, and so on. There are also UE-level procedures that are relevant to all the sessions of a UE. In the UE-level procedures, some IEs are not reported, such as APNs, UE IP, and so on.

The following procedures are UE-level procedures that are relevant to all the sessions of a UE:

- MME-initiated release of S1U
- Downlink data notification to the MME
- Delete UE administrative

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6.2 Results

The MAG-c supports success and failure results IEs for PCMD.

Table 69: Results

Result	Name
1	Normal
2	Failure

6.3 Causes

The MAG-c supports success and failure causes IEs for PCMD.

6.3.1 Success causes

The following table lists the success causes.

Table 70: Success causes

Cause	Name	Description	Protocol	Protocol value
112	GTP_CAUSE_ SUCCESS	Request accepted	GTPv2	16
113	GTP_CAUSE_ PARTIAL_ SUCCESS	Request accepted partially	GTPv2	17
114	GTP_CAUSE_ NEW_PDN_ NWPREFS	New PDN type because of network preference	GTPv2	18
115	GTP_CAUSE_ NEW_PDN_ SINGLE_ ADDRESS_ BEARER	New PDN type because of single address bearer only	GTPv2	19
150	SBI_200_OK	—	HTTP/2	200
151	SBI_201_ CREATED	—	HTTP/2	201
152	SBI_202_ ACCEPTED	—	HTTP/2	202

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Cause	Name	Description	Protocol	Protocol value
154	SBI_204_NO_CONTENT	—	HTTP/2	204
430	PFCP_REQ_ACCEPTED	Request accepted (success)	PFCP	1

6.3.2 Failure causes

The following table lists the failure causes.

Table 71: Failure causes

Cause	Name	Description	Protocol	Protocol value
238	GTP_CAUSE_RESERVED	Reserved	GTPv2	0
239	GTP_CAUSE_PAGING	Paging	GTPv2	1
240	GTP_CAUSE_LOCAL_DETACH	Local Detach	GTPv2	2
241	GTP_CAUSE_COMPLETE_DETACH	Complete Detach	GTPv2	3
242	GTP_CAUSE_RAT_3GPP2NON3GPP	RAT changed from 3GPP to non-3GPP	GTPv2	4
243	GTP_CAUSE_ISR_DEACTIVATION	ISR deactivation	GTPv2	5
244	GTP_CAUSE_ERR_IND_FROM_RNCENB	Error Indication received from RNC/eNodeB/S4-SGSN	GTPv2	6
245	GTP_CAUSE_IMSI_DETACH	IMSI Detach Only	GTPv2	7
246	GTP_CAUSE_REACTIVATION_REQUESTED	Reactivation Requested	GTPv2	8
247	GTP_CAUSE_PDN_RECONN_DISALLOWED	PDN reconnection to this APN disallowed	GTPv2	9

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Cause	Name	Description	Protocol	Protocol value
248	GTP_CAUSE_ACCESS_NON3GPP23GPP	Access changed from non-3GPP to 3GPP	GTPv2	10
249	GTP_CAUSE_PDN_INACTIVE_TIMEOUT	PDN connection inactivity timer expires	GTPv2	11
250	GTP_CAUSE_CONTEXT_NOT_FOUND	Context Not Found	GTPv2	64
251	GTP_CAUSE_INVALID_MSG_FMT	Invalid Message Format	GTPv2	65
252	GTP_CAUSE_VERSION_NOT_SUPPORTED	Version not supported by next peer	GTPv2	66
253	GTP_CAUSE_INVALID_LENGTH	Invalid length	GTPv2	67
254	GTP_CAUSE_SERVICE_NOT_SUPPORTED	Service not supported	GTPv2	68
255	GTP_CAUSE_MANDAT_IE_INCORRECT	Mandatory IE incorrect	GTPv2	69
256	GTP_CAUSE_MANDAT_IE_MISSING	Mandatory IE missing	GTPv2	70
257	GTP_CAUSE_OPT_IE_INCORRECT	Optional IE incorrect	GTPv2	71
258	GTP_CAUSE_SYSTEM_FAILURE	System failure	GTPv2	72
259	GTP_CAUSE_NO_RESOURCES	No resources available	GTPv2	73
260	GTP_CAUSE_SEMANTIC_ERR_TFT	Semantic error in the TFT operation	GTPv2	74
261	GTP_CAUSE_SYNTAX_ERR_TFT	Syntactic error in	GTPv2	75

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Cause	Name	Description	Protocol	Protocol value
		the TFT operation		
262	GTP_CAUSE_SEMANTIC_ERR_PKTFILTER	Semantic errors in packet filters	GTPv2	76
263	GTP_CAUSE_SYNTAX_ERR_PKTFILTER	Syntactic errors in packet filters	GTPv2	77
264	GTP_CAUSE_MISSING_APN	Missing or unknown APN	GTPv2	78
266	GTP_CAUSE_GREKEY_NOT_FOUND	GRE key not found	GTPv2	80
267	GTP_CAUSE_RELOCATION_FAILURE	Relocation failure	GTPv2	81
268	GTP_CAUSE_DENIED_RAT	Denied in RAT	GTPv2	82
269	GTP_CAUSE_PREF_PDNTYPE_NOT_ SUPPORT	Preferred PDN type not supported	GTPv2	83
270	GTP_CAUSE_ALL_DYNAMIC_ADDR_ OCCUPIED	All dynamic addresses are occupied	GTPv2	84
271	GTP_CAUSE_UE_CXT_ACTIVATED_ WITHOUT_TFT	UE context without TFT already activated	GTPv2	85
272	GTP_CAUSE_PROTO_NOT_SUPPORTED	Protocol type not supported	GTPv2	86
273	GTP_CAUSE_UE_NOT_RESPONDING	UE not responding	GTPv2	87
274	GTP_CAUSE_UE_REFUSES	UE refuses	GTPv2	88
275	GTP_CAUSE_SERVICE_DENIED	Service denied	GTPv2	89
276	GTP_CAUSE_UNABLE_TO_PAGE_UE	Unable to page UE	GTPv2	90

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Cause	Name	Description	Protocol	Protocol value
277	GTP_CAUSE_NO_MEM	No memory available	GTPv2	91
278	GTP_CAUSE_USER_AUTH_FAILED	User authentication failed	GTPv2	92
279	GTP_CAUSE_APN_ACCESS_DENIED	APN access denied - no subscription	GTPv2	93
280	GTP_CAUSE_REQUEST_REJECTED	Request rejected (reason not specified)	GTPv2	94
281	GTP_CAUSE_PTMSI_MISMATCH	P-TMSI Signature mismatch	GTPv2	95
282	GTP_CAUSE_IMSI_NOT_KNOWN	IMSI/IMEI not known	GTPv2	96
283	GTP_CAUSE_SEMANTIC_ERR_TAD	Semantic error in the TAD operation	GTPv2	97
284	GTP_CAUSE_SYNTACTIC_ERR_TAD	Syntactic error in the TAD operation	GTPv2	98
285	GTP_CAUSE_RESERVED_MSG_VAL	Used to indicate specific IE value validation failure cases.	GTPv2	99
286	GTP_CAUSE_REM_PEER_NO_RESPONSE	Remote peer not responding, used for all types of peers without differentiation	GTPv2	100
289	GTP_CAUSE_COLLISION_WITH_NW_REQS	Collision with	GTPv2	101

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Cause	Name	Description	Protocol	Protocol value
		network-initiated request		
290	GTP_CAUSE_UNABLE_TO_PAGE_DUE_TO_SUSPENSION	Unable to page UE because of Suspension	GTPv2	102
291	GTP_CAUSE_CONDITIONAL_IE_MISSING	Conditional IE missing	GTPv2	103
292	GTP_CAUSE_APN_RESTRICTION_INCOMPATIBLE	APN Restriction type Incompatible with current active PDN connection		104
293	GTP_CAUSE_INVALID_OVERALL_LEN_TRIG_PIGGY	Invalid overall length of the triggered response message and a piggybacked initial message	GTPv2	105
294	GTP_CAUSE_DATA_FOWARDING_NOT_SUPPORTED	Data forwarding not supported	GTPv2	106
295	GTP_CAUSE_INVALID_REPLY_REMOTE_PEER	Invalid reply from remote peer	GTPv2	107
296	GTP_CAUSE_FALLBACK_TO_GTPV1	Fallback to GTPv1	GTPv2	108
297	GTP_CAUSE_INVALID_PEER	Invalid peer	GTPv2	109
298	GTP_CAUSE_HANDOVER_IN_PROGRESS	Temporarily rejected because of a handover procedure in progress	GTPv2	110

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Cause	Name	Description	Protocol	Protocol value
299	GTP_CAUSE_MOD_BEYONG_S1U_ BEARERS	Modifications not limited to S1-U bearers	GTPv2	111
300	GTP_CAUSE_UE_REATTACHED	UE already re-attached	GTPv2	115
301	GTP_CAUSE_MPDN_PER_APN_NOT_ ALLOWED	Multiple PDN connections for a specific APN not allowed	GTPv2	116
302	GTP_CAUSE_SGW_RECOVERY_IDLE	SGW/ combined SGW/PGW indicates to the MME that Geo-redundancy fail-over just occurred. This is a proprietary definition.	GTPv2	254
303	GTP_CAUSE_PGW_NOT_RESPONDING	For PGW Restart Notification (PRN) message to indicate the PGW down case.	GTPv2	12
409	GTP_CAUSE_MME_REFUSE_VPLMN_PCY	The MME or the SGSN refuses because of VPLMN Policy	GTPv2	119
410	GTP_CAUSE_UE_UNREACH_PWR_SAV	The UE is temporarily not reachable because	GTPv2	123

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Cause	Name	Description	Protocol	Protocol value
		of power saving		
411	GTP_CAUSE_UE_NO_AUTH_BY_OCS_AAA	The UE is not authorized by the Online Charging Server or the external AAA server	GTPv2	125
412	GTP_CAUSE_REQ_REJECT_UE_ CAPABILITY	The request was rejected because of UE Capability	GTPv2	127
422	GTP_CAUSE_LATE_OVERLAP_REQ	Late Overlapping Request; see DIAMETER cause 420	GTPv2	121
423	GTP_CAUSE_TIMED_OUT_REQ	Timed Out Request; see DIAMETER cause 421	GTPv2	122
424	E_PCMD_CAUSE_GTP1_NETWORK_ FAILURE	Sent by SGSN in the Delete PDP Context Request to indicate a network problem	GTPv1	8
431	PFCP_CAUSE_REQ_REJECTED	Request Rejected (no specified reason)	PFCP	64
432	PFCP_CAUSE_CONTEXT_NOT_FOUND	Session Context not found	PFCP	65

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Cause	Name	Description	Protocol	Protocol value
433	PFCP_CAUSE_MANDATORY_IE_MISSING	Mandatory IE Missing	PFCP	66
434	PFCP_CAUSE_CONDITIONAL_IE_MISSING	Conditional IE Missing	PFCP	67
435	PFCP_CAUSE_INVALID_LENGTH	Invalid message length	PFCP	68
436	PFCP_CAUSE_MANDATORY_IE_ INCORRECT	Mandatory IE Incorrect	PFCP	69
501	SBI_307_TMP_REDIRECT	—	HTTP	307
502	SBI_308_PERM_REDIRECT	—	HTTP	308
503	SBI_400_BAD_REQUEST_INVALID_API	—	HTTP	400
504	SBI_400_BAD_REQUEST_INVALID_ MESSAGE_FORMAT	—	HTTP/2	400
505	SBI_400_BAD_REQUEST_INVALID_ QUERY_PARAM	—	HTTP/2	400
506	SBI_400_BAD_REQUEST_MANDATORY_IE_ INCORRECT	—	HTTP/2	400
507	SBI_400_BAD_REQUEST_MANDATORY_IE_ MISSING	—	HTTP/2	400
508	SBI_400_BAD_REQUEST_MANDATORY_ QUERY_PARAM_INCORRECT	—	HTTP/2	400
509	SBI_400_BAD_REQUEST_MANDATORY_ QUERY_PARAM_MISSING	—	HTTP/2	400
510	SBI_400_BAD_REQUEST_OPTIONAL_IE_ INCORRECT	—	HTTP/2	400
511	SBI_400_BAD_REQUEST_OPTIONAL_ QUERY_PARAM_INCORRECT	—	HTTP/2	400
512	SBI_400_BAD_REQUEST_UNSPECIFIED_ MSG_FAILURE	—	HTTP/2	400
513	SBI_403_FORBIDDEN_DEFAULT_EPS_ BEARER_INACTIVE	—	HTTP/2	403
514	SBI_403_FORBIDDEN_DNN_DENIED	—	HTTP/2	403
515	SBI_403_FORBIDDEN_DNN_NOT_ SUPPORTED	—	HTTP/2	403
516	SBI_403_FORBIDDEN_EBI_EXHAUSTED	—	HTTP/2	403

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Cause	Name	Description	Protocol	Protocol value
517	SBI_403_FORBIDDEN_EBI_REJECTED_LOCAL_POLICY	—	HTTP/2	403
518	SBI_403_FORBIDDEN_EBI_REJECTED_NO_N26	—	HTTP/2	403
519	SBI_403_FORBIDDEN_HO_TAU_IN_PROGRESS	—	HTTP/2	403
520	SBI_403_FORBIDDEN_HOME_ROUTED_ROAMING_REQUIRED	—	HTTP/2	403
521	SBI_403_FORBIDDEN_INTEGRITY_PROTECTED_MDR_NOT_ACCEPTABLE	—	HTTP/2	403
522	SBI_403_FORBIDDEN_MODIFICATION_NOT_ALLOWED	—	HTTP/2	403
523	SBI_403_FORBIDDEN_N1_SM_ERROR	—	HTTP/2	403
524	SBI_403_FORBIDDEN_N2_SM_ERROR	—	HTTP/2	403
525	SBI_403_FORBIDDEN_NO_EPS_5GS_CONTINUITY	—	HTTP/2	403
526	SBI_403_FORBIDDEN_OUT_OF_LADN_SERVICE_AREA	—	HTTP/2	403
527	SBI_403_FORBIDDEN_PDU_SESSION_ANCHOR_CHANGE	—	HTTP/2	403
528	SBI_403_FORBIDDEN_PDUTYPE_DENIED	—	HTTP/2	403
529	SBI_403_FORBIDDEN_PDUTYPE_NOT_SUPPORTED	—	HTTP/2	403
530	SBI_403_FORBIDDEN_PRIORITIZED_SERVICES_ONLY	—	HTTP/2	403
531	SBI_403_FORBIDDEN_REJECTED_BY_UE	—	HTTP/2	403
532	SBI_403_FORBIDDEN_REJECTED_DUE_VPLMN_POLICY	—	HTTP/2	403
533	SBI_403_FORBIDDEN_SNSSAI_DENIED	—	HTTP/2	403
534	SBI_403_FORBIDDEN_SSC_DENIED	—	HTTP/2	403
535	SBI_403_FORBIDDEN_SSC_NOT_SUPPORTED	—	HTTP/2	403
536	SBI_403_FORBIDDEN_SUBSCRIPTION_DENIED	—	HTTP/2	403
537	SBI_403_FORBIDDEN_TARGET_MME_CAPABILITY	—	HTTP/2	403

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Cause	Name	Description	Protocol	Protocol value
538	SBI_403_FORBIDDEN_UE_NOT_RESPONDING	—	HTTP/2	403
539	SBI_403_FORBIDDEN_UNABLE_TO_PAGE_UE	—	HTTP/2	403
540	SBI_404_NOT_FOUND_CONTEXT_NOT_FOUND	—	HTTP/2	404
541	SBI_404_NOT_FOUND_RESOURCE_URI_STRUCTURE_NOT_FOUND	—	HTTP/2	404
542	SBI_404_NOT_FOUND_SUBSCRIPTION_NOT_FOUND	—	HTTP/2	404
543	SBI_411_LENGTH_REQUIRED_INCORRECT_LENGTH	—	HTTP/2	411
544	SBI_429_TOO_MANY_REQUESTS_NF_CONGESTION_RISK	—	HTTP/2	429
545	SBI_500_INTERNAL_SERVER_ERROR_INSUFFICIENT_RESOURCES	—	HTTP/2	500
546	SBI_500_INTERNAL_SERVER_ERROR_INSUFFICIENT_RESOURCES_SLICE	—	HTTP/2	500
547	SBI_500_INTERNAL_SERVER_ERROR_INSUFFICIENT_RESOURCES_SLICE_DNN	—	HTTP/2	500
548	SBI_500_INTERNAL_SERVER_ERROR_SYSTEM_FAILURE	—	HTTP/2	500
549	SBI_500_INTERNAL_SERVER_ERROR_UNSPECIFIED_NF_FAILURE	—	HTTP/2	500
550	SBI_503_SERVICE_UNAVAILABLE_DNN_CONGESTION	—	HTTP/2	503
551	SBI_503_SERVICE_UNAVAILABLE_NF_CONGESTION	—	HTTP/2	503
552	SBI_503_SERVICE_UNAVAILABLE_S_NSSAI_CONGESTION	—	HTTP/2	503
553	SBI_504_GATEWAY_TIMEOUT_NETWORK_FAILURE	—	HTTP/2	504
554	SBI_504_GATEWAY_TIMEOUT_PEER_NOT_RESPONDING	—	HTTP/2	504
555	SBI_400_BAD_REQUEST_CHARGING_FAILED	—	HTTP/2	400

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Cause	Name	Description	Protocol	Protocol value
556	SBI_403_FORBIDDEN_CHARGING_NOT_APPLICABLE	—	HTTP/2	403
557	SBI_403_FORBIDDEN_END_USER_REQUEST_DENIED	—	HTTP/2	403
558	SBI_403_FORBIDDEN_QUOTA_LIMIT_REACHED	—	HTTP/2	403
559	SBI_403_FORBIDDEN_END_USER_REQUEST_REJECTED	—	HTTP/2	403
560	SBI_404_NOT_FOUND_USER_UNKNOWN	—	HTTP/2	404
561	N10_UNAUTHORIZED_ERROR	Error when building HTTP/2 Authorization Header	HTTP/2	—
562	N10_EXTERNAL_ERROR	Various error cases when decoding N10 peer message	HTTP/2	—
563	N10_INTERNAL_ERROR	Various error cases when sending HTTP/2 N10 peer message	HTTP/2	—
564	N7_INTERNAL_ERROR	Various error cases when sending HTTP/2 N7 peer message	HTTP/2	—
565	SBI_400_BAD_REQUEST	—	HTTP/2	400
566	SBI_403_FORBIDDEN	—	HTTP/2	403
567	SBI_404_NOT_FOUND	—	HTTP/2	404
568	SBI_411_LENGTH_REQUIRED	—	HTTP/2	411
569	SBI_429_TOO_MANY_REQUESTS	—	HTTP/2	429
570	SBI_500_INTERNAL_SERVER_ERROR	—	HTTP/2	500
571	SBI_503_SERVICE_UNAVAILABLE	—	HTTP/2	503

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Cause	Name	Description	Protocol	Protocol value
572	SBI_504_GATEWAY_TIMEOUT	—	HTTP/2	504
573	SBI_403_UE_IN_NON_ALLOWED_AREA	—	HTTP/2	573
574	PFCP_NO_RESOURCES	Resources unavailable	PFCP	75
575	PFCP_ENTITY_CONGESTED	Node level congestion	PFCP	74
576	PFCP_SERVICE_NOT_SUPPORTED	Service not supported	PFCP	76
577	PFCP_SYSTEM_FAILURE	System error condition	PFCP	77
578	SBI_409_CONFLICT	—	HTTP/2	409
579	SBI_409_HIGHER_PRIORITY_REQUEST_ ONGOING	—	HTTP/2	409
580	409_TEMPORARY_REJECT_ REGISTRATION_ONGOING	—	HTTP/2	409
581	SBI_409_TEMPORARY_REJECT_ HANDOVER_ONGOING	—	HTTP/2	409
582	SBI_409_UE_IN_CM_IDLE_STATE	—	HTTP/2	409

6.4 Detailed causes

The MAG-c supports detailed cause IEs for PCMD.

Table 72: Detailed causes

Detailed cause ID	Description	Related event	Related cause
1008	Address Pool Missing/ cfg	LTE_ADDR_POOL_ NOT_PRESENT	GTP1_CAUSE_NO_ RESOURCES
1009	Unsupported Auth Type	LTE_UNSUPP_AUTH_ TYPE	GTP1_CAUSE_AUTH_ FAILURE
1010	Invalid Authentication Key	LTE_INV_AUTH_KEY	GTP1_CAUSE_AUTH_ FAILURE
1011	Invalid Authentication Type	LTE_INV_AUTH_TYPE	GTP1_CAUSE_AUTH_ FAILURE
1012	Authentication Failed	LTE_AUTH_FAIL	GTP1_CAUSE_AUTH_ FAILURE

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Detailed cause ID	Description	Related event	Related cause
1013	Failed	LTE_FAILED	GTP1_CAUSE_USER_AUTH_FAILURE
1014	UE Reattach	LTE_UE_REATTACH	GTP_CAUSE_SUCCESS
1015	User authentication failure	LTE_USER_AUTH_FAIL	GTP1_CAUSE_USER_AUTH_FAILURE
1016	Diameter (PCRF) disabled	LTE_DIAM_PCRF_DISABLED	GTP1_CAUSE_USER_AUTH_FAILURE
1017	ROL session establishment failure	LTE_ROL_SESS_FAILED	GTP1_CAUSE_USER_AUTH_FAILURE
1018	Addr Alloc Failed	LTE_ADDR_ALLOC_FAIL	GTP1_CAUSE_PDP_ADDR_NOT_AVAI
1019	Address Pool Exhausted	LTE_ADDR_POOL_EXHAUSTED	GTP1_CAUSE_PDP_ADDR_NOT_AVAI
1020	Address Pool Empty	LTE_ADDR_POOL_EMPTY	GTP1_CAUSE_PDP_ADDR_NOT_AVAI
1021	APN access denied	LTE_APN_ACCESS_DENIED	GTP1_CAUSE_APN_ACC_DENIED
1022	APN Selection Mode Mismatch	LTE_APN_SELECTION_MODE_MISMATCH	GTP1_CAUSE_APN_ACC_DENIED
1023	Session Termination because of Timeout	LTE_SESSION_TIMEOUT	GTP_CAUSE_PDN_INACTIVE_TIMEOUT
1024	Delete Session Idle Timeout	LTE_IDLE_TIMEOUT	GTP_CAUSE_PDN_INACTIVE_TIMEOUT
1025	UE Context Not Found	LTE_UE_CTXT_NOT_FOUND	GTP_CAUSE_CONTEXT_NOT_FOUND
1026	PDN Context Not Found	LTE_PDN_CTXT_NOT_FOUND	GTP_CAUSE_CONTEXT_NOT_FOUND
1027	Bearer Context Not Found	LTE_BEARER_CTXT_NOT_FOUND	GTP_CAUSE_CONTEXT_NOT_FOUND
1028	BCE PBU Prefixes Set Mismatch	LTE_BCE_PBU_PFX_SET_MISMATCH	GTP_CAUSE_CONTEXT_NOT_FOUND
1029	Unexpected IE	LTE_IE_UNEXPECTED	GTP_CAUSE_INVALID_MSG_FMT

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Detailed cause ID	Description	Related event	Related cause
1030	Proxy registration not enabled for the mobile node	LTE_PROXY_REG_ NOT_ENABLED	GTP_CAUSE_ SERVICE_NOT_ SUPPORTED
1031	Not local mobility anchor for the mobile node	LTE_NOT_LMA_FOR_ THIS_MN	GTP_CAUSE_ SERVICE_NOT_ SUPPORTED
1032	The mobile access gateway is not authorized to send proxy binding updates	LTE_MAG_NO_AUTH_ FOR_PROXY_REG	GTP_CAUSE_ SERVICE_NOT_ SUPPORTED
1033	Service Not Supported	LTE_SERVICE_NOT_ SUPPORTED	GTP_CAUSE_ SERVICE_NOT_ SUPPORTED
1034	Timestamp Mismatch	LTE_TIMESTAMP_ MISMATCH	GTP_CAUSE_ MANDAT_IE_ INCORRECT
1035	Older Timestamp	LTE_TIMESTAMP_IN_ PAST	GTP_CAUSE_ MANDAT_IE_ INCORRECT
1036	Invalid Mand/Cond IE	LTE_INV_REQ_IE	GTP_CAUSE_ MANDAT_IE_ INCORRECT
1037	Missing Home Net Pfx Option	LTE_MISSING_HOME_ NET_PFX_OPT	GTP_CAUSE_ MANDAT_IE_MISSING
1038	Missing UE ID Option	LTE_MISSING_MN_ IDENTIFIER_OPT	GTP_CAUSE_ MANDAT_IE_MISSING
1039	Missing Handoff Ind Option	LTE_MISSING_ HANDOFF_ INDICATOR_OPT	GTP_CAUSE_ MANDAT_IE_MISSING
1040	Missing Access Tech Type Option	LTE_MISSING_ ACCESS_TECH_ TYPE_OPT	GTP_CAUSE_ MANDAT_IE_MISSING
1041	Missing IE	LTE_MISSING_IE	GTP_CAUSE_ MANDAT_IE_MISSING
1042	Addr Pool Invalid Mscp	LTE_ADDR_POOL_ INVALID_MSCP	GTP_CAUSE_ALL_ DYNAMIC_ADDR_ OCCUPIED
1043	One of the Gateways is active or the MSCP group is active	LTE_BUSY	GTP_CAUSE_UE_ NOT_RESPONDING

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Detailed cause ID	Description	Related event	Related cause
1044	Relinking Attributes failed - discarded	LTE_DISCARD	GTP_CAUSE_UE_ REFUSES
1045	Unauthorized for Home Net Pfx	LTE_NO_AUTH_FOR_ HOME_NET_PFX	GTP_CAUSE_USER_ AUTH_FAILED
1047	MME No Resp	LTE_MME_NO_RESP	GTP_CAUSE_REM_ PEER_NO_RESPONSE
1048	PGW No Resp	LTE_PGW_NO_RESP	GTP_CAUSE_REM_ PEER_NO_RESPONSE
1049	SGW No Resp	LTE_SGW_NO_RESP	GTP_CAUSE_REM_ PEER_NO_RESPONSE
1050	Disallowed RAT Type	LTE_DISALLOWED_ RAT	GTP_CAUSE_DENIED_ RAT
1051	Peer is considered to be down	LTE_PEER_DOWN	GTP_CAUSE_ SUCCESS
1052	Multiple failed rules	RFC_MULTIPLE_ FAILED_RULES	DIAMETER_PCC_ BEARER_EVENT/ DIAMETER_PCC_ RULE_ EVENT
1053	Unknown Rule Name	RFC_UNK_RULE_ NAME	DIAMETER_PCC_ BEARER_EVENT/ DIAMETER_PCC_ RULE_ EVENT
1054	Rating group Error	RFC_RATING_GRP_ ERR	DIAMETER_PCC_ BEARER_EVENT/ DIAMETER_PCC_ RULE_ EVENT
1055	Service ID error	RFC_SERVICE_ID_ ERR	DIAMETER_PCC_ BEARER_EVENT/ DIAMETER_PCC_ RULE_ EVENT
1056	Gateway Malfunction	RFC_GW_MALFUNC	DIAMETER_PCC_ BEARER_EVENT/ DIAMETER_PCC_ RULE_ EVENT
1057	Resource Limitation	RFC_RESOURCE_ LIMIT	DIAMETER_PCC_ BEARER_EVENT/ DIAMETER_PCC_ RULE_ EVENT
1058	Max number of Bearers reached	RFC_MAX_NR_ BEARER_REACHED	DIAMETER_PCC_ BEARER_EVENT/

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Detailed cause ID	Description	Related event	Related cause
			DIAMETER_PCC_ RULE_ EVENT
1059	Unknown Bearer ID	RFC_UNK_BEARER_ID	DIAMETER_PCC_ BEARER_EVENT/ DIAMETER_PCC_ RULE_ EVENT
1060	Missing Bearer ID	RFC_MISS_BEARER_ ID	DIAMETER_PCC_ BEARER_EVENT/ DIAMETER_PCC_ RULE_ EVENT
1061	Missing Flow Description	RFC_MISS_FLOW_ DESCRIPTION	DIAMETER_PCC_ BEARER_EVENT/ DIAMETER_PCC_ RULE_ EVENT
1062	Resource allocation Failure	RFC_RSRC_ALLOC_ FAILURE	DIAMETER_PCC_ BEARER_EVENT/ DIAMETER_PCC_ RULE_ EVENT
1063	Unsuccessful QoS validation	RFC_UNSUCC_QOS_ VALIDATION	DIAMETER_PCC_ BEARER_EVENT/ DIAMETER_PCC_ RULE_ EVENT
1064	Incorrect flow information	RFC_INCORRECT_ FLOW_INFO	DIAMETER_PCC_ BEARER_EVENT/ DIAMETER_PCC_ RULE_ EVENT
1065	PS to CS handover	RFC_PS2CS_ HANDOVER	DIAMETER_PCC_ BEARER_EVENT/ DIAMETER_PCC_ RULE_ EVENT
1066	TDF application identifier error	RFC_TDF_APPL_ID_ ERR	DIAMETER_PCC_ BEARER_EVENT/ DIAMETER_PCC_ RULE_ EVENT
1067	No IP-CAN bearer without traffic mapping information	RFC_NO_BEARER_ BOUND	DIAMETER_PCC_ BEARER_EVENT/ DIAMETER_PCC_ RULE_ EVENT
1068	Filter restrictions	RFC_FILTER_ RESTRICTIONS	DIAMETER_PCC_ BEARER_EVENT/ DIAMETER_PCC_ RULE_ EVENT

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Detailed cause ID	Description	Related event	Related cause
1069	AN gateway failed	RFC_ANGW_FAILED	DIAMETER_PCC_ BEARER_EVENT/ DIAMETER_PCC_ RULE_ EVENT
1070	Missing redirect server address	RFC_MISS_REDIR_ SERVR_ADDR	DIAMETER_PCC_ BEARER_EVENT/ DIAMETER_PCC_ RULE_ EVENT
1071	End user service denied	RFC_CM_END_USER_ SERVICE_DENIED	DIAMETER_PCC_ BEARER_EVENT/ DIAMETER_PCC_ RULE_ EVENT
1072	Credit control not applicable	RFC_CM_CREDIT_ CONTROL_NOT_ APPLICABLE	DIAMETER_PCC_ BEARER_EVENT/ DIAMETER_PCC_ RULE_ EVENT
1073	Authorization rejected	RFC_CM_ AUTHORIZATION_ REJECTED	DIAMETER_PCC_ BEARER_EVENT/ DIAMETER_PCC_ RULE_ EVENT
1074	User unknown	RFC_CM_USER_ UNKNOWN	DIAMETER_PCC_ BEARER_EVENT/ DIAMETER_PCC_ RULE_ EVENT
1075	Rating failed	RFC_CM_RATING_ FAILED	—
1076	Diameter Internal Error	DIAMETER_ INTERNAL_ERROR	—
1077	Diameter Fsm Error	DIAMETER_FSM_ ERROR	—
1078	Diameter PCRF OOS	DIAMETER_PCRF_ OOS	—
1079	Diameter PCRF Disabled	DIAMETER_PCRF_ DISABLED	—
1080	Diameter Mem Error	DIAMETER_MEM_ ERROR	—
1081	Diameter Tx Tmr Expiry	DIAMETER_TX_TMR_ EXPIRY	—
1082	Diameter Gen Encode Error	DIAMETER_GEN_ ENCODE_ERROR	—

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Detailed cause ID	Description	Related event	Related cause
1083	Diameter Gen Decode Error	DIAMETER_GEN_ DECODE_ERROR	—
1084	Diameter AMS Error	DIAMETER_AMS_ ERROR	—
1085	Diameter Session Gone	DIAMETER_SESSION_ GONE	—
1086	Diameter Timer Error	DIAMETER_TIMER_ ERROR	—
1087	LTE APN is shut	LTE_APN_IS_SHUT	GTP_CAUSE_APN_ ACCESS_DENIED
1088	LTE is missing PCO IE	LTE_MISSING_PCO_IE	GTP_CAUSE_ MANDAT_IE_MISSING
1089	GTP request is rejected because dual connectivity is disabled	LTE_DUAL_ CONNECTIVITY_NOT_ SUPPORTED	GTP_CAUSE_ SERVICE_NOT_ SUPPORTED
1090	Session is rejected because of Diameter Overload Indication Conveyance (DOIC)	DIAMETER_DOIC_ DROP	GTP_CAUSE_NO_ RESOURCES
1094	Context not found	LTE_NOT_FOUND	HTTP_STATUS_404_ CONTEXT_NOT_ FOUND
1095	Local Area DN Session Release	LTE_LADN_PDU_ SESS_REL	—
1096	Failure Sending Message	LTE_MSG_SEND_FAIL	—
1097	N2 Encoding Failure	LTE_N2_ENCODE_FAIL	—
1098	Encoding Failure	LTE_ENCODE_FAIL	—
1099	AMF Configuration Error	LTE_AMF_CFG_NF_ FAIL	—
1100	PDU Session Rejected Only Allow IPv4	LTE_PDU_ONLY_ ALLOW_IPV4	HTTP_STATUS_403_ PDUTYPE_DENIED
1101	PDU Session Rejected Only Allow IPv6	LTE_PDU_ONLY_ ALLOW_IPV6	HTTP_STATUS_403_ PDUTYPE_DENIED
1102	SSC mode is not supported	LTE_UNSUPPORTED_ SSCMODE	HTTP_STATUS_ 403_SSC_NOT_ SUPPORTED

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Detailed cause ID	Description	Related event	Related cause
1103	Insufficient resource in slice	LTE_INSUFFICIENT_ RES_SLICE	HTTP_STATUS_ 500_INSUFFIC_ RESOURCES_SLICE
1104	PDU session type unknown	LTE_UNKNOWN_PDU_ SESSTYPE	HTTP_STATUS_403_ PDUTYPE_DENIED
1105	N2 PDU Setup Failure	LTE_N2_ESTB_FAIL	HTTP_STATUS_200_ OK
1106	N1_T3591 and N1_ T3592 timeout	LTE_N1_TIMER_ TIMEOUT	—
1107	N2 Decoding Failure	LTE_N2_DECODING_ FAILED	HTTP_STATUS_500_ UNSPECIFIED_NF_ FAILURE / HTTP_STATUS_403_ N2_SM_ERROR
1108	AMF reported 5G AN not responding	LTE_AN_NOT_ RESPONDING	—
1110	UPF no response	LTE_PEER_REQ_ TIMEOUT	—
1111	Handover Cancel	HANDOVER_CANCEL	—
1112	S1-U address mismatch between the MME and the combined SGW + PGW	LTE_S1U_IP_ VERSION_MISMATCH	—
1113	N40 Assume Positive	CHF_AP_CONTINUE	All relevant HTTP error codes or timeout
1114	N10 Assume Positive	UDM_AP_CONTINUE	All relevant HTTP error codes or timeout
1115	N7 Assume Positive	PCF_AP_CONTINUE	All relevant HTTP error codes or timeout
1116	CHF No Response	CHF_TIMEOUT	—
1117	UDM No Response	UDM_TIMEOUT	—
1118	PCF No Response	PCF_TIMEOUT	—
1119	AMF No Response	AMF_NO_RESP	—
1120	N2 setup failure because of multiple PDU session ID instances	Multiple PDU Session ID instances	—
1121	Fallback to offline CHF	CHF_FALLBACK_ OFFLINE	—

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6.5 Message marker IDs and SBI service operation messages

Table 73: MessageMarker_n IDs

Message marker ID	Message interface, name, direction / service operation	Node	Protocol	Interface / SBI service
0	No_Message	N/A	N/A	N/A
1	Create_Session_Request	Combined SGW-C + PGW-C	GTPv2	S11
2	Create_Session_Response	Combined SGW-C + PGW-C	GTPv2	S11
3	Delete_Session_Request	Combined SGW-C + PGW-C	GTPv2	S11
4	Delete_Session_Response	Combined SGW-C + PGW-C	GTPv2	S11
5	Modify_Bearer_Request	Combined SGW-C + PGW-C	GTPv2	S11
6	Modify_Bearer_Response	Combined SGW-C + PGW-C	GTPv2	S11
7	Resume_Notification	Combined SGW-C + PGW-C	GTPv2	S11
8	Resume_Acknowledge	Combined SGW-C + PGW-C	GTPv2	S11
9	Modify_Bearer_Command	SGW, PGW, combined SGW-C + PGW-C	GTPv2	S11
10	Modify_Bearer_Failure_ Indication	Combined SGW-C + PGW-C	GTPv2	S11
11	Delete_Bearer_Command	Combined SGW-C + PGW-C	GTPv2	S11
12	Delete_Bearer_Failure_ Indication	Combined SGW-C + PGW-C	GTPv2	S11
13	Bearer_Resource_Command	Combined SGW-C + PGW-C	GTPv2	S11
14	Bearer_Resource_Failure_ Indication	Combined SGW-C + PGW-C	GTPv2	S11
15	Downlink_Data_Notification_ Failure_Indication	Combined SGW-C + PGW-C	GTPv2	S11

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Message marker ID	Message interface, name, direction / service operation	Node	Protocol	Interface / SBI service
16	Create_Bearer_Request	Combined SGW-C + PGW-C	GTPv2	S11
17	Create_Bearer_Response	Combined SGW-C + PGW-C	GTPv2	S11
18	Update_Bearer_Request	Combined SGW-C + PGW-C	GTPv2	S11
19	Update_Bearer_Response	Combined SGW-C + PGW-C	GTPv2	S11
20	Delete_Bearer_Request	Combined SGW-C + PGW-C	GTPv2	S11
21	Delete_Bearer_Response	Combined SGW-C + PGW-C	GTPv2	S11
22	Suspend_Notification	Combined SGW-C + PGW-C	GTPv2	S11
23	Suspend_Acknowledge	Combined SGW-C + PGW-C	GTPv2	S11
24	Create_Indirect_Data_ Forwarding_Tunnel_Request	Combined SGW-C + PGW-C	GTPv2	S11
25	Create_Indirect_Data_ Forwarding_Tunnel_ Response	Combined SGW-C + PGW-C	GTPv2	S11
26	Delete_Indirect_Data_ Forwarding_Tunnel_Request	Combined SGW-C + PGW-C	GTPv2	S11
27	Delete_Indirect_Data_ Forwarding_Tunnel_ Response	Combined SGW-C + PGW-C	GTPv2	S11
28	Release_Access_Bearers_ Request	Combined SGW-C + PGW-C	GTPv2	S11
29	Release_Access_Bearers_ Response	Combined SGW-C + PGW-C	GTPv2	S11
30	Downlink_Data_Notification	Combined SGW-C + PGW-C	GTPv2	S11
31	Downlink_Data_Notification_ Acknowledge	Combined SGW-C + PGW-C	GTPv2	S11
32	PGW_Restart_Notification	Combined SGW-C + PGW-C	GTPv2	S11

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Message marker ID	Message interface, name, direction / service operation	Node	Protocol	Interface / SBI service
33	PGW_Restart_Notification_ Acknowledge	Combined SGW-C + PGW-C	GTPv2	S11
82	Modify_Access_Bearer_ Request	Combined SGW-C + PGW-C	GTPv2	S11
83	Modify_Access_Bearer_ Response	Combined SGW-C + PGW-C	GTPv2	S11
83	Modify_Access_Bearer_ Response	Combined SGW-C + PGW-C	GTPv2	S11
84	PFCP Session Establishment Request	Combined SGW-C + PGW-C	PFCP	Sx, N4
85	PFCP Session Establishment Response	Combined SGW-C + PGW-C	PFCP	Sx, N4
86	PFCP Session Modification Request	Combined SGW-C + PGW-C	PFCP	Sx, N4
87	PFCP Session Modification Response	Combined SGW-C + PGW-C	PFCP	Sx, N4
88	PFCP Session Deletion Request	Combined SGW-C + PGW-C	PFCP	Sx, N4
89	PFCP Session Deletion Response	Combined SGW-C + PGW-C	PFCP	Sx, N4
90	PFCP Session Report Request	Combined SGW-C + PGW-C	PFCP	Sx, N4
91	PFCP Session Report Response	Combined SGW-C + PGW-C	PFCP	Sx, N4
101	Create SM Context Request	SMF	HTTP/2	Nsmf_ PDUSession
102	Create SM Context Response	SMF	HTTP/2	Nsmf_ PDUSession
103	Update SM Context Request	SMF	HTTP/2	Nsmf_ PDUSession
104	Update SM Context Response	SMF	HTTP/2	Nsmf_ PDUSession
105	Release SM Context Request	SMF	HTTP/2	Nsmf_ PDUSession
106	Release SM Context Response	SMF	HTTP/2	Nsmf_ PDUSession

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Message marker ID	Message interface, name, direction / service operation	Node	Protocol	Interface / SBI service
107	SM Context Notify Request	SMF	HTTP/2	Nsmf_ PDUSession
108	SM Context Notify Response	SMF	HTTP/2	Nsmf_ PDUSession
109	N1N2MessageTransfer Request	SMF	HTTP/2	Namf_ Communication
110	N1N2MessageTransfer Response	SMF	HTTP/2	Namf_ Communication
111	N1N2Message Transfer Failure Notification Request	SMF	HTTP/2	Namf_ Communication
112	N1N2Message Transfer Failure Notification Response	SMF	HTTP/2	Namf_ Communication
115	Subscriber Data Management Get Request	SMF, combined SGW-C + PGW-C	HTTP/2	Nudm_ SubscriberData Management
116	Subscriber Data Management Get Response	SMF, combined SGW-C + PGW-C	HTTP/2	Nudm_ SubscriberData Management
117	Subscriber Data Management Subscribe Request	SMF, combined SGW-C + PGW-C	HTTP/2	Nudm_ SubscriberData Management
118	Subscriber Data Management Subscribe Response	SMF, combined SGW-C + PGW-C	HTTP/2	Nudm_ SubscriberData Management
119	Subscriber Data Management Unsubscribe Request	SMF, combined SGW-C + PGW-C	HTTP/2	Nudm_ SubscriberData Management
120	Subscriber Data Management Unsubscribe Response	SMF, combined SGW-C + PGW-C	HTTP/2	Nudm_ SubscriberData Management
121	Subscriber Data Change Notification Request	SMF, combined SGW-C + PGW-C	HTTP/2	Nudm_ SubscriberData Management
122	Subscriber Data Change Notification Response	SMF, combined SGW-C + PGW-C	HTTP/2	Nudm_ SubscriberData Management

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Message marker ID	Message interface, name, direction / service operation	Node	Protocol	Interface / SBI service
123	UE Context Management Register Request	SMF, combined SGW-C + PGW-C	HTTP/2	Nudm_ UEContext Management
124	UE Context Management Register Response	SMF, combined SGW-C + PGW-C	HTTP/2	Nudm_ UEContext Management
125	UE Context Management Deregister Request	SMF, combined SGW-C + PGW-C	HTTP/2	Nudm_ UEContext Management
126	UE Context Management Deregister Response	SMF, combined SGW-C + PGW-C	HTTP/2	Nudm_ UEContext Management
127	SM Policy Control Get Request	SMF, combined SGW-C + PGW-C	HTTP/2	Npcf_SMPolicy Control
128	SM Policy Control Get Response	SMF, combined SGW-C + PGW-C	HTTP/2	Npcf_SMPolicy Control
129	SM Policy Control Delete Request	SMF, combined SGW-C + PGW-C	HTTP/2	Npcf_SMPolicy Control
130	SM Policy Control Delete Response	SMF, combined SGW-C + PGW-C	HTTP/2	Npcf_SMPolicy Control
131	SM Policy Control Update Notify Request	SMF, combined SGW-C + PGW-C	HTTP/2	Npcf_SMPolicy Control
132	SM Policy Control Update Notify Response	SMF, combined SGW-C + PGW-C	HTTP/2	Npcf_SMPolicy Control
133	SM Policy Control Update Request	SMF, combined SGW-C + PGW-C	HTTP/2	Npcf_SMPolicy Control
134	SM Policy Control Update Response	SMF, combined SGW-C + PGW-C	HTTP/2	Npcf_SMPolicy Control
135	Charging Data Request [Initial]	SMF, combined SGW-C + PGW-C	HTTP/2	Nchf_Converged Charging
136	Charging Data Response [Initial]	SMF, combined SGW-C + PGW-C	HTTP/2	Nchf_Converged Charging
137	Charging Data Request [Update]	SMF, combined SGW-C + PGW-C	HTTP/2	Nchf_Converged Charging
138	Charging Data Response [Update]	SMF, combined SGW-C + PGW-C	HTTP/2	Nchf_Converged Charging

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Message marker ID	Message interface, name, direction / service operation	Node	Protocol	Interface / SBI service
139	Charging Data Request [Terminate]	SMF, combined SGW-C + PGW-C	HTTP/2	Nchf_Converged Charging
140	Charging Data Response [Terminate]	SMF, combined SGW-C + PGW-C	HTTP/2	Nchf_Converged Charging
141	SM Policy Control Delete Notify Request	SMF, combined SGW-C + PGW-C	HTTP/2	Npcf_SMPolicy Control
142	SM Policy Control Delete Notify Response	SMF, combined SGW-C + PGW-C	HTTP/2	Npcf_SMPolicy Control
143	EBI Request	SMF	HTTP/2	Namf_ Communication
144	EBI Response	SMF	HTTP/2	Namf_ Communication
145	Retrieve SM Context Request	SMF	HTTP/2	Nsmf_ PDUSession
146	Retrieve SM Context Response	SMF	HTTP/2	Nsmf_ PDUSession
147	Charging Data Request [Notify]	SMF, combined SGW-C + PGW-C	HTTP/2	Nchf_Converged Charging
148	Charging Data Request [Notify]	SMF, combined SGW-C + PGW-C	HTTP/2	Nchf_Converged Charging

6.6 Reference point and SBI services IDs

Table 74: Reference point and SBI services IDs

Reference point ID / service ID	Reference point / SBI service name	Involved Nodes	Protocol
0	Unknown	N/A	N/A
1	S11	Combined SGW-C + PGW-C, MME	GTPv2
15	Combined Sxa/Sxb	Combined SGW-C + PGW-C, Combined SGW-U + PGW-U	PFCP
16	N4	SMF, UPF	PFCP
17	Nsmf_PDUSession	SMF, AMF	HTTP/2
19	Namf_Communication	SMF, AMF	HTTP/2

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Reference point ID / service ID	Reference point / SBI service name	Involved Nodes	Protocol
22	Nudm_SubscriberData Management	SMF, Combined SGW-C + PGW-C, UDM	HTTP/2
23	Nudm_UEContextManagement	SMF, Combined SGW-C + PGW-C, UDM	HTTP/2
24	Npcf_SMPolicyControl	SMF, Combined SGW-C + PGW-C, PCF	HTTP/2
25	Nchf_ConvergedCharging	SMF, Combined SGW-C + PGW-C, CHF	HTTP/2

6.7 Direction_n IDs

Table 75: Direction_n IDs

Direction ID	Direction
0	Ingress
1	Egress

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7 PCMD conversion function

Save PCMD records in CSV files to easily process PCMD data with analytics tools or use it for operational support functions.

The PCMD conversion function (PCMD-VM) is an add-on service in the MAG-c application that is designed for converting PCMD session records to other data formats. The PCMD-VM receives PCMD streams from session-processing functions of the MAG-c and converts them into a data format suitable for analytics tools or operational support functions in the network. The PCMD-VM can be installed alongside other MAG-c VMs.

Key functionalities of the PCMD conversion function:

- PCMD session record management – receives and processes PCMD session records, converting them into CSV format
- automated file lifecycle management – manages creation and deletion of CSV files based on defined intervals and retention policies
- CSV file compression – supports saving converted CSV files in compressed file format
- disk space management – supports automated cleanup action to maintain storage space for new records
- secure file transfer – facilitates SFTP transfers of generated CSV files to external systems

PCMD conversion configuration parameters

The following configuration parameters can be set on the PCMD-VM:

- interval – defines the period for receiving PCMD session records for a new file to be generated
- retention period – defines how long generated files should be kept before being automatically deleted
- file-compression – defines the algorithm used to compress CSV files, for example, GZIP and ZSTD

Files collection and naming

Analytics systems can retrieve generated CSV files periodically from the PCMD-VM via SFTP.

The following file naming conventions apply:

```
pcmd-<csv-version>-<record-type>-<mag-c-nodeIP>-<start-time>-<end-time>-<uniqueId>.csv.gz
```

- pcmd – prefix indicating PCMD data
- csv-version – set to 1 for this release
- record-type – set to session for this release
- mag-c-nodeIP – IP address of the source MAG-c node
- start-time– ISO8601 UTC timestamps for the data period start
- end-time – ISO8601 UTC timestamps for the data period end
- uniqueId – unique identifier to support parallel file writing
- .csv.gz, .csv.zst – file extension indicating the compression format

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Example: Generated CSV filename

```
pcmd-1-session-100.9.9.9-20260304T083032.947363973Z-20260304T083102.947363973Z-0.csv.gz
```

To improve writing speed, the PCMD-VM supports writing parallel files with a unique ID embedded in the filename.

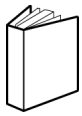
File management policy

The PCMD-VM implements a file management policy to handle large, converted CSV files and ensure continuous operation.

- **retention period**
  This is a configurable option for setting longer retention periods, depending on the available storage.
- **disk space management**
  When storage capacity reaches the predefined limits, the PCMD-VM initiates a cleanup action automatically to ensure that older files are removed to free up space.

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