3GPP TS 29.272 V15.2.0 (2017-12)

Technical Specification

**3rd Generation Partnership Project;
Technical Specification Group Core Network and Terminals;
Evolved Packet System (EPS);
Mobility Management Entity (MME)
and Serving GPRS Support Node (SGSN) related interfaces
based on Diameter protocol
(Release 15)**

Keywords
3GPP, LTE, DIAMETER

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Contents

Foreword

This Technical Specification has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

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1 Scope

The present document describes the Mobility Management Entity (MME) and Serving GPRS Support Node (SGSN) related diameter-based interfaces towards the Home Subscriber Server (HSS) or the CSG Subscriber Server (CSS), and the MME and the SGSN related diameter-based interface towards the Equipment Identity Register (EIR).

This specification defines the Diameter application for the MME-HSS, S6a reference point, for the MME-CSS, S7a reference point, for the SGSN-HSS, S6d reference point, and for the SGSN-CSS, S7d reference point. The interactions between the HSS/CSS and the MME/SGSN are specified, including the signalling flows.

This specification defines the Diameter application for the MME-EIR, S13 reference point, and for the SGSN-EIR, S13' reference point. The interactions between the MME/SGSN and the EIR are specified, including the signalling flows.

In this specification, if there is no specific indication, the following principles apply:

- "SGSN" refers to an SGSN which at least supports the S4 interface and may support Gn and Gp interfaces.

- "S4-SGSN" refers to an SGSN which supports the S4 interface and does not support Gn and Gp interfaces.

- Gn/Gp-SGSN refers to an SGSN which supports the Gn and Gp interfaces and does not support S4 interface.

- "GPRS subscription data" refers to the parameters in the HLR column in Table 5.2. in 3GPP TS 23.008 [30].

- "EPS subscription data" refers to the parameters in the HSS column in Table 5.2A-1 in 3GPP TS 23.008 [30].

The Evolved Packet System stage 2 description (architecture and functional solutions) is specified in 3GPP TS 23.401 [2] and in 3GPP TS 23.060 [12].

SGSN CAMEL Subscription Data are not supported over S6d interface.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.

- For a specific reference, subsequent revisions do not apply.

- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1]   3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2]   3GPP TS 23.401: "GPRS enhancements for E-UTRAN access ".

[3]   3GPP TS 23.003: "Numbering, addressing and identification".

[4]   Void.

[5]   3GPP TS 33.401: "3GPP System Architecture Evolution: Security Architecture".

[6]   Void".

[7]   IETF RFC 2234: "Augmented BNF for syntax specifications".

[8]   3GPP TS 32.299: "Charging management; Diameter charging applications".

[9]   3GPP TS 29.229: "Cx and Dx interfaces based on the Diameter protocol".

[10]   3GPP TS 29.212: "Policy and Charging Control (PCC); Reference points".

[11]   3GPP TS 29.214: "Policy and Charging Control over Rx reference point".

[12]   3GPP TS 23.060: "General Packet Radio Service (GPRS); Service description; Stage 2".

[13]   3GPP TS 22.016: "International Mobile station Equipment Identities (IMEI)".

[14]   IETF RFC 4960: "Stream Control Transmission Protocol".

[15]   Void

[16]   3GPP TS 33.210: "3G Security; Network Domain Security; IP Network Layer Security"..

[17]   3GPP TS 29.228: "IP multimedia (IM) Subsystem Cx and Dx Interfaces; Signalling flows and Message Elements".

[18]   3GPP TS 33.102: "3G Security; Security Architecture".

[19]   3GPP TS 36.413: "Evolved Universal Terrestrial Radio Access Network (E-UTRAN); S1 Application Protocol (S1AP)".

[20]   IETF RFC 5778: "Diameter Mobile IPv6: Support for Home Agent to Diameter Server Interaction".

[21]   3GPP TS 29.061: "Interworking between the Public Land Mobile Network (PLMN) supporting packet based services and Packet Data Networks (PDN)".

[22]   3GPP TS 32.298: "Charging Management; CDR parameter description".

[23]   3GPP TS 32.422: "Telecommunication management; Subscriber and equipment trace; Trace control and configuration management".

[24]   3GPP TS 29.002: "Mobile Application Part (MAP) specification".

[25]   3GPP TS 29.329: "Sh Interface based on the Diameter protocol".

[26]   IETF RFC 5447: "Diameter Mobile IPv6: Support for Network Access Server to Diameter Server Interaction".

[27]   IETF RFC 4004: "Diameter Mobile IPv4 Application".

[28]   3GPP2 A.S0022: "Interoperability Specification (IOS) for Evolved High Rate Packet Data (eHRPD) Radio Access Network Interfaces and Interworking with Enhanced Universal Terrestrial Radio Access Network (E-UTRAN)".

[29]   3GPP TS 23.011: "Technical realization of Supplementary Services - General Aspects".

[30]   3GPP TS 23.008: "Organization of subscriber data".

[31]   3GPP TS 24.008: "Mobile radio interface Layer 3 specification; Core network protocols; Stage 3".

[32]   IETF RFC 5516: "Diameter Command Code Registration for Third Generation Partnership Project (3GPP) Evolved Packet System (EPS)".

[33]   3GPP TS 32.251: "Telecommunication management; Charging management; Packet Switched (PS) domain charging".

[34]   3GPP TS 23.292: "IP Multimedia Subsystem (IMS) centralized services ".

[35]   3GPP TS 23.216: "Single Radio Voice Call Continuity (SRVCC)".

[36]   3GPP TS 23.015:"Technical realization of Operator Determined Barring (ODB)".

[37]   3GPP TS 29.173: "Diameter-based SLh interface for Control Plane LCS".

[38]   3GPP TS 29.303: "Domain Name System Procedures; Stage 3".

[39]   3GPP TS 29.060: "General Packet Radio Service (GPRS); GPRS Tunnelling Protocol (GTP) across the Gn and Gp Interface".

[40] 3GPP TS 36.300: "Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Universal Terrestrial Radio Access Network (E-UTRAN); Overall description; Stage 2".

[41] ITU-T Recommendation E.164: "The international public telecommunication numbering plan".

[42] 3GPP TS 22.042: "Network Identity and TimeZone (NITZ); Service description; Stage 1".

[43] 3GPP TS 23.007: "Restoration procedures".

[44] 3GPP TS 23.272: "Circuit Switched (CS) fallback in Evolved Packet System (EPS); Stage 2".

[45] 3GPP TS 29.010: "Information element mapping between Mobile Station - Base Station System (MS - BSS) and Base Station System - Mobile-services Switching Centre (BSS - MSC)".

[46] 3GPP TS 29.118: "Mobility Management Entity (MME) –Visitor Location Register (VLR)SGs interface specification ".

[47] 3GPP TS 29.172: "Evolved Packet Core (EPC) LCS Protocol (ELP) between the Gateway Mobile Location Centre (GMLC) and the Mobile Management Entity (MME)".

[48] 3GPP TS 29.338: "Diameter based protocols to support Short Message Service (SMS) capable Mobile Management Entities (MMEs)".

[49] 3GPP TS 29.344: "Proximity-services (ProSe) Function to Home Subscriber Server (HSS) aspects; Stage 3".

[50] IETF RFC 7683: "Diameter Overload Indication Conveyance".

[51] 3GPP TS 23.380: "IMS Restoration Procedures".

[52] 3GPP TS 22.153: "Multimedia Priority Service".

[53] 3GPP TS 23.221: "Architectural requirements".

[54] 3GPP TS 29.336: "Home Subscriber Server (HSS) diameter interfaces for interworking with packet data networks and applications".

[55] 3GPP TS 23.682: "Architecture enhancements to facilitate communications with packet data networks and applications ".

[56] 3GPP TS 29.217: "Congestion reporting over Np reference point".

[57] IETF RFC 7944: "Diameter Routing Message Priority".

[58] 3GPP TS 43.020: "Security related network functions".

[59] 3GPP TS 29.273: "Evolved Packet System (EPS); 3GPP EPS AAA interfaces".

[60] IETF draft-ietf-dime-load-03: "Diameter Load Information Conveyance".

Editor's note: The above document cannot be formally referenced until it is published as an RFC.

[61] IETF RFC 6733: "Diameter Base Protocol".

[62] 3GPP TS 36.331: "Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification".

[63] 3GPP TS 29.128: "Mobility Management Entity (MME) and Serving GPRS Support Node (SGSN) interfaces for interworking with packet data networks and applications".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in 3GPP TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in 3GPP TR 21.905 [1].

CSG subscription data from CSS: It identifies the CSG subscription data that a MME or a SGSN has received from a CSS for a subscriber identified by its IMSI.

CSG subscription data from HSS: It identifies the CSG subscription data that a MME or a SGSN has received from a HSS for a subscriber identified by its IMSI.

3.2 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [1].

AVP	Attribute Value Pair
C	Conditional
CSS	CSG Subscriber Server
DCN	Dedicated Core Network
DRMP	Diameter Routing Message Priority
DSCP	Differentiated Services Code Point
EIR	Equipment Identity Register
ESM	EPS Session Management
HSS	Home Subscriber Server
IE	Information Element
LAA	Licensed Assisted Access
LWA	LTE/WLAN Aggregation
LWIP	LTE/WLAN Radio Level Integration with IPsec Tunnel
M	Mandatory
MME	Mobility Management Entity
NR	New Radio
O	Optional
ODB	Operator Determined Barring
SCEF	Service Capability Exposure Function
URRP-MME	User Reachability Request Parameter for MME
URPP-SGSN	User Reachability Request Parameter for SGSN

4 General Description

This document describes the S6a/S6d and S13/S13' interfaces related procedures, message parameters and protocol specifications.

The procedures, message parameters and protocol are similar between S6a and S6d. S6a is used for location changes of the MME, while S6d is for location changes of the SGSN. Refer to section 5 for the differences, especially section 5.2.1.

The procedures, message parameters and protocol are identical as for the S13 and S13'. See section 6 for details.

In the tables that describe the Information Elements transported by each Diameter command, each Information Element is marked as (M) Mandatory, (C) Conditional or (O) Optional in the "Cat." column. For the correct handling of the Information Element according to the category type, see the description detailed in section 6 of the 3GPP TS 29.228 [17].

5 MME – HSS (S6a) and SGSN – HSS (S6d)

5.1 Introduction

The S6a interface enables the transfer of subscriber related data between the MME and the HSS as described in the 3GPP TS 23.401 [2].

The S6d interface enables the transfer of subscriber related data between the SGSN and the HSS as described in 3GPP TS 23.060 [12].

5.2 Mobility Services

5.2.1 Location Management Procedures

5.2.1.1 Update Location

5.2.1.1.1 General

The Update Location Procedure shall be used between the MME and the HSS and between the SGSN and the HSS to update location information in the HSS. The procedure shall be invoked by the MME or SGSN and is used:

- to inform the HSS about the identity of the MME or SGSN currently serving the user, and optionally in addition;

- to update MME or SGSN with user subscription data; subscription data that are applicable to MMEs but not to SGSNs should not be sent to the SGSN unless the SGSN is known to be a combined MME/SGSN; similarly subscription data that are applicable to SGSNs but not to MMEs should not be sent to the MME unless the MME is known to be a combined MME/SGSN.

- to provide the HSS with other user data, such as Terminal Information or UE SRVCC Capability.

This procedure is mapped to the commands Update-Location-Request/Answer (ULR/ULA) in the Diameter application specified in chapter 7.

Table 5.2.1.1.1/1 specifies the involved information elements for the request.

Table 5.2.1.1.1/2 specifies the involved information elements for the answer.

Table 5.2.1.1.1/1: Update Location Request

Information element name	Mapping to Diameter AVP	Cat.	Description
IMSI	User-Name (See IETF RFC 6733 [61])	M	This information element shall contain the user IMSI, formatted according to 3GPP TS 23.003 [3], clause 2.2.
Supported Features (See 3GPP TS 29.229 [9])	Supported-Features	O	If present, this information element shall contain the list of features supported by the origin host.
Terminal Information (See 7.3.3)	Terminal-Information	O	This information element shall contain information about the user's mobile equipment. Within this Information Element, only the IMEI and the Software-Version AVPs shall be used on the S6a/S6d interface.
ULR Flags (See 7.3.7)	ULR-Flags	M	This Information Element contains a bit mask. See 7.3.7 for the meaning of the bits.
Visited PLMN Id (See 7.3.9)	Visited-PLMN-Id	M	This IE shall contain the MCC and the MNC, see 3GPP TS 23.003 [3]. It may be used to apply roaming based features.
Equivalent PLMN List (See 7.3.151)	Equivalent-PLMN-List	O	This Information Element shall contain the equivalent PLMN list of which the MME/SGSN requests the corresponding CSG Subscription data.
RAT Type (See 7.3.13)	RAT-Type	M	This Information Element contains the radio access type the UE is using. See section 7.3.13 for details.
SGSN number (See 7.3.102)	SGSN-Number	C	This Information Element contains the ISDN number of the SGSN, see 3GPP TS 23.003 [3]. It shall be present when the message is sent on the S6d interface and the SGSN supports LCS (using MAP based Lg interface) or SMS functionalities or the Gs interface. It may be present when the message is sent on the S6a interface and the requesting node is a combined MME/SGSN.
Homogeneous Support of IMS Voice Over PS Sessions	Homogeneous-Support-of-IMS-Voice-Over-PS-Sessions	O	This Information Element, if present, indicates whether or not "IMS Voice over PS Sessions" is supported homogeneously in all TAs or RAs in the serving node (MME or SGSN or combined MME/SGSN). The value "SUPPORTED" indicates that there is support for "IMS Voice over PS Sessions" in all TAs or RAs. The value "NOT_SUPPORTED" indicates that theres is not support for "IMS Voice over PS Sessions" in any of the TAs or RAs.
V-GMLC address	GMLC-Address	C	This Information Element shall contain, if available, the IPv4 or IPv6 address of the V-GMLC associated with the serving node.
Active APN	Active-APN	O	This Information Element, if present, contains the list of active APNs stored by the MME or SGSN, including the identity of the PDN GW assigned to each APN. For the case of explicitly subscribed APNs, the following information shall be present: - Context-Identifier: context id of subscribed APN in use - Service-Selection: name of subscribed APN in use - MIP6-Agent-Info: including PDN GW identity in use for subscribed APN - Visited-Network-Identifier: identifies the PLMN where the PDN GW was allocated For the case of the Wildcard APN, the following information shall be present: - Context-Identifier: context id of the Wildcard APN - Specific-APN-Info: list of APN-in use and related PDN GW identity when the subscribed APN is the wildcard APN It may be present when MME or SGSN needs to restore PDN GW data in HSS due to a Reset procedure.
UE SRVCC Capability	UE-SRVCC-Capability	C	This information element shall indicate if the UE supports or does not support the SRVCC capability and shall be present if the MME or the SGSN supports SRVCC and this information is available to the MME or the SGSN.
MME Number for MT SMS	MME-Number-for-MT-SMS	C	This Information Element contains the ISDN number of the MME to route SMS to the UE through the MME, see 3GPP TS 23.003 [3]. It shall be present when the MME supports SMS in MME and wishes to

			provide SMS in MME.
SMS Register Request	SMS-Register-Request	C	This information element is used to inform the HSS if the MME or the SGSN needs to be registered for SMS, prefers not to be registered for SMS or has no preference. It shall be present when the MME supports SMS in MME and requests to be registered for SMS. It shall be present when the SGSN supports "SMS in SGSN" as defined in subclause 5.3.18 in 23.060 [12], and requests to be registered for SMS.
SGs MME identity	SGs-MME-Identity	O	This information element is used to inform the HSS of the MME identity that the MME will use over the SGs interface. This information element shall be present, if the MME supports this information element and if the MME identity used over SGs is different from the MME Diameter identity used over S6a.
Coupled node's Diameter identity	Coupled-Node-Diameter-ID	O	This information element contains the Diameter identity of the coupled node (i.e. MME's Diameter identity for the SGSN and SGSN's Diameter identity for the MME) when the message is sent by the combined MME/SGSN. This information element may be present when the message is sent on the S6a/S6d interface and the requesting node is a combined MME/SGSN.
Adjacent PLMNs	Adjacent-PLMNs	O	This information element, if present, shall contain the list of PLMNs where an UE served by the MME/SGSN is likely to make a handover from the PLMN where the MME/SGSN is located. This list is statically configured by the operator in the MME/SGSN, according to the geographical disposition of the different PLMNs in that area, the roaming agreements, etc...
Supported Services (3GPP TS 29.336 [54])	Supported-Services	O	If present, this Information Element shall contain AVPs indicating details of the services supported by the MME/SGSN.

Table 5.2.1.1.1/2: Update Location Answer

Information element name	Mapping to Diameter AVP	Cat.	Description
Supported Features (See 3GPP TS 29.229 [9])	Supported-Features	O	If present, this information element shall contain the list of features supported by the origin host.
Result (See 7.4)	Result-Code / Experimental-Result	M	This IE shall contain the result of the operation. The Result-Code AVP shall be used to indicate success / errors as defined in the Diameter base protocol (see IETF RFC 6733 [61]). The Experimental-Result AVP shall be used for S6a/S6d errors. This is a grouped AVP which shall contain the 3GPP Vendor ID in the Vendor-Id AVP, and the error code in the Experimental-Result-Code AVP. The following errors are applicable: - User Unknown - Unknown EPS Subscription - RAT Not Allowed - Roaming Not Allowed
Error-Diagnostic	Error-Diagnostic	O	If the Experimental Result indicates "Unknown EPS Subscription", Error Diagnostic may be present to indicate whether or not GPRS subscription data are subscribed (i.e. whether or not Network Access Mode stored in the HSS indicates that only circuit service is allowed). If the Experimental Result indicates "Roaming Not Allowed", and the Update Location is rejected due to ODB, Error Diagnostic may be present to indicate the specific type of ODB.
ULA-Flags (See 7.3.8)	ULA-Flags	C	This Information Element contains a bit mask. See 7.3.8 for the meaning of the bits. It shall be present only when the Result-Code AVP is DIAMETER_SUCCESS.
Subscription Data (See 7.3.2)	Subscription-Data	C	This Information Element shall contain the complete subscription profile of the user. It shall be present if success is reported, unless an explicit "skip subscriber data" indication was present in the request.
Reset-IDs (See 7.3.184)	Reset-ID	O	The Reset-ID uniquely identifies a fallible resource in the HSS on which the user (IMSI) depends. In the event of a restart of the fallible resource a Reset message containing the Reset-ID will exactly identify the impacted subscribers.

5.2.1.1.2 Detailed behaviour of the MME and the SGSN

The MME shall make use of this procedure to update the MME identity stored in the HSS (e.g. at initial attach, inter MME tracking area update or radio contact after HSS reset).

The SGSN shall make use of this procedure to update the SGSN identity stored in the HSS (e.g. at initial attach, inter SGSN routing area update or radio contact after HSS reset).

The MME shall make use of this procedure to request SMS data and to become registered for SMS.

The SGSN shall make use of this procedure to request to become registered for SMS.

A combined MME/SGSN which uses different Diameter Identities for the MME and SGSN parts shall not send a second ULR when in a first ULA the ULA-Flag "Separation Indication" was not set.

For UEs receiving emergency services, in which the UE was not successfully authenticated, the MME or SGSN shall not make use of the Update Location procedure.

If the Update Location request is to be sent due to an inter node (SGSN to MME) update and the previous SGSN is a Gn/Gp SGSN, the MME shall set the "Single-Registration-Indication" flag in the ULR-Flags information element in the request.

If the Update Location request is to be sent due to an initial attach, the MME or SGSN shall set the "Initial-Attach-Indicator" flag in the ULR-Flags information element in the request.

When receiving and supporting Reset-ID AVPs in the response, the MME or SGSN shall delete all the stored Reset-IDs, if there are any, and then store all the received Reset-IDs.

A combined MME/SGSN shall set the "Skip Subscriber Data" flag in the ULR-Flags if subscriber data are already available due to a previous location update.

A combined MME/SGSN that has advertised its support for the combined MME/SGSN capability, by either including the SGSN Number within ULR sent over S6a or including the Coupled-Node-Diameter-ID within ULR sent over S6a/S6d or by using same Diameter identity over S6a and S6d interfaces, shall be prepared to receive a single subscription data update message (IDR or DSR) from the HSS when the subscription data is modified.

If the MME or SGSN knows about the homogeneity of the support of IMS Voice over PS Sessions in all TAs or RAs associated to that serving node (i.e., it is supported in all the TA/RAs or it is not supported in any of the TA/RAs), it shall include this indication to the HSS in the "Homogeneous Support of IMS Voice over PS Sessions" IE.

The MME or SGSN may include dynamic APN and PGW ID data in the list of Active-APN AVPs, in order to restore this information in the HSS after a Reset procedure.

The MME/SGSN may include an equivalent PLMN list to request the CSG Subscription data of the equivalent PLMNs.

A standalone MME shall not indicate its support for any SGSN specific features, and it shall not request explicitly the download of GPRS data (via the GPRS-Subscription-Data-Indicator flag; see clause 7.3.7). A standalone MME that does not support the "SMS in MME" feature shall not provide its MME Number for MT SMS, "SMS only" indication or SMS Registration Request and therefore not indicate its support for any SMS related features (such as ODB or barring services).

For an SGSN, if a DIAMETER_ERROR_CAMEL_SUBSCRIPTION_PRESENT is received, the SGSN shall initiate the update location procedure with MAP over Gr interface and use Gr for the subsequent mobility procedures.

For a standalone MME or SGSN, if EPS or GPRS subscription data is received, the standalone MME or SGSN shall replace all of the EPS or GPRS subscription data of the user in the MME or SGSN. Any optional EPS or GPRS data not received, but stored in the standalone MME or SGSN, shall be deleted.

For a combined MME/SGSN, if EPS subscription data of the user is received, it shall replace all of the EPS subscription data of the user. Any optional EPS data not received by the combined MME/SGSN, but stored in the MME/SGSN, shall be deleted.

For a combined MME/SGSN, if GPRS subscription data of the user is received, it shall replace all of the GPRS subscription data of the user. Any optional GPRS data not received by the combined MME/ SGSN, but stored in the MME/SGSN, shall be deleted.

When receiving an Update Location response from the HSS, the MME or SGSN shall check the result code. If it indicates success the MME or SGSN shall store the received subscription profile (if any), and it shall store the HSS identity as received in the Origin-Host AVP.

If an Additional MSISDN (A-MSISDN) is available in the subscription data and downloaded in the A-MSISDN AVP to the MME/SGSN in an Update Location and if the MME or SGSN supports the additional MSISDN feature, the MME or SGSN shall use the Additional MSISDN as C-MSISDN.

For UEs receiving emergency services (i.e. emergency attached UEs or normal attached UEs with a UE Requested PDN Connection for emergency services), and if the MME or SGSN supports emergency services for users in limited service state, the MME or SGSN shall proceed even if the Update Location procedure fails (e.g. authenticated users with roaming restrictions or RAT-Type restrictions in HSS).

When receiving GPRS-Subscription-Data AVP in the response, the SGSN or combined MME/SGSN shall delete all the stored PDP-Contexts, if there are any, and then store all the received PDP-Contexts.

When receiving the APN-Configuration-Profile AVP in a ULA, the MME or SGSN shall delete all the stored APN-Configurations, if there are any, and then store all the received APN-Configurations.

For each of the received APN-Configurations in the APN-Configuration-Profile, if both the MIP6-Agent-Info and the PDN-GW-Allocation-Type AVPs are absent in the APN-Configuration AVP and the MME or SGSN does not have any associated PGW information, the MME or SGSN shall perform the PGW selection (static or dynamic) according to the local configuration. If MIP6-Agent-Info is present, and PDN-GW-Allocation-Type is not present, this means that the PDN GW address included in MIP6-Agent-Info has been statically allocated. If the MIP6-Agent-Info contains an FQDN of the PDN GW, the MME shall retrieve the PGW PLMN ID from the MIP-Home-Agent-Host AVP within the MIP6-Agent-Info AVP.

When receiving an Update Location response from the HSS in the TAU or RAU procedure, for each of the received APN-Configurations in the APN-Configuration-Profile, if both the MIP6-Agent-Info and the PDN-GW-Allocation-Type AVPs are absent in the APN-Configuration AVP and the MME or SGSN has associated PGW information and the UE-level access restriction "HO-To-Non-3GPP-Access Not Allowed" is not set, the MME or SGSN should send a Notify Request if HO to the WLAN is supported in the network, including the APN and PDN GW identity to the HSS in order to restore this information in the HSS e.g. after a Reset procedure.

If the MME/SGSN supports interworking with Gn/Gp-SGSNs, it shall ensure that the Context -Identifier sent over GTPv1 for each of the received APN-Configurations is within the range of 1 and 255.

NOTE 1: If the MME/SGSN receives from HSS a Context-Identifier value higher than 255, how this value is mapped to a value between 1 and 255 is implementation specific.

If the subscriber is not roaming and the SIPTO-Permission information for an APN is present, the MME or SGSN shall allow SIPTO above RAN for that APN only if the SIPTO-Permission information indicates so.

If the subscriber is not roaming and the SIPTO-Permission information for an APN is not present, the MME or SGSN may allow SIPTO above RAN for that APN.

If the subscriber is roaming and the SIPTO-Permission information for an APN is present, the MME or SGSN shall allow SIPTO above RAN for that APN only if the SIPTO-Permission information indicates so and the VPLMN Dynamic Address is allowed and the MME or SGSN selects a PDN GW in the VPLMN.

If the subscriber is roaming and the SIPTO-Permission information for an APN is not present, the MME or SGSN shall not allow SIPTO above RAN for that APN.

NOTE 2: Based on local configuration, the MME or SGSN can determine not to allow SIPTO above RAN for an APN, regardless if the SIPTO-Permission information is present.

If the subscriber is not roaming and the SIPTO-Local-Network-Permission information for an APN is present, the MME or SGSN shall allow SIPTO at the local network for that APN only if the SIPTO-Local-Network-Permission information indicates so.

If the subscriber is not roaming and the SIPTO-Local-Network-Permission information for an APN is not present, the MME or SGSN may allow SIPTO at the local network for that APN.

If the subscriber is roaming and the SIPTO-Local-Network-Permission information for an APN is present, the MME or SGSN shall allow SIPTO at the local network for that APN only if the SIPTO-Local-Network-Permission information indicates so and the VPLMN Dynamic Address is allowed and the MME or SGSN selects a L-GW in the VPLMN.

If the subscriber is roaming and the SIPTO-Local-Network-Permission information for an APN is not present, the MME or SGSN shall not allow SIPTO at the local network for that APN.

> NOTE 3: Based on local configuration, the MME or SGSN can determine not to allow SIPTO at the local network for an APN, regardless if the SIPTO-Local-Network-Permission information is present.

If MPS-Priority AVP is present and the UE is subscribed to the eMLPP or 1x RTT priority service in the CS domain as indicated by the MPS-CS-Priority bit of the AVP, the MME shall allow the UE to initiate the RRC connection with higher priority than other normal UEs during CS Fallback procedure. If the MPS-Priority AVP is present and the UE is subscribed to MPS in the EPS domain as indicated by the MPS-EPS-Priority bit of the AVP, the MME shall allow the UE to initiate the RRC connection with higher priority than other normal UEs.

If the subscriber is not roaming, the MME or SGSN may allow or prohibit the UE to use LIPA as indicated by LIPA-Permission for a specific APN.

If the subscriber is roaming and the VPLMN-LIPA-Allowed AVP indicates that the UE is not allowed to use LIPA in the VPLMN where the UE is attached, the MME or SGSN shall not provide LIPA for the UE and shall not consider the LIPA-Permission AVP. If the VPLMN-LIPA-Allowed AVP indicates that the UE is allowed to use LIPA in the VPLMN, the MME or SGSN may allow or prohibit the UE to use LIPA as indicated by LIPA-Permission for a specific APN. The VPLMN-Dynamic-Address-Allowed AVP shall not be considered if it is received when the MME or SGSN establishes a PDN connection with LIPA.

If the LIPA-Permission information for an APN indicates LIPA only, the MME or SGSN shall only allow LIPA for that APN via the authorized CSGs according to the CSG Subscription Data. If the LIPA-Permission information for an APN indicates LIPA prohibited, the MME or SGSN shall not allow LIPA for that APN. If the LIPA-Permission information for an APN indicates LIPA conditional, the MME or SGSN shall allow non LIPA, and LIPA for that APN via the authorized CSGs according to the CSG Subscription Data. If the LIPA-Permission AVP is not present for a specific APN, the APN shall not be allowed to use LIPA.

The LIPA-Permission information for the Wildcard APN shall apply to any APN that is not explicitly present in the subscription data.

The SIPTO-Permission information for the Wildcard APN shall apply to any APN that is not explicitly present in the subscription data.

The SIPTO-Local-Network-Permission information for the Wildcard APN shall apply to any APN that is not explicitly present in the subscription data.

If the subscription data received for a certain APN indicates that the APN was authorized as a consequence of having the Wildcard APN in the user subscription in HSS, then the MME shall not store this APN data beyond the lifetime of the UE session and the MME shall delete them upon disconnection of the UE.

If the MME supports the Relay Node functionality (see 3GPP TS 36.300 [40]) and the subscription data indicates that the subscriber is not a relay, the MME shall reject the attach request from a device attempting to attach to EPS as a Relay Node. If a device requests to be attached to EPS as an UE, the MME shall proceed with the attach procedure regardless of the content of the Relay Node Indicator.

If trace data are received in the subscriber data, the MME or SGSN shall start a Trace Session. For details, see 3GPP TS 32.422 [23].

If the Ext-PDP-Type AVP is present in the PDP-Context AVP, the SGSN or combined MME/SGSN shall ignore the value of the PDP-Type AVP.

If the subscriber is not roaming and the Subscribed-Periodic-RAU-TAU-Timer information is present, the MME or SGSN shall allocate the subscribed value to the UE as periodic RAU or TAU timer. If the subscriber is roaming and the Subscribed-Periodic-RAU-TAU-Timer information is present, the MME or SGSN may use the subscribed periodic RAU/TAU timer value as an indication to decide for allocating a locally configured periodic RAU/TAU timer value to the UE.

For a combined MME/SGSN, the node may include the Coupled-Node-Diameter-ID AVP to allow the HSS to determine if the UE is served by the MME and SGSN parts of the same combined MME/SGSN. When the message is

sent over S6a interface and if this AVP is included, the MME shall include the Diameter identity of the coupled SGSN which is used by the SGSN over S6d interface. When the message is sent over S6d interface and if this AVP is included, the SGSN shall include the Diameter identity of the coupled MME which is used by the MME over S6a interface.

NOTE 4: The Coupled-Node-Diameter-ID AVP allows the HSS to determine if the UE is served by the MME and SGSN parts of the same combined MME/SGSN, when the SGSN number is not available and when Diameter identity of S6a and S6d interfaces of the combined MME/SGSN are not the same.

If the MME supports the "SMS in MME" feature and the UE has requested a combined EPS/IMSI attach or Combined TA/LA Update (see 3GPP TS 23.272 [44]) and the MME is not currently registered for SMS, the MME requests to be registered for SMS by indicating its MME Number for MT SMS in the request, including the SMS-Register-Request AVP and the SMS-Only-Indication flag set in the ULR-Flags AVP if UE indicates "SMS only".

If the MME supports the "SMS in MME" feature, when receiving an EPS attach or a TAU from a UE accessing NB-IoT which requests SMS by indicating "SMS transfer without Combined Attach" (see 3GPP TS 23.401 [2]), and if the MME is not currently registered for SMS, the MME requests to be registered for SMS by indicating its MME Number for MT SMS in the request, including the SMS-Register-Request AVP.

If the HSS provides the MME with SMS data in the ULA and the ULA-Flags is received with "MME Registered for SMS" flag set, the MME shall store this data for providing SMS in MME service and consider itself registered for SMS.

If the SGSN supports the "SMS in SGSN" feature as specified in 3GPP TS 23.060 [12], clause 5.3.18, and wishes to provide SMS via SGSN it shall set the "SMS in SGSN" flag in the Feature-List AVP, and include SMS-Register-Request AVP. If the SGSN supports the Diameter based Gdd interface for SMS in SGSN, it shall set the "Gdd-in-SGSN" flag in the Feature-List AVP. If the UE has indicated "SMS-Only" this shall be indicated to the HSS setting the SMS-Only–Indication flag in the ULR-Flags AVP.

NOTE 5: the setting of the "SMS in SGSN" feature bit reflects the "SMS in SGSN Offered" as described in stage 2 above.

If the SMS-In-SGSN-Allowed-Indication flag is set in the received Subscription-Data-Flags AVP, the SGSN shall store the subscription data for providing SMS in SGSN service.

If the subscriber is not roaming and the Restoration-Priority information for a certain APN is present, the MME or SGSN shall consider the subscribed value as the relative priority of the user's PDN connection among PDN connections to the same APN when restoring PDN connections affected by an SGW or PGW failure/restart (see 3GPP TS 23.007 [43]). If the subscriber is roaming and the Restoration-Priority information for a certain APN is present, the MME or SGSN may use the subscribed value as an indication of the relative priority of the user's PDN connection among PDN connections to the same APN based on service level agreements. The MME/SGSN may use a locally configured value as default restoration priority if the Restoration-Priority AVP for a certain APN is not present, or if it is not permitted by service level agreements for an in-bound roamer.

If the subscription data received for a certain APN includes WLAN-offloadability AVP, then the MME or SGSN shall determine the offloadability of the UE's PDN Connection(s) to that APN based on subscription data and locally configured policy (e.g. for roaming users or when the subscription data does not include any offloadability indication).

NOTE 6: As indicated in section 7.3.31, if the UE-level access restriction "HO-To-Non-3GPP-Access Not Allowed" is set, the offload of PDN Connections to WLAN is not allowed for any APN.

If the subscription data received for the user includes the DL-Buffering-Suggested-Packet-Count AVP, then the MME or SGSN should take into account the subscription data, in addition to local policies, to determine whether to invoke extended buffering of downlink packets at the SGW for High Latency Communication. Otherwise, the MME or SGSN shall make this determination based on local policies only.

When receiving IMSI-Group-Id AVP(s) within the Subscription-Data AVP, the MME or SGSN shall replace stored IMSI-Group Ids (if any) with the received information rather than add the received information to the stored information.

When receiving a Monitoring-Event-Configuration in the ULA, the MME or SGSN shall start the detection of the Monitoring events indicated in that AVP.

If the MME/SGSN supports Monitoring, the MME/SGSN shall include the Supported-Services AVP with Supported-Monitoring-Events included in the ULR command.

If the MME and the UE support Attach without PDN connection (i.e. EMM-REGISTERED without PDN connection) and the PDN-Connection-Restricted flag is set in the received Subscription-Data-Flags AVP, the MME shall not establish any non-emergency PDN connectionand shall tear down any existing non-emergency PDN connection for this user.

If the subscription data received for the user includes the Preferred-Data-Mode AVP, for an IP APN configuration or for a non-IP APN configuration with SGi based delivery, then the MME should (if the subscriber is not roaming) or may (if the subscriber is roaming) take into account the subscription data, in addition to local policies and the UE's Preferred Network Behaviour, to determine whether to transmit the traffic associated with this APN over the User Plane and/or over the Control Plane.Otherwise, the MME shall make this determination based on local policies and the UE's Preferred Network Behaviour only.

If the MME receives from the HSS an Update Location response containing the Emergency-Info AVP in the Subscription-Data, the MME shall use the PDN-GW identity included in Emergency-Info as the PDN-GW used to establish emergency PDN connections with the emergency APN, for non-roaming authenticated UEs requesting the handover of an emergency PDN connection if the MME is configured to use a dynamic PDN-GW for emergency services for such user.

When receiving V2X-Subscription-Data in the ULA, the MME shall determine whether the UE is authorized to use V2X communication over PC5 according to V2X subscription data and UE provided network capability. If the UE is authorized to use V2X communication over PC5, the MME shall store the "V2X service authorized" indication together with the UE AMBR used for PC5 interface (i.e. UE-PC5-AMBR), and provide such information to the eNodeB when needed.

5.2.1.1.3   Detailed behaviour of the HSS

When receiving an Update Location request the HSS shall check whether subscription data exists for the IMSI.

If the HSS determines that there is not any type of subscription for the IMSI (including EPS, GPRS and CS subscription data), a Result Code of DIAMETER_ERROR_USER_UNKNOWN shall be returned.

If the Update Location Request is received over the S6a interface, and the subscriber has not any APN configuration, the HSS shall return a Result Code of DIAMETER_ERROR_UNKNOWN_EPS_SUBSCRIPTION.

If the Update Location Request is received over S6a, from an MME that does not support the "Non-IP PDN Type APNs" feature, and the user's subscripton profile contains only APN configurations of type "Non-IP", the HSS shall return a Result Code of DIAMETER_ERROR_UNKNOWN_EPS_SUBSCRIPTION.

If the Update Location Request is received over the S6d interface, and the subscriber has neither an APN configuration profile nor GPRS subscription data, the HSS shall return a Result Code of DIAMETER_ERROR_UNKNOWN_EPS_SUBSCRIPTION.

When sending DIAMETER_ERROR_UNKNOWN_EPS_SUBSCRIPTION, an Error Diagnostic information may be added to indicate whether or not GPRS subscription data are subscribed (i.e. whether or not Network Access Mode stored in the HSS indicates that only CS service is allowed).

The HSS shall check whether the RAT type the UE is using is allowed for the subscriber in the serving PLMN. If it is not, a Result Code of DIAMETER_ERROR_RAT_NOT_ALLOWED shall be returned.

The HSS shall check whether roaming is not allowed in the VPLMN due to ODB. If so a Result Code of DIAMETER_ERROR_ROAMING_NOT_ALLOWED shall be returned. When this error is sent due to the MME or SGSN not supporting a certain ODB category, an Error Diagnostic information element may be added to indicate the type of ODB; if this error is sent due to the ODB indicating "Barring of Roaming", Error Diagnostic shall not be included.

If the Update Location Request is received over the S6d interface and the HSS supports the "SGSN CAMEL Capability" feature, and the SGSN indicates support of SGSN CAMEL capability, the HSS shall check if the subscriber has SGSN CAMEL Subscription data. If the subscriber has SGSN CAMEL Subscription data, the HSS shall return a Result Code of DIAMETER_ERROR_CAMEL_SUBSCRIPTION_PRESENT.

If the Update Location Request is received over the S6a interface, the HSS shall send a Cancel Location Request with a Cancellation-Type of MME_UPDATE_PROCEDURE (CLR; see chapter 7.2.7) to the previous MME (if any) and replace the stored MME-Identity with the received value (the MME-Identity is received within the Origin-Host AVP). The HSS shall reset the "UE purged in MME" flag and delete any stored last known MME location information of the

(no longer) purged UE. If the "Single-Registration-Indication" flag was set in the received request, the HSS shall send a Cancel Location Request with a Cancellation-Type of SGSN_UPDATE_PROCEDURE to the SGSN (MAP Cancel Location), and delete the stored SGSN address and SGSN number. If the "Initial-Attach-Indicator" flag was set in the received request, and the "Single-Registration-Indication" flag was not set, the HSS shall send a Cancel Location Request with a Cancellation-Type of INITIAL_ATTACH_PROCEDURE (CLR; see chapter 7.2.7, or MAP Cancel Location) to the SGSN if there is an SGSN registration.

If the Update Location Request is received over the S6d interface, the HSS shall send a Cancel Location Request with a Cancellation-Type of SGSN_UPDATE_PROCEDURE (CLR; see chapter 7.2.7, or MAP Cancel Location) to the previous SGSN (if any) and replace the stored SGSN-Identity with the received value (the SGSN-Identity is received within the Origin-Host AVP). The HSS shall reset the "UE purged in SGSN" flag and delete any stored last known SGSN location information of the (no longer) purged UE. If the "Initial-Attach-Indicator" flag was set in the received request, the HSS shall send a Cancel Location Request with a Cancellation-Type of INITIAL_ATTACH_PROCEDURE (CLR; see chapter 7.2.7) to the MME if there is an MME registration.

When the HSS receives the Update Location Request, if a 15th digit of the IMEI AVP is received, the HSS may discard the digit.

If the Update Location Request includes the list of active APNs, the HSS shall delete all the stored dynamic PDN GW information, if there are any, and then replace them by the PDN GW information received in the list of Active-APN AVPs.

If the Update Location Request includes an equivalent PLMN list, the HSS shall return the CSG list (if any) for each equivalent PLMN to the MME with the subscription data, and Visited-PLMN-Id AVP shall be present in the CSG-Subscription-Data AVP to indicate the corresponding PLMN. If there is no equivalent PLMN list received, the HSS may not include Visited-PLMN-Id AVP in the CSG-Subscription-Data AVP, and the CSG-Subscription-Data AVP shall contain the CSG subscription data of the registered PLMN of the MME or the SGSN.

If the Update Location Request is received over the S6a interface for a user for which the URRP-MME parameter is set in the HSS, the HSS shall clear the URRP-MME parameter and send an indication to the corresponding Service Related Entities.

If the Update Location Request is received over the S6d interface for a user for which the URRP-SGSN parameter is set in the HSS, the HSS shall clear the URRP-SGSN parameter and send an indication to the corresponding Service Related Entities.

If no result code has been sent to the MME or SGSN so far, the HSS shall include the subscription data in the ULA command according to the ULR-Flags and the supported/unsupported features of the MME or SGSN, unless an explicit "skip subscriber data" indication has been received in the request, and shall return a Result Code of DIAMETER_SUCCESS.

When the APN-Configuration-Profile AVP is present in the Subscription-Data AVP sent within a ULA, the AVP shall contain at least the default APN Configuration and a Context-Identifier AVP that identifies the per subscriber's default APN configuration. The default APN Configuration shall not contain the Wildcard APN (see 3GPP TS 23.003 [3], clause 9.2); the default APN shall always contain an explicit APN.

The GPRS Subscription data (if available in the HSS) shall only be present in the ULA command if it was indicated by the serving node in the ULR-Flags AVP (see clause 7.3.7), or when the subscription data is returned by a Pre-Rel-8 HSS (via an IWF) or when the Update Location Request is received over the S6d interface and there is no APN configuration profile stored for the subscriber.

The HSS shall use the indication received in the GPRS-Subscription-Data-Indicator for future use in the subscriber data update procedures.

The HSS shall store the new terminal information and/or the new UE SRVCC capability, if they are present in the request. If the UE SRVCC capability is not present, the HSS shall store that it has no knowledge of the UE SRVCC capability.

If the MME/SGSN indicates support of the Additional-MSISDN feature and an additional MSISDN (A-MSISDN) is available in the subscription data, the HSS shall send the provisioned additional MSISDN together with the MSISDN.

If the MME/SGSN does not support the Additional-MSISDN feature, the HSS shall populate the MSISDN AVP either with the subscribed MSISDN or the subscribed additional MSISDN based on operator policy and availability.

NOTE: When the MME/SGSN does not support the Additional-MSISDN feature, the MME/SGSN will use the MSISDN from the MSISDN AVP as C-MSISDN.

LCS-Info, Teleservice-List and Call-Barring-Info data shall be included according to the list of supported features indicated by the serving node (see clause 7.3.10).

If the HSS supports the "SMS in MME" feature and receives the indication that the MME supports the "SMS in MME" feature and requests to be registered for SMS by including the MME Number for MT SMS, SMS-Register-Request AVP and/or setting the SMS-Only-Indication flag in the ULR-Flags AVP if indicated from the UE, the HSS shall determine if SMS can be provided via the MME as described in 3GPP TS 23.272 [44]. If SMS in MME is accepted the HSS shall register the MME for SMS, store the "MME number for MT SMS" as the corresponding MSC number to be used for MT SMS and return an indication of MME registered for SMS in ULA-Flags AVP.

If the MME is successfully registered for SMS the HSS shall download the available SMS related subscription data that may comprise SMS teleservice, MSISDN, ODB and barring services for SMS according to supported features. Also, if the user is considered as not reachable (i.e., MNRF flag is set in HSS for that user), and the UE is considered to have free available memory (i.e., MCEF flag is not set in HSS for that user), the HSS shall send a MAP-Alert-Service-Centre message or S6c-Alert-Service-Centre-Request to the SMS-IWMSC (see 3GPP TS 29.338 [48]).

If the HSS supports the "SMS in SGSN" feature as described in 3GPP TS 23.060 [12], clause 5.3.18 and receives the indication from the SGSN that it supports "SMS in SGSN" feature, and SMS-Register-Request AVP and/or the SMS-Only-Indication flag in the ULR-Flags AVP if indicated from the UE, and the PS subscriber data allow for SMS services (e.g. the subscription information indicates "PS and SMS-Only"), the HSS shall determine if SMS can be provided via the SGSN as described in 3GPP TS 23.060 [12]. If "SMS in SGSN" is accepted the HSS shall indicate in the ULA that "SMS in SGSN" is allowed to the SGSN and shall handle MT SMS as described in 3GPP TS 23.060 [12], clause 5.3.18. If the HSS supports the "Gdd-in-SGSN" feature and receives the indication from the SGSN that it supports the "Gdd-in-SGSN" feature, the HSS shall store the information that the SGSN supports the Gdd interface. Also, if the user is considered as not reachable (i.e., MNRG flag is set in HSS for that user), and the UE is considered to have free available memory (i.e., MCEF flag is not set in HSS for that user), the HSS shall send a MAP-Alert-Service-Centre message or S6c-Alert-Service-Centre-Request to the SMS-IWMSC (see 3GPP TS 29.338 [48]).

The HSS may use the indication received in the Node-Type-Indicator for future use in the subscriber data update procedures.

Subscriber-Status AVP shall be present in the Subscription-Data AVP when sent within a ULA. If the value "OPERATOR_DETERMINED_BARRING" is sent, the Operator-Determined-Barring AVP or HPLMN-ODB AVP shall also be present in the Subscription-Data AVP, or vice versa.

Access-Restriction-Data AVP shall be present within the Subscription-Data AVP sent within a ULA if at least one of the defined restrictions applies.

The AMBR AVP shall be present in the Subscription-Data AVP when the APN-Configuration-Profile AVP is sent within a ULA (as part of the Subscription-Data AVP) and may be present in the Subscription-Data AVP when the GPRS-Subscription-Data AVP is present.

The EPS-Subscribed-QoS-Profile AVP and the AMBR AVP shall be present in the APN-Configuration AVP when the APN-Configuration AVP is sent in the APN-Configuration-Profile AVP and when the APN-Configuration-Profile AVP is sent within a ULA (as part of the Subscription-Data AVP).

For those APNs that have been authorized as a consequence of having the Wildcard APN in the user subscription, the HSS shall include the specific APN name and associated PDN-GW identity inside the APN context of the Wildcard APN. This indicates to the MME that the particular APN shall not be cached in the MME and it shall be deleted when the UE session is terminated.

If a Result Code of DIAMETER_SUCCESS is returned, the HSS shall set the Separation Indication in the response.

If the HSS receives an indication in the ULR command about the homogeneous support of IMS Voice over PS Sessions in all TA/RAs associated to a serving node, it may use this information in the future in order to skip the T-ADS data retrieval, as described in clause 5.2.2.1 (IDR/IDA commands).

Subscribed-VSRVCC AVP shall be present within the Subscription-Data AVP sent within a ULA only if the user is subscribed to the SRVCC and vSRVCC.

If the UE is allowed to use Proximity-based Services in the visited PLMN, the HSS shall include ProSe-Subscription-Data AVP within the Subscription-Data AVP sent within a ULA.

If the HSS receives the SGs MME identity and if the HSS supports this information element, the HSS shall store it for use with VLR restoration.

If the HSS receives Update Location Request over both the S6a and S6d interfaces then based on the following conditions the HSS concludes if the UE is served by the MME and SGSN parts of the same combined MME/SGSN:

- if both the messages contain the same SGSN number; or

- if the Diameter identity received over S6a matches with the Diameter identity received over S6d; or

- if the Coupled-Node-Diameter-ID AVP received over S6a interface matches with the Diameter identity received within Origin-Host AVP over S6d interface OR if the Coupled-Node-Diameter-ID AVP received over S6d interface matches with the Diameter identity received within Origin-Host AVP over S6a interface.

If the HSS supports the handling of access restrictions for adjacent PLMNs, and it receives a list of adjacent PLMNs from the MME/SGSN, the HSS may send the associated Access Restriction Data, according to local operator policies, in the Adjacent-Access-Restriction-Data AVP, so the MME/SGSN can use this information to allow, or prevent, inter-RAT inter-PLMN handovers towards any of the PLMNs indicated by the HSS. The HSS shall not include in the list of Adjacent-Access-Restriction-Data the PLMN-ID, and its access restrictions, of the current PLMN where the MME/SGSN is located, since this information is already conveyed in the Access-Restriction-Data AVP inside the Subscription-Data AVP.

If the HSS supports Monitoring events and receives a Supported-Services AVP it shall only trigger those services which are supported by the MME/SGSN.

If the HSS has previously received over SWx (see 3GPP TS 29.273 [59]) the identity of the PDN-GW to be used for the establishment of emergency PDN connections, it shall include it as part of the Subscription-Data AVP (in the Emergeny-Info AVP), in the Update Location response to the MME.

If the UE is allowed to use V2X service in the visited PLMN and the MME supports V2X service, the HSS shall include V2X-Subscription-Data AVP into Subscription-Data AVP within the ULA command.

If the MME/SGSN supports the "External-Identifier" feature, the HSS shall include the External-Identifier associated with Monitoring Event Configuration in the External-Identifier AVP if populated in the subscription.

5.2.1.2 Cancel Location

5.2.1.2.1 General

The Cancel Location Procedure shall be used between the HSS and the MME and between the HSS and the SGSN to delete a subscriber record from the MME or SGSN. The procedure shall be invoked by the HSS and is used:

- to inform the MME or SGSN about a subscription withdrawal, or a change in the subscriber profile that does not allow PS services anymore (e.g., the Network Access Mode does not allow PS services), or

- to inform the MME or SGSN about an ongoing update procedure i.e. MME or SGSN change or

- to inform the MME or SGSN about an initial attach procedure.

This procedure is mapped to the commands Cancel-Location-Request/Answer (CLR/CLA) in the Diameter application specified in chapter 7.

Table 5.2.1.2.1/1 specifies the involved information elements for the request.

Table 5.2.1.2.1/2 specifies the involved information elements for the answer.

Table 5.2.1.2.1/1: Cancel Location Request

Information element name	Mapping to Diameter AVP	Cat.	Description
IMSI	User-Name (See IETF RFC 6733 [61])	M	This information element shall contain the user IMSI, formatted according to 3GPP TS 23.003 [3], clause 2.2.
Supported Features (See 3GPP TS 29.229 [9])	Supported-Features	O	If present, this information element shall contain the list of features supported by the origin host.
Cancellation Type (See 7.3.24)	Cancellation-Type	M	Defined values that can be used are: - MME-Update Procedure, - SGSN-Update Procedure, - Subscription Withdrawal, - Update Procedure_IWF, - Initial Attach Procedure.
CLR Flags (See 7.3.152)	CLR-Flags	O	This Information Element contains a bit mask. See 7.3.152 for the meaning of the bits and the condition for each bit to be set or not.

Table 5.2.1.2.1/2: Cancel Location Answer

Information element name	Mapping to Diameter AVP	Cat.	Description
Supported Features (See 3GPP TS 29.229 [9])	Supported-Features	O	If present, this information element shall contain the list of features supported by the origin host.
Result (See 7.4)	Result-Code / Experimental-Result	M	The result of the operation. The Result-Code AVP shall be used to indicate success / errors as defined in the Diameter base protocol (see IETF RFC 6733 [61]).

5.2.1.2.2 Detailed behaviour of the MME and the SGSN

When receiving a Cancel Location request the MME or SGSN shall check whether the IMSI is known.

If it is not known, a result code of DIAMETER_SUCCESS is returned.

If it is known, the MME or SGSN shall check the Cancellation Type and act accordingly.

If the Cancellation Type is "Subscription Withdrawal", the MME or SGSN shall delete the subscription data and detach the UE; in addition, if the Reattach-Required flag is set, the MME or SGSN shall indicate to the UE to initiate an immediate re-attach procedure, as described in 3GPP TS 23.401 [2] and 3GPP TS 23.060 [12]. A result code of DIAMETER_SUCCESS shall be returned.

If a cancellation type of "Initial Attach Procedure" is received, the MME or SGSN shall not delete the subscription data. For details see 3GPP TS 23.401 [2] and 3GPP TS 23.060 [12]. If the MME receives this cancelation type, and it is registered for SMS, it shall consider itself as unregistered for SMS. Also in this case a result code of DIAMETER_SUCCESS shall be returned.

When a UE is served by a single combined MME/SGSN for both E-UTRAN and non-E-UTRAN access, the combined MME/SGSN shall check the Cancellation-Type. If it indicates Subscription Withdrawal or Update Procedure_IWF, the CLR is processed both in the MME part and in the SGSN part of the combined node. If it indicates Initial Attach Procedure, and if the CLR-Flags AVP is received and supported by the combined MME/SGSN, the CLR is processed only in the affected part of the combined node as indicated by the "S6a/S6d-Indicator" flag in the CLR-Flags AVP. Otherwise, the CLR is processed only in the affected part of the combined node and subscription data are kept for the not affected part.

5.2.1.2.3 Detailed behaviour of the HSS

The HSS shall make use of this procedure when the subscription is withdrawn by the HSS operator and when the HSS detects that the UE has moved to a new MME or SGSN area.

The HSS shall include a cancellation type of "Subscription Withdrawal" if the subscription is withdrawn by the operator, or if the subscriber profile does not allow PS services anymore; the HSS may set the Reattach-Required flag in order to request the MME or the SGSN to trigger an immediate reattachment of the UE.

The HSS shall include a cancellation type of "MME Update Procedure" if the UE moved to a new MME area.

The HSS shall include a cancellation type of "SGSN Update Procedure" if the UE moved to a new SGSN area.

The HSS shall include a cancellation type of "Initial Attach Procedure" if the cancel location is initiated due to an Initial Attach from the UE.

The HSS shall include the CLR-Flags with the "S6a/S6d-Indicator" flag indicating the affected part of the combined node if the cancel location is to be sent to a combined MME/SGSN during initial attach procedure.

5.2.1.3 Purge UE

5.2.1.3.1 General

The Purge UE Procedure shall be used between the MME and the HSS and between the SGSN and the HSS to indicate that the subscriber's profile has been deleted from the MME or SGSN either by an MMI interaction or automatically, e.g. because the UE has been inactive for several days.

This procedure is mapped to the commands Purge-UE-Request/Answer (PUR/PUA) in the Diameter application specified in chapter 7.

Table 5.2.1.3.1/1 specifies the involved information elements for the request.

Table 5.2.1.3.1/2 specifies the involved information elements for the answer.

Table 5.2.1.3.1/1: Purge UE Request

Information element name	Mapping to Diameter AVP	Cat.	Description
IMSI	User-Name (See IETF RFC 6733 [61])	M	This information element shall contain user IMSI, formatted according to 3GPP TS 23.003 [3], clause 2.2.
Supported Features (See 3GPP TS 29.229 [9])	Supported-Features	O	If present, this information element shall contain the list of features supported by the origin host.
PUR-Flags (See 7.3.149)	PUR-Flags	O	If present, this Information Element shall contain a bitmask. See section 7.3.149 for the meaning of the bits.
EPS-Location-Information (See 7.3.111)	EPS-Location-Information	C	This Information Element shall contain the last known EPS-Location Information of the purged UE. Shall be present if available.

Table 5.2.1.3.1/2: Purge UE Answer

Information element name	Mapping to Diameter AVP	Cat.	Description
Supported Features (See 3GPP TS 29.229 [9])	Supported-Features	O	If present, this information element shall contain the list of features supported by the origin host.
Result (See 7.4)	Result-Code / Experimental-Result	M	This IE shall contain the result of the operation. The Result-Code AVP shall be used to indication success / errors as defined in the Diameter base protocol (see IETF RFC 6733 [61]). The Experimental-Result AVP shall be used for S6a/S6d errors. This is a grouped AVP which shall contain the 3GPP Vendor ID in the Vendor-Id AVP, and the error code in the Experimental-Result-Code AVP. The following errors are applicable: - User Unknown
PUA-Flags (See 7.3.48)	PUA-Flags	C	This Information Element shall contain a bit mask. See section 7.3.48 for the meaning of the bits. It shall be present only when the Result-Code AVP is DIAMETER_SUCCESS.

5.2.1.3.2 Detailed behaviour of the MME and the SGSN

The MME shall make use of this procedure to set the "UE Purged in the MME" flag in the HSS when the subscription profile is deleted from the MME database due to MMI interaction or after long UE inactivity.

The SGSN shall make use of this procedure to set the "UE Purged in SGSN" flag in the HSS when the subscription profile is deleted from the SGSN database due to MMI interaction or after long UE inactivity.

The combined MME/SGSN when using a single Origin-Host identity shall make use of this procedure to set the "UE Purged in MME" and "UE Purged in SGSN" flags in the HSS when the subscription profile is deleted from the common MME/SGSN database due to MMI interaction or after long UE inactivity on all registered accesses. If the HSS has indicated support for the Partial Purge feature (see clause 7.3.10), the combined MME/SGSN may also indicate to the HSS a Purge of the UE in only one of the serving nodes in the combined node (either in the MME or in the SGSN).

The combined MME/SGSN when using different Origin-Host identities for MME and SGSN shall send two Purge UE Requests as if it was not combined.

When receiving a Purge UE response from the HSS the MME shall check the Result Code. If it indicates success, the MME shall check the PUA flag "freeze M-TMSI", and if set freeze the M-TMSI i.e. block it for immediate re-use.

When receiving a Purge UE response from the HSS the SGSN shall check the Result Code. If it indicates success, the SGSN shall check the PUA flag "freeze P-TMSI", and if set freeze the P-TMSI i.e. block it for immediate re-use.

When receiving a Purge UE response from the HSS the combined MME/SGSN shall check the Result Code. If it indicates success, the combined MME/SGSN shall check the PUA flag "freeze M-TMSI" and "freeze P-TMSI", and if set freeze the M-TMSI and/or the P-TMSI i.e. block it for immediate re-use.

5.2.1.3.3 Detailed behaviour of HSS

When receiving a Purge UE request the HSS shall check whether the IMSI is known.

If it is not known, a result code of DIAMETER_ERROR_USER_UNKNOWN shall be returned.

If it is known, the HSS shall set the result code to DIAMETER_SUCCESS and compare the received identity in the Origin-Host with the stored MME-Identity and with the stored SGSN-Identity.

If the received identity matches the stored MME-identity and the stored SGSN-Identity (no matter whether the node type indicator bit in ULR-Flags was set or clear), then:

- if the HSS supports the Partial Purge feature (see clause 7.3.10), and the combined MME/SGSN indicated that the UE was purged in only one of the serving nodes, the HSS shall set the PUA flags according to the serving node where the purge was done (i.e., either "freeze M-TMSI" if the purge was done in the MME, or "freeze P-TMSI" if the purge was done in the SGSN); similarly, the HSS shall either set the "UE purged in MME" flag and

store the received last known MME Location information of the purged UE, or set the "UE purged in SGSN" flag and store the received last known SGSN-Location Information of the purged UE, accordingly;

- if the HSS does not support the Partial Purge feature, or the combined MME/SGSN did not indicate that the UE was purged in only one of the serving nodes, the HSS shall set the PUA flags "freeze M-TMSI" and "freeze P-TMSI" in the answer message and set the flag "UE purged in MME" and "UE purged in SGSN" and store the received last known EPS Location Information of the purged UE;

If the received identity matches the stored MME-identity but not the stored SGSN-identity, the HSS shall set the PUA flag "freeze M-TMSI" and clear the PUA flag "freeze P-TMSI" in the answer message, set the flag "UE purged in MME" and store the received last known MME location information of the purged UE;

If the received identity matches the stored SGSN-identity but not the stored MME-identity, the HSS shall set the PUA flag "freeze P-TMSI" and clear the PUA flag "freeze M-TMSI" in the answer message and set the flag "UE purged in SGSN" and store the received last known SGSN location information of the purged UE;

If the received identity does not match the stored MME-identity and does not match the stored SGSN-identity, the HSS shall clear the PUA flags "freeze M-TMSI" and "freeze P-TMSI in the answer message.

5.2.2 Subscriber Data Handling Procedures

5.2.2.1 Insert Subscriber Data

5.2.2.1.1 General

The Insert Subscriber Data Procedure shall be used between the HSS and the MME and between the HSS and the SGSN for updating and/or requesting certain user data in the MME or SGSN in the following situations:

- due to administrative changes of the user data in the HSS and the user is now located in an MME or SGSN, i.e. if the user was given a subscription and the subscription has changed; subscription data that are applicable to MMEs but not to SGSNs should not be sent to the SGSN unless the SGSN is known to be a combined MME/SGSN; similarly subscription data that are applicable to SGSNs but not to MMEs should not be sent to the MME unless the MME is known to be a combined MME/SGSN.

- the operator has applied, changed or removed Operator Determined Barring for this user;

- activate subscriber tracing in the MME or the SGSN;

- to indicate to the MME or SGSN that the HSS has requested to be notified when the UE has become reachable;

- to request from the MME or SGSN the necessary data to support the T-ADS functionality;

- to retrieve location information and/or state information from the MME or the SGSN;

- to retrieve from the MME or the SGSN the Local Time Zone of the location in the visited network where the UE is attached;

- to update the STN-SR (e.g., as a result of an Sh interaction with an SCC-AS).

- to update the MME/SGSN with the identity of a dynamically allocated PDN GW as a result of the first PDN connection establishment associated with an APN over non 3GPP access.

- to update the MME with the identity of a PDN GW for Emergency Services as a result of the PDN connection establishment for Emergency Services over non 3GPP access.

- to indicate to the MME that the HSS has deregistered the MME for SMS.

- to indicate to the MME/SGSN that the HSS-based P-CSCF restoration procedure, as described in 3GPP TS 23.380 [51] subclause 5.4, shall be executed.

- to request the MME or the SGSN to configure and report the detection of Monitoring events, or delete stored Monitoring events configuration.

- to update the MME with the O&M configured desired Active Time for power saving mode (PSM), or with the value received from the SCEF if Active Time is provided as part of the Suggested-Network-Configuration AVP.

If the HSS knows that the UE has attached to the MME and SGSN parts of the same combined MME/SGSN via both the E-UTRAN and UTRAN/GERAN (refer to clause 5.2.1.1.2, 5.2.1.1.3 for further details), the HSS should invoke this procedure for a single time to update and/or request certain user data in the combined MME/SGSN, i.e. the HSS should not invoke this procedure for each of the MME and the SGSN registered respectively.

If the Node-Type-Indicator information has been previously received as cleared in the ULR-Flags and if the MME has not been registered for SMS during update location procedure for the MME, the HSS may skip any change of the SMS related subscription data and consequently does not have to make use of the Insert Subscriber Data procedure to update the SMS subscription data in the MME.

This procedure is mapped to the commands Insert Subscriber Data-Request/Answer (IDR/IDA) in the Diameter application specified in clause 7.

Table 5.2.2.1.1/1 specifies the involved information elements for the request.

Table 5.2.2.1.1/2 specifies the involved information elements for the answer.

Table 5.2.2.1.1/1: Insert Subscriber Data Request

Information element name	Mapping to Diameter AVP	Cat.	Description
IMSI	User-Name (See IETF RFC 6733 [61])	M	This information element shall contain the user IMSI, formatted according to 3GPP TS 23.003 [3], clause 2.2.
Supported Features (See 3GPP TS 29.229 [9])	Supported-Features	O	If present, this information element shall contain the list of features supported by the origin host.
Subscription Data (See 7.3.2)	Subscription-Data	M	This Information Element shall contain the part of the subscription profile that either is to be added to the subscription profile stored in the MME or SGSN or is replacing a part of the subscription profile stored in the MME or SGSN.
IDR Flags (See 7.3.103)	IDR-Flags	C	This Information Element shall contain a bit mask. See 7.3.103 for the meaning of the bits.
Reset-IDs (See 7.3.184)	Reset-ID	O	The Reset-ID uniquely identifies a fallible resource in the HSS on which the user (IMSI) depends. In the event of a restart of the fallible resource a Reset message containing the Reset-ID will exactly identify the impacted subscribers.

Table 5.2.2.1.1/2: Insert Subscriber Data Answer

Information element name	Mapping to Diameter AVP	Cat.	Description
Supported Features (See 3GPP TS 29.229 [9])	Supported-Features	O	If present, this information element shall contain the list of features supported by the origin host.
Result (See 7.4)	Result-Code / Experimental-Result	M	This IE shall contain the result of the operation. Result-Code AVP shall be used to indicate success / errors defined in the Diameter base protocol (see IETF RFC 6733 [61]). The Experimental-Result AVP shall be used for S6a/S6d errors. This is a grouped AVP which shall contain the 3GPP Vendor ID in the Vendor-Id AVP, and the error code in the Experimental-Result-Code AVP. The following errors are applicable in this case: - User Unknown
IMS Voice over PS Sessions Supported (See 7.3.106)	IMS-Voice-Over-PS-Sessions-Supported	C	If available to the serving node, this information element shall indicate whether or not "IMS Voice over PS Sessions" is supported by the UE's most recently used TA or RA in the serving node (MME or SGSN or combined MME/SGSN). If the UE is in detached state, this information element shall not be included in the response.
Last UE Activity Time (See 7.3.108)	Last-UE-Activity-Time	C	If available to the serving node, this information element shall contain the time of the last radio contact with the UE. If the UE is in detached state, this information element shall not be included in the response.
RAT Type (See 7.3.13)	RAT-Type	C	If available to the serving node, this information element shall indicate the RAT Type of the access where the UE was present at the time of the last radio contact. If the UE is in detached state, this information element shall not be included in the response.
IDA-Flags (See 7.3.47)	IDA-Flags	C	This Information Element shall contain a bit mask. See 7.3.47 for the meaning of the bits.
EPS-User-State (See 7.3.110)	EPS-User-State	C	This Information Element shall contain the EPS-User State. It shall be present if EPS user state was requested within IDR.
EPS-Location-Information (See 7.3.111)	EPS-Location-Information	C	This Information Element shall contain the EPS-Location Information. It shall be present if EPS location information was requested within IDR.
Local Time Zone (See 7.3.156)	Local-Time-Zone	C	This Information Element shall contain information on the Local Time Zone of the location in the visited network where the UE is attached. It shall be present if the Local Time Zone was requested within IDR.
Monitoring Event Report	Monitoring-Event-Report	C	This Information Element shall contain the report of Monitoring event. It shall be present if Monitoring event configuration is included within IDR and any of the requested Monitoring events are available to be reported.
Monitoring Event Config Status	Monitoring-Event-Config-Status	C	This Information Element shall be present if Monitoring event configuration is included in IDR. It shall contain all the configuration status for each Monitoring event that was requested.
Supported Services (3GPP TS 29.336 [54])	Supported-Services	O	If present, this Information Element shall contain AVPs indicating details of the services supported by the MME/SGSN.

5.2.2.1.2 Detailed behaviour of the MME and the SGSN

When receiving an Insert Subscriber Data request the MME or SGSN shall check whether the IMSI is known.

If it is not known, a result code of DIAMETER_ERROR_USER_UNKNOWN shall be returned.

If it is known, the MME or SGSN shall replace the specific part of the stored subscription data with the received data, or shall add the received data to the stored data.

When receiving the APN-Configuration-Profile AVP within the Subscription-Data AVP, the MME or SGSN shall check the All-APN-Configurations-Included-Indicator value. If it indicates "All_APN_CONFIGURATIONS_INCLUDED", the MME or SGSN shall delete all stored APN-Configurations and then store all received APN-Configurations. Otherwise, the MME or SGSN shall check the Context-Identifier value of each received APN-Configuration. If the Context-Identifier of a received APN-Configuration matches a Context-

Identifier of a stored APN-Configuration, the MME or SGSN shall replace the stored APN-Configuration with the received APN-Configuration. If the Context-Identifier of a received APN-Configuration does not match a Context-Identifier of a stored APN-Configuration, the MME or SGSN shall add the received APN-Configuration to the stored APN-Configurations. If the addition or update of the subscription data succeeds in the MME or SGSN, the Result-Code shall be set to DIAMETER_SUCCESS. The MME or SGSN shall then acknowledge the Insert Subscriber Data message by returning an Insert Subscriber Data Answer.

For each of the received APN-Configurations in the APN-Configuration-Profile, if both the MIP6-Agent-Info and the PDN-GW-Allocation-Type AVPs are absent in the APN-Configuration AVP, the MME or SGSN shall perform the PGW selection (static or dynamic) according to the local configuration. If MIP6-Agent-Info is present, and PDN-GW-Allocation-Type is not present, this means that the PDN GW address included in MIP6-Agent-Info has been statically allocated.

If the MME/SGSN supports interworking with Gn/Gp-SGSNs, it shall ensure that the context identifier sent over GTPv1 for each of the received APN-Configurations is within the range of 1 and 255.

NOTE 1: If the MME/SGSN receives from HSS a Contex-Identifier value higher than 255, how this value is mapped to a value between 1 and 255 is implementation specific.

If the MME is requested to notify the HSS when the UE becomes reachable, the MME shall set the URRP-MME parameter to indicate the need to inform the HSS about UE reachability, e.g. when the next NAS activity from the UE is detected. If the SGSN is requested to notify the HSS when the UE becomes reachable, the SGSN shall set the URRP-SGSN parameter to indicate the need to inform the HSS about UE reachability, e.g. when the next NAS activity from the UE is detected.

When receiving GPRS-Subscription-Data AVP within the Subscription-Data AVP, the SGSN or combined MME/SGSN shall check the Complete-Data-List-Included-Indicator value. If it indicates "All_PDP_CONTEXTS_INCLUDED", the SGSN or combined MME/SGSN shall delete all stored PDP-Contexts and then store all received PDP-Contexts. Otherwise, the SGSN or combined MME/SGSN shall check the Context-Identifier value of each received PDP-Context. If the Context-Identifier of a received PDP-Context matches a Context-Identifier of a stored PDP-Context, the SGSN or combined MME/SGSN shall replace the stored PDP-Context with the received PDP-Context. If the Context-Identifier of a received PDP-Context does not match a Context-Identifier of a stored PDP-Context, the SGSN or combined MME/SGSN shall add the received PDP-Context to the stored PDP-Contexts.

If the MME or SGSN receives an empty Subscription-Data AVP, it shall take no action with regard to the stored subscription data.

When receiving HPLMN-ODB AVP within the Subscription-Data AVP, the MME or SGSN shall replace stored HPLMN-ODB data (if any) with the received information rather than add the received information to the stored information. Unsupported Barring categories need not be stored.

When receiving Operator-Determined-Barring AVP within the Subscription-Data AVP, the MME or SGSN shall replace stored ODB subscription information (if any) with the received information rather than add the received information to the stored information. Unsupported Barring categories need not be stored.

When receiving Access-Restriction-Data or Adjacent-Access-Restriction-Data AVPs within the Subscription-Data AVP, the MME or SGSN shall replace the corresponding stored information (if any) with the new received information, rather than adding received information to stored information. The handling of access restrictions per-PLMN is defined in 3GPP TS 23.221 [53], clause 6.3.5a and in 3GPP TS 23.401 [2] clause 4.3.28.

When receiving APN-OI-Replacement AVP within the Subscription-Data AVP, the MME or SGSN shall replace the stored information (if any) with the received information.

When receiving Regional-Subscription-Zone-Code AVP within the Subscription-Data AVP, the MME or SGSN shall replace stored Zone Codes (if any) with the received information rather than add the received information to the stored information. MMEs and SGSNs that do not support regional subscription need not store zone codes. If due to regional subscription restrictions or access restrictions the entire SGSN area is restricted, SGSN shall report it to the HSS by returning the "SGSN Area Restricted" indication within the IDA flags.

When receiving CSG-Subscription-Data AVPs within the Subscription-Data AVP the MME or SGSN shall replace all stored information from previously received CSG-Subscription-Data AVPs (if any) with the received information rather than add the received information to the stored information.

When receiving Teleservice-List AVP, Call-Barring-Info, or LCS-Info AVP, the MME or SGSN shall replace stored information (if any) with the received information rather than add the received information to the stored information.

When receiving ProSe-Subscription-Data AVP, the MME or combined MME/SGSN shall replace stored information (if any) with the received information rather than add the received information to the stored information.

When receiving and supporting Reset-ID AVPs within the request, the MME or SGSN shall replace stored information (if any) with received information rather than add received information to stored information.

When receiving the IDR-Flags with the "T-ADS Data Request" bit set, and the UE is in attached state, the MME or SGSN or combined MME/SGSN shall return in the IDA message the time stamp of the UE's most recent radio contact and the associated RAT Type, and an indication of whether or not IMS Voice over PS is supported in the current (and most recently used) TA or RA. If the UE is in detached state, the MME or SGSN or combined MME/SGSN shall answer successfully to the T-ADS request from HSS, but it shall not include any of the T-ADS IEs in the response (IMS Voice over PS Sessions Supported, RAT Type and Last UE Activity Time).

When receiving the IDR-Flags with the "EPS User State Request" bit and/or "EPS Location Information Request" bits set the MME or SGSN shall return the corresponding user information to the HSS. If the serving node is a combined MME/SGSN, and the UE is attached via both E-UTRAN and UTRAN/GERAN on the same node, the combined MME/SGSN shall provide the corresponding user information relevant for both MME and SGSN. If the Current Location Request bit was also set and the UE is in idle mode and is expected to be reachable even when it uses a power saving feature (e.g. extended idle mode DRX or PSM as defined in 3GPP TS 23.685 [55]), then the MME or SGSN or combined MME/SGSN shall page the UE in order to return the most up-to-date corresponding user information. If the Current Location Request bit was also set and either paging is unsuccessful or the UE is not expected to be reachable, then the last known location of the UE shall be returned to the HSS. If the Current Location Request bit was also set and the UE (attached via E-UTRAN) is in connected mode, then the MME or combined MME/SGSN shall use S1AP Location Reporting Control procedure towards the eNB prior to reporting the E-UTRAN Cell Global Identification in order to return the UE's most up-to-date cell information. When the location is returned to the HSS, the MME or the combined MME/SGSN shall provide the age of location information if stored in the MME or the combined MME/SGSN or received from eNB.

When receiving the IDR-Flags with only the "Current Location Request" bit set (i.e. the "EPS Location Information Request" bit is not set), the MME or SGSN or combined MME/SGSN shall set the Result-Code to DIAMETER_UNABLE_TO_COMPLY.

If the "Local Time Zone Request" bit was set the MME or SGSN if supported shall provide the Local Time Zone corresponding to the location (e.g. TAI or RAI) of the UE to the HSS.

If the MME or SGSN cannot fulfil the received request, e.g. due to a database error or any of the required actions cannot be performed, it shall set the Result-Code to DIAMETER_UNABLE_TO_COMPLY. If subscription data are received, the MME or SGSN shall mark the subscription record "Subscriber to be restored in HSS".

If trace data are received in the subscriber data, the MME or SGSN shall start a Trace Session. For details, see 3GPP TS 32.422 [23].

If the Ext-PDP-Type AVP is present in the PDP-Context AVP, the SGSN or combined MME/SGSN shall ignore the value of the PDP-Type AVP.

When receiving the IDR-Flags with the bit "Remove SMS Registration" set, the MME shall consider itself unregistered for SMS.

If the subscription data received for a certain APN includes WLAN-offloadability AVP, then the MME or SGSN shall determine the offloadability of the UE's PDN Connection(s) to that APN based on subscription data and locally configured policy (e.g. for roaming users or when the subscription data does not include any offloadability indication).

> NOTE 2: As indicated in section 7.3.31, if the UE-level access restriction "HO-To-Non-3GPP-Access Not Allowed" is set, the offload of PDN Connections to WLAN is not allowed for any APN.

When receiving the IDR-Flags with the "P-CSCF Restoration Request" bit set, the MME or SGSN or combined MME/SGSN shall execute the procedures for HSS-based P-CSCF Restoration, as described in 3GPP TS 23.380 [51] subclause 5.4.

If the subscription data received for the user includes the DL-Buffering-Suggested-Packet-Count AVP, then the MME or SGSN should take into account the subscription data, in addition to local policies, to determine whether to invoke

extended buffering of downlink packets at the SGW for High Latency Communication. Otherwise, the MME or SGSN shall make this determination based on local policies only.

When receiving IMSI-Group-Id AVP(s) within the Subscription-Data AVP, the MME or SGSN shall replace stored IMSI-Group Ids (if any) with the received information rather than add the received information to the stored information.

When receiving a Monitoring-Event-Configuration in the IDR:

- if the SCEF-Reference-ID-for-Deletion is present in the IDR, the MME or SGSN shall stop the detection of the Monitoring event related to the SCEF-Reference-ID-for-Deletion and SCEF-ID pair, and shall delete the corresponding Monitoring event configuration data;

- if the SCEF-Reference-ID is present in the IDR but not stored in the MME or SGSN, the MME or SGSN shall store the received Monitoring event configuration data related to the SCEF-Reference-ID and SCEF-ID pair, and shall start the detection for the specified Monitoring event(s).

- if the SCEF-Reference-ID is present in the IDR and stored in the MME or SGSN, the MME or SGSN shall replace the stored Monitoring event configuration data related to the SCEF-Reference-ID and SCEF-ID pair with the received information.

NOTE 3: In roaming scenarios the MME/SGSN can reply immediately to the HSS without waiting for the outcome of the interaction with the IWK-SCEF.

For the monitoring event configurations for which the configuration status have changed since the last status informed to the HSS, the MME/SGSN shall notify the HSS about the outcome of the interaction with the IWK-SCEF as specified in sub-clause 5.2.5.1.2.

If the HSS indicates the support of Monitoring event feature to the MME/SGSN and the MME/SGSN supports Monitoring, the MME/SGSN shall include the Supported-Services AVP with Supported-Monitoring-Event included in the IDA command.

When receiving the Maximum-Response-Time in Monitoring-Event-Configuration in IDR, the MME shall use the Maximum-Response-Time as the Active Time for the usage of PSM in UE. If not, when the MME receives the Active-Time in subscription data, the MME shall use the Active-Time as the Active Time for the usage of PSM in UE.

When receiving AESE-Communication-Pattern AVP(s) within the Subscription-Data AVP with an SCEF-Reference ID for which the MME has already stored data, it shall delete the stored data (CP set(s)) and store the received ones.

When receiving AESE-Communication-Pattern AVP(s) within the Subscription-Data AVP with one or more SCEF-Reference ID for deletion the MME shall delete the data related to the indicated SCEF-Reference ID.

If the MME and the UE support an Attach without PDN connection (i.e. EMM-REGISTERED without PDN connection) and the PDN-Connection-Restricted flag is set in the received Subscription-Data-Flags AVP, the MME shall not establish any non-emergency PDN connection and shall tear down any existing non-emergency PDN connection for this user.

If the subscription data received for the user includes the Preferred-Data-Mode AVP, for an IP APN configuration or for a non-IP APN configuration with SGi based delivery, then the MME should (if the subscriber is not roaming) or may (if the subscriber is roaming) take into account the subscription data, in addition to local policies and the UE's Preferred Network Behaviour, to determine whether to transmit the traffic associated with this APN over the User Plane and/or over the Control Plane. Otherwise, the MME shall make this determination based on local policies and the UE's Preferred Network Behaviour only.

If the MME subscription data received for the user includes the Emergency-Info AVP, the MME shall use the PDN-GW identity contained in such AVP as the PDN-GW used to establish emergency PDN connections with the emergency APN, for non-roaming authenticated UEs requesting the handover of an emergency PDN connection if the MME is configured to use a dynamic PDN-GW for emergency services for such user.

When receiving V2X-Subscription-Data in the IDR, the MME shall determine whether the UE is authorized to use V2X communication over PC5 according to V2X subscription data and UE provided network capability. If the UE is authorized to use V2X communication over PC5, the MME shall store the "V2X service authorized" indication together with the UE AMBR used for PC5 interface (i.e. UE-PC5-AMBR), and provide such information to the eNodeB when needed.

5.2.2.1.3 Detailed behaviour of HSS

The HSS shall make use of this procedure to replace a specific part of the user data stored in the MME or SGSN with the data sent, or to add a specific part of user data to the data stored in the MME or SGSN. The HSS shall also make use of this procedure to indicate to the MME that it is no longer registered for SMS.

> NOTE: When a Cancel Location message is required for other reasons, the use of IDR to indicate that the MME is no longer registered for SMS is not needed (see clause 5.2.1.2).

Subscriber-Status AVP shall be present in the Subscription-Data AVP, sent within IDR, if the current value in the MME or SGSN needs to be changed. To remove all Operator Determined Barring Categories the Subscriber-Status shall be set to "SERVICE_GRANTED". If Subscriber-Status AVP is present and set to OPERATOR_DETERMINED_BARRING, the Operator-Determined-Barring AVP or HPLMN-ODB AVP shall also be present in the Subscription-Data AVP.

Access-Restriction-Data AVP shall be present within the Subscription-Data AVP send within an IDR if the information stored in the MME or SGSN needs to be modified.

APN-OI-Replacement AVP shall be present in the Subscription-Data AVP sent within an IDR, if the UE level APN-OI-Replacement has been added or modified in the HSS.

The APN-Configuration-Profile AVP shall be present in the Subscription-Data AVP sent within an IDR if the Context-Identifier associated with the default APN configuration is changed or at least one APN-Configuration is added or modified by the HSS. If the default APN is changed in the HSS, the APN-Configuration-Profile AVP shall contain the Context-Identifier associated with the default APN and the APN-Configuration AVP for the default APN. The default APN Configuration shall not contain the Wildcard APN (see 3GPP TS 23.003 [3], clause 9.2); the default APN shall always contain an explicit APN.

The EPS-Subscribed-QoS-Profile AVP and the AMBR AVP shall be present in the APN-Configuration AVP when the APN-Configuration AVP is sent in the APN-Configuration-Profile AVP and when the APN-Configuration-Profile AVP is sent within a IDR (as part of the Subscription-Data AVP).

If the GPRS-Subscription-Data-Indicator information has been previously received as set in the ULR-Flags during update location procedure for the SGSN or combined MME/SGSN, the HSS shall make use of this procedure to replace the GPRS Subscription Data stored in the SGSN or combined MME/SGSN with the data sent or to add a PDP-Context to the data stored in the SGSN or combined MME/SGSN.

ProSe-Subscription-Data AVP shall be present in the Subscription-Data AVP sent within an IDR, if the ProSe Subscription data has been added or modified in the HSS.

If the HSS receives a message (e.g. via MAP ATM or Sh Sh-Subs-Notif) from a Service Related Entity (e.g. IP-SM-GW) indicating that the UE is unreachable,

- the HSS shall associate the subscription to UE reachability of the service-related entity to the URRP-MME and the URRP-SGSN parameters (if not already done)

- and if the URRP-MME and/or the URRP-SGSN parameters were not already set (i.e. at least one service-related entity already listed as subscribed), the HSS shall

  - set the URRP-MME and/or URRP-SGSN parameters and

  - send an IDR command to the registered MME and/or to the registered SGSN including the "UE Reachability Request flag" in the IDR Request Flags in order to request the MME and/or SGSN to notify the HSS when the UE becomes reachable again, unless the HSS knows from the previous ULR command that the registered MME and/or the registerd SGSN do not support UE reachability notifications.

If the IDR is sent for the only purpose to request the MME and/or SGSN about the UE reachability status notification, the Subscription-Data AVP shall be included empty.

If the HSS has received a message from a service related entity requesting EPS User State and/or EPS Location Information without the Serving Node Indication IE, the HSS shall set the "EPS User State Request" bit and/or "EPS Location Information Request" bit respectively in the IDR-Flags. The HSS may optionally also set the "Current Location Request" bit along with the "EPS Location Information Request" bit in the IDR-Flags, if the most up-to-date set of information is needed, unless the HSS knows from the previous ULR command that the registered MME and/or the registered SGSN do not support State/Location Information retrieval. If the IDR is sent only for the purpose of

requesting the MME or the SGSN User State or Location Information, the Subscription-Data AVP included shall be empty.

If the HSS cannot request EPS Location Information from the MME/SGSN e.g. because the UE is purged from the MME/SGSN, the HSS may make use of stored EPS Location information received in a previous IDA or PUR message.

If the HSS has received a message from an AS requesting the current access network's support status of "IMS Voice over PS Sessions", and there is no indication about homogeneous support of IMS Voice over PS Sessions in all the serving nodes currently registered in HSS for the UE, the HSS shall set the "T-ADS Data Request flag" in the IDR Request Flags, unless the HSS knows from the previous ULR command that the registered MME and/or the registered SGSN do not support T-ADS data retrieval. If the IDR is sent for the only purpose to retrieve the "IMS Voice over PS Sessions Supported" indication from the MME or SGSN, the Subscription-Data AVP included shall be empty.

If the HSS has received a message from an AS requesting the Local Time Zone, the HSS shall set the " Local Time Zone Request" bit in the IDR-Flags, unless the HSS knows from the previous ULR command that the registered MME and/or the registered SGSN do not support Local Time Zone retrieval. If the IDR is sent only for the purpose of requesting the Local Time Zone, the Subscription-Data AVP included shall be empty.

If the HSS received an indication in a former ULR command from the MME or SGSN about homogeneous support of IMS Voice over PS Sessions in all TA/RAs associated to that serving node, it may use this information to skip the retrieval of T-ADS data. This can only be done if all the registered serving nodes in HSS for the UE indicated in ULR the same type of homogeneous support (i.e. both serving nodes indicated "SUPPORTED", or both serving nodes indicated "NOT_SUPPORTED"); otherwise, the retrieval of T-ADS data shall be done, to receive the time of the last radio contact with the UE.

All APN and PGW-ID pairs stored in the HSS not associated with an explicit APN subscription, (i.e. the access to that APN has been authorized as a consequence of having the Wildcard APN in the user subscription), shall be included by the HSS inside the APN context of the Wildcard APN, as multiple instances of the Specific-APN-Info AVP.

When receiving an Insert Subscriber Data answer with "SGSN Area Restricted" the HSS shall set the SGSN area restricted flag as "SGSN area restricted".

Subscribed-VSRVCC AVP may be present within the Subscription-Data AVP sent within an ISR only if the user is subscribed to the SRVCC and vSRVCC.

If the HSS determines that the MME shall be unregistered for SMS it shall set the "Remove SMS Registration" bit in the IDR-Flags. If the IDR is sent for the only purpose to indicate that the MME is no longer registered for SMS, the Subscription-Data AVP shall be included empty.

If the HSS needs to request to the MME/SGSN the execution of the HSS-based P-CSCF restoration procedure, as described in 3GPP TS 23.380 [51] subclause 5.4, the HSS shall set the "P-CSCF Restoration Request" bit in the IDR-Flags, if supported by the MME/SGSN. If the IDR is sent only for the purpose of requesting the execution of the HSS-based P-CSCF restoration procedures, the Subscription-Data AVP included shall be empty.

If the HSS receives a SCEF request to configure Monitoring events for the UE to be handled by the MME/SGSN or receives a SCEF request for deleting Monitoring events for the UE in the MME/SGSN, the HSS shall include Monitoring-Event-Configuration AVP(s) in the Subscription-Data AVP sent within the IDR. If the HSS has registered both an MME and an SGSN as serving nodes for a given user, and both nodes are not part of a same combined MME/SGSN node, the HSS shall send the Monitoring-Event-Configuration AVP(s) to each one of the serving nodes that supports the Monitoring event service. If the HSS receives the IDA with Monitoring-Event-Report AVP(s), the HSS shall forward the Monitoring-Event-Report AVP(s) to the SCEF associated to those Monitoring events.

If the HSS does not receive a SCEF request to configure Monitoring events for the UE to be handled by the MME/SGSN and does not receive an Active Time with the Suggested-Network-Configuration AVP , the HSS may send an O&M configured desired Active Time value within the Active-Time AVP.

If the HSS receives a Supported-Services AVP it shall only trigger those services which are supported by the MME/SGSN.

If the HSS has previously received over SWx (see 3GPP TS 29.273 [59]) the identity of the PDN-GW to be used for the establishment of emergency PDN connections, it shall send it to the registered MME (if any) in the IDR command as part of the Subscription-Data AVP (in the Emergeny-Info AVP).

If V2X subscription data has been added or modified in the HSS, the HSS shall include the V2X-Subscription-Data AVP in the Subscription-Data AVP sent within an IDR.

If the External-Identifier associated with Monitoring Event Configuration for the UE has been added or modified in the HSS and the MME/SGSN supports the "External-Identifier" feature, the HSS shall include the External-Identifier AVP in the Subscription-Data AVP.

5.2.2.2 Delete Subscriber Data

5.2.2.2.1 General

This procedure shall be used between the MME and the HSS and between the SGSN and the HSS, to remove some data of the HSS user profile stored in the MME or SGSN. The procedure shall be invoked by the HSS and it corresponds to the functional level operation Delete Subscriber Data (see 3GPP TS 23.401 [2]).

It shall be used to remove:

- a subset (wich may or may not be the complete set of APN configurations) of the APN Configuration Profile for the subscriber from the SGSN or combined MME/SGSN;

- a proper subset (i.e. a subset that is not equal to the complete set of APN configurations and does not contain the default APN configuration) of the APN Configuration Profile for the subscriber from the MME;

- the regional subscription;

- the subscribed charging characteristics;

- Session Transfer Number for SRVCC;

- trace data;

- ProSe subscription data;

- Reset-IDs;

- MSISDN;

- UE Usage Type;

- V2X subscription data.

If the HSS knows that the UE has attached to the MME and SGSN parts of the same combined MME/SGSN via both E-UTRAN and UTRAN/GERAN(refer to clause 5.2.1.1.2, 5.2.1.1.3 for further details), the HSS should invoke this procedure for a single time to remove some or all data of the HSS user profile stored in the combined MME/SGSN, i.e. not invoke this procedure for each of the MME and the SGSN registered respectively.

If the Node-Type-Indicator information has been previously received as cleared in the ULR-Flags and if the MME has not been registered for SMS during update location procedure for the MME, the HSS may skip any removal of the SMS related subscription data and consequently does not have to make use of the Delete Subscriber Data procedure to update the SMS subscription data in the MME.

This procedure is mapped to the commands Delete-Subscriber-Data-Request/Answer (DSR/DSA) in the Diameter application specified in chapter 7.

Table 5.2.2.2.1/1 specifies the involved information elements for the request.

Table 5.2.2.2.1/2 specifies the involved information elements for the answer.

Table 5.2.2.2.1/1: Delete Subscriber Data Request

Information element name	Mapping to Diameter AVP	Cat.	Description
IMSI	User-Name (See IETF RFC 6733 [61])	M	This information element shall contain the user IMSI, formatted according to 3GPP TS 23.003 [3], clause 2.2.
Supported Features (See 3GPP TS 29.229 [9])	Supported-Features	O	If present, this information element shall contain the list of features supported by the origin host.
DSR Flags (See 7.3.25)	DSR-Flags	M	This Information Element shall contain a bit mask. See 7.3.25 for the meaning of the bits.
Trace Reference (See 7.3.64)	Trace-Reference	C	This parameter shall contain the same value as used for the activation of the Trace Session. This element shall be present only if the "Trace Data Withdrawal" bit is set in the DSR-Flags.
Context Identifier (See 7.3.27)	Context-Identifier	C	This parameter shall identify the PDN subscription context or GPRS-PDP context that shall be deleted. This element shall be present only if the "PDN subscription contexts Withdrawal" bit or the "PDP context withdrawal" bit is set in the DSR-Flags. In the "PDN subscription contexts Withdrawal" case, the Context-Identifier shall not be associated with the default APN configuration. For the compatibility with the MAP protocol as defined in the 3GPP TS 29.002 [24], this parameter shall not have a value of zero.
TS Code List (See 7.3.100)	TS-Code	C	This parameter shall contain the teleservice codes that are to be deleted from the subscription. This element shall be present only if the "SMS Withdrawal" bit is set in the DSR-Flags and the SMS related teleservice codes are to be deleted.
SS Code List (See 7.3.87)	SS-Code	C	This parameter shall contain the supplementary service codes that are to be deleted from the subscription. This element shall be present only if the "SMS Withdrawal" bit is set or the "LCS Withdrawal" bit is set in the DSR-Flags.
SCEF-Id (See 3GPP TS 29.336 [54])	SCEF-ID	C	This parameter shall contain the identity of the SCEF to which monitoring events that are to be deleted are associated. This element shall be present if the "Delete monitoring events" bit is set in the DSR-Flags.

Table 5.2.2.2.1/2: Delete Subscriber Data Answer

Information element name	Mapping to Diameter AVP	Cat.	Description
Supported Features (See 3GPP TS 29.229 [9])	Supported-Features	O	If present, this information element shall contain the list of features supported by the origin host.
Result (See 7.4)	Result-Code / Experimental-Result	M	This IE shall contain the result of the operation. The Result-Code AVP shall be used to indicate success / errors as defined in the Diameter base protocol (see IETF RFC 6733 [61]). The Experimental-Result AVP shall be used for S6a/S6d errors. This is a grouped AVP which shall contain the 3GPP Vendor ID in the Vendor-Id AVP, and the error code in the Experimental-Result-Code AVP. The following errors are applicable in this case: - User Unknown
DSA Flags (See 7.3.26)	DSA-Flags	C	This Information Element shall contain a bit mask. See 7.3.26 for the meaning of the bits.

5.2.2.2.2 Detailed behaviour of the MME and the SGSN

When receiving a Delete Subscriber Data request, the MME or SGSN shall check whether the IMSI is known.

If it is not known, a result code of DIAMETER_ERROR_USER_UNKNOWN shall be returned.

If it is known, but the Context-Identifier is associated with the default APN configuration, the MME shall not delete the PDN subscription context, and return an error with a Result-Code set to DIAMETER_UNABLE_TO_COMPLY. Otherwise, the MME or SGSN shall delete the corresponding data according to the indication as sent in the request, and acknowledge the Delete Subscriber Data message by returning a Delete Subscriber Data Answer.

If an MME receives a Delete Subscriber Data Request with the "Complete APN Configuration Profile Withdrawal" bit set in the DSR-Flags AVP, it shall return an error with a Result-Code set to DIAMETER_UNABLE_TO_COMPLY.

If the deletion of the subscription data succeeds in the MME or SGSN, the Result-Code shall be set to DIAMETER_SUCCESS.

If the Regional Subscription is deleted from the subscription data, the SGSN shall check for its routing areas whether they are allowed or not. If the entire SGSN area is restricted, SGSN shall report it to the HSS by returning the "SGSN Area Restricted" indication within the DSA flags.

If the EPS Subscription Data is deleted from the subscription data, the MME or SGSN shall check whether all EPS Subscription Data for the subscriber is deleted or if only a subset of the stored EPS Subscription Data for the subscriber is deleted, the MME or SGSN may then deactivate the associated affected active EPS bearers.

If the Subscribed Charging Characteristics are deleted from the subscription data, the Gn/Gp-SGSN shall maintain the existing Subscribed Charging Characteristics throughout the lifetime of the existing MM and PDP contexts, see 3GPP TS 32.251 [33].

If the Subscribed Charging Characteristics are deleted from the subscription data, the MME or S4-SGSN shall maintain the existing Subscribed Charging Characteristics throughout the lifetime of the existing IP CAN bearer, see 3GPP TS 32.251 [33].

If the MSISDN is deleted from the subscription data, the MME or SGSN shall maintain the existing MSISDN throughout the lifetime of the existing PDN connections that were established prior to the deletion of the MSISDN (i.e., other network nodes, such as PDN-GW, are not informed of such deletion for the existing PDN connections).

If the MME or SGSN cannot fulfil the received request for other reasons, e.g. due to a database error, it shall set the Result-Code to DIAMETER_UNABLE_TO_COMPLY. In this case, the MME or SGSN shall mark the subscription record "Subscriber to be restored in HSS".

If trace data are deleted from the subscription data, the MME or SGSN shall deactivate the Trace Session identified by the trace reference. For details, see 3GPP TS 32.422 [23].

5.2.2.2.3 Detailed behaviour of the HSS

The HSS shall make use of this procedure to remove deleted subscription data from the MME or SGSN.

The HSS shall make use of this procedure to remove deleted GPRS Subscription Data from the SGSN or combined MME/SGSN if the GPRS-Subscription-Data-Indicator information has been previously received as set in the ULR-Flags during update location procedure for the MME.

The HSS shall not set the "Complete APN Configuration Profile Withdrawal" bit in the DSR-Flags AVP when sending a Delete Subscriber Data Request to an MME, since the default APN shall always be present in an MME.

When receiving a Delete Subscriber Data Answer with "SGSN Area Restricted" the HSS shall set the SGSN area restricted flag as "SGSN area restricted".

5.2.3 Authentication Procedures

5.2.3.1 Authentication Information Retrieval

5.2.3.1.1 General

The Authentication Information Retrieval Procedure shall be used by the MME and by the SGSN to request Authentication Information from the HSS.

This procedure is mapped to the commands Authentication-Information-Request/Answer (AIR/AIA) in the Diameter application specified in chapter 7.

Table 5.2.3.1.1/1 specifies the involved information elements for the request.

Table 5.2.3.1.1/2 specifies the involved information elements for the answer.

Table 5.2.3.1.1/1: Authentication Information Request

Information element name	Mapping to Diameter AVP	Cat.	Description
IMSI	User-Name (See IETF RFC 6733 [61])	M	This information element shall contain the user IMSI, formatted according to 3GPP TS 23.003 [3], clause 2.2.
Supported Features (See 3GPP TS 29.229 [9])	Supported-Features	O	If present, this information element shall contain the list of features supported by the origin host.
Requested E-UTRAN Authentication Info (See 7.3.11)	Requested-EUTRAN-Authentication-Info	C	This information element shall contain the information related to authentication requests for E-UTRAN.
Requested UTRAN/GERAN Authentication Info (See 7.3.12)	Requested-UTRAN-GERAN Authentication-Info	C	This information element shall contain the information related to authentication requests for UTRAN or GERAN.
Visited PLMN ID (See 7.3.9)	Visited-PLMN-ID	M	This IE shall contain the MCC and the MNC of the visited PLMN, see 3GPP TS 23.003 [3].
AIR Flags (See 7.3.201)	AIR-Flags	O	This IE, if present, contains a bit mask. See subclause 7.3.201 for the meaning of the different bits.

Table 5.2.3.1.1/2: Authentication Information Answer

Information element name	Mapping to Diameter AVP	Cat.	Description
Result (See 7.4)	Result-Code / Experimental-Result	M	This IE shall contain the result of the operation. This IE shall contain the Result-Code AVP shall be used to indicate success / errors as defined in the Diameter base protocol (see IETF RFC 6733 [61]). The Experimental-Result AVP shall be used for S6a/S6d errors. This is a grouped AVP which shall contain the 3GPP Vendor ID in the Vendor-Id AVP, and the error code in the Experimental-Result-Code AVP. The following errors are applicable in this case: - User Unknown - Unknown EPS Subscription - Authentication Data Unavailable
Error-Diagnostic	Error-Diagnostic	O	If the Experimental Result indicated "Unknown EPS Subscription", Error Diagnostic may be present to indicate whether or not GPRS subscription data are subscribed (i.e. whether or not Network Access Mode stored in the HSS indicates that only CS service is allowed).
Supported Features (See 3GPP TS 29.229 [9])	Supported-Features	O	If present, this information element shall contain the list of features supported by the origin host.
Authentication Info (See 7.3.17)	Authentication-Info	C	This IE shall contain the Authentication Vectors.
UE Usage Type (See 7.3.202)	UE-Usage-Type	C	This IE shall be present if the HSS supports the Dedicated Core Networks feature, and the "Send UE Usage Type" flag was set in the AIR-Flags AVP in the AIR command, and this information is available in the user subscription. If present, this IE shall contain the UE Usage Type of the subscriber (see subclause 7.3.202).

5.2.3.1.2 Detailed behaviour of the MME and the SGSN

The MME or SGSN shall make use of this procedure in order to retrieve the Authentication Vectors from the HSS.

If the MME or SGSN supports Emergency services for users in limited service state, and the user's IMSI is not available from the UE, or the user's IMSI is marked as unauthenticated, the MME or SGSN shall not make use of the Authentication Information Retrieval procedure.

If the request is triggered by a synchronization failure during E-UTRAN authentication, the MME or combined MME/SGSN shall include the Re-Synchronization Information in the Requested-EUTRAN-Authentication-Info AVP in the request.

If the request is triggered by a synchronization failure during UTRAN or GERAN authentication, the SGSN or combined MME/SGSN shall include the Re-Synchronization Information in the Requested-UTRAN-GERAN-Authentication-Info AVP in the request.

Re-Synchronization Information shall not be present in both the Requested-EUTRAN-Authentication-Info AVP and the Requested-UTRAN-GERAN-Authentication-Info AVP.

A stand alone MME shall include the Requested-EUTRAN-Authentication-Info AVP and shall not include the Requested-UTRAN-GERAN-Authentication-Info AVP in the request. The Immediate-Response-Preferred AVP should be present if a EUTRAN-Vector is needed for immediate use.

A stand alone SGSN shall not include the Requested-EUTRAN-Authentication-Info AVP and shall include the Requested-UTRAN-GERAN-Authentication-Info AVP in the request. The Immediate-Response-Preferred AVP should be present if a UTRAN/GERAN-Vector is needed for immediate use.

A combined MME/SGSN may include both the Requested-EUTRAN-Authentication-Info AVP and the Requested-UTRAN-GERAN-Authentication-Info AVP in the request. If both the Requested-EUTRAN-Authentication-Info AVP and the Requested-UTRAN-GERAN-Authentication-Info AVP are present in the request, the Immediate-Response-Preferred AVP shall be present if the requested authentication vectors are needed for immediate use. The content of the Immediate-Response-Preferred AVP shall correspond to the access type which the UE is currently to be authenticated. The Immediate-Response-Preferred AVP shall not be present in both the Requested-EUTRAN-Authentication-Info AVP and the Requested-UTRAN-GERAN-Authentication-Info AVP. The presence of an Immediate-Response-Preferred AVP shall indicate that a vector is needed for immediate use.

When EUTRAN-AVs and UTRAN-AVs or GERAN-AVs are requested, presence of Immediate-Response-Preferred AVP within the Requested-EUTRAN-Authentication-Info AVP shall indicate that EUTRAN-AVs are requested for immediate use in the MME/SGSN; presence of Immediate-Response-Preferred AVP within the Requested-UTRAN-GERAN-Authentication-Info AVP shall indicate that UTRAN-AVs or GERAN-AVs are requested for immediate use in the MME/SGSN. It may be used by the HSS to determine the number of vectors to be obtained from the AuC and the number of vectors downloaded to the MME or SGSN.

If the MME or SGSN supports the Dedicated Core Networks functionality, and the MME or SGSN needs to retrieve the UE Usage Type from the HSS, it shall set the "Send UE Usage Type" flag in the AIR-Flags AVP in the AIR command.

When receiving an Authentication Information response from the HSS, the MME or SGSN shall check the Result Code. If it indicates success and Authentication Information is present in the result, the MME or SGSN shall use the received vectors. For details see 3GPP TS 33.401 [5].

If the MME or SGSN supports Emergency services for users in limited service state, the MME or SGSN shall proceed even if the Authentication Information Retrieval procedure has failed. In this case, the MME or SGSN shall mark the user's IMSI as unauthenticated.

Vectors with lower Item Number should be used before Vectors with higher Item Number are used in the MME or SGSN. For Vectors received within different requests those received by the earlier request should be used before those received by the later request.

5.2.3.1.3 Detailed behaviour of the HSS

When receiving an Authentication Information request the HSS shall check whether subscription data exists for the IMSI.

If the HSS determines that there is not any type of subscription for the IMSI (including EPS, GPRS and CS subscription data), a result code of DIAMETER_ERROR_USER_UNKNOWN shall be returned.

If the Authentication Information Request contains a Requested-EUTRAN-Authentication-Info AVP but no Requested-UTRAN-GERAN-Authentication-Info AVP, and the subscriber has not any APN configuration, the HSS shall return a Result Code of DIAMETER_ERROR_UNKNOWN_EPS_SUBSCRIPTION.

If the Authentication Information Request contains a Requested-UTRAN-GERAN-Authentication-Info AVP but no Requested-EUTRAN-Authentication-Info AVP, and the subscriber has neither an APN configuration profile nor GPRS subscription data, the HSS shall return a Result Code of DIAMETER_ERROR_UNKNOWN_EPS_SUBSCRIPTION.

If the Authentication Information Request contains both Requested-EUTRAN-Authentication-Info AVP and Requested-UTRAN-GERAN-Authentication-Info AVP, and the Requested-EUTRAN-Authentication-Info AVP does not contain an Immediate-Response-Preferred AVP, and the subscriber has not any APN configuration, the HSS shall not return E-UTRAN vectors.

If the Authentication Information Request contains both Requested-EUTRAN-Authentication-Info AVP and Requested-UTRAN-GERAN-Authentication-Info AVP, and the Requested-EUTRAN-Authentication-Info AVP contains an Immediate-Response-Preferred AVP, and the subscriber does not have any APN configuration, the HSS shall return a Result Code of DIAMETER_ERROR_UNKNOWN_EPS_SUBSCRIPTION.

When sending DIAMETER_ERROR_UNKNOWN_EPS_SUBSCRIPTION, an Error Diagnostic information may be added to indicate whether or not GPRS subscription data are subscribed (i.e. whether or not Network Access Mode stored in the HSS indicates that only circuit service is allowed).

If EUTRAN-Authentication-Info is requested, the HSS shall check if serving nodes within the realm identified by the received Origin-Realm AVP are allowed to request authentication information for use in the serving network identified by the received Visited-PLMN-Id AVP.

The HSS shall then request the AuC to generate the corresponding requested Authentication Vectors (AVs). Subject to load considerations and/or other implementation specific considerations which may be based on the presence of an Immediate-Response-Preferred AVP, less AVs than the requested number of AVs may be generated.

If EUTRAN-Authentication-Info is requested, when receiving AVs from the AuC, the HSS shall generate the KASME before sending the response to the MME or combined MME-SGSN.

If the AuC is unable to calculate any corresponding AVs due to unallowed attachment for the UE, e.g. the UE is attaching via E-UTRAN with a SIM card equipped, the HSS shall return an error DIAMETER_AUTHORIZATION_REJECTED, the HSS shall not return any AV to the requesting node in the response. Otherwise, if no corresponding pre-computed AV is available, and the AuC is unable to calculate any corresponding AVs due to unknown failures, such as the internal database error, the result code shall be set to DIAMETER_AUTHENTICATION_DATA_UNAVAILABLE. The MME or the SGSN may request authentication vectors again.

For details see 3GPP TS 33.401 [5]. KASME generation is not performed before sending the response to the SGSN.

If the Requested-EUTRAN-Authentication-Info AVP is present in the request, the HSS shall download E-UTRAN authentication vectors to the MME. If the Requested-UTRAN-GERAN-Authentication-Info AVP is present in the request, the HSS shall download UTRAN or GERAN authentication vectors to the SGSN.

If the Immediate Response Preferred parameter has been received, the HSS may use it together with the number of requested vectors and the number of vectors stored in the HSS that are pre-computed to determine the number of vectors to be obtained from the AuC. The HSS may return less number of vectors than requested to the MME or SGSN. If both the Requested-EUTRAN-Authentication-Info AVP and the Requested-UTRAN-GERAN-Authentication-Info AVP are in the request, and one of them includes the Immediate Response Preferred parameter, the HSS may omit the vectors request that are not for immediate use. If both the Requested-EUTRAN-Authentication-Info AVP and the Requested-UTRAN-GERAN-Authentication-Info AVP are in the request, and both of them includes the Immediate Response Preferred parameter, the HSS may return E-UTRAN authentication vectors and UTRAN or GERAN authentication vectors. KASME is always computed for each E-UTRAN vector due to the PLMN-binding before sending the response to the MME independent of the presence of the Immediate Response Preferred parameter.

If the Re-Synchronization-Info AVP has been received, the HSS shall check the AUTS parameter before sending new authentication vectors to the MME or the SGSN. For details see 3GPP TS 33.102 [18]. If both the Requested-EUTRAN-Authentication-Info AVP and the Requested-UTRAN-GERAN-Authentication-Info AVP are in the request,

and both of them include the Re-Synchronization-Info AVP, the HSS shall not check the AUTS parameter and return the result code of DIAMETER_UNABLE_TO_COMPLY. Any authentication vectors shall not be sent by the HSS to the requesting node in the response.

If more than one EPS or UTRAN or GERAN Vector is to be included within one Authentication-Info AVP, the Item-Number AVP shall be present within each Vector.

If the HSS supports the Dedicated Core Networks functionality, and the MME or SGSN has set the "Send UE Usage Type" flag in the AIR-Flags AVP in the AIR command:

- if the UE Usage Type value is available in the subscription data of the user:

  - if the Immediate Response Preferred parameter is not present in the Requested-EUTRAN-Authentication-Info nor in the Requested-UTRAN-GERAN-Authentication-Info, the HSS may return no authentication vectors in the response; the HSS shall then return the result code DIAMETER_SUCCESS and may return the generated AVs (if any) to the MME or SGSN;

- the HSS shall include the UE-Usage-Type AVP in the AIA response command if the result code is DIAMETER_SUCCESS or DIAMETER_AUTHENTICATION_DATA_UNAVAILABLE.

- if the UE Usage Type value is not available in the subscription data of the user, the HSS shall answer as if the MME/SGSN had not requested the UE Usage Type parameter.

5.2.4 Fault Recovery Procedures

5.2.4.1 Reset

5.2.4.1.1 General

The Reset Procedure shall be used by the HSS, after a restart, to indicate to the MME and to the SGSN that a failure has occurred.

The Reset Procedure may also be used by the HSS as part of operation and maintenance actions e.g. to allow planned HSS outage without service interruption, or to update subscription data shared by multiple subscribers.

This procedure is mapped to the commands Reset-Request/Answer (RSR/RSA) in the Diameter application specified in chapter 7.

Table 5.2.4.1.1/1 specifies the involved information elements for the request.

Table 5.2.4.1.1/2 specifies the involved information elements for the answer.

Table 5.2.4.1.1/1: Reset Request

Information element name	Mapping to Diameter AVP	Cat.	Description
User Id List (See 7.3.50)	User-Id	O	This IE shall contain a list of User-Ids where a User-Id comprises the leading digits of an IMSI (i.e. MCC, MNC, leading digits of MSIN) and it shall identify the set of subscribers whose IMSIs begin with the User-Id. The HSS may include this information element if the occurred failure is limited to subscribers identified by one or more User-Ids.
Supported Features (See 3GPP TS 29.229 [9])	Supported-Features	O	If present, this information element shall contain the list of features supported by the origin host.
Reset-IDs (See 7.3.184)	Reset-ID	O	If present, this information element identifies the set of impacted subscribers.
Subscription Data (See 7.3.2)	Subscription-Data	O	If the Reset Procedure is used to add/ modify subscription data shared by multiple subscribers, this Information Element shall contain the part of the subscription profile that either is to be added to the subscription profile stored in the MME or SGSN or combined MME/SGSN or is replacing a part of the subscription profiles of the impacted subscribers stored in the MME or SGSN. Shall be absent if Subscription-Data-Deletion AVP is present. Shall be absent if Reset-ID AVP is absent
Subscription Data Deletion (See 7.3.208)	Subscription-Data-Deletion	O	If the Reset Procedure is used to delete subscription data shared by multiple subscribers, this Information Element shall contain identifications of the part of the subscription profile that is to be deleted from the subscription profiles of the impacted subscribers stored in the MME or SGSN or combined MME/SGSN. Shall be absent if Subscription-Data AVP is present. Shall be absent if Reset-ID AVP is absent

Table 5.2.4.1.1/2: Reset Answer

Information element name	Mapping to Diameter AVP	Cat.	Description
Supported Features (See 3GPP TS 29.229 [9])	Supported-Features	O	If present, this information element shall contain the list of features supported by the origin host.
Result (See 7.4)	Result-Code / Experimental-Result	M	This IE shall contain the result of the operation. The Result-Code AVP shall be used to indicate success / errors as defined in the Diameter base protocol (see IETF RFC 6733 [61]). The Experimental-Result AVP shall be used for S6a/S6d errors. This is a grouped AVP which shall contain the 3GPP Vendor ID in the Vendor-Id AVP, and the error code in the Experimental-Result-Code AVP. There are no Experimental-Result codes applicable for this command.

5.2.4.1.2 Detailed behaviour of the MME and the SGSN

When receiving a Reset message neither containing Subscription-Data nor Subscription-Data-Deletion the MME or SGSN or combined MME/SGSN shall mark all impacted subscriber records "Location Information Confirmed in HSS " as "Not Confirmed".

When receiving a Reset message containing Subscription-Data or Subscription-Data-Deletion the MME or SGSN or combined MME/SGSN shall update all impacted subscriber records accordingly, i.e. each impacted subscriber record is updated as if an individual IDR or DSR for that subscriber was received; for details see clauses 5.2.2.1.2 and 5.2.2.2.2. The MME or SGSN or combined MME/SGSN shall not mark successfully updated subscriber records "Location Information Confirmed in HSS " as "Not Confirmed". If an impacted subscriber record cannot be updated for any reason (e.g. the updated data is considered not shareable by the MME or SGSN or combined MME/SGSN, or the update requires an individual acknowledgement to be sent to the HSS), the MME or SGSN or combined MME/SGSN shall mark that record "Location Information Confirmed in HSS " as "Not Confirmed".

NOTE: Which subscription data are considered by the MME or SGSN or combined MME/SGSN not shareable by multiple subscribers is implementation specific.

If the update of shared subscription data requires only local updates in the MME or SGSN or combined MME/SGSN (i.e., the update of the profile does not imply to initiate any signalling interaction towards other network nodes), the updates should be performed immediately (e.g. deleting an Operator Determined Barring).

If the update of shared subscription data implies initiating a signalling interaction towards other nodes (e.g. towards the PGW/PCRF for the change of an APN configuration parameter, such as APN-AMBR), depending on the UE's state the following shall apply:

- If the UE is in CONNECTED state, the updates shall be performed immediately including signalling towards other nodes.

- If the UE is in IDLE state, the signalling towards other nodes should be deferred to the next authenticated radio contact with that UE.

NOTE: The rational for the recommendation to defer signalling towards other nodes until the next authenticated radio contact is to consider impacts to the network only when the updates are required, and to spread the signalling towards other nodes over some time, based on user's activity.

In both cases, to avoid high processing/signalling load resulting from shared subscription data update, processing/signalling actions resulting from data updates in the MME or SGSN or combined MME/SGSN may take a maximum operator configuration-depending time.

If the Reset-IDs IE is supported and received, the MME or SGSN or combined MME/SGSN shall make use of the Reset-IDs (together with the HSS's realm) in order to determine which subscriber records are impacted (i.e. check whether at least one received Reset-ID is associated with the subscriber); otherwise the MME or SGSN or combined MME/SGSN shall make use of the HSS Identity received in the Origin-Host AVP (by comparing it with the value stored after successful ULA) and may make use of the received User-Id-List (if any) in order to determine which subscriber records are impacted.

At the next authenticated radio contact with the UE concerned, if the subscriber record "Location Information Confirmed in HSS" is marked as "Not Confirmed", the restoration procedure shall be triggered.

See also 3GPP TS 29.118 [46] clause 5.9.2.

5.2.4.1.3 Detailed behaviour of the HSS

The HSS shall make use of this procedure in order to indicate to all relevant MMEs, SGSN, and combined MME/SGSNs that the HSS has restarted and may have lost the current MME-Identity and SGSN-Identity of some of its subscribers who may be currently roaming in the MME area and/or SGSN area, and that the HSS, therefore, cannot send a Cancel Location messages or Insert Subscriber Data messages when needed.

The HSS may make use of this procedure in order to indicate to all relevant MMEs, SGSN, and combined MME/SGSNs that the HSS has updated subscription data shared by some of its subscribers who may be currently roaming in the MME area and/or SGSN area.

If the Reset-ID feature is not supported by the MME/SGSN and HSS, the HSS optionally may include a list of Ids identifying a subset of subscribers served by the HSS, if the occurred failure is limited to those subscribers.

If the Reset-ID feature is supported by the MME or SGSN, the HSS optionally may include one (or several) Reset-ID AVPs identifying e.g. failed hardware components if the occured failure is limited to those subscribers associated with e.g. the identified failed hardware components.

The HSS should invoke this procedure towards a combined MME/SGSN only for a single time even if some of the impacted subscribers are attached to the combined MME/SGSN via UTRAN/GERAN and some of the impacted subscribers are attached to the combined MME/SGSN via E-UTRAN.

5.2.5 Notification Procedures

5.2.5.1 Notification

5.2.5.1.1 General

The Notification Procedure shall be used between the MME and the HSS and between the SGSN and the HSS when an inter MME or SGSN location update does not occur but the HSS needs to be notified about

- an update of terminal information;

- an update of the UE SRVCC capability (only if the MME/SGSN supports SRVCC).

The Notification Procedure shall also be used between the MME and the HSS and between the SGSN and the HSS if the HSS needs to be notified about:

- an assignment/change of a dynamically allocated PDN GW for an APN, if such a notification is needed taking into account the access restrictions and the type of PDN;

NOTE: If the PDN is of type "non-IP", the APN is not accessible via non-3GPP access and therefore the PDN-GW ID does not need to be conveyed across accesses.

- an assignment/change of a dynamically allocated PDN GW for the establishment of emergency PDN connections, if such notification is needed for a non roaming authenticated user, based on operator policy (e.g. on whether the operator uses static PDN GW or not for emergency services) taking into account the access restrictions and feature support;

- the status of the monitoring event configuration at the IWK-SCEF.

The Notification Procedure shall be used between the MME and the HSS when an inter MME location update does not occur but the HSS needs to be notified about

- the need to send a Cancel Location to the current SGSN.

The Notification Procedure shall be used between the MME and the HSS when the "SMS in MME" feature is applied and between the SGSN and the HSS when an earlier short message delivery failed and the HSS needs to be notified about:

- the UE is reachable or the UE has memory capacity available to receive one or more short messages.

The Notification Procedure shall be used between the MME and the HSS and between the SGSN and the HSS when the HSS has requested to be notified about:

- the UE is reachable.

The Notification Procedure shall be used between the MME and the HSS and between the SGSN and the HSS to notify the HSS about:

- an update of the Homogeneous Support of IMS Voice Over PS Sessions.

The Notification Procedure shall be used between the MME and the HSS to notify the HSS about:

- removal of MME registration for SMS.

This procedure is mapped to the commands Notify-Request/Answer (NOR/NOA) in the Diameter application specified in chapter 7.

Table 5.2.5.1.1/1 specifies the involved information elements for the request.

Table 5.2.5.1.1/2 specifies the involved information elements for the answer.

Table 5.2.5.1.1/1: Notify Request

Information element name	Mapping to Diameter AVP	Cat.	Description
IMSI	User-Name (See IETF RFC 6733 [61])	M	This information element shall contain the user IMSI, formatted according to 3GPP TS 23.003 [3], clause 2.2.
Supported Features (See 3GPP TS 29.229 [9])	Supported-Features	O	If present, this information element shall contain the list of features supported by the origin host.
Terminal Information (See 7.3.3)	Terminal-Information	C	This information element shall contain information about the user's mobile equipment. When notifying the HSS about any change of Terminal Information, the MME or SGSN shall include the new Terminal Information in the request. Within this Information Element, only the IMEI and the Software-Version AVPs shall be used on the S6a/S6d interface.
PDN GW Identity (See 7.3.45)	MIP6-Agent-Info	C	This IE shall contain the identity of the selected and dynamically allocated PDN GW for an APN. It shall be present if a new PDN-GW has been selected and the subscriber is allowed handover to non 3GPP access. When notifying the HSS about a newly selected PDN GW, the MME or SGSN shall include the PDN-GW-Identity in the request. For establishment of emergency PDN connections, this IE shall contain the identity of the PDN-GW used to establish those PDN connections.
PGW PLMN ID	Visited-Network-Identifier	C	This IE identifies the PLMN in which the PDN GW is located. It shall be present when the PDN GW Identity is present and does not contain an FQDN.
Context Identifier (See 7.3.27)	Context-Identifier	O	This parameter shall identify the APN Configuration with which the selected PDN GW shall be correlated. It may be present if it is available and the PDN-GW is present and is particular for one specific APN and not common to all the APNs. For the compatibility with the MAP protocol as defined in the 3GPP TS 29.002 [24], this parameter shall not have a value of zero.
APN (See TS 23.008 [30])	Service-Selection (See IETF RFC 5778 [20])	C	This IE shall contain the APN for the selected and dynamically allocated PDN GW. For establishment of non-emergency PDN connections, it shall be present if the selected PDN-GW is present and is particular for one specific APN and not common to all the APNs. For establishment of emergency PDN connections (i.e., the Emergency-Services AVP is present, with the Emergency-Indication flag set), this AVP shall be left absent.
Alert Reason (See 7.3.83)	Alert-Reason	C	This parameter shall indicate if the mobile subscriber is present or the MS has memory available. It shall be present when notifying the HSS about the presence of the UE or the UE has memory capacity available to receive one or more short messages.
UE SRVCC Capability	UE-SRVCC-Capability	C	This information element shall indicate if the UE supports or does not support the SRVCC capability. If the MME/SGSN supports SRVCC and the UE SRVCC Capability has changed, the MME or SGSN shall include the new UE SRVCC Capability in the request.
NOR Flags (See 7.3.49)	NOR-Flags	C	This Information Element shall contain a bit mask. See 7.3.49 for the meaning of the bits. Absence of this information element shall be interpreted as all bits set to 0. When notifying the HSS about the need to send cancel location to the current SGSN, the MME shall set the "Single-Registration-Indication" flag in the NOR-Flags. When notifying the HSS about the "restricted" status of the current SGSN area, the SGSN shall set the "SGSN area restricted" flag in the NOR-Flags. When notifying the HSS about the reachability of the UE or the UE has memory capacity available to receive one or more short messages, the MME, if the "SMS in MME" feature is applied, or SGSN shall set the "Ready for SM" flag correspondingly in the NOR-Flags.

			When notifying the HSS that the UE is reachable, the MME or SGSN shall set the "UE Reachable" flag correspondingly in the NOR-Flags. When notifying the HSS about update of the Homogeneous Support of IMS Voice Over PS Sessions, the MME or the SGSN shall set the "Homogeneous Support of IMS Voice Over PS Sessions" flag and S6a/S6d-Indicator flag for a combined MME/SGSN correspondingly in the NOR-Flags. When notifying the HSS about removal of MME registration for SMS, the MME shall set the "Removal of MME Registration for SMS" flag correspondingly in the NOR-Flags.
Homogeneous Support of IMS Voice Over PS Sessions (See 7.3.107)	Homogeneous -Support-of-IMS-Voice-Over-PS-Sessions	C	This Information Element shall be present if Homogeneous Support of IMS Voice Over PS Sessions is modified to one of the values "SUPPORTED" or "NOT_SUPPORTED". The value "SUPPORTED" indicates that there is support for "IMS Voice over PS Sessions" in all TAs or RAs. The value "NOT_SUPPORTED" indicates that there is not support for "IMS Voice over PS Sessions" in any of the TAs or RAs.
Maximum UE Availability Time	Maximum-UE-Availability-Time	O	This information element may be included when notifying the HSS that the UE is reachable. When present, it shall indicate the timestamp (in UTC) until which a UE using a power saving mechanism (such as extended idle mode DRX) is expected to be reachable for SM Delivery. This information may be used by the SMS Center to prioritize the retransmission of Short Message to UEs using a power saving mechanism.
Monitoring Event Config Status	Monitoring-Event-Config-Status	C	This information element shall be present if MME/SGSN sends the Notify Request after receiving the Configuration-Information-Answer from the IWK-SCEF. This information element shall only contain the monitoring event configuration status of those events whose configuration status has changed since the last status informed to the HSS.
Emergency Services (See 3GPP TS 29.273 [59])	Emergency-Services	C	The MME shall include this information element, and set the Emergency-Indication flag, to notify the HSS that a new PDN-GW has been selected for the establishment of an emergency PDN connection, whose identify is conveyed in the "PDN GW Identity" IE.

Table 5.2.5.1.1/2: Notify Answer

Information element name	Mapping to Diameter AVP	Cat.	Description
Result (See 7.4)	Result-Code / Experimental-Result	M	This IE shall contain the result of the operation. he Result-Code AVP shall be used to indicate success / errors as defined in the Diameter base protocol (see IETF RFC 6733 [61]). The Experimental-Result AVP shall be used for S6a/S6d errors. This is a grouped AVP which shall contain the 3GPP Vendor ID in the Vendor-Id AVP, and the error code in the Experimental-Result-Code AVP. The following errors are applicable in this case: - User Unknown
Supported Features (See 3GPP TS 29.229 [9])	Supported-Features	O	If present, this information element shall contain the list of features supported by the origin host.

5.2.5.1.2 Detailed behaviour of the MME and the SGSN

If the MME or SGSN supports Emergency services, the MME or SGSN shall not make use of the Notification procedure for emergency attached unauthenticated UEs; for authenticated UEs, the MME shall make use of the Notification procedure to inform the HSS about the PDN-GW selected to establish emergency PDN connections, if the MME is configured to use a dynamic PGW for emergency services for such UEs.

The MME or SGSN shall not make use of the Notification procedure to inform the HSS about the identity of the dynamically selected PDN-GW, if the access restrictions indicate that the user is not allowed to get service via non-3GPP access, or the PDN type of the APN is of type "non-IP".

The MME or SGSN shall include conditional AVPs in NOR according to the description given in table 5.2.5.1.1/1.

If the MME sends a Notify Request to inform the HSS that the UE has become reachable again, the MME shall clear the corresponding URRP-MME for the UE.

If the SGSN sends a Notify Request to inform the HSS that the UE has become reachable again, the SGSN shall clear the corresponding URRP-SGSN for the UE.

If the MME sends a Notify Request to inform the HSS about the presence of the UE to receive one or more short messages, the MME shall clear the corresponding MNRF for the UE.

If the SGSN sends a Notify Request to inform the HSS about the presence of the UE to receive one or more short messages, the SGSN shall clear the corresponding MNRG for the UE.

If the MME or SGSN determines that it needs to update the Homogeneous Support of IMS Voice Over PS Sessions in the HSS, the MME or SGSN shall send a Notify Request with the "Homogeneous Support of IMS Voice Over PS Sessions" bit set in the NOR-Flags AVP; if there is homogeneous support, or homogeneous non-support, of IMS Voice Over PS Sessions, the MME or SGSN shall report it by including the updated Homogeneous-Support-of-IMS-Voice-Over-PS-Sessions AVP; if the support is not homogeneous, the MME or SGSN shall report it by leaving such AVP absent in the Notify Request to the HSS.

If the MME needs to indicate to the HSS that it is no longer registered for SMS in the HSS, the MME shall send a Notify Request with "Removal of MME Registration for SMS" flag set in the NOR-Flags AVP.

When receiving a Notify response from the HSS, if the result code indicates DIAMETER_ERROR_UNKNOWN_SERVING_NODE, the MME or SGSN shall consider the Notification procedure as failed, and it shall mark the subscriber record as "Subscriber to be restored in HSS".

When receiving a Notify response from the HSS, if the result code indicates DIAMETER_ERROR_USER_UNKNOWN, the MME or SGSN shall detach the subscriber and remove the subscriber from its database.

When the MME/SGSN has received the Configuration-Information-Answer from the IWK-SCEF during the monitoring event configuration procedure, the MME/SGSN shall send the Notify Request command with the Monitoring-Event-Config-Status AVP as received from the IWK-SCEF in the Configuration-Information-Answer, for the monitoring event configurations whose status have changed since last informed to the HSS.

   NOTE 1: If the Monitoring-Event-Configuration was received at the MME/SGSN in the ULA command, then the HSS is not yet informed of any status of the monitoring event configuration. In this case, the entire Monitoring-Event-Config-Status as received from IWK-SCEF has to be transferred to the HSS through a Notify Request Command.

5.2.5.1.3 Detailed behaviour of the HSS

When receiving a Notify request the HSS shall check whether the IMSI is known.

If it is not known, a result code of DIAMETER_ERROR_USER_UNKNOWN shall be returned.

If the IMSI is known, and the source MME or SGSN originating the Notify message is not currently registered in HSS for that UE, a result code of DIAMETER_ ERROR_ UNKNOWN_SERVING_NODE shall be returned.

If the IMSI is known, and the source MME or SGSN is currently registered in HSS, the HSS shall set the result code to DIAMETER_SUCCESS, unless otherwise stated, and

-   store the new terminal information if present in the request;

-   store the new UE SRVCC capability if present in the request;

-   store the new PDN GW and PLMN ID for an APN if present in the request and the APN is present in the subscription and if PDN GW is dynamically allocated; otherwise the HSS shall not store the new PDN GW data and shall set the result code to DIAMETER_ERROR_UNABLE_TO_COMPLY;

-   store the new PDN GW and PLMN ID, and the APN itself, if both are present in the request, and the APN is not present in the subscription but a wild card APN is present in the subscription;

- if the Emergency Services IE is present, with the Emergency-Indication flag set, store the new PDN GW, as the PDN GW used to establish emergency PDN connections; the HSS shall store this information not bound to any specific APN;

- mark the location area as "restricted" if so indicated in the request;

- send Cancel Location to the current SGSN if so indicated in the request;

- if the UE has become reachable again, and NOR is received on S6a from an MME or on S6d from an SGSN, the HSS shall respectively clear the URRP-MME or the URPP-SGSN parameter for the UE and send an indication t of UE reachability from MME or SGSN o the Service Related Entities if there is any;

- when NOR is received on S6d from an SGSN (with the Alert Reason present), the HSS shall reset the MNRG flag and send a MAP-Alert-Service-Centre message or S6c-Alert-Service-Centre-Request (see 3GPP TS 29.338 [48], i.e. the behaviour in the HSS should be the same as when a MAP-Ready for SM is received from an SGSN;

- when NOR is received on S6a from an MME (with the Alert Reason present), the HSS shall reset the MNRF flag and send a MAP-Alert-Service-Centre message or S6c-Alert-Service-Centre-Request (see 3GPP TS 29.338 [48], i.e. the behaviour in the HSS should be the same as when a MAP-Ready for SM is received from a VLR/MSC;

- when NOR is received on S6a from an MME or on S6d from an SGSN to update the Homogeneous Support of IMS Voice Over PS Sessions, the HSS shall store the updated Homogeneous Support of IMS Voice Over PS Sessions and may use this information in the future in order to skip the T-ADS data retrieval, as described in clause 5.2.2.1 (IDR/IDA commands). If the "Homogeneous Support of IMS Voice Over PS Sessions" bit is set in the NOR-Flags AVP received but without Homogeneous-Support-of-IMS-Voice-Over-PS-Sessions AVP present in the NOR message, the HSS shall take the Homogeneous Support of IMS Voice Over PS Sessions as unknown to the serving node. If the "Homogeneous Support of IMS Voice Over PS Sessions" bit is not set in the NOR-Flags AVP, the HSS shall ignore (if present) the Homogeneous-Support-of-IMS-Voice-Over-PS-Sessions AVP;

- when NOR is received on S6a from an MME for removal of MME registration for SMS, the HSS shall remove the MME registration for SMS and the "MME number for SMS" as the corresponding MSC number to be used for MT SMS.

- when NOR is received on S6a from an MME or on S6d from an SGSN with the Monitoring-Event-Config-Status AVP, the HSS shall trigger a Monitoring event cancelation procedure for the monitoring events that were not successfully configured at the MME/SGSN and the IWK-SCEF, as specified in sub-clause 7.2.2.2 of 3GPP TS 29.336 [54].

and then send the response to the MME or SGSN.

5A MME – CSS (S7a) and SGSN – CSS (S7d)

5A.1 Introduction

The S7a interface enables the transfer of subscriber related CSG data in the VPLMN between the MME and the CSS as described in 3GPP TS 23.401 [2].

The S7d interface enables the transfer of subscriber related CSG data in the VPLMN between the SGSN and the CSS as described in 3GPP TS 23.060 [12].

5A.2 Mobility Services

5A.2.1 Location Management Procedures

5A.2.1.1 Update VCSG Location

5A.2.1.1.1 General

The Update VCSG Location Procedure shall be used between the MME and the CSS or between the SGSN and the CSS to update location information in the CSS or retrieve the CSG subscription data of the UE from the CSS. The procedure allows:

- to inform the CSS about the identity of the MME or SGSN currently serving the user,

- to update MME or SGSN with user CSG subscription data received from the CSS.

This procedure is mapped to the commands Update-VCSG-Location-Request/Answer (UVR/UVA) in the Diameter application specified in chapter 7.

Table 5A.2.1.1.1/1 specifies the involved information elements for the request.

Table 5A.2.1.1.1/2 specifies the involved information elements for the answer.

Table 5A.2.1.1.1/1: Update VCSG Location Request

Information element name	Mapping to Diameter AVP	Cat.	Description
IMSI	User-Name (See IETF RFC 6733 [61])	M	This information element shall contain the user IMSI, formatted according to 3GPP TS 23.003 [3], clause 2.2.
Supported Features (See 3GPP TS 29.229 [9])	Supported-Features	O	If present, this information element shall contain the list of features supported by the origin host.
MSISDN	MSISDN	C	This information element shall contain the user MSISDN, formatted according to 3GPP TS 29.329 [25]. It shall be present if available.
UVR Flags (See 7.3.153)	UVR-Flags	M	This Information Element contains a bit mask. See 7.3.153 for the meaning of the bits.
SGSN number (See 7.3.102)	SGSN-Number	C	This Information Element contains the ISDN number of the SGSN, see 3GPP TS 23.003 [3]. It shall be present when the message is sent on the S7d interface. It may be present when the message on the S7a interface and the requesting node is a combined MME/SGSN.

Table 5A.2.1.1.1/2: Update VCSG Location Answer

Information element name	Mapping to Diameter AVP	Cat.	Description
Supported Features (See 3GPP TS 29.229 [9])	Supported-Features	O	If present, this information element shall contain the list of features supported by the origin host.
Result (See 7.4)	Result-Code / Experimental-Result	M	This IE shall contain the result of the operation. The Result-Code AVP shall be used to indicate success / errors as defined in the Diameter base protocol (see IETF RFC 6733 [61]). The Experimental-Result AVP shall be used for S7a/S7d errors. This is a grouped AVP which shall contain the 3GPP Vendor ID in the Vendor-Id AVP, and the error code in the Experimental-Result-Code AVP. The following errors are applicable: - User Unknown
VPLMN CSG Subscription Data (See 7.3.155)	VPLMN-CSG-Subscription-Data	C	This Information Element shall contain the list of CSG Ids and the associated expiry dates stored in the CSS. It shall be present if success is reported, unless an explicit "skip subscriber data" indication was present in the request or the Temporary Empty VPLMN CSG Subscription Data flag is set.
UVA Flags (See 7.3.154)	UVA-Flags	C	This Information Element contains a bit mask. See 7.3.154 for the meaning of the bits.

5A.2.1.1.2   Detailed behaviour of the MME and the SGSN

The MME or SGSN shall make use of this procedure to register the UE in the CSS and to retrieve the "CSG subscription data from CSS" when:

-    the VPLMN supports Autonomous CSG Roaming

-    and the HPLMN has enabled Autonomous CSG Roaming in the VPLMN

-    and the UE has requested an initial attach or a tracking area procedure or a routing area procedure to a CSG cell

-    and the MME or SGSN have not yet registered the UE in the CSS.

If the Autonomous CSG Roaming in the VPLMN is not supported or is not allowed by the HPLMN of the subscriber, the MME or SGSN shall not make use of the Update CSG Location procedure.

For UEs receiving emergency services, in which the UE was not successfully authenticated, the MME or SGSN shall not make use of the Update VCSG Location procedure.

A combined MME/SGSN shall set the "Skip Subscriber Data" flag in the UVR-Flags if the "CSG subscription data from CSS" are already available due to a previously VCSG Location updating.

A combined MME/SGSN that has chosen the option to include the SGSN Number within an Update VCSG Request sent over S7a shall be prepared to receive a single CSG subscription data update message from the CSS when the CSG subscription data is modified in the CSS.

When receiving an Update VCSG Location Answer from the CSS, the MME or SGSN shall check the result code. If it indicates success the MME or SGSN shall delete all the stored "CSG subscription data from CSS" (if any) and then store the received "CSG subscription data from the CSS" (if any), and it shall store the CSS identity as received in the Origin-Host AVP.

If the same CSG Id exists in both "CSG subscription data from CSS" and "CSG subscription data from HSS", the "CSG subscription data from HSS" shall take precedence over the "CSG subscription data from CSS" in further use.

If an error response is received from the CSS, the MME or SGSN shall not reject the UE and shall end the procedure when the UE is attaching to a normal cell. If the UE is attaching to a CSG cell, in this case the MME or SGSN shall check if there is such CSG Id from the HSS. If there is no such CSG Id, the MME or SGSN shall reject the UE.

5A.2.1.1.3 Detailed behaviour of the CSS

When receiving an Update VCSG Location request the CSS shall check whether the user is known.

If the user is not known, and if the Update VCSG Location Request is received over the S7a/S7d interface, the CSS may:

- store the MME or SGSN identity received within the Origin-Host AVP, and include the UVA-Flags AVP with "Temporary Empty VPLMN CSG Subscription Data" flag set, and return a Result Code of DIAMETER_ SUCCESS, or

- return a Result Code of DIAMETER_ERROR_USER_UNKNOWN.

   NOTE: A mechanism is needed in the CSS to associate the CSG subscription data of the user with the received IMSI.

If the Update VCSG Location Request is received over the S7a/S7d interface, the CSS shall replace the stored MME or SGSN identity with the received value (the identity is received within the Origin-Host AVP).

If no result code indicating an error is sent to the MME or SGSN, the CSS shall include the VPLMN CSG subscription data in the Update VCSG Location Answer unless an explicit "skip subscriber data" indication has been received in the request, and shall return a Result Code of DIAMETER_SUCCESS.

5A.2.1.2 Cancel VCSG Location

5A.2.1.2.1 General

The Cancel VCSG Location Procedure shall be used between the CSS and the MME and between the CSS and the SGSN. The procedure shall be invoked by the CSS and is used:

- to inform the MME or SGSN about the subscriber's VCSG subscription withdrawal by the CSS operator and the removal of their registration in the CSS.

This procedure is mapped to the commands Cancel-VCSG-Location-Request/Answer (CVR/CVA) in the Diameter application specified in chapter 7.

Table 5A.2.1.2.1/1 specifies the involved information elements for the request.

Table 5A.2.1.2.1/2 specifies the involved information elements for the answer.

Table 5A.2.1.2.1/1: Cancel VCSG Location Request

Information element name	Mapping to Diameter AVP	Cat.	Description
IMSI	User-Name (See IETF RFC 673 3 [61])	M	This information element shall contain the user IMSI, formatted according to 3GPP TS 23.003 [3], clause 2.2.
Supported Features (See 3GPP TS 29.229 [9])	Supported-Features	O	If present, this information element shall contain the list of features supported by the origin host.
Cancellation Type (See 7.3.24)	Cancellation-Type	M	Defined values that can be used are: - Subscription Withdrawal, applied to the VPLMN CSG subscription.

Table 5A.2.1.2.1/2: Cancel VCSG Location Answer

Information element name	Mapping to Diameter AVP	Cat.	Description
Supported Features (See 3GPP TS 29.229 [9])	Supported-Features	O	If present, this information element shall contain the list of features supported by the origin host.
Result (See 7.4)	Result-Code / Experimental-Result	M	The result of the operation. The Result-Code AVP shall be used to indicate success / errors as defined in the Diameter base protocol (see IETF RFC 6733 [61]).

5A.2.1.2.2   Detailed behaviour of the MME and the SGSN

When receiving a Cancel VCSG Location request the MME or SGSN shall check whether the IMSI is known.

If it is not known, a result code of DIAMETER_SUCCESS is returned.

If it is known, the MME or SGSN shall check if the Cancellation Type is Subscription Withdrawal. In this case, the MME or SGSN shall remove the information of their registration in the CSS and the stored VPLMN CSG subscription if any. Also in this case a result code of DIAMETER_SUCCESS is returned.

When a UE is served by a single combined MME/SGSN for both E-UTRAN and non-E-UTRAN access, the combined MME/SGSN shall check if the Cancellation Type is Subscription Withdrawal. In this case, the Cancel VCSG Location request is processed both in the MME part and in the SGSN part of the combined node.

5A.2.1.2.3   Detailed behaviour of the CSS

The CSS shall make use of this procedure when the user's VPLMN CSG subscription is withdrawn by the CSS operator and shall include a cancellation type of "Subscription Withdrawal.

5A.2.2   Subscriber Data Handling Procedures

5A.2.2.1   Insert VCSG Subscriber Data

5A.2.2.1.1   General

The Insert VCSG Subscriber Data Procedure shall be used between the CSS and the MME and between the CSS and the SGSN for updating CSG subscription data in the MME or SGSN in the following situations:

- due to administrative changes of the user data in the CSS and the user is now located in an MME or SGSN, i.e. if the user was given a CSG subscription and the CSG subscription has changed;

If the CSS knows that the UE has attached to the same combined MME/SGSN via both the E-UTRAN and UTRAN/GERAN, i.e. the CSS has received the Update VCSG Location Request over both the S7a interface and S7d interface respectively with the same SGSN number, the CSS should invoke this procedure for a single time to update CSG subscription data in the combined MME/SGSN, i.e. the CSS should not invoke this procedure for each of the MME and the SGSN registered respectively.

This procedure is mapped to the commands Insert-Subscriber Data-Request/Answer (IDR/IDA) in the Diameter application specified in clause 7.

Table 5A.2.2.1.1/1 specifies the involved information elements for the request.

Table 5A.2.2.1.1/2 specifies the involved information elements for the answer.

Table 5A.2.2.1.1/1: Insert VCSG Subscriber Data Request

Information element name	Mapping to Diameter AVP	Cat.	Description
IMSI	User-Name (See IETF RFC 6733 [61])	M	This information element shall contain the user IMSI, formatted according to 3GPP TS 23.003 [3], clause 2.2.
Supported Features (See 3GPP TS 29.229 [9])	Supported-Features	O	If present, this information element shall contain the list of features supported by the origin host.
VPLMN CSG Subscription Data (See 7.3.2)	VPLMN-CSG-Subscription-Data	M	This Information Element shall contain the list of CSG Ids and the associated expiry dates stored in the VPLMN CSS.

Table 5A.2.2.1.1/2: Insert VCSG Subscriber Data Answer

Information element name	Mapping to Diameter AVP	Cat.	Description
Supported Features (See 3GPP TS 29.229 [9])	Supported-Features	O	If present, this information element shall contain the list of features supported by the origin host.
Result (See 7.4)	Result-Code / Experimental-Result	M	This IE shall contain the result of the operation. Result-Code AVP shall be used to indicate success / errors defined in the Diameter base protocol (see IETF RFC 6733 [61]).The Experimental-Result AVP shall be used for S7a/S7d errors. This is a grouped AVP which shall contain the 3GPP Vendor Id in the Vendor-Id AVP, and the error code in the Experimental-Result-Code AVP. The following errors are applicable in this case: - User Unknown.

5A.2.2.1.2   Detailed behaviour of the MME and the SGSN

When receiving an Insert VCSG Subscriber Data request, the MME or SGSN shall check whether the IMSI is known.

If it is not known, a result code of DIAMETER_ERROR_USER_UNKNOWN shall be returned.

If the request does not contain any CSG-Subscription-Data AVP, Experimental-Result shall be set to DIAMETER_ERROR_SUBS_DATA_ABSENT.

If the request contains at least one CSG-Subscription-Data AVPs, the MME or SGSN shall delete all the stored "CSG subscription data from CSS" (if any), and then store the received "CSG subscription data from CSS".

If the MME or SGSN cannot fulfil the received request, e.g. due to a database error, it shall set the Result-Code to DIAMETER_UNABLE_TO_COMPLY.

If the same CSG Id exists in both "CSG subscription data from CSS" and "CSG subscription data from HSS", the "CSG subscription data from HSS" shall take precedence over the "CSG subscription data from CSS" in further use.

5A.2.2.1.3   Detailed behaviour of CSS

The CSS shall make use of this procedure to delete the "CSG subscription data from CSS" stored in the MME or SGSN and replace them with the CSG subscription data sent.

If the CSS receives a Insert VCSG Subscriber Data answer with the Result Code DIAMETER_ERROR_USER_UNKNOWN, the CSS shall clear the stored MME or SGSN identity.

5A.2.2.2 Delete VCSG Subscriber Data

5A.2.2.2.1 General

This procedure shall be used between the CSS and the MME or between the CSS and the SGSN, to remove all the "CSG subscription data from CSS" stored in the MME or SGSN. The procedure shall be invoked by the CSS.

If the CSS knows that the UE has attached to the same combined MME/SGSN via both E-UTRAN and UTRAN/GERAN, i.e. the CSS has received the Update VCSG Location Request over both the S7a interface and S7d interface respectively with the same SGSN number, the CSS should invoke this procedure for a single time to remove all the "CSG subscription data from CSS" stored in the combined MME/SGSN, i.e. not invoke this procedure for each of the MME and the SGSN registered respectively.

This procedure is mapped to the commands Delete-Subscriber-Data-Request/Answer (DSR/DSA) in the S7a/S7d Diameter application specified in clause 7.

Table 5A.2.2.2.1/1 specifies the involved information elements for the request.

Table 5A.2.2.2.1/2 specifies the involved information elements for the answer.

Table 5A.2.2.2.1/1: Delete VCSG Subscriber Data Request

Information element name	Mapping to Diameter AVP	Cat.	Description
IMSI	User-Name (See IETF RFC 6733 [61])	M	This information element shall contain the user IMSI, formatted according to 3GPP TS 23.003 [3], clause 2.2.
Supported Features (See 3GPP TS 29.229 [9])	Supported-Features	O	If present, this information element shall contain the list of features supported by the origin host.
DSR Flags (See 7.3.25)	DSR-Flags	M	This Information Element shall contain a bit mask. See 7.3.25 for the meaning of the bits.

Table 5A.2.2.2.1/2: Delete VCSG Subscriber Data Answer

Information element name	Mapping to Diameter AVP	Cat.	Description
Supported Features (See 3GPP TS 29.229 [9])	Supported-Features	O	If present, this information element shall contain the list of features supported by the origin host.
Result (See 7.4)	Result-Code / Experimental-Result	M	This IE shall contain the result of the operation. The Result-Code AVP shall be used to indicate success / errors as defined in the Diameter base protocol (see IETF RFC 6733 [61]). The Experimental-Result AVP shall be used for S7a/S7d errors. This is a grouped AVP which shall contain the 3GPP Vendor ID in the Vendor-Id AVP, and the error code in the Experimental-Result-Code AVP. The following errors are applicable in this case: - User Unknown

5A.2.2.2.2 Detailed behaviour of the MME and the SGSN

When receiving a Delete VCSG Subscriber Data request, the MME or SGSN shall check whether the IMSI is known.

If it is not known, a result code of DIAMETER_ERROR_USER_UNKNOWN shall be returned.

If it is known, the MME or SGSN shall delete all the stored "CSG subscription data from CSS".

If the deletion of the subscription data succeeds in the MME or SGSN, the Result-Code shall be set to DIAMETER_SUCCESS.

If the MME or SGSN cannot fulfil the received request for other reasons, e.g. due to a database error, it shall set the Result-Code to DIAMETER_UNABLE_TO_COMPLY.

5A.2.2.2.3 Detailed behaviour of the CSS

The CSS shall make use of this procedure to remove all the CSG subscription data associated to CSS from the MME or SGSN.

NOTE: When a Delete VCSG Subscriber Data procedure occurs, the MME or SGSN remains registered in the CSS

If the CSS receives a Delete VCSG Subscriber Data answer with the Result Code DIAMETER_ERROR_USER_UNKNOWN from the MME or SGSN, the CSS shall clear the stored MME or SGSN identity.

5A.2.3 Fault Recovery Procedures

5A.2.3.1 VCSG Reset

5A.2.3.1.1 General

The VCSG Reset Procedure shall be used by the CSS, after a restart, to indicate to the MME and to the SGSN that a failure has occurred.

This procedure is mapped to the commands Reset-Request/Answer (RSR/RSA) in the S7a/S7d Diameter application specified in chapter 7.

Table 5A.2.3.1.1/1 specifies the involved information elements for the request.

Table 5A.2.3.1.1/2 specifies the involved information elements for the answer.

Table 5A.2.3.1.1/1: VCSG Reset Request

Information element name	Mapping to Diameter AVP	Cat.	Description
Supported Features (See 3GPP TS 29.229 [9])	Supported-Features	O	If present, this information element shall contain the list of features supported by the origin host.

Table 5A.2.3.1.1/2: VCSG Reset Answer

Information element name	Mapping to Diameter AVP	Cat.	Description
Result (See 7.4)	Result-Code / Experimental-Result	M	This IE shall contain the result of the operation. The Result-Code AVP shall be used to indicate success / errors as defined in the Diameter base protocol (see IETF RFC 6733 [61]). The Experimental-Result AVP shall be used for S7a/S7d errors. This is a grouped AVP which shall contain the 3GPP Vendor ID in the Vendor-Id AVP, and the error code in the Experimental-Result-Code AVP. There are no Experimental-Result codes applicable for this command.
Supported Features (See 3GPP TS 29.229 [9])	Supported-Features	O	If present, this information element shall contain the list of features supported by the origin host.

5A.2.3.1.2 Detailed behaviour of the MME and the SGSN

When receiving a VCSG Reset message, the MME or SGSN or combined MME/SGSN, for all roaming users for which they have a registration in CSS, shall mark "Location Information Confirmed in CSS" record as "Not Confirmed". The

MME or SGSN or combined MME/SGSN shall make use of the CSS Identity received in the Origin-Host AVP (by comparing it with the value stored after successful ULA) in order to determine which user records are impacted.

When, as described in 3GPP TS 23.007 [43], an event requiring the MME or SGSN to check the "CSG subscription data from CSS" occurs, and if the user record "Location Information Confirmed in CSS" is marked as "Not Confirmed", the restoration procedure shall be triggered.

5A.2.3.1.3 Detailed behaviour of the CSS

The CSS shall make use of this procedure in order to indicate to all relevant MMEs, SGSNs, and combined MME/SGSNs that the CSS has restarted and may have lost the current MME-Identity and SGSN-Identity of some of its users who may be currently roaming in the MME area and/or SGSN area, and to which the CSS, therefore, cannot send e.g. Insert VCSG Subscriber Data messages when needed.

The CSS should invoke this procedure towards a combined MME/SGSN only for a single time even if some of the impacted subscribers are attached to the combined MME/SGSN via UTRAN/GERAN and some of the impacted subscribers are attached to the combined MME/SGSN via E-UTRAN.

6 MME – EIR (S13) and SGSN – EIR (S13')

6.1 Introduction

The S13 interface shall enable the ME Identity check procedure between the MME and the EIR as described in the 3GPP TS 23.401 [2].

The S13' interface shall enable the ME Identity check procedure between the SGSN and the EIR as described in the 3GPP TS 23.060 [12].

6.2 ME Identity Check Procedures

6.2.1 ME Identity Check

6.2.1.1 General

This Mobile Equipment Identity Check Procedure shall be used between the MME and the EIR and between the SGSN and the EIR to check the Mobile Equipment's identity status (e.g. to check that it has not been stolen, or, to verify that it does not have faults).

This procedure is mapped to the commands ME-Identity-Check-Request/Answer (ECR/ECA) in the Diameter application specified in chapter 6.

Table 6.2.1.1/1 specifies the involved information elements for the request.

Table 6.2.1.1/2 specifies the involved information elements for the answer.

Table 6.2.1.1/1: ME Identity Check Request

Information element name	Mapping to Diameter AVP	Cat.	Description
Terminal Information (See 7.3.3)	Terminal-Information	M	This information element shall contain the information about the used mobile equipment i.e. the IMEI. Within this Information Element, only the IMEI and the Software-Version AVPs shall be used on the S13/S13' interface.
IMSI	User-Name (See IETF RFC 6733 [61])	O	This information element shall contain the user IMSI, formatted according to 3GPP TS 23.003 [3], clause 2.2.

Table 6.2.1.1/2: ME Identity Check Answer

Information element name	Mapping to Diameter AVP	Cat.	Description
Result (See 7.4)	Result-Code / Experimental-Result	M	This IE shall contain the result of the operation. The Result-Code AVP shall be used to indicate success / errors as defined in the Diameter base protocol (see IETF RFC 6733 [61]). The Experimental-Result AVP shall be used for S13/S13' errors. This is a grouped AVP which shall contain the 3GPP Vendor ID in the Vendor-Id AVP, and the error code in the Experimental-Result-Code AVP. The following errors are applicable in this case: - Unknown equipment
Equipment Status (See 7.3.51)	Equipment-Status	C	This information element shall contain the status of the requested mobile equipment as defined in 3GPP TS 22.016 [13]. It shall be present if the result of the ME Identity Check is DIAMETER_SUCCESS.

6.2.1.2 Detailed behaviour of the MME and the SGSN

The MME or the SGSN shall make use of this procedure to check the ME identity, if the MME or the SGSN is configured to check the IMEI with the EIR.

Terminal-Information, when sent by the MME/SGSN to the EIR, shall contain the IMEI AVP, and it may contain also the Software-Version AVP.

IMSI may be sent together with Terminal Information to the EIR for operator-determined purposes.

When receiving the ME Identity Check answer from the EIR, the MME or the SGSN shall check the result code and the equipment status. Dependent upon the result, the MME or the SGSN will decide its subsequent actions (e.g. sending an Attach Reject if the EIR indicates that the Mobile Equipment is unknown or blacklisted).

6.2.1.3 Detailed behaviour of the EIR

When receiving an ME Identity Check request, the EIR shall check whether the mobile equipment is known.

The EIR shall identify the mobile equipment based on the first 14 digits of the IMEI AVP; if a 15th digit is received in the IMEI AVP, this digit shall be ignored by the EIR.

Based on operator policies, the EIR may also use the Software-Version AVP, in addition to the first 14 digits of the IMEI AVP, to check the equipment identity against Black and Grey lists (see 3GPP TS 22.016 [13]).

If the mobile equipment identity is not known, a result code of DIAMETER_ERROR_ EQUIPMENT_UNKNOWN is returned.

If it is known, the EIR shall return DIAMETER_SUCCESS with the equipment status.

7 Protocol Specification and Implementation

7.1 Introduction

7.1.1 Use of Diameter base protocol

The Diameter base protocol as specified in IETF RFC 6733 [61] shall apply except as modified by the defined support of the methods and the defined support of the commands and AVPs, result and error codes as specified in this specification. Unless otherwise specified, the procedures (including error handling and unrecognised information handling) shall be used unmodified.

7.1.2 Securing Diameter Messages

For secure transport of Diameter messages, see 3GPP TS 33.210 [16].

If there are no intermediate Diameter Agent networks located between the visited PLMN and the home PLMN, the HSS or the first Diameter Agent located in the home PLMN which has direct connection with the serving network is required to check that the realm contained in the Origin-Realm AVP in the request from the serving network corresponds to the right serving network.

If there are intermediate Diameter Agent networks located between the visited PLMN and home PLMN, the first Diameter Agent which has direct connection with the serving network is required to check that the realm contained in the Origin-Realm AVP in the request from the serving network corresponds to the right serving network.

   NOTE 1: How to do the above check is implementation specific, e.g. it may be done by checking if the IP addresses of the serving network nodes match with the realm received in the Origin-Realm AVP in the request.

   NOTE 2: Network configurations where a (potential) visited PLMN acts as intermediate Diameter Agent network are not allowed.

   NOTE 3: In the case there are intermediate Diameter Agent networks, the home network has to trust these intermediate Diameter agent networks to do the check and other hop by hop security check. This trust is usually substantiated by contracts since there are no remote technical means to verify if the checks were actually performed.

7.1.3 Accounting functionality

Accounting functionality (Accounting Session State Machine, related command codes and AVPs) shall not be used on the S6a, S6d, S13 and S13' interfaces.

7.1.4 Use of sessions

Between the MME and the HSS and between the SGSN and the HSS and between the MME and the EIR, Diameter sessions shall be implicitly terminated. An implicitly terminated session is one for which the server does not maintain state information. The client shall not send any re-authorization or session termination requests to the server.

The Diameter base protocol specified in IETF RFC 6733 [61] includes the Auth-Session-State AVP as the mechanism for the implementation of implicitly terminated sessions.

The client (server) shall include in its requests (responses) the Auth-Session-State AVP set to the value NO_STATE_MAINTAINED (1), as described in IETF RFC 6733 [61]. As a consequence, the server shall not maintain any state information about this session and the client shall not send any session termination request. Neither the Authorization-Lifetime AVP nor the Session-Timeout AVP shall be present in requests or responses.

7.1.5 Transport protocol

Diameter messages over the S6a, S6d, S13, S13', S7a and S7d interfaces shall make use of SCTP IETF RFC 4960 [14].

7.1.6 Routing considerations

This clause specifies the use of the Diameter routing AVPs Destination-Realm and Destination-Host.

If an MME or SGSN knows the address/name of the HSS for a certain user, and the associated home network domain name, both the Destination-Realm and Destination-Host AVPs shall be present in the request.

> NOTE: When sending a ULR command for a certain user due to HSS restoration procedure (i.e, after the MME/SGSN have received a Reset command from the HSS), the MME or the SGSN might consider the stored address/name of the HSS for the user to be invalid and hence not known.

If an MME or SGSN knows only the home network domain name for a certain user, the Destination-Realm AVP shall be present and the command shall be routed to the next Diameter node.

If an MME or SGSN knows only the identity of the user, the home network domain name shall be derived from the user's IMSI (MNC and MCC values) to construct the EPC Home Network Realm/Domain, as indicated in 3GPP TS 23.003 [3], clause 19.2, and use it as Destination-Realm.

Consequently, the Destination-Host AVP is declared as optional in the ABNF for all requests initiated by an MME or SGSN.

The address/name of the EIR shall be locally configured in the MME.

Requests initiated by the HSS towards an MME or SGSN shall include both Destination-Host and Destination-Realm AVPs.

The HSS obtains the Destination-Host AVP to use in requests towards an MME or SGSN, from the Origin-Host AVP received in previous requests from the MME or SGSN. Consequently, the Destination-Host AVP is declared as mandatory in the ABNF for all requests initiated by the HSS. The Origin-Host AVP received in requests from the MME may contain a Diameter identity of the MME encoded as specified in subclause 19.4.2.4 of 3GPP TS 23.003 [3]. The Origin-Host AVP received in requests from the SGSN may contain a Diameter identity of the SGSN encoded as specified in subclause 19.4.2.6 of 3GPP TS 23.003 [3].

The HSS obtains the Destination-Realm AVP to use in requests towards an MME or SGSN, from the Origin-Realm AVP received in previous requests from the MME or SGSN. The Origin-Realm AVP in the requests received by the HSS in roaming cases, should contain the domain name of the network to which the MME or the SGSN belongs, encoded as specified in subclause 19.2 of 3GPP TS 23.003 [3].

The Destination-Realm AVP is declared as mandatory in the ABNF for all requests.

If the Vendor-Specific-Application-ID AVP is received in any of the commands defined in this specification, it shall be ignored by the receiving node, and it shall not be used for routing purposes.

7.1.7 Advertising Application Support

The HSS, MME, SGSN and EIR shall advertise support of the Diameter S6a/S6d and/or S13/S13' Application by including the value of the application identifier in the Auth-Application-Id AVP within the Vendor-Specific-Application-Id grouped AVP of the Capabilities-Exchange-Request and Capabilities-Exchange-Answer commands.

The vendor identifier value of 3GPP (10415) shall be included in the Supported-Vendor-Id AVP of the Capabilities-Exchange-Request and Capabilities-Exchange-Answer commands, and in the Vendor-Id AVP within the Vendor-Specific-Application-Id grouped AVP of the Capabilities-Exchange-Request and Capabilities-Exchange-Answer commands.

The Vendor-Id AVP included in Capabilities-Exchange-Request and Capabilities-Exchange-Answer commands that is not included in the Vendor-Specific-Application-Id AVPs as described above shall indicate the manufacturer of the Diameter node as per IETF RFC 6733 [61].

7.1.8 Diameter Application Identifier

This clause specifies three Diameter applications: The S6a/S6d interface application, the S13/S13' interface application, and the S7a/S7d interface application.

The S6a/S6d interface application allows a Diameter server and a Diameter client:

- to exchange location information;

- to authorize a user to access the EPS;

- to exchange authentication information;

- to download and handle changes in the subscriber data stored in the server.

The S6a/S6d interface protocol shall be defined as an IETF vendor specific Diameter application, where the vendor is 3GPP. The vendor identifier assigned by IANA to 3GPP (http://www.iana.org/assignments/enterprise-numbers) is 10415.

The Diameter application identifier assigned to the S6a/S6d interface application is 16777251 (allocated by IANA).

The S13/S13' interface application allows a Diameter server and a Diameter client:

- to check the validity of the ME Identity.

The S13/S13' interface protocol shall be defined as an IETF vendor specific Diameter application, where the vendor is 3GPP. The vendor identifier assigned by IANA to 3GPP (http://www.iana.org/assignments/enterprise-numbers) is 10415.

The Diameter application identifier assigned to the S13/S13' interface application is 16777252 (allocated by IANA).

The S7a/S7d interface application allows a Diameter server and a Diameter client:

- to authorize a user to access CSGs identified in the CSS while roaming;

- to download and handle changes in CSG subscriber data stored in the CSS.

The S7a/S7d interface protocol shall be defined as an IETF vendor specific Diameter application, where the vendor is 3GPP. The vendor identifier assigned by IANA to 3GPP (http://www.iana.org/assignments/enterprise-numbers) is 10415.

The Diameter application identifier assigned to the S7a/S7d interface application is 16777308 (allocated by IANA).

7.1.9   Use of the Supported-Features AVP

When new functionality is introduced on the S6a/S6d interfaces, it should be defined as optional. If backwards incompatible changes can not be avoided, the new functionality shall be introduced as a new feature and support advertised with the Supported-Features AVP. The usage of the Supported-Features AVP on the S6a/S6d interfaces is consistent with the procedures for the dynamic discovery of supported features as defined in clause 7.2 of 3GPP TS 29.229 [9].

When extending the application by adding new AVPs for a feature, the new AVPs shall have the M bit cleared and the AVP shall not be defined mandatory in the command ABNF.

As defined in 3GPP TS 29.229 [9], the Supported-Features AVP is of type grouped and contains the Vendor-Id, Feature-List-ID and Feature-List AVPs. On the all reference points as specified in this specificaion, the Supported-Features AVP is used to identify features that have been defined by 3GPP and hence, for features defined in this document, the Vendor-Id AVP shall contain the vendor ID of 3GPP (10415). If there are multiple feature lists defined for the reference point, the Feature-List-ID AVP shall differentiate those lists from one another.

The Table 7.3.10/1 defines the features applicable to the S6a/S6d interfaces for the feature list with a Feature-List-ID of 1. The Table 7.3.10/2 defines the features applicable to the S6a/S6d interfaces for the feature list with a Feature-List-ID of 2.

NOTE 1: If the support of a feature by the receiver is required in order for the receiver to be able to correctly process the request command, then the feature is included in the Supported-Features AVP and the M-bit of the Supported-Features AVP has to be set in the request command, according to 3GPP TS 29.229 [9] subclause 7.2.1.

NOTE 2:   Currently none of the features that can be included in the Supported-Features AVP of the ULR command requires that the HSS supports them to successfully process the ULR command. For this reason the MME or SGSN does not need to set the M-bit of the Supported-Features AVP in the ULR command. This corresponds to the exception to the general rule requiring the setting of the M-bit of the Supported-Features AVP in a request described in 3GPP TS 29.229 [9] subclause 7.2.1. Setting the M-bit of the Supported-Features AVP in the ULR command will mean that, if any of the features is not supported, the HSS will reject the ULR command as according to 3GPP TS 29.229 [9] subclause 7.2.1.

7.2   Commands

7.2.1   Introduction

This section defines the Command code values and related ABNF for each command described in this specification.

7.2.2   Command-Code values

This section defines Command-Code values for the S6a/S6d interface application and S13/S13' interface application as allocated by IANA in the IETF RFC 5516 [32].

Every command is defined by means of the ABNF syntax IETF RFC 2234 [7], according to the Command Code Format (CCF) specification defined in IETF RFC 6733 [61]. In the case, the definition and use of an AVP is not specified in this document, the guidelines in IETF RFC 6733 [61] shall apply.

The Vendor-Specific-Application-Id AVP shall not be included in any command sent by Diameter nodes supporting applications defined in this specification. If the Vendor-Specific-Application-Id AVP is received in any of the commands defined in this specification, it shall be ignored by the receiving node.

NOTE: The Vendor-Specific-Application-Id is included as an optional AVP in all Command Code Format specifications defined in this specification in order to overcome potential interoperability issues with intermediate Diameter agents non-compliant with the IETF RFC 6733 [61].

The following Command Codes are defined in this specification:

Table 7.2.2/1: Command-Code values for S6a/S6d

Command-Name	Abbreviation	Code	Section
Update-Location-Request	ULR	316	7.2.3
Update-Location-Answer	ULA	316	7.2.4
Cancel-Location-Request	CLR	317	7.2.7
Cancel-Location-Answer	CLA	317	7.2.8
Authentication-Information-Request	AIR	318	7.2.5
Authentication-Information-Answer	AIA	318	7.2.6
Insert-Subscriber-Data-Request	IDR	319	7.2.9
Insert-Subscriber-Data-Answer	IDA	319	7.2.10
Delete-Subscriber-Data-Request	DSR	320	7.2.11
Delete-Subscriber-Data-Answer	DSA	320	7.2.12
Purge-UE-Request	PUR	321	7.2.13
Purge-UE-Answer	PUA	321	7.2.14
Reset-Request	RSR	322	7.2.15
Reset-Answer	RSA	322	7.2.16
Notify-Request	NOR	323	7.2.17
Notify-Answer	NOA	323	7.2.18

For these commands, the Application-ID field shall be set to 16777251 (application identifier of the S6a/S6d interface application, allocated by IANA).

Table 7.2.2/2: Command-Code values for S13/S13'

Command-Name	Abbreviation	Code	Section
ME-Identity-Check-Request	ECR	324	7.2.19
ME-Identity-Check-Answer	ECA	324	7.2.20

For these commands, the Application-ID field shall be set to 16777252 (application identifier of the S13/S13' interface application, allocated by IANA).

Table 7.2.2/3: Command-Code values for S7a/S7d

Command-Name	Abbreviation	Code	Section
Update-VCSG-Location-Request	UVR	8388638	7.2.21
Update-VCSG-Location-Answer	UVA	8388638	7.2.22
Insert-Subscription-Data-Request	IDR	319	7.2.9
Insert-Subscription-Data-Answer	IDA	319	7.2.10
Delete-Subscriber-Data-Request	DSR	320	7.2.11
Delete-Subscriber-Data-Answer	DSA	320	7.2.12
Reset-Request	RSR	322	7.2.15
Reset-Answer	RSA	322	7.2.16
Cancel-VCSG-Location-Request	CVR	8388642	7.2.23
Cancel-VCSG-Location-Answer	CVA	8388642	7.2.24

For these commands, the Application-ID field shall be set to 16777308 (application identifier of the S7a/S7d interface application, allocated by IANA).

7.2.3 Update-Location-Request (ULR) Command

The Update-Location-Request (ULR) command, indicated by the Command-Code field set to 316 and the "R" bit set in the Command Flags field, is sent from MME or SGSN to HSS.

Message Format

```
< Update-Location-Request> ::=    < Diameter Header: 316, REQ, PXY, 16777251 >
                        < Session-Id >
                        [ DRMP ]
                        [ Vendor-Specific-Application-Id ]
                        { Auth-Session-State }
                        { Origin-Host }
                        { Origin-Realm }
                        [ Destination-Host ]
                        { Destination-Realm }
                        { User-Name }
                        [ OC-Supported-Features ]
                        *[ Supported-Features ]
                        [ Terminal-Information ]
                        { RAT-Type }
                        { ULR-Flags }
                        [UE-SRVCC-Capability ]
                        { Visited-PLMN-Id }
                        [ SGSN-Number ]
                        [ Homogeneous-Support-of-IMS-Voice-Over-PS-Sessions ]
                        [ GMLC-Address ]
                        *[ Active-APN ]
                        [ Equivalent-PLMN-List ]
                        [ MME-Number-for-MT-SMS ]
                        [ SMS-Register-Request ]
                        [ SGs-MME-Identity ]
                        [ Coupled-Node-Diameter-ID ]
                        [ Adjacent-PLMNs ]
```

```
                                      [ Supported-Services ]
                                      *[ AVP ]
                                      *[ Proxy-Info ]
                                      *[ Route-Record ]
```

7.2.4   Update-Location-Answer (ULA) Command

The Update-Location-Answer (ULA) command, indicated by the Command-Code field set to 316 and the 'R' bit cleared in the Command Flags field, is sent from HSS to MME or SGSN.

Message Format

```
    < Update-Location-Answer> ::=    < Diameter Header: 316, PXY, 16777251 >
                                     < Session-Id >
                                     [ DRMP ]
                                     [ Vendor-Specific-Application-Id ]
                                     [ Result-Code ]
                                     [ Experimental-Result ]
                                     [ Error-Diagnostic ]
                                     { Auth-Session-State }
                                     { Origin-Host }
                                     { Origin-Realm }
                                     [ OC-Supported-Features ]
                                     [ OC-OLR ]
                                     *[ Load ]
                                     *[ Supported-Features ]
                                     [ ULA-Flags ]
                                     [ Subscription-Data ]
                                     *[ Reset-ID ]
                                     *[ AVP ]
                                     [ Failed-AVP ]
                                     *[ Proxy-Info ]
                                     *[ Route-Record ]
```

7.2.5   Authentication-Information-Request (AIR) Command

The Authentication-Information-Request (AIR) command, indicated by the Command-Code field set to 318 and the 'R' bit set in the Command Flags field, is sent from MME or SGSN to HSS.

Message Format

```
    < Authentication-Information-Request> ::=    < Diameter Header: 318, REQ, PXY, 16777251 >
                                     < Session-Id >
                                     [ DRMP ]
                                     [ Vendor-Specific-Application-Id ]
                                     { Auth-Session-State }
                                     { Origin-Host }
                                     { Origin-Realm }
                                     [ Destination-Host ]
                                     { Destination-Realm }
                                     { User-Name }
                                     [ OC-Supported-Features ]
                                     *[Supported-Features]
                                     [ Requested-EUTRAN-Authentication-Info ]
                                     [ Requested-UTRAN-GERAN-Authentication-Info ]
                                     { Visited-PLMN-Id }
                                     [ AIR-Flags ]
                                     *[ AVP ]
                                     *[ Proxy-Info ]
                                     *[ Route-Record ]
```

7.2.6 Authentication-Information-Answer (AIA) Command

The Authentication-Information-Answer (AIA) command, indicated by the Command-Code field set to318 and the 'R' bit cleared in the Command Flags field, is sent from HSS to MME or SGSN.

Message Format

```
< Authentication-Information-Answer> ::=    < Diameter Header: 318, PXY, 16777251 >
                                       < Session-Id >
                                       [ DRMP ]
                                       [ Vendor-Specific-Application-Id ]
                                       [ Result-Code ]
                                       [ Experimental-Result ]
                                       [ Error-Diagnostic ]
                                       { Auth-Session-State }
                                       { Origin-Host }
                                       { Origin-Realm }
                                       [ OC-Supported-Features ]
                                       [ OC-OLR ]
                                       *[ Load ]
                                       *[Supported-Features]
                                       [ Authentication-Info ]
                                       [ UE-Usage-Type ]
                                       *[ AVP ]
                                       [ Failed-AVP ]
                                       *[ Proxy-Info ]
                                       *[ Route-Record ]
```

7.2.7 Cancel-Location-Request (CLR) Command

The Cancel-Location-Request (CLR) command, indicated by the Command-Code field set to 317 and the 'R' bit set in the Command Flags field, is sent from HSS to MME or SGSN.

Message Format

```
< Cancel-Location-Request> ::=    < Diameter Header: 317, REQ, PXY, 16777251 >
                                 < Session-Id >
                                 [ DRMP ]
                                 [ Vendor-Specific-Application-Id ]
                                 { Auth-Session-State }
                                 { Origin-Host }
                                 { Origin-Realm }
                                 { Destination-Host }
                                 { Destination-Realm }
                                 { User-Name }
                                 *[Supported-Features ]
                                 { Cancellation-Type }
                                 [ CLR-Flags ]
                                 *[ AVP ]
                                 *[ Proxy-Info ]
                                 *[ Route-Record ]
```

7.2.8 Cancel-Location-Answer (CLA) Command

The Cancel-Location-Answer (CLA) command, indicated by the Command-Code field set to 317 and the 'R' bit cleared in the Command Flags field, is sent from MME or SGSN to HSS.

Message Format

```
< Cancel-Location-Answer> ::=    < Diameter Header: 317, PXY, 16777251 >
                                < Session-Id >
                                [ DRMP ]
```

[Vendor-Specific-Application-Id]
*[Supported-Features]
[Result-Code]
[Experimental-Result]
{ Auth-Session-State }
{ Origin-Host }
{ Origin-Realm }
*[AVP]
[Failed-AVP]
*[Proxy-Info]
*[Route-Record]

7.2.9   Insert-Subscriber-Data-Request (IDR) Command

The Insert-Subscriber-Data-Request (IDR) command, indicated by the Command-Code field set to 319 and the 'R' bit set in the Command Flags field, is sent from HSS or CSS to MME or SGSN.

Message Format when used over the S6a or S6d application:

< Insert-Subscriber-Data-Request> ::=   < Diameter Header: 319, REQ, PXY, 16777251 >
< Session-Id >
[DRMP]
[Vendor-Specific-Application-Id]
{ Auth-Session-State }
{ Origin-Host }
{ Origin-Realm }
{ Destination-Host }
{ Destination-Realm }
{ User-Name }
*[Supported-Features]
{ Subscription-Data}
[IDR- Flags]
*[Reset-ID]
*[AVP]
*[Proxy-Info]
*[Route-Record]

Message Format when used over the S7a or S7d application:

< Insert-Subscriber-Data-Request> ::=   < Diameter Header: 319, REQ, PXY, 16777308 >
< Session-Id >
[DRMP]
[Vendor-Specific-Application-Id]
{ Auth-Session-State }
{ Origin-Host }
{ Origin-Realm }
{ Destination-Host }
{ Destination-Realm }
{ User-Name }
*[Supported-Features]
*{ VPLMN-CSG-Subscription-Data }
*[Reset-ID]
*[AVP]
*[Proxy-Info]
*[Route-Record]

7.2.10   Insert-Subscriber-Data-Answer (IDA) Command

The Insert-Subscriber-Data-Answer (IDA) command, indicated by the Command-Code field set to 319 and the 'R' bit cleared in the Command Flags field, is sent from MME or SGSN to HSS or CSS.

Message Format when used over the S6a or S6d application:

< Insert-Subscriber-Data-Answer> ::=   < Diameter Header: 319, PXY, 16777251 >
                                        < Session-Id >
                                        [DRMP]
                                        [Vendor-Specific-Application-Id]
                                        *[Supported-Features]
                                        [Result-Code]
                                        [Experimental-Result]
                                        { Auth-Session-State }
                                        { Origin-Host }
                                        { Origin-Realm }
                                        [IMS-Voice-Over-PS-Sessions-Supported]
                                        [Last-UE-Activity-Time]
                                        [RAT-Type]
                                        [IDA-Flags]
                                        [EPS-User-State]
                                        [EPS-Location-Information]
                                        [Local-Time-Zone]
                                        [Supported-Services]
                                        *[Monitoring-Event-Report]
                                        *[Monitoring-Event-Config-Status]
                                        *[AVP]
                                        [Failed-AVP]
                                        *[Proxy-Info]
                                        *[Route-Record]

Message Format when used over the S7a or S7d application:

< Insert-Subscriber-Data-Answer> ::=   < Diameter Header: 319, PXY, 16777308 >
                                        < Session-Id >
                                        [DRMP]
                                        [Vendor-Specific-Application-Id]
                                        *[Supported-Features]
                                        [Result-Code]
                                        [Experimental-Result]
                                        { Auth-Session-State }
                                        { Origin-Host }
                                        { Origin-Realm }
                                        *[AVP]
                                        [Failed-AVP]
                                        *[Proxy-Info]
                                        *[Route-Record]

7.2.11   Delete-Subscriber-Data-Request (DSR) Command

The Delete-Subscriber Data-Request (DSR) command, indicated by the Command-Code field set to 320 and the 'R' bit set in the Command Flags field, is sent from HSS or CSS to MME or SGSN.

Message Format when used over the S6a/S6d application:

< Delete-Subscriber-Data-Request > ::=   < Diameter Header: 320, REQ, PXY, 16777251 >
                                        < Session-Id >
                                        [DRMP]
                                        [Vendor-Specific-Application-Id]
                                        { Auth-Session-State }
                                        { Origin-Host }
                                        { Origin-Realm }
                                        { Destination-Host }
                                        { Destination-Realm }
                                        { User-Name }
                                        *[Supported-Features]
                                        { DSR-Flags }
                                        [SCEF-ID]
                                        *[Context-Identifier]

```
[ Trace-Reference ]
*[ TS-Code ]
*[ SS-Code ]
*[ AVP ]
*[ Proxy-Info ]
*[ Route-Record ]
```

The SCEF-ID shall be present when the flag "Delete monitoring events" in DSR-Flags AVP is set.

Message Format when used over the S7a/S7d application:

```
< Delete-Subscriber-Data-Request > ::=   < Diameter Header: 320, REQ, PXY, 16777308 >
                                    < Session-Id >
                                    [ DRMP ]
                                    [ Vendor-Specific-Application-Id ]
                                    { Auth-Session-State }
                                    { Origin-Host }
                                    { Origin-Realm }
                                    { Destination-Host }
                                    { Destination-Realm }
                                    { User-Name }
                                    *[ Supported-Features ]
                                    { DSR-Flags }
                                    *[ AVP ]
                                    *[ Proxy-Info ]
                                    *[ Route-Record ]
```

7.2.12   Delete-Subscriber-Data-Answer (DSA) Command

The Delete-Subscriber Data-Answer (DSA) command, indicated by the Command-Code field set to 320 and the 'R' bit cleared in the Command Flags field, is sent from MME or SGSN to HSS or CSS.

Message Format when used over the S6a/S6d application:

```
< Delete-Subscriber-Data-Answer> ::= < Diameter Header: 320, PXY, 16777251 >
                                    < Session-Id >
                                    [ DRMP ]
                                    [ Vendor-Specific-Application-Id ]
                                    *[ Supported-Features ]
                                    [ Result-Code ]
                                    [ Experimental-Result ]
                                    { Auth-Session-State }
                                    { Origin-Host }
                                    { Origin-Realm }
                                    [ DSA-Flags ]
                                    *[ AVP ]
                                    [ Failed-AVP ]
                                    *[ Proxy-Info ]
                                    *[ Route-Record ]
```

Message Format when used over the S7a /S7d application:

```
< Delete-Subscriber-Data-Answer> ::= < Diameter Header: 320, PXY, 16777308>
                                    < Session-Id >
                                    [ DRMP ]
                                    [ Vendor-Specific-Application-Id ]
                                    *[ Supported-Features ]
                                    [ Result-Code ]
                                    [ Experimental-Result ]
                                    { Auth-Session-State }
                                    { Origin-Host }
```

```
                                    { Origin-Realm }
                                    *[ AVP ]
                                    [ Failed-AVP ]
                                    *[ Proxy-Info ]
                                    *[ Route-Record ]
```

7.2.13   Purge-UE-Request (PUR) Command

The Purge-UE-Request (PUR) command, indicated by the Command-Code field set to 321 and the 'R' bit set in the Command Flags field, is sent from MME or SGSN to HSS.

Message Format

```
    < Purge-UE-Request> ::=    < Diameter Header: 321, REQ, PXY, 16777251 >
                                    < Session-Id >
                                    [ DRMP ]
                                    [ Vendor-Specific-Application-Id ]
                                    { Auth-Session-State }
                                    { Origin-Host }
                                    { Origin-Realm }
                                    [ Destination-Host ]
                                    { Destination-Realm }
                                    { User-Name }
                                    [ OC-Supported-Features ]
                                    [ PUR-Flags ]
                                    *[ Supported-Features ]
                                    [ EPS-Location-Information ]
                                    *[ AVP ]
                                    *[ Proxy-Info ]
                                    *[ Route-Record ]
```

7.2.14   Purge-UE-Answer (PUA) Command

The Purge-UE-Answer (PUA) command, indicated by the Command-Code field set to 321 and the 'R' bit cleared in the Command Flags field, is sent from HSS to MME or SGSN.

Message Format

```
    < Purge-UE-Answer> ::=    < Diameter Header: 321, PXY, 16777251 >
                                    < Session-Id >
                                    [ DRMP ]
                                    [ Vendor-Specific-Application-Id ]
                                    *[ Supported-Features ]
                                    [ Result-Code ]
                                    [ Experimental-Result ]
                                    { Auth-Session-State }
                                    { Origin-Host }
                                    { Origin-Realm }
                                    [ OC-Supported-Features ]
                                    [ OC-OLR ]
                                    *[ Load ]
                                    [ PUA-Flags ]
                                    *[ AVP ]
                                    [ Failed-AVP ]
                                    *[ Proxy-Info ]
                                    *[ Route-Record ]
```

7.2.15 Reset-Request (RSR) Command

The Reset-Request (RSR) command, indicated by the Command-Code field set to 322 and the 'R' bit set in the Command Flags field, is sent from HSS or CSS to MME or SGSN.

Message Format when used over the S6a/S6d application:

```
< Reset-Request> ::=      < Diameter Header: 322, REQ, PXY, 16777251 >
                          < Session-Id >
                          [ DRMP ]
                          [ Vendor-Specific-Application-Id ]
                          { Auth-Session-State }
                          { Origin-Host }
                          { Origin-Realm }
                          { Destination-Host }
                          { Destination-Realm }
                          *[ Supported-Features ]
                          *[ User-Id ]
                          *[ Reset-ID ]
                          [ Subscription-Data ]
                          [ Subscription-Data-Deletion ]
                          *[ AVP ]
                          *[ Proxy-Info ]
                          *[ Route-Record ]
```

Message Format when used over the S7a /S7d application:

```
< Reset-Request> ::=      < Diameter Header: 322, REQ, PXY, 16777308 >
                          < Session-Id >
                          [ DRMP ]
                          [ Vendor-Specific-Application-Id ]
                          { Auth-Session-State }
                          { Origin-Host }
                          { Origin-Realm }
                          { Destination-Host }
                          { Destination-Realm }
                          *[ Supported-Features ]
                          *[ Reset-ID ]
                          *[ AVP ]
                          *[ Proxy-Info ]
                          *[ Route-Record ]
```

7.2.16 Reset-Answer (RSA) Command

The Reset-Answer (RSA) command, indicated by the Command-Code field set to 322 and the 'R' bit cleared in the Command Flags field, is sent from MME or SGSN to HSS or CSS.

Message Format when used over the S6a/S6d application:

```
< Reset-Answer> ::=      < Diameter Header: 322, PXY, 16777251 >
                         < Session-Id >
                         [ DRMP ]
                         [ Vendor-Specific-Application-Id ]
                         *[ Supported-Features ]
                         [ Result-Code ]
                         [ Experimental-Result ]
                         { Auth-Session-State }
                         { Origin-Host }
                         { Origin-Realm }
                         *[ AVP ]
                         [ Failed-AVP ]
                         *[ Proxy-Info ]
```

                        *[Route-Record]

Message Format when used over the S7a /S7d application:

```
< Reset-Answer> ::=     < Diameter Header: 322, PXY, 16777308 >
                        < Session-Id >
                        [ DRMP ]
                        [ Vendor-Specific-Application-Id ]
                        *[ Supported-Features ]
                        [ Result-Code ]
                        [ Experimental-Result ]
                        { Auth-Session-State }
                        { Origin-Host }
                        { Origin-Realm }
                        *[ AVP ]
                        [ Failed-AVP ]
                        *[ Proxy-Info ]
                        *[ Route-Record ]
```

7.2.17   Notify-Request (NOR) Command

The Notify-Request (NOR) command, indicated by the Command-Code field set to 323 and the 'R' bit set in the Command Flags field, is sent from MME or SGSN to HSS.

Message Format

```
< Notify-Request> ::=   < Diameter Header: 323, REQ, PXY, 16777251 >
                        < Session-Id >
                        [ Vendor-Specific-Application-Id ]
                        [ DRMP ]
                        { Auth-Session-State }
                        { Origin-Host }
                        { Origin-Realm }
                        [ Destination-Host ]
                        { Destination-Realm }
                        { User-Name }
                        [ OC-Supported-Features ]
                        * [ Supported-Features ]
                        [ Terminal-Information ]
                        [ MIP6-Agent-Info ]
                        [ Visited-Network-Identifier ]
                        [ Context-Identifier ]
                        [Service-Selection]
                        [ Alert-Reason ]
                        [ UE-SRVCC-Capability ]
                        [ NOR-Flags ]
                        [ Homogeneous-Support-of-IMS-Voice-Over-PS-Sessions ]
                        [ Maximum-UE-Availability-Time ]
                        *[ Monitoring-Event-Config-Status ]
                        [ Emergency-Services ]
                        *[ AVP ]
                        *[ Proxy-Info ]
                        *[ Route-Record ]
```

7.2.18   Notify-Answer (NOA) Command

The Notify-Answer (NOA) command, indicated by the Command-Code field set to 323 and the 'R' bit cleared in the Command Flags field, is sent from HSS to MME or SGSN.

Message Format

```
< Notify-Answer> ::=    < Diameter Header: 323, PXY, 16777251 >
                        < Session-Id >
                        [ DRMP ]
                        [ Vendor-Specific-Application-Id ]
                        [ Result-Code ]
                        [ Experimental-Result ]
                        { Auth-Session-State }
                        { Origin-Host }
                        { Origin-Realm }
                        [ OC-Supported-Features ]
                        [ OC-OLR ]
                        *[ Load ]
                        *[ Supported-Features ]
                        *[ AVP ]
                        [ Failed-AVP ]
                        *[ Proxy-Info ]
                        *[ Route-Record ]
```

7.2.19   ME-Identity-Check-Request (ECR) Command

The ME-Identity-Check-Request (ECR) command, indicated by the Command-Code field set to 324 and the 'R' bit set in the Command Flags field, is sent from MME or SGSN to EIR.

Message Format

```
< ME-Identity-Check-Request > ::=    < Diameter Header: 324, REQ, PXY, 16777252 >
                                     < Session-Id >
                                     [ DRMP ]
                                     [ Vendor-Specific-Application-Id ]
                                     { Auth-Session-State }
                                     { Origin-Host }
                                     { Origin-Realm }
                                     [ Destination-Host ]
                                     { Destination-Realm }
                                     { Terminal-Information }
                                     [ User-Name ]
                                     *[ AVP ]
                                     *[ Proxy-Info ]
                                     *[ Route-Record ]
```

7.2.20   ME-Identity-Check-Answer (ECA) Command

The ME-Identity-Check-Answer (ECA) command, indicated by the Command-Code field set to 324 and the 'R' bit cleared in the Command Flags field, is sent from EIR to MME or SGSN.

Message Format

```
< ME-Identity-Check-Answer> ::=    < Diameter Header: 324, PXY, 16777252 >
                                   < Session-Id >
                                   [ DRMP ]
                                   [ Vendor-Specific-Application-Id ]
                                   [ Result-Code ]
                                   [ Experimental-Result ]
                                   { Auth-Session-State }
                                   { Origin-Host }
                                   { Origin-Realm }
                                   [ Equipment-Status ]
                                   *[ AVP ]
                                   [ Failed-AVP ]
                                   *[ Proxy-Info ]
                                   *[ Route-Record ]
```

7.2.21 Update-VCSG-Location-Request (UVR) Command

The Update-VCSG-Location-Request (UVR) command, indicated by the Command-Code field set to 8388638 and the "R" bit set in the Command Flags field, is sent from MME or SGSN to CSS.

Message Format

```
< Update-VCSG-Location-Request> ::=   < Diameter Header: 8388638, REQ, PXY, >
                                < Session-Id >
                                [ DRMP ]
                                [ Vendor-Specific-Application-Id ]
                                { Auth-Session-State }
                                { Origin-Host }
                                { Origin-Realm }
                                [ Destination-Host ]
                                { Destination-Realm }
                                { User-Name }
                                [ MSISDN ]
                                [ SGSN-Number ]
                                *[ Supported-Features ]
                                { UVR-Flags }
                                *[ AVP ]
                                *[ Proxy-Info ]
                                *[ Route-Record ]
```

7.2.22 Update-VCSG-Location-Answer (UVA) Command

The Update-VCSG-Location-Answer (UVA) command, indicated by the Command-Code field set to 8388638 and the 'R' bit cleared in the Command Flags field, is sent from CSS to MME or SGSN.

Message Format

```
< Update-VCSG-Location-Answer> ::=   < Diameter Header: 8388638, PXY, >
                                < Session-Id >
                                [ DRMP ]
                                [ Vendor-Specific-Application-Id ]
                                [ Result-Code ]
                                [ Experimental-Result ]
                                [ Error-Diagnostic ]
                                { Auth-Session-State }
                                { Origin-Host }
                                { Origin-Realm }
                                *[ Supported-Features ]
                                *[ VPLMN-CSG-Subscription-Data ]
                                [ UVA-Flags ]
                                *[ AVP ]
                                [ Failed-AVP ]
                                *[ Proxy-Info ]
                                *[ Route-Record ]
```

7.2.23 Cancel-VCSG-Location-Request (CVR) Command

The Cancel-VCSG-Location-Request (CVR) command, indicated by the Command-Code field set to 8388642 and the 'R' bit set in the Command Flags field, is sent from CSS to MME or SGSN.

Message Format

```
< Cancel-VCSG-Location-Request> ::=   < Diameter Header: 8388642, REQ, PXY, >
                                < Session-Id >
                                [ DRMP ]
                                [ Vendor-Specific-Application-Id ]
                                { Auth-Session-State }
```

                                    { Origin-Host }
                                    { Origin-Realm }
                                    { Destination-Host }
                                    { Destination-Realm }
                                    { User-Name }
                                    *[Supported-Features]
                                    { Cancellation-Type }
                                    *[AVP]
                                    *[Proxy-Info]
                                    *[Route-Record]

7.2.24   Cancel-VCSG-Location-Answer (CVA) Command

The Cancel-VCSG-Location-Answer (CVA) command, indicated by the Command-Code field set to 8388642 and the
'R' bit cleared in the Command Flags field, is sent from MME or SGSN to CSS.

Message Format

        < Cancel-VCSG-Location-Answer> ::=   < Diameter Header: 8388642, PXY, >
                                    < Session-Id >
                                    [DRMP]
                                    [Vendor-Specific-Application-Id]
                                    *[Supported-Features]
                                    [Result-Code]
                                    [Experimental-Result]
                                    { Auth-Session-State }
                                    { Origin-Host }
                                    { Origin-Realm }
                                    *[AVP]
                                    [Failed-AVP]
                                    *[Proxy-Info]
                                    *[Route-Record]

7.3 Information Elements

7.3.1 General

The following table specifies the Diameter AVPs defined for the S6a/S6d interface protocol, the S7a/S7d interface protocol and the S13/S13' interface protocol, their AVP Code values, types, possible flag values and whether or not the AVP may be encrypted. The Vendor-ID header of all AVPs defined in this specification shall be set to 3GPP (10415).

For all AVPs which contain bit masks and are of the type Unsigned32, e.g., ULR-Flags, DSR-Flags, PUA-Flags, etc., bit 0 shall be the least significant bit. For example, to get the value of bit 0, a bit mask of 0x0001 should be used.

Table 7.3.1/1: S6a/S6d, S7a/S7d and S13/S13' specific DiameterAVPs

| Attribute Name | AVP Code | Section defined | Value Type | AVP Flag rules | | | | |
				Must	May	Should not	Must not	May Encr.
Subscription-Data	1400	7.3.2	Grouped	M, V				No
Terminal-Information	1401	7.3.3	Grouped	M, V				No
IMEI	1402	7.3.4	UTF8String	M, V				No
Software-Version	1403	7.3.5	UTF8String	M, V				No
QoS-Subscribed	1404	7.3.77	OctetString	M, V				No
ULR-Flags	1405	7.3.7	Unsigned32	M, V				No
ULA-Flags	1406	7.3.8	Unsigned32	M, V				No
Visited-PLMN-Id	1407	7.3.9	OctetString	M, V				No
Requested-EUTRAN-Authentication-Info	1408	7.3.11	Grouped	M, V				No
Requested-UTRAN-GERAN-Authentication-Info	1409	7.3.12	Grouped	M, V				No
Number-Of-Requested-Vectors	1410	7.3.14	Unsigned32	M, V				No
Re-Synchronization-Info	1411	7.3.15	OctetString	M, V				No
Immediate-Response-Preferred	1412	7.3.16	Unsigned32	M, V				No
Authentication-Info	1413	7.3.17	Grouped	M, V				No
E-UTRAN-Vector	1414	7.3.18	Grouped	M, V				No
UTRAN-Vector	1415	7.3.19	Grouped	M, V				No
GERAN-Vector	1416	7.3.20	Grouped	M, V				No
Network-Access-Mode	1417	7.3.21	Enumerated	M, V				No
HPLMN-ODB	1418	7.3.22	Unsigned32	M, V				No
Item-Number	1419	7.3.23	Unsigned32	M, V				No
Cancellation-Type	1420	7.3.24	Enumerated	M, V				No
DSR-Flags	1421	7.3.25	Unsigned32	M, V				No
DSA-Flags	1422	7.3.26	Unsigned32	M, V				No
Context-Identifier	1423	7.3.27	Unsigned32	M, V				No
Subscriber-Status	1424	7.3.29	Enumerated	M, V				No
Operator-Determined-Barring	1425	7.3.30	Unsigned32	M, V				No
Access-Restriction-Data	1426	7.3.31	Unsigned32	M, V				No
APN-OI-Replacement	1427	7.3.32	UTF8String	M, V				No
All-APN-Configurations-Included-Indicator	1428	7.3.33	Enumerated	M, V				No
APN-Configuration-Profile	1429	7.3.34	Grouped	M, V				No
APN-Configuration	1430	7.3.35	Grouped	M, V				No
EPS-Subscribed-QoS-Profile	1431	7.3.37	Grouped	M, V				No
VPLMN-Dynamic-Address-Allowed	1432	7.3.38	Enumerated	M, V				No
STN-SR	1433	7.3.39	OctetString	M, V				No
Alert-Reason	1434	7.3.83	Enumerate	M, V				No
AMBR	1435	7.3.41	Grouped	M, V				No
CSG-Subscription-Data	1436	7.3.78	Grouped	M. V				No
CSG-Id	1437	7.3.79	Unsigned32	M, V				No
PDN-GW-Allocation-Type	1438	7.3.44	Enumerated	M, V				No
Expiration-Date	1439	7.3.80	Time	M, V				No
RAT-Frequency-Selection-Priority-ID	1440	7.3.46	Unsigned32	M, V				No
IDA-Flags	1441	7.3.47	Unsigned32	M, V				No
PUA-Flags	1442	7.3.48	Unsigned32	M, V				No
NOR-Flags	1443	7.3.49	Unsigned32	M, V				No
User-Id	1444	7.3.50	UTF8String	V			M	No
Equipment-Status	1445	7.3.51	Enumerated	M, V				No
Regional-Subscription-Zone-Code	1446	7.3.52	OctetString	M, V				No

RAND	1447	7.3.53	OctetString	M, V				No
XRES	1448	7.3.54	OctetString	M, V				No
AUTN	1449	7.3.55	OctetString	M, V				No
KASME	1450	7.3.56	OctetString	M, V				No
Trace-Collection-Entity	1452	7.3.98	Address	M, V				No
Kc	1453	7.3.59	OctetString	M, V				No
SRES	1454	7.3.60	OctetString	M, V				No
PDN-Type	1456	7.3.62	Enumerated	M, V				No
Roaming-Restricted-Due-To-Unsupported-Feature	1457	7.3.81	Enumerated	M, V				No
Trace-Data	1458	7.3.63	Grouped	M, V				No
Trace-Reference	1459	7.3.64	OctetString	M, V				No
Trace-Depth	1462	7.3.67	Enumerated	M, V				No
Trace-NE-Type-List	1463	7.3.68	OctetString	M, V				No
Trace-Interface-List	1464	7.3.69	OctetString	M, V				No
Trace-Event-List	1465	7.3.70	OctetString	M, V				No
OMC-Id	1466	7.3.71	OctetString	M, V				No
GPRS-Subscription-Data	1467	7.3.72	Grouped	M, V				No
Complete-Data-List-Included-Indicator	1468	7.3.73	Enumerated	M, V				No
PDP-Context	1469	7.3.74	Grouped	M, V				No
PDP-Type	1470	7.3.75	OctetString	M, V				No
3GPP2-MEID	1471	7.3.6	OctetString	M, V				No
Specific-APN-Info	1472	7.3.82	Grouped	M, V				No
LCS-Info	1473	7.3.84	Grouped	M, V				No
GMLC-Number	1474	7.3.85	OctetString	M, V				No
LCS-PrivacyException	1475	7.3.86	Grouped	M, V				No
SS-Code	1476	7.3.87	OctetString	M, V				No
SS-Status	1477	7.3.88	OctetString	M, V				No
Notification-To-UE-User	1478	7.3.89	Enumerated	M, V				No
External-Client	1479	7.3.90	Grouped	M, V				No
Client-Identity	1480	7.3.91	OctetString	M, V				No
GMLC-Restriction	1481	7.3.92	Enumerated	M, V				No
PLMN-Client	1482	7.3.93	Enumerated	M, V				No
Service-Type	1483	7.3.94	Grouped	M, V				No
ServiceTypeIdentity	1484	7.3.95	Unsigned32	M, V				No
MO-LR	1485	7.3.96	Grouped	M, V				No
Teleservice-List	1486	7.3.99	Grouped	M, V				No
TS-Code	1487	7.3.100	OctetString	M, V				No
Call-Barring-Info	1488	7.3.101	Grouped	M, V				No
SGSN-Number	1489	7.3.102	OctetString	M, V				No
IDR-Flags	1490	7.3.103	Unsigned32	M, V				No
ICS-Indicator	1491	7.3.104	Enumerated	V			M	No
IMS-Voice-Over-PS-Sessions-Supported	1492	7.3.106	Enumerated	V			M	No
Homogeneous-Support-of-IMS-Voice-Over-PS-Sessions	1493	7.3.107	Enumerated	V			M	No
Last-UE-Activity-Time	1494	7.3.108	Time	V			M	No
EPS-User-State	1495	7.3.110	Grouped	V			M	No
EPS-Location-Information	1496	7.3.111	Grouped	V			M	No
MME-User-State	1497	7.3.112	Grouped	V			M	No
SGSN-User-State	1498	7.3.113	Grouped	V			M	No
User-State	1499	7.3.114	Enumerated	V			M	No
MME-Location Information	1600	7.3.115	Grouped	V			M	No
SGSN-Location-Information	1601	7.3.116	Grouped	V			M	No

E-UTRAN-Cell-Global-Identity	1602	7.3.117	OctetString	V			M	No
Tracking-Area-Identity	1603	7.3.118	OctetString	V			M	No
Cell-Global-Identity	1604	7.3.119	OctetString	V			M	No
Routing-Area-Identity	1605	7.3.120	OctetString	V			M	No
Location-Area-Identity	1606	7.3.121	OctetString	V			M	No
Service-Area-Identity	1607	7.3.122	OctetString	V			M	No
Geographical-Information	1608	7.3.123	OctetString	V			M	No
Geodetic-Information	1609	7.3.124	OctetString	V			M	No
Current-Location-Retrieved	1610	7.3.125	Enumerated	V			M	No
Age-Of-Location-Information	1611	7.3.126	Unsigned32	V			M	No
Active-APN	1612	7.3.127	Grouped	V			M	No
Error-Diagnostic	1614	7.3.128	Enumerated	V			M	No
Ext-PDP-Address	1621	7.3.129	Address	V			M	No
UE-SRVCC-Capability	1615	7.3.130	Enumerated	V			M	No
MPS-Priority	1616	7.3.131	Unsigned32	V			M	No
VPLMN-LIPA-Allowed	1617	7.3.132	Enumerated	V			M	No
LIPA-Permission	1618	7.3.133	Enumerated	V			M	No
Subscribed-Periodic-RAU-TAU-Timer	1619	7.3.134	Unsigned32	V			M	No
Ext-PDP-Type	1620	7.3.75A	OctetString	V			M	No
SIPTO-Permission	1613	7.3.135	Enumerated	V			M	No
MDT-Configuration	1622	7.3.136	Grouped	V			M	No
Job-Type	1623	7.3.137	Enumerated	V			M	No
Area-Scope	1624	7.3.138	Grouped	V			M	No
List-Of-Measurements	1625	7.3.139	Unsigned32	V			M	No
Reporting-Trigger	1626	7.3.140	Unsigned32	V			M	No
Report-Interval	1627	7.3.141	Enumerated	V			M	No
Report-Amount	1628	7.3.142	Enumerated	V			M	No
Event-Threshold-RSRP	1629	7.3.143	Unsigned32	V			M	No
Event-Threshold-RSRQ	1630	7.3.144	Unsigned32	v			M	No
Logging-Interval	1631	7.3.145	Enumerated	V			M	No
Logging-Duration	1632	7.3.146	Enumerated	V			M	No
Relay-Node-Indicator	1633	7.3.147	Enumerated	V			M	No
MDT-User-Consent	1634	7.3.148	Enumerated	V			M	No
PUR-Flags	1635	7.3.149	Unsigned32	V			M	No
Subscribed-VSRVCC	1636	7.3.150	Enumerated	V			M	No
Equivalent-PLMN-List	1637	7.3.151	Grouped	V			M	No
CLR-Flags	1638	7.3.152	Unsigned32	V			M	No
UVR-Flags	1639	7.3.153	Unsigned32	M, V				No
UVA-Flags	1640	7.3.154	Unsigned32	M, V				No
VPLMN-CSG-Subscription-Data	1641	7.3.155	Grouped	M, V				No

Time-Zone	1642	7.3.163	UTF8String	V			M	No
A-MSISDN	1643	7.3.157	OctetString	V			M	No
MME-Number-for-MT-SMS	1645	7.3.159	OctetString	V			M	No
SMS-Register-Request	1648	7.3.162	Enumerated	V			M	No
Local-Time-Zone	1649	7.3.156	Grouped	V			M	No
Daylight-Saving-Time	1650	7.3.164	Enumerated	V			M	No
Subscription-Data-Flags	1654	7.3.165	Unsigned32	V			M	No
Measurement-Period-LTE	1655	7.3.166	Enumerated	V			M	No
Measurement-Period-UMTS	1656	7.3.167	Enumerated	V			M	No
Collection-Period-RRM-LTE	1657	7.3.168	Enumerated	V			M	No
Collection-Period-RRM-UMTS	1658	7.3.169	Enumerated	V			M	No
Positioning-Method	1659	7.3.170	OctetString	V			M	No
Measurement-Quantity	1660	7.3.171	OctetString	V			M	No
Event-Threshold-Event-1F	1661	7.3.172	Integer32	V			M	No
Event-Threshold-Event-1I	1662	7.3.173	Integer32	V			M	No
Restoration-Priority	1663	7.3.174	Unsigned32	V			M	No
SGs-MME-Identity	1664	7.3.175	UTF8String	V			M	No
SIPTO-Local-Network-Permission	1665	7.3.176	Unsigned32	V			M	No
Coupled-Node-Diameter-ID	1666	7.3.177	DiameterIdentity	V			M	No
WLAN-offloadability	1667	7.3.181	Grouped	V			M	No
WLAN-offloadability-EUTRAN	1668	7.3.182	Unsigned32	V			M	No
WLAN-offloadability-UTRAN	1669	7.3.183	Unsigned32	V			M	No
Reset-ID	1670	7.3.184	OctetString	V			M	No
MDT-Allowed-PLMN-Id	1671	7.3.185	OctetString	V			M	No
Adjacent-PLMNs	1672	7.3.186	Grouped	V			M	No
Adjacent-Access-Restriction-Data	1673	7.3.187	Grouped	V			M	No
DL-Buffering-Suggested-Packet-Count	1674	7.3.188	Integer32	V			M	No
IMSI-Group-Id	1675	7.3.189	Grouped	V			M	No
Group-Service-Id	1676	7.3.190	Unsigned32	V			M	No
Group-PLMN-Id	1677	7.3.191	OctetString	V			M	No
Local-Group-Id	1678	7.3.192	OctetString	V			M	No
AIR-Flags	1679	7.3.201	Unsigned32	V			M	No
UE-Usage-Type	1680	7.3.202	Unsigned32	V			M	No
Non-IP-PDN-Type-Indicator	1681	7.3.204	Enumerated	V			M	No
Non-IP-Data-Delivery-Mechanism	1682	7.3.205	Unsigned32	V			M	No
Additional-Context-ID	1683	7.3.206	Unsigned32	V			M	No
SCEF-Realm	1684	7.3.207	DiameterIdentity	V			M	No
Subscription-Data-Deletion	1685	7.3.208	Grouped	V			M	No
Preferred-Data-Mode	1686	7.3.209	Grouped	V			M	No
Emergency-Info	1687	7.3.210	Grouped	V			M	No
V2X-Subscription-Data	1688	7.3.212	Grouped	V			M	No
V2X-Permission	1689	7.3.213	Unsigned32	V			M	No
PDN-Connection-Continuity	1690	7.3.214	Unsigned32	V			M	No
eDRX-Cycle-Length	1691	7.3.215	Grouped	V			M	No
eDRX-Cycle-Length-Value	1692	7.3.216	OctetString	V			M	No
UE-PC5-AMBR	1693	7.3.217	Unsigned32	V			M	No
MBSFN-Area	1694	7.3.219	Grouped	V			M	No
MBSFN-Area-ID	1695	7.3.220	Unsigned32	V			M	No
Carrier-Frequency	1696	7.3.221	Unsigned32	V			M	No

RDS-Indicator	1697	7.3.222	Enumerated	V			M	No
NOTE 1:	The AVP header bit denoted as "M", indicates whether support of the AVP is required. The AVP header bit denoted as "V", indicates whether the optional Vendor-ID field is present in the AVP header. For further details, see IETF RFC 6733 [61].							
NOTE 2:	If the M-bit is set for an AVP and the receiver does not understand the AVP, it shall return a rejection. If the M-bit is not set for an AVP, the receiver shall not return a rejection, whether or not it understands the AVP. If the receiver understands the AVP but the M-bit value does not match with the definition in this table, the receiver shall ignore the M-bit.							

The following table specifies the Diameter AVPs re-used by the S6a/S6d interface protocol from existing Diameter Applications, including a reference to their respective specifications and when needed, a short description of their use within S6a and S6d.

Any other AVPs from existing Diameter Applications, except for the AVPs from Diameter base protocol specified in IETF RFC 6733 [61], do not need to be supported. The AVPs from the Diameter base protocol specified in IETF RFC 6733 [61] are not included in table 7.3.1/2, but they may be re-used for the S6a/S6d protocol, the S7a/S7protocol and the S13/S13' protocol.

**Table 7.3.1/2: S6a/S6d, S7a/S7d and S13/S13' re-used
Diameter AVPs**

Attribute Name	Reference	Comments	M-bit
Service-Selection	IETF RFC 5778 [20]	See section 7.3.36	
3GPP-Charging-Characteristics	3GPP TS 29.061 [21]	See 3GPP TS 32.251 [33] Annex A and 3GPP TS 32.298 [22] section 5.1.2.2.7 This attribute holds the EPS PDN Connection Charging Characteristics data for an EPS APN Configuration, or the PDP context Charging Characteristics for GPRS PDP context, or the Subscribed Charging Characteristics data for the subscriber level 3GPP Charging Characteristics; refer to 3GPP TS 23.008 [30].	
Supported-Features	3GPP TS 29.229 [9]		
Feature-List-ID	3GPP TS 29.229 [9]		
Feature-List	3GPP TS 29.229 [9]	See section 7.3.10	
Served-Party-IP-Address	3GPP TS 32.299 [8]	holds the PDN IP Address of the user	
QoS-Class-Identifier	3GPP TS 29.212 [10]		
Allocation-Retention-Priority	3GPP TS 29.212 [10]	See section 7.3.40	
Priority-Level	3GPP TS 29.212 [10]		
Pre-emption-Capability	3GPP TS 29.212 [10]		
Pre-emption-Vulnerability	3GPP TS 29.212 [10]		
Max-Requested-Bandwidth-DL	3GPP TS 29.214 [11]		
Max-Requested-Bandwidth-UL	3GPP TS 29.214 [11]		
Extended-Max-Requested-BW-DL	3GPP TS 29.214 [11]		
Extended-Max-Requested-BW-UL	3GPP TS 29.214 [11]		
RAT-Type	3GPP TS 29.212 [10]	See section 7.3.13	Must set
MSISDN	3GPP TS 29.329 [25]		
MIP6-Agent-Info	IETF RFC 5447 [26]		
MIP-Home-Agent-Address	IETF RFC 4004 [27]		
MIP-Home-Agent-Host	IETF RFC 4004 [27]		
PDP-Address	3GPP TS 32.299 [8]		
Confidentiality-Key	3GPP TS 29.229 [9]	See section 7.3.57	
Integrity-Key	3GPP TS 29.229 [9]	See section 7.3.58	
Visited-Network-Identifier	3GPP TS 29.229 [9]	See section 7.3.105	Must not set
GMLC-Address	3GPP TS 29.173 [37]	See section 7.3.109	Must not set
User-CSG-Information	3GPP TS 32.299 [8]		Must not set
ProSe-Subscription-Data	3GPP TS 29.344 [49]	See section 7.3.180	Must not set
OC-Supported-Features	IETF RFC 7683 [50]	See section 7.3.178	Must not set
OC-OLR	IETF RFC 7683 [50]	See section 7.3.179	Must not set

Attribute Name	Reference	Comments	M-bit
SCEF-Reference-ID	3GPP TS 29.336 [54]		Must not set
SCEF-ID	3GPP TS 29.336 [54]		Must not set
AESE-Communication-Pattern	3GPP TS 29.336 [54]	see section 7.3.193	Must not set
Communication-Pattern-set	3GPP TS 29.336 [54]	see section 7.3.194	Must not set
Monitoring-Event-Configuration	3GPP TS 29.336 [54]	See section 7.3.195	Must not set
Monitoring-Event-Report	3GPP TS 29.336 [54]	See section 7.3.196	Must not set
UE-Reachability-Configuration	3GPP TS 29.336 [54]	See section 7.3.197	Must not set
eNodeB-ID	3GPP TS 29.217 [56]	See section 7.3.198	Must not set
SCEF-Reference-ID-for-Deletion	3GPP TS 29.336 [54]		Must not set
Monitoring-Type	3GPP TS 29.336 [54]		Must not set
Maximum-Number-of-Reports	3GPP TS 29.336 [54]		Must not set
Monitoring-Duration	3GPP TS 29.336 [54]		Must not set
Charged-Party	3GPP TS 29.336 [54]		Must not set
UE-Reachability-Configuration	3GPP TS 29.336 [54]		Must not set
Location-Information-Configuration	3GPP TS 29.336 [54]		Must not set
Reachability-Type	3GPP TS 29.336 [54]		Must not set
Maximum-Response-Time	3GPP TS 29.336 [54]		Must not set
Reachability-Information	3GPP TS 29.336 [54]		Must not set
Monitoring-Event-Config-Status	3GPP TS 29.336 [54]		Must not set
Supported-Services	3GPP TS 29.336 [54]	see section 7.3.199	Must not set
Supported-Monitoring-Events	3GPP TS 29.336 [54]	see section 7.3.200	Must not set
DRMP	IETF RFC 7944 [57]	see section 7.3.203	Must not set
Reference-ID-Validity-Time	3GPP TS 29.336 [54]		Must not set
Maximum-UE-Availability-Time	3GPP TS 29.338 [48]	see section 5.3.3.22	Must not set
Emergency-Services	3GPP TS 29.273 [59]		
Load	IETF draft-ietf-dime-load-03 [60]	See section 7.3.211	Must not set
Extended-eNodeB-ID	3GPP TS 29.217 [56]	See section 7.3.218	Must not set
External-Identifier	3GPP TS29.336 [54]		Must not set
Loss-Of-Connectivity-Reason	3GPP TS 29.336 [54]		Must not set
Active-Time	3GPP TS 29.128 [63]		Must not set

Attribute Name	Reference	Comments	M-bit
NOTE 1:		The M-bit settings for re-used AVPs override those of the defining specifications that are referenced. Values include: "Must set", "Must not set". If the M-bit setting is blank, then the defining specification applies.	
NOTE 2:		If the M-bit is set for an AVP and the receiver does not understand the AVP, it shall return a rejection. If the M-bit is not set for an AVP, the receiver shall not return a rejection, whether or not it understands the AVP. If the receiver understands the AVP but the M-bit value does not match with the definition in this table, the receiver shall ignore the M-bit.	

7.3.2 Subscription-Data

The Subscription-Data AVP is of type Grouped. It shall contain the information related to the user profile relevant for EPS and GERAN/UTRAN.

AVP format:

> Subscription-Data ::= <AVP header: 1400 10415>
>
>> [Subscriber-Status]
>>
>> [MSISDN]
>>
>> [A-MSISDN]
>>
>> [STN-SR]
>>
>> [ICS-Indicator]
>>
>> [Network-Access-Mode]
>>
>> [Operator-Determined-Barring]
>>
>> [HPLMN-ODB]
>>
>> *10[Regional-Subscription-Zone-Code]
>>
>> [Access-Restriction-Data]
>>
>> [APN-OI-Replacement]
>>
>> [LCS-Info]
>>
>> [Teleservice-List]
>>
>> *[Call-Barring-Info]
>>
>> [3GPP-Charging-Characteristics]
>>
>> [AMBR]
>>
>> [APN-Configuration-Profile]
>>
>> [RAT-Frequency-Selection-Priority-ID]
>>
>> [Trace-Data]
>>
>> [GPRS-Subscription-Data]
>>
>> *[CSG-Subscription-Data]
>>
>> [Roaming-Restricted-Due-To-Unsupported-Feature]
>>
>> [Subscribed-Periodic-RAU-TAU-Timer]
>>
>> [MPS-Priority]
>>
>> [VPLMN-LIPA-Allowed]
>>
>> [Relay-Node-Indicator]
>>
>> [MDT-User-Consent]
>>
>> [Subscribed-VSRVCC]
>>
>> [ProSe-Subscription-Data]
>>
>> [Subscription-Data-Flags]

                *[Adjacent-Access-Restriction-Data]

                   [DL-Buffering-Suggested-Packet-Count]

                   *[IMSI-Group-Id]

                   [UE-Usage-Type]

                   *[AESE-Communication-Pattern]

                   *[Monitoring-Event-Configuration]

                   [Emergency-Info]

                   [V2X-Subscription-Data]

                   *[eDRX-Cycle-Length]

                   [External-Identifier]

                   [Active-Time]

                   *[AVP]

The AMBR included in this grouped AVP shall include the AMBR associated to the user's subscription (UE-AMBR); Max-Requested-Bandwidth-UL and Max-Requested-Bandwidth-DL within this AVP shall not both be set to "0".

The APN-OI-Replacement included in this grouped AVP shall include the UE level APN-OI-Replacement associated to the user's subscription.

7.3.3 Terminal-Information

The Terminal-Information AVP is of type Grouped. This AVP shall contain the information about the user's terminal.

AVP format

       Terminal-Information ::= <AVP header: 1401 10415>

                [IMEI]

                [3GPP2-MEID]

                [Software-Version]

                *[AVP]

7.3.4 IMEI

The IMEI AVP is of type UTF8String. This AVP shall contain the International Mobile Equipment Identity, as specified in 3GPP TS 23.003 [3]. It should consist of 14 digits, including the 8-digit Type Allocation Code (TAC) and the 6-digit Serial Number (SNR). It may also include a 15th digit.

7.3.5 Software-Version

The Software-Version AVP is of type UTF8String. This AVP shall contain the 2-digit Software Version Number (SVN) of the International Mobile Equipment Identity, as specified in 3GPP TS 23.003 [3].

7.3.6 3GPP2-MEID

This AVP is of type OctetString. This AVP contains the Mobile Equipment Identifier of the user's terminal. For further details on the encoding of the AVP data, refer to the encoding of the Mobile Identity (MEID) octets 3 to 10 in 3GPP2 A.S0022 [28] Annex A.

7.3.7 ULR-Flags

The ULR-Flags AVP is of type Unsigned32 and it shall contain a bit mask. The meaning of the bits shall be as defined in table 7.3.7/1:

Table 7.3.7/1: ULR-Flags

Bit	Name	Description
0	Single-Registration-Indication	This bit, when set, indicates that the HSS shall send Cancel Location to the SGSN. An SGSN shall not set this bit when sending ULR.
1	S6a/S6d-Indicator	This bit, when set, indicates that the ULR message is sent on the S6a interface, i.e. the source node is an MME (or a combined MME/SGSN to which the UE is attached via E-UTRAN). This bit, when cleared, indicates that the ULR message is sent on the S6d interface, i.e. the source node is an SGSN (or a combined MME/SGSN to which the UE is attached via UTRAN or GERAN).
2	Skip Subscriber Data	This bit, when set, indicates that the HSS may skip subscription data in ULA. If the subscription data has changed in the HSS after the last successful update of the MME/SGSN, the HSS shall ignore this bit and send the updated subscription data. If the HSS effectively skips the sending of subscription data, the GPRS-Subscription-Data-Indicator flag can be ignored.
3	GPRS-Subscription-Data-Indicator	This bit, when set, indicates that the HSS shall include in the ULA command the GPRS subscription data, if available in the HSS; it shall be included in the GPRS-Subscription-Data AVP inside the Subscription-Data AVP (see 7.3.2). Otherwise, the HSS shall not include the GPRS-Subscription-Data AVP in the response, unless the Update Location Request is received over the S6d interface and there is no APN configuration profile stored for the subscriber, or when the subscription data is returned by a Pre-Rel-8 HSS (via an IWF). A standalone MME shall not set this bit when sending a ULR.
4	Node-Type-Indicator	This bit, when set, indicates that the requesting node is a combined MME/SGSN. This bit, when cleared, indicates that the requesting node is a single MME or SGSN; in this case, if the S6a/S6d-Indicator is set, the HSS may skip the check of those supported features only applicable to the SGSN, and if, in addition the MME does not request to be registered for SMS, the HSS may consequently skip the download of the SMS related subscription data to a standalone MME. NOTE2
5	Initial-Attach-Indicator	This bit, when set, indicates that the HSS shall send Cancel Location to the MME or SGSN if there is the MME or SGSN registration.
6	PS-LCS-Not-Supported-By-UE	This bit, when set, indicates to the HSS that the UE does not support neither UE Based nor UE Assisted positioning methods for Packet Switched Location Services. The MME shall set this bit on the basis of the UE capability information. The SGSN shall set this bit on the basis of the UE capability information and the access technology supported by the SGSN.
7	SMS-Only-Indication	This bit, when set, indicates that the UE indicated "SMS only" when requesting a combined IMSI attach or combined RA/LU.
NOTE1:	Bits not defined in this table shall be cleared by the sending MME or SGSN and discarded by the receiving HSS.	
NOTE2:	If the MME is registered for SMS then the HSS will download the SMS related data also for the standalone MME.	

7.3.8 ULA-Flags

The ULA-Flags AVP is of type Unsigned32 and it shall contain a bit mask. The meaning of the bits shall be as defined in table 7.3.8/1:

Table 7.3.8/1: ULA-Flags

Bit	Name	Description
0	Separation Indication	This bit, when set, indicates that the HSS stores SGSN number and MME number in separate memory. A Rel-8 HSS shall set the bit. An IWF interworking with a pre Rel-8 HSS/HLR shall clear the bit.
1	MME Registered for SMS	This bit, when set, indicates that the HSS has registered the MME for SMS.
NOTE:	Bits not defined in this table shall be cleared by the sending HSS and discarded by the receiving MME or SGSN.	

7.3.9   Visited-PLMN-Id

The Visited-PLMN-Id AVP is of type OctetString. This AVP shall contain the concatenation of MCC and MNC. See 3GPP TS 23.003 [3]. The content of this AVP shall be encoded as an octet string according to table 7.3.9-1.

See 3GPP TS 24.008 [31], clause 10.5.1.13, PLMN list, for the coding of MCC and MNC. If MNC is 2 digits long, bits 5 to 8 of octet 2 are coded as "1111".

Table 7.3.9/1: Encoding format for Visited-PLMN-Id AVP

8	7	6	5	4	3	2	1	
MCC digit 2				MCC digit 1				octet 1
MNC digit 3				MCC digit 3				octet 2
MNC digit 2				MNC digit 1				octet 3

7.3.10   Feature-List AVP

7.3.10.1   Feature-List AVP for the S6a/S6d application

The syntax of this AVP is defined in 3GPP TS 29.229 [9].

For the S6a/S6d application, the meaning of the bits shall be as defined in table 7.3.10/1 for the Feature-List-ID 1 and in table 7.3.10/2 for the Feature-List-ID 2.

Table 7.3.10/1: Features of Feature-List- ID 1 used in S6a/S6d

Feature bit	Feature	M/O	Description
0	ODB-all-APN	O	Operator Determined Barring of all Packet Oriented Services This feature is applicable for the ULR/ULA and IDR/IDA command pairs. If the MME or SGSN does not support this feature, the HSS shall not send this ODB barring category to the MME or SGSN within ULA. Instead the HSS may reject location update by sending DIAMETER_ERROR_ROAMING_NOT_ALLOWED and, optionally, including the type of ODB in the Error-Diagnostic AVP. If the MME or SGSN does not indicate support of this feature in IDA and the HSS has sent this ODB category within IDR, the HSS may apply barring of roaming and send CLR.
1	ODB-HPLMN-APN	O	Operator Determined Barring of Packet Oriented Services from access points that are within the HPLMN whilst the subscriber is roaming in a VPLMN This feature is applicable for the ULR/ULA and IDR/IDA command pairs. If the MME or SGSN does not support this feature, the HSS shall not send this ODB barring category to the MME or SGSN within ULA. Instead the HSS may reject location update by sending DIAMETER_ERROR_ROAMING_NOT_ALLOWED and, optionally, including the type of ODB in the Error-Diagnostic AVP. If the MME or SGSN does not indicate support of this feature in IDA and the HSS has sent this ODB category within IDR, the HSS may apply barring of roaming and send CLR.
2	ODB-VPLMN-APN	O	Operator Determined Barring of Packet Oriented Services from access points that are within the roamed to VPLMN This feature is applicable for the ULR/ULA and IDR/IDA command pairs. If the MME or SGSN does not support this feature, the HSS shall not send this ODB barring category to the MME or SGSN within ULA. Instead the HSS may reject location update by sending DIAMETER_ERROR_ROAMING_NOT_ALLOWED and, optionally, including the type of ODB in the Error-Diagnostic AVP. If the MME or SGSN does not indicate support of this feature in IDA and the HSS has sent this ODB category within IDR, the HSS may apply barring of roaming and send CLR.
3	ODB-all-OG	O	Operator Determined Barring of all outgoing calls This feature is applicable for the ULR/ULA and IDR/IDA command pairs. If the MME or SGSN does not support this feature, the HSS shall not send this ODB barring category to the MME or SGSN within ULA. Instead the HSS may reject location update. If the MME or SGSN does not indicate support of this feature in IDA and the HSS has sent this ODB category within IDR, the HSS may apply barring of roaming and send CLR.
4	ODB-all-InternationalOG	O	Operator Determined Barring of all outgoing international calls This feature is applicable for the ULR/ULA and IDR/IDA command pairs.If the MME or SGSN does not support this feature, the HSS shall not send this ODB barring category to the MME or SGSN within ULA. Instead the HSS may reject location update. If the MME or SGSN does not indicate support of this feature in IDA and the HSS has sent this ODB category within IDR, the HSS may apply barring of roaming and send CLR.
5	ODB-all-InternationalOGNotToHPLMN-Country	O	Operator Determined Barring of all outgoing international calls except those directed to the home PLMN country This feature is applicable for the ULR/ULA and IDR/IDA command pairs. If the MME or SGSN does not support this feature, the HSS shall not send this ODB barring category to the MME or SGSN within ULA. Instead the HSS may reject location update. If the MME or SGSN does not indicate support of this feature in IDA and the HSS has sent this ODB category within IDR, the HSS may apply barring of roaming and send CLR.

6	ODB-all-Interzonal OG	O	Operator Determined Barring of all outgoing inter-zonal calls This feature is applicable for the ULR/ULA and IDR/IDA command pairs. If the MME or SGSN does not support this feature, the HSS shall not send this ODB barring category to the MME or SGSN within ULA. Instead the HSS may reject location update. If the MME or SGSN does not indicate support of this feature in IDA and the HSS has sent this ODB category within IDR, the HSS may apply barring of roaming and send CLR.
7	ODB-all-Interzonal OGNotTo HPLMN-Country	O	Operator Determined Barring of all outgoing inter-zonal calls except those directed to the home PLMN country This feature is applicable for the ULR/ULA and IDR/IDA command pairs. If the MME or SGSN does not support this feature, the HSS shall not send this ODB barring category to the MME or SGSN within ULA. Instead the HSS may reject location update. If the MME or SGSN does not indicate support of this feature in IDA and the HSS has sent this ODB category within IDR, the HSS may apply barring of roaming and send CLR.
8	ODB-all-Interzonal OGAndInt ernational OGNotTo HPLMN-Country	O	Operator Determined Barring of all outgoing international calls except those directed to the home PLMN country and Barring of all outgoing inter-zonal calls This feature is applicable for the ULR/ULA and IDR/IDA command pairs. If the MME or SGSN does not support this feature, the HSS shall not send this ODB barring category to the MME or SGSN within ULA. Instead the HSS may reject location update. If the MME or SGSN does not indicate support of this feature in IDA and the HSS has sent this ODB category within IDR, the HSS may apply barring of roaming and send CLR.
9	RegSub	O	Regional Subscription This feature is applicable for the ULR/ULA, IDR/IDA and DSR/DSA command pairs. If the MME or SGSN does not support this feature, the HSS shall not send Regional Subscription Zone Codes to the MME or SGSN within ULA. Instead the HSS may reject location update. If the MME or SGSN does not indicate support of this feature in IDA and the HSS has sent Regional Subscription Zone Codes within IDR, the HSS may apply barring of roaming and send CLR.
10	Trace	O	Trace Function This feature is applicable for the ULR/ULA, IDR/IDA and DSR/DSA command pairs. If the MME or SGSN does not indicate support of this feature in ULR, the HSS shall not send Trace Data to the MME or SGSN within ULA. If the MME or SGSN does not indicate support of this feature in IDA, and the HSS has sent Trace Data within IDR, the HSS may store this indication, and not send any further Trace Data to that MME or SGSN. If the MME or SGSN does not indicate support of this feature in DSA, and the HSS has sent Trace Data within DSR, the HSS may store this indication, and not send any further Trace Data to that MME or SGSN
11	LCS-all-PrivExcep (NOTE 1)	O	All LCS Privacy Exception Classes This feature is applicable for the ULR/ULA and IDR/IDA command pairs over the S6d interface, when the SGSN supports MAP based Lg interface. If the SGSN does not support this feature, the HSS shall not send the related LCS information to the SGSN within ULA. If the SGSN does not indicate support of this feature in IDA, and the HSS has sent the related LCS information within IDR, the HSS may store this indication, and not send any further LCS information to that SGSN.

12	LCS-Universal (NOTE 1)	O	Allow location by any LCS client This feature is applicable for the ULR/ULA and IDR/IDA command pairs over the S6d interface, when the SGSN supports MAP based Lg interface. If the SGSN does not support this feature, the HSS shall not send the related LCS information to the SGSN within ULA. If the SGSN does not indicate support of this feature in IDA, and the HSS has sent the related LCS information within IDR, the HSS may store this indication, and not send any further LCS information to that SGSN.
13	LCS-CallSessionRelated (NOTE 1)	O	Allow location by any value added LCS client to which a call/session is established from the target UE This feature is applicable for the ULR/ULA and IDR/IDA command pairs over the S6d interface, when the SGSN supports MAP based Lg interface. If the SGSN does not support this feature, the HSS shall not send the related LCS information to the SGSN within ULA. If the SGSN does not indicate support of this feature in IDA, and the HSS has sent the related LCS information within IDR, the HSS may store this indication, and not send any further LCS information to that SGSN.
14	LCS-CallSessionUnrelated (NOTE 1)	O	Allow location by designated external value added LCS clients This feature is applicable for the ULR/ULA and IDR/IDA command pairs over the S6d interface, when the SGSN supports MAP based Lg interface. If the SGSN does not support this feature, the HSS shall not send the related LCS information to the SGSN within ULA. If the SGSN does not indicate support of this feature in IDA, and the HSS has sent the related LCS information within IDR, the HSS may store this indication, and not send any further LCS information to that SGSN.
15	LCS-PLMNOperator (NOTE 1)	O	Allow location by designated PLMN operator LCS clients This feature is applicable for the ULR/ULA and IDR/IDA command pairs over the S6d interface, when the SGSN supports MAP based Lg interface. If the SGSN does not support this feature, the HSS shall not send the related LCS information to the SGSN within ULA. If the SGSN does not indicate support of this feature in IDA, and the HSS has sent the related LCS information within IDR, the HSS may store this indication, and not send any further LCS information to that SGSN.
16	LCS-ServiceType (NOTE 1)	O	Allow location by LCS clients of a designated LCS service type This feature is applicable for the ULR/ULA and IDR/IDA command pairs over the S6d interface, when the SGSN supports MAP based Lg interface. If the SGSN does not support this feature, the HSS shall not send the related LCS information to the SGSN within ULA. If the SGSN does not indicate support of this feature in IDA, and the HSS has sent the related LCS information within IDR, the HSS may store this indication, and not send any further LCS information to that SGSN.
17	LCS-all-MOLR-SS (NOTE 1)	O	All Mobile Originating Location Request Classes This feature is applicable for the ULR/ULA and IDR/IDA command pairs. Over S6d interface, this feature is applicable when the SGSN supports MAP based Lg interface. If the MME or SGSN does not support this feature, the HSS shall not send the related LCS information to the MME or SGSN within ULA. If the MME or SGSN does not indicate support of this feature in IDA, and the HSS has sent the related LCS information within IDR, the HSS may store this indication, and not send any further LCS information to that MME or SGSN.

18	LCS-BasicSelf Location (NOTE 1)	O	Allow an MS to request its own location This feature is applicable for the ULR/ULA and IDR/IDA command pairs. Over S6d interface, this feature is applicable when the SGSN supports MAP based Lg interface. If the MME or SGSN does not support this feature, the HSS shall not send the related LCS information to the MME or SGSN within ULA. If the MME or SGSN does not indicate support of this feature in IDA, and the HSS has sent the related LCS information within IDR, the HSS may store this indication, and not send any further LCS information to that MME or SGSN.
19	LCS-AutonomousSelfLocation (NOTE 1)	O	Allow an MS to perform self location without interaction with the PLMN This feature is applicable for the ULR/ULA and IDR/IDA command pairs. Over S6d interface, this feature is applicable when the SGSN supports MAP based Lg interface. If the MME or SGSN does not support this feature, the HSS shall not send the related LCS information to the MME or SGSN within ULA. If the MME or SGSN does not indicate support of this feature in IDA, and the HSS has sent the related LCS information within IDR, the HSS may store this indication, and not send any further LCS information to that MME or SGSN.
20	LCS-TransferToThirdParty	O	Allow an MS to request transfer of its location to another LCS client This feature is applicable for the ULR/ULA and IDR/IDA command pairs. Over S6d interface, this feature is applicable when the SGSN supports MAP based Lg interface. If the MME or SGSN does not support this feature, the HSS shall not send the related LCS information to the MME or SGSN within ULA. If the MME or SGSN does not indicate support of this feature in IDA, and the HSS has sent the related LCS information within IDR, the HSS may store this indication, and not send any further LCS information to that MME or SGSN.
21	SM-MO-PP (NOTE 1)	O	Short Message MO-PP This feature is applicable for the ULR/ULA and IDR/IDA command pairs. If the MME or SGSN does not support this feature, the HSS shall not send the related SMS information to the MME or SGSN within ULA. If the MME or SGSN does not indicate support of this feature in IDA, and the HSS has sent the related SMS information within IDR, the HSS may store this indication, and not send any further SMS information to that MME or SGSN.
22	Barring-Outgoing Calls	O	Barring of Outgoing Calls This feature is applicable for the ULR/ULA and IDR/IDA command pairs. If the MME or SGSN does not support this feature, the HSS shall not send the related SMS information to the MME or SGSN within ULA. If the MME or SGSN does not indicate support of this feature in IDA, and the HSS has sent the related SMS information within IDR, the HSS may store this indication, and not send any further SMS information to that MME or SGSN.
23	BAOC	O	Barring of all outgoing calls This feature is applicable for the ULR/ULA and IDR/IDA command pairs. If the MME or SGSN does not support this feature, the HSS shall not send the related SMS information to the MME or SGSN within ULA. If the MME or SGSN does not indicate support of this feature in IDA, and the HSS has sent the related SMS information within IDR, the HSS may store this indication, and not send any further SMS information to that MME or SGSN.

24	BOIC	O	Barring of outgoing international calls This feature is applicable for the ULR/ULA and IDR/IDA command pairs. If the SGSN does not support this feature, the HSS shall not send the related SMS information to the MME or SGSN within ULA. If the MME or SGSN does not indicate support of this feature in IDA, and the HSS has sent the related SMS information within IDR, the HSS may store this indication, and not send any further SMS information to that MME or SGSN.
25	BOICExHC	O	Barring of outgoing international calls except those directed to the home PLMN Country This feature is applicable for the ULR/ULA and IDR/IDA command pairs. If the MME or SGSN does not support this feature, the HSS shall not send the related SMS information to the MME or SGSN within ULA. If the MME or SGSN does not indicate support of this feature in IDA, and the HSS has sent the related SMS information within IDR, the HSS may store this indication, and not send any further SMS information to that MME or SGSN.
26	UE-Reachability-Notification	O	UE Reachability Notifcation This feature is applicable for the ULR/ULA and IDR/IDA command pairs, over S6a and S6d. If the MME or SGSN indicates in the ULR command that it does not support the UE-Reachability-Notifications, the HSS shall not set the "UE-Reachability-Request" bit in IDR-Flags in subsequent IDR commands towards that MME or SGSN.
27	T-ADS Data Retrieval	O	Terminating Access Domain Selection Data Retrieval This feature is applicable for the ULR/ULA and IDR/IDA command pairs, over S6a and S6d. If the MME or SGSN indicates in the ULR command that it does not support the retrieval of T-ADS data via IDR/IDA commands, the HSS shall not set the "T-ADS Data Request" bit in IDR-Flags in subsequent IDR commands towards that MME or SGSN.
28	State/Location-Information-Retrieval	O	State/Location Information Retrieval This feature is applicable for the ULR/ULA and IDR/IDA command pairs, over S6a and S6d. If the MME or SGSN indicates in the ULR command that it does not support State/Location Information Retrieval, the HSS shall not set the "EPS User State Request", "EPS Location Information Request" or "Current Location Request" bits in IDR-Flags in subsequent IDR commands towards that MME or SGSN.
29	Partial Purge	O	Partial Purge from a Combined MME/SGSN This feature is applicable for the ULR/ULA and PUR/PUA command pairs, over S6a and S6d. If the HSS indicates in the ULA command that it does not support Partial Purge, the combined MME/SGSN shall not include in the PUR command the indication of the specific serving node where the Purge has been done.
30	Local Time Zone Retrieval	O	UE Time Zone Retrieval This feature is applicable for the ULR/ULA and IDR/IDA command pairs, over S6a and S6d. If the MME or SGSN indicates in the ULR command that it does not support the retrieval of Local Time Zone via IDR/IDA commands, the HSS shall not set the "Local Time Zone Request" bit in IDR-Flags in subsequent IDR commands towards that MME or SGSN.

31	Additional MSISDN	O	Additional MSISDN This feature is applicable for the ULR/ULA, IDR/IDA and DSR/DSA command pairs, over S6a and S6d. If the MME or SGSN indicates in the ULR command that it does not support A-MSISDN, the HSS shall populate the MSISDN AVP either with the subscribed MSISDN or the subscribed additional MSISDN based on operator policy and availability and the HSS shall not send IDR with the A-MSISDN AVP or DSR with the "A-MSISDN Withdrawal" bit to the serving nodes when the subscription data is changed. If the MME or SGSN indicates in the IDA command that it does not support this feature and the HSS has already sent an A-MSISDN value within IDR, the HSS may store this indication and not send any further A-MSISDN updates to that MME or SGSN.
Feature bit: The order number of the bit within the Supported-Features AVP, e.g. "1". Feature: A short name that can be used to refer to the bit and to the feature, e.g. "ODB-HPLMN-APN". M/O: Defines if the implementation of the feature is mandatory ("M") or optional ("O"). Description: A clear textual description of the feature. NOTE 1: If both bits, corresponding to the feature defined for Lg interface and Lgd interface respectively, are not set, and the HSS supports the feature, the HSS shall not send the related LCS information to the SGSN within ULA and IDR.			

Table 7.3.10/2: Features of Feature-List- ID 2 used in S6a/S6d

Feature bit	Feature	M/O	Description
0	SMS in MME	O	SMS in MME This feature is applicable for the ULR/ULA, IDR/IDA, DSR/DSA, NOR/NOA command pairs, over S6a. It is used by the MME to notify the HSS it is capable of SMS transfer without the need of establishing an SGs association with an MSC. If the MME does not support this feature, the HSS shall not send the related SMS information to the MME within ULA. If the MME does not indicate support of this feature in IDA, and the HSS has sent the related SMS information within IDR, the HSS may store this indication, and not send any further SMS information to that MME. If the HSS does not support this feature, the HSS shall ignore any request for a registration for SMS; the MME may store this feature indication, and not send any further request for a registration for SMS to the HSS.
1	SMS in SGSN	O	SMS in SGSN This feature is applicable for the ULR/ULA command pair, over S6d. If the SGSN indicates in the ULR command that it does not support this feature, the HSS shall not indicate "SMS in SGSN Allowed" to the SGSN.
2	Dia-LCS-all-PrivExcep (NOTE 1)	O	All LCS Privacy Exception Classes This feature is applicable for the ULR/ULA and IDR/IDA command pairs over the S6d interface, when the SGSN supports Diameter based Lgd interface. If the SGSN does not support this feature, the HSS shall not send the related LCS information to the SGSN within ULA. If the SGSN does not indicate support of this feature in IDA, and the HSS has sent the related LCS information within IDR, the HSS may store this indication, and not send any further LCS information to that SGSN.
3	Dia-LCS-Universal (NOTE 1)	O	Allow location by any LCS client This feature is applicable for the ULR/ULA and IDR/IDA command pairs over the S6d interface, when the SGSN supports Diameter based Lgd interface. If the SGSN does not support this feature, the HSS shall not send the related LCS information to the SGSN within ULA. If the SGSN does not indicate support of this feature in IDA, and the HSS has sent the related LCS information within IDR, the HSS may store this indication, and not send any further LCS information to that SGSN.
4	Dia-LCS-CallSessionRelated (NOTE 1)	O	Allow location by any value added LCS client to which a call/session is established from the target UE This feature is applicable for the ULR/ULA and IDR/IDA command pairs over the S6d interface, when the SGSN supports Diameter based Lgd interface. If the SGSN does not support this feature, the HSS shall not send the related LCS information to the SGSN within ULA. If the SGSN does not indicate support of this feature in IDA, and the HSS has sent the related LCS information within IDR, the HSS may store this indication, and not send any further LCS information to that SGSN.

5	Dia-LCS-CallSessionUnrelated (NOTE 1)	O	Allow location by designated external value added LCS clients This feature is applicable for the ULR/ULA and IDR/IDA command pairs over the S6d interface, when the SGSN supports Diameter based Lgd interface. If the SGSN does not support this feature, the HSS shall not send the related LCS information to the SGSN within ULA. If the SGSN does not indicate support of this feature in IDA, and the HSS has sent the related LCS information within IDR, the HSS may store this indication, and not send any further LCS information to that SGSN.
6	Dia-LCS-PLMNOperator (NOTE 1)	O	Allow location by designated PLMN operator LCS clients This feature is applicable for the ULR/ULA and IDR/IDA command pairs over the S6d interface, when the SGSN supports Diameter based Lgd interface. If the SGSN does not support this feature, the HSS shall not send the related LCS information to the SGSN within ULA. If the SGSN does not indicate support of this feature in IDA, and the HSS has sent the related LCS information within IDR, the HSS may store this indication, and not send any further LCS information to that SGSN.
7	Dia-LCS-ServiceType (NOTE 1)	O	Allow location by LCS clients of a designated LCS service type This feature is applicable for the ULR/ULA and IDR/IDA command pairs over the S6d interface, when the SGSN supports Diameter based Lgd interface. If the SGSN does not support this feature, the HSS shall not send the related LCS information to the SGSN within ULA. If the SGSN does not indicate support of this feature in IDA, and the HSS has sent the related LCS information within IDR, the HSS may store this indication, and not send any further LCS information to that SGSN.
8	Dia-LCS-all-MOLR-SS (NOTE 1)	O	All Mobile Originating Location Request Classes This feature is applicable for the ULR/ULA and IDR/IDA command pairs over the S6d interface, when the SGSN supports Diameter based Lgd interface. If the SGSN does not support this feature, the HSS shall not send the related LCS information to the SGSN within ULA. If the SGSN does not indicate support of this feature in IDA, and the HSS has sent the related LCS information within IDR, the HSS may store this indication, and not send any further LCS information to that SGSN.
9	Dia-LCS-BasicSelfLocation (NOTE 1)	O	Allow an MS to request its own location This feature is applicable for the ULR/ULA and IDR/IDA command pairs over the S6d interface, when the SGSN supports Diameter based Lgd interface. If the SGSN does not support this feature, the HSS shall not send the related LCS information to the SGSN within ULA. If the SGSN does not indicate support of this feature in IDA, and the HSS has sent the related LCS information within IDR, the HSS may store this indication, and not send any further LCS information to that SGSN.
10	Dia-LCS-AutonomousSelfLocation (NOTE 1)	O	Allow an MS to perform self location without interaction with the PLMN This feature is applicable for the ULR/ULA and IDR/IDA command pairs over the S6d interface, when the SGSN supports Diameter based Lgd interface. If the SGSN does not support this feature, the HSS shall not send the related LCS information to the SGSN within ULA. If the SGSN does not indicate support of this feature in IDA, and the HSS has sent the related LCS information within IDR, the HSS may store this indication, and not send any further LCS information to that SGSN.

11	Dia-LCS-TransferToThirdParty (NOTE 1)	O	Allow an MS to request transfer of its location to another LCS client
			This feature is applicable for the ULR/ULA and IDR/IDA command pairs over the S6d interface, when the SGSN supports Diameter based Lgd interface. If the SGSN does not support this feature, the HSS shall not send the related LCS information to the SGSN within ULA.
			If the SGSN does not indicate support of this feature in IDA, and the HSS has sent the related LCS information within IDR, the HSS may store this indication, and not send any further LCS information to that SGSN.
12	Gdd-in-SGSN	O	Support of Diameter based Gdd interface for SMS in SGSN
			This feature is applicable for the ULR/ULA command pair over S6d, when the SGSN supports the Diameter based Gdd interface for SMS in SGSN.
13	Optimized-LCS-Proc-Support	O	Support for the optimized LCS procedure
			This feature is applicable for the ULR/ULA command pair over S6a/S6d, when the network supports ISR and when the node is combined MME/SGSN and supports optimized LCS procedure as described in 3GPP TS 29.172 [47] subclause 6.2.2.
14	SGSN CAMEL Capability	O	Support of SGSN CAMEL Capability
			This feature is applicable for the ULR/ULA command pair over S6d, when the SGSN supports the CAMEL capability.
15	ProSe Capability	O	Support of ProSe Capability
			This feature is applicable for the ULR/ULA and IDR/IDA command pairs over S6a (and S6d), when the MME (or combined MME/SGSN) supports the ProSe capability. If the MME or combined MME/SGSN does not support this feature, the HSS shall not send the related ProSe subscription data to the MME or combined MME/SGSN within ULA.
			If the MME or combined MME/SGSN does not indicate support of this feature in IDA, and the HSS has sent the related ProSe subscription data within IDR, the HSS may store this indication, and not send any further ProSe subscription data to that MME.
16	P-CSCF Restoration	O	Support of P-CSCF Restoration
			This feature is applicable to the ULR/ULA and IDR/IDA command pairs over the S6a or S6d interfaces, when the MME or SGSN supports the execution of the P-CSCF restoration procedures.
			If the MME or the SGSN does not indicate support of this feature in ULR, the HSS shall not send subsequent IDR commands requesting the execution of HSS-based P-CSCF restoration procedures, as described in 3GPP TS 23.380 [51] subclause 5.4.
17	Reset-IDs	O	Support of Reset-IDs
			This feature is applicable to the ULR/ULA and IDR/IDA and DSR/DSA and RSR/RSA command pairs over the S6a and S6d interfaces.
			If the MME or SGSN indicates in the ULR command that it does not support Reset-IDs, the HSS shall not include Reset-ID AVPs in RSR commands sent to that MME or SGSN.
			If the MME or SGSN indicates that it does not support this feature in IDA, and the HSS has already sent a Reset-ID value within IDR, the HSS may store this indication and not send any further Reset-ID updates to that MME or SGSN.

18	Communication-Pattern	O	Support of AESE communication patterns
			This feature is applicable to the ULR/ULA and IDR/IDA command pairs over S6a (and S6d), when the MME (or combined MME/SGSN) supports the AESE communication patterns.
			If the MME or combined MME/SGSN does not indicate the support for this feature, the HSS shall not send CP parameter sets to the MME or combined MME/SGSN within IDR/ULA command.
			If the MME or combined MME/SGSN indicates that it does not support this feature in IDA, and the HSS has already sent CP parameter sets within IDR, the HSS may store this indication and not send any further updates related to CP parameter sets to that MME or combined MME/SGSN.
19	Monitoring-Event	O	Support of Monitoring Event This feature is applicable to the ULR/ULA and IDR/IDA command pairs over the S6a or S6d interfaces, when the MME or SGSN supports the Monitoring event feature.
			If the MME or SGSN does not indicate support of this feature in ULR, the HSS shall not send Monitoring event configuration data to the MME or SGSN within ULA and shall not send subsequent IDR commands requesting the configuration of Monitoring events in the MME or SGSN.
			If the MME or SGSN indicates that it does not support this feature in IDA, and the HSS has already sent Monitoring event configuration data within IDR, the HSS may store this indication and not send any further updates related to Monitoring events to that MME or SGSN.
20	Dedicated Core Networks	O	Support of Dedicated Core Networks
			This feature is applicable to the ULR/ULA, IDR/IDA and DSR/DSA command pairs over the S6a and S6d interfaces.
			If the MME/SGSN does not indicate support of this feature in the ULR command, the HSS shall not send DCN-related subscription data (e.g., UE Usage Type) in ULA, and shall not send subsequent IDR or DSR commands when such subscription data are updated.
			If the MME/SGSN does not indicate support of this feature in the IDA command and the HSS has already sent DCN-related subscription data in IDR, the HSS may store this indication and not send further updates related to DCN subscription data.
21	Non-IP PDN Type APNs	O	Support of Non-IP PDN Type APNs
			This feature is applicable to the ULR/ULA and IDR/IDA command pairs over the S6a and S6d interfaces.
			If the MME/SGSN does not indicate support of this feature in the ULR command, the HSS shall not send APN configurations with a Non-IP PDN type in the subscription data sent in ULA or in IDR, and shall not send IDR commands with the only purpose to update such subscription data.
			If the MME or SGSN indicates in the IDA command that it does not support this feature, and the HSS has already sent Non-IP PDN Type APNs within IDR, the HSS may store this indication, and not send any further updates related to Non-IP PDN Type APNs to that MME or SGSN.

22	Non-IP PDP Type APNs	O	Support of Non-IP PDP Type APNs
			This feature is applicable to the ULR/ULA and IDR/IDA command pairs over the S6a/S6d interface.
			If the MME/SGSN does not indicate support of this feature in the ULR command, the HSS shall not send PDP contexts (as part of the GPRS-Subscription-Data) with a Non-IP PDP type in the subscription data sent in ULA or in IDR, and shall not send IDR commands with the only purpose to update such subscription data.
			If the MME or SGSN indicates in the IDA command that it does not support this feature, and the HSS has already sent Non-IP PDP Type APNs within IDR, the HSS may store this indication, and not send any further updates related to Non-IP PDP Type APNs to that MME or SGSN.
23	Removal of MSISDN	O	Support of Removal of MSISDN
			This feature is applicable to the ULR/ULA and DSR/DSA command pairs over the S6a/S6d interface.
			If the MME/SGSN does not indicate support of this feature in the ULR command, the HSS shall not send DSR with the "MSISDN Withdrawal" bit set, to remove an existing MSISDN value from the subscription profile stored in the MME/SGSN.
24	Emergency Service Continuity	O	Support of Emergency Services Continuity
			This feature is applicable to the ULR/ULA, NOR/NOA and IDR/IDA command pairs over the S6a interface, when the HSS and the MME support the continuity of emergency services upon mobility between 3GPP and WLAN accesses, as specified in 3GPP TS 23.401 [2].
			If the MME does not indicate support of this feature in a former ULR command, the HSS shall not include the Emergency Info in an ULA command and shall not send an IDR command to update the PGW in use for emergency services.
			If the HSS does not indicate support of this feature in a former ULA command, the MME shall not send a NOR command to update the PGW in use for emergency services.
			If the HSS supports this feature on S6a, it shall also support the Emergency Service Continuity feature on SWx, see 3GPP TS 29.273 [59].
25	V2X Capability	O	Support of V2X Service
			This feature is applicable for the ULR/ULA and IDR/IDA command pairs over S6a (and S6d), when the MME (or combined MME/SGSN) supports the V2X service.
			If the MME or combined MME/SGSN does not support this feature, the HSS shall not send the related V2X subscription data to the MME or combined MME/SGSN within ULA.
			If the MME or combined MME/SGSN does not indicate support of this feature in IDA, and the HSS has sent the related V2X subscription data within IDR, the HSS may store this indication, and not send any further V2X subscription data to that MME or that combined MME/SGSN.
26	External-Identifier	O	Support of External-Identifier
			This feature is applicable for the ULR/ULA, DSR/DSA and IDR/IDA command pairs over S6a (and S6d), when the MME (or combined MME/SGSN) supports the External-Identifier.
			If the MME or combined MME/SGSN does not support this feature:
			-The HSS shall not send the External-Identifier subscription data to the MME or combined MME/SGSN within ULA.
			-The HSS shall not send Monitoring Event configuration for UEs that are part of a group and have no MSISDN as part of its subscription data to the MME/SGSN.
			-The HSS shall not indicate External-Identifier-Withdrawal in the DSR-Flags AVP of the DSR.

27	NR as Secondary RAT	O	Support of NR as Secondary RAT This feature is applicable to the ULR/ULA and IDR/IDA command pairs over S6a (and S6d) when the MME (or combined MME/SGSN) supports NR as Secondary RAT, and over S6d when the SGSN supports the indication related to NR as Secondary RAT (such as, e.g., the related Access Restriction Data, or extended QoS parameters). If the MME, SGSN, or combined MME/SGSN does not support this feature, the HSS shall not send (in ULA) or update (in IDR) subscription data related to NR as Secondary RAT. If the HSS does not support this feature, the MME shall ignore the bit "NR as Secondary RAT Not Allowed" in Access-Restriction-Data.
28	Unlicensed Spectrum as Secondary RAT	O	Support of Unlicensed Spectrum as Secondary RAT This feature is applicable to the ULR/ULA and IDR/IDA command pairs over S6a (and S6d) when the MME (or combined MME/SGSN) supports the use of unlicensed spectrum in the form of LAA or LWA/LWIP as Secondary RAT. If the MME (or combined MME/SGSN) does not support this feature, the HSS shall not send (in ULA) or update (in IDR) subscription data related to the use of unlicensed spectrum in the form of LAA or LWA/LWIP as Secondary RAT (such as, e.g., the related Access Restriction Data). If the HSS does not support this feature, the MME shall ignore the bit "Unlicensed Spectrum as Secondary RAT Not Allowed" in Access-Restriction-Data.
Feature bit: The order number of the bit within the Supported-Features AVP, e.g. "1". Feature: A short name that can be used to refer to the bit and to the feature, e.g. "SMS in MME". M/O: Defines if the implementation of the feature is mandatory ("M") or optional ("O"). Description: A clear textual description of the feature. NOTE 1: If both bits, corresponding to the same feature defined for Lg interface and Lgd interface, are not set, and the HSS supports the feature, the HSS shall not send the related LCS information to the SGSN within ULA and IDR.			

Features that are not indicated in the Supported-Features AVPs within a given application message shall not be used to construct that message.

7.3.10.2 Feature-List AVP for the S7a/S7d application

For the S7a/S7d application, the feature list does not contain any feature in this release.

7.3.11 Requested-EUTRAN-Authentication-Info

The Requested-EUTRAN-Authentication-Info is of type Grouped. It shall contain the information related to the authentication requests for E-UTRAN.

AVP format

> Requested-EUTRAN-Authentication-Info ::= <AVP header: 1408 10415>
>
> > [Number-Of-Requested-Vectors]
> >
> > [Immediate-Response-Preferred]
> >
> > [Re-synchronization-Info]
> >
> > *[AVP]

7.3.12 Requested-UTRAN- GERAN-Authentication-Info

The Requested-UTRAN-GERAN-Authentication-Info is of type Grouped. It shall contain the information related to the to authentication requests for UTRAN or GERAN.

AVP format

Requested-UTRAN-GERAN-Authentication-Info ::= <AVP header: 1409 10415>

    [Number-Of-Requested-Vectors]

    [Immediate-Response-Preferred]

    [Re-synchronization-Info]

    *[AVP]

7.3.13   RAT-Type

The RAT-Type AVP is of type Enumerated and is used to identify the radio access technology that is serving the UE. See 3GPP TS 29.212 [10] for the defined values.

7.3.14   Number-Of-Requested-Vectors

The Number-Of-Requested-Vectors AVP is of type Unsigned32. This AVP shall contain the number of AVs the MME or SGSN is prepared to receive.

7.3.15   Re-Synchronization-Info

The Re-Synchronization-Info AVP is of type OctetString. It shall contain the concatenation of RAND and AUTS.

7.3.16   Immediate-Response-Preferred

The Immediate-Response-Preferred AVP is of type Unsigned32. This optional AVP indicates by its presence that immediate response is preferred, and by its absence that immediate response is not preferred. If present, the value of this AVP is not significant.

When EUTRAN-AVs and UTRAN-AVs or GERAN-AVs are requested, presence of this AVP within the Requested-EUTRAN-Authentication-Info AVP shall indicate that EUTRAN-AVs are requested for immediate use in the MME/SGSN; presence of this AVP within the Requested-UTRAN-GERAN-Authentication-Info AVP shall indicate that UTRAN-AVs or GERAN-AVs are requested for immediate use in the MME/SGSN. It may be used by the HSS to determine the number of vectors to be obtained from the AuC and the number of vectors downloaded to the MME or SGSN.

7.3.17   Authentication-Info

The Authentication-Info AVP is of type Grouped. This AVP contains Authentication Vectors.

AVP format:

Authentication-Info ::= <AVP header: 1413 10415>

    *[E-UTRAN-Vector]

    *[UTRAN-Vector]

    *[GERAN-Vector]

    *[AVP]

7.3.18   E-UTRAN-Vector

The E-UTRAN-Vector AVP is of type Grouped. This AVP shall contain an E-UTRAN Vector.

AVP format:

E-UTRAN-Vector ::= <AVP header: 1414 10415>

[Item-Number]

{ RAND }

{ XRES }

{ AUTN }

{ KASME }

*[AVP]

7.3.19 UTRAN-Vector

The UTRAN-Vector AVP is of type Grouped. This AVP shall contain an UTRAN Vector.

AVP format:

UTRAN-Vector ::= <AVP header: 1415 10415>

[Item-Number]

{ RAND }

{ XRES }

{ AUTN }

{ Confidentiality-Key }

{ Integrity-Key }

*[AVP]

7.3.20 GERAN-Vector

The GERAN-Vector AVP is of type Grouped. This AVP shall contain a GERAN Vector.

AVP format:

GERAN-Vector ::= <AVP header: 1416 10415>

[Item-Number]

{ RAND }

{ SRES }

{ Kc }

*[AVP]

7.3.21 Network-Access-Mode

The Network-Access-Mode AVP is of type Enumerated. The following values are defined:

PACKET_AND_CIRCUIT (0)

Reserved (1)

ONLY_PACKET (2)

7.3.22 HPLMN-ODB

The HPLMN-ODB AVP is of type Unsigned32 and it shall contain a bit mask indicating the HPLMN specific services of a subscriber that are barred by the operator. The meaning of the bits is HPLMN specific:

Table 7.3.22/1: HPLMN-ODB

Bit	Description
0	HPLMN specific barring type 1
1	HPLMN specific barring type 2
2	HPLMN specific barring type 3
3	HPLMN specific barring type 4

HPLMN-ODB may apply to mobile originated short messages; See 3GPP TS 23.015 [36].

7.3.23 Item-Number

The Item-Number AVP is of type Unsigned32. The Item Number is used to order Vectors received within one request.

7.3.24 Cancellation-Type

The Cancellation-Type AVP is of type Enumerated and indicates the type of cancellation. The following values are defined:

> MME_UPDATE_PROCEDURE (0)

This value is used when the Cancel Location is sent to the previous MME due to a received Update Location message from a new MME.

> SGSN_UPDATE_PROCEDURE (1)

This value is used when the Cancel Location is sent to the previous SGSN due to a received Update Location message from a new SGSN.

> SUBSCRIPTION_WITHDRAWAL (2)

This value is used:

- when the Cancel Location is sent by the HSS to the current MME or SGSN due to withdrawal of the user's subscription by the HSS operator;

- when the Cancel VCSG Location is sent by the CSS to the current MME or SGSN due to withdrawal of the user's VPLMN CSG subscription by the CSS operator.

> UPDATE_PROCEDURE_IWF (3)

This value is used by an IWF when interworking with a pre-Rel-8 HSS.

> INITIAL_ATTACH_PROCEDURE (4)

This value is used when the Cancel Location is sent to the MME or SGSN due to a received Update Location message during initial attach procedure from an SGSN or MME respectively.

7.3.25 DSR-Flags

The DSR-Flags AVP is of type Unsigned32 and it shall contain a bit mask. The meaning of the bits is defined in table 7.3.25/1:

Table 7.3.25/1: DSR-Flags

Bit	Name	Description
0	Regional Subscription Withdrawal	This bit, when set, indicates that Regional Subscription shall be deleted from the subscriber data.
1	Complete APN Configuration Profile Withdrawal	This bit, when set, indicates that all EPS APN configuration data for the subscriber shall be deleted from the subscriber data. This flag only applies to the S6d interface.
2	Subscribed Charging Characteristics Withdrawal	This bit, when set, indicates that the Subscribed Charging Characteristics have been deleted from the subscription data.
3	PDN subscription contexts Withdrawal	This bit, when set, indicates that the PDN subscription contexts whose identifier is included in the Context-Identifier AVP shall be deleted. (Note 1)
4	STN-SR	This bit, when set, indicates that the Session Transfer Number for SRVCC shall be deleted from the subscriber data.
5	Complete PDP context list Withdrawal	This bit, when set, indicates that all PDP contexts for the subscriber shall be deleted from the subscriber data.
6	PDP contexts Withdrawal	This bit, when set, indicates that the PDP contexts whose identifier is included in the Context-Identifier AVP shall be deleted. (Note 2)
7	Roaming Restricted due to unsupported feature	This bit, when set, indicates that the roaming restriction shall be deleted from the subscriber data in the MME or SGSN.
8	Trace Data Withdrawal	This bit, when set, indicates that the Trace Data shall be deleted from the subscriber data.
9	CSG Deleted	This bit, when set, indicates that - the "CSG-Subscription-Data from HSS" shall be deleted in the MME or SGSN when received over the S6a or S6d interface - the "CSG-Subscription-Data from CSS" shall be deleted in the MME or SGSN when received over the S7a or S7d interface.
10	APN-OI-Replacement	This bit, when set, indicates that the UE level APN-OI-Replacement shall be deleted from the subscriber data.
11	GMLC List Withdrawal	This bit, when set, indicates that the subscriber's LCS GMLC List shall be deleted from the MME or SGSN.
12	LCS Withdrawal	This bit, when set, indicates that the LCS service whose code is included in the SS-Code AVP shall be deleted from the MME or SGSN.
13	SMS Withdrawal	This bit, when set, indicates that the SMS service whose code is included in the SS-Code AVP or TS-Code AVP shall be deleted from the MME or SGSN.
14	Subscribed periodic RAU-TAU Timer Withdrawal	This bit, when set, indicates that the subscribed periodic RAU TAU Timer value shall be deleted from the subscriber data.
15	Subscribed VSRVCC Withdrawal	This bit, when set, indicates that the Subscribed VSRVCC shall be deleted from the subscriber data.
16	A-MSISDN Withdrawal	This bit, when set, indicates that the additional MSISDN, if present, shall be deleted from the subscriber data.
17	ProSe Withdrawal	This bit, when set, indicates that the ProSe subscription data shall be deleted from the MME or combined MME/SGSN.
18	Reset-IDs	This bit, when set, indicates that the set of Reset-IDs shall be deleted from the MME or SGSN.
19	DL-Buffering-Suggested-Packet-Count Withdrawal	This bit, when set, indicates that the DL-Buffering-Suggested-Packet-Count shall be deleted in the MME or SGSN.
20	Subscribed IMSI-Group-Id Withdrawal	This bit, when set, indicates that all subscribed IMSI-Group-Id(s) shall be deleted in the MME or SGSN.

21	Delete monitoring events	This bit when set indicates to the MME or SGSN to delete all the Monitoring events for the subscriber which are associated with the provided SCEF-ID.
22	User Plane Integrity Protection Withdrawal	This bit, when set, indicates to the SGSN that User Plane Integrity Protection may no longer be required when GERAN is used. The MME shall ignore it.
23	MSISDN Withdrawal	This bit, when set, indicates that the MSISDN shall be deleted from the subscriber data.
24	UE Usage Type Withdrawal	This bit, when set, indicates to the MME or SGSN that the UE Usage Type shall be deleted from the subscription data.
25	V2X Withdrawal	This bit, when set, indicates that the V2X subscription data shall be deleted from the MME or combined MME/SGSN.
26	External-Identifier-Withdrawal	This bit, when set, indicates that the External-Identifier shall be deleted from the subscriber data.
Note 1:	If the Complete APN Configuration Profile Withdrawal bit is set, this bit should not be set.	
Note 2:	If the Complete PDP context list Withdrawal bit is set, this bit should not be set.	
Note 3:	Bits not defined in this table shall be cleared by the sending HSS and discarded by the receiving MME or SGSN.	
Note 4:	Bits 3 and 6 are excluding alternatives and shall not both be set.	
Note 5:	When this AVP is transferred over the S7a/S7d interface, only the bit 9 (CSG Deleted) is meaningful, other bits shall be cleared.	

7.3.26 DSA-Flags

The DSA-Flags AVP is of type Unsigned32 and it shall contain a bit mask. The meaning of the bits is defined in table 7.3.26/1:

Table 7.3.26/1: DSA-Flags

Bit	Name	Description
0	Network Node area restricted	This bit, when set, shall indicate that the complete Network Node area (SGSN area) is restricted due to regional subscription.
Note: Bits not defined in this table shall be cleared by the sending SGSN and discarded by the receiving HSS.		

7.3.27 Context-Identifier

The Context-Identifier AVP is of type Unsigned32.

7.3.28 Void

7.3.29 Subscriber-Status

The 3GPP Subscriber Status AVP is of type Enumerated. It shall indicate if the service is barred or granted. The following values are defined:

SERVICE_GRANTED (0)

OPERATOR_DETERMINED_BARRING (1)

7.3.30 Operator-Determined-Barring

The Operator-Determined-Barring AVP is of type Unsigned32 and it shall contain a bit mask indicating the services of a subscriber that are barred by the operator. The meaning of the bits is the following:

Table 7.3.30/1: Operator-Determined-   Barring

Bit	Description
0	All Packet Oriented Services Barred
1	Roamer Access HPLMN-AP Barred
2	Roamer Access to VPLMN-AP Barred
3	Barring of all outgoing calls
4	Barring of all outgoing international calls
5	Barring of all outgoing international calls except those directed to the home PLMN country
6	Barring of all outgoing inter-zonal calls
7	Barring of all outgoing inter-zonal calls except those directed to the home PLMN country
8	Barring of all outgoing international calls except those directed to the home PLMN country and Barring of all outgoing inter-zonal calls

7.3.31   Access-Restriction-Data

The Access-Restriction-Data AVP is of type Unsigned32 and it shall contain a bit mask where each bit when set to 1 indicates a restriction. The meaning of the bits is the following:

Table 7.3.31/1: Access-Restriction-Data

Bit	Description
0	UTRAN Not Allowed
1	GERAN Not Allowed
2	GAN Not Allowed
3	I-HSPA-Evolution Not Allowed
4	WB-E-UTRAN Not Allowed
5	HO-To-Non-3GPP-Access Not Allowed
6	NB-IoT Not Allowed
7	Enhanced Coverage Not Allowed
8	NR as Secondary RAT Not Allowed
9	Unlicensed Spectrum as Secondary RAT Not Allowed
NOTE:	Bits not defined in this table shall be cleared by the HSS and discarded by the receiving MME/SGSN.

The restriction "HO-To-Non-3GPP-Access Not Allowed" shall take a higher precedence than the APN-level parameter "WLAN-Offloadability" (see section 7.3.181).

7.3.32   APN-OI-Replacement

The APN-OI-Replacement AVP is of type UTF8String. This AVP shall indicate the domain name to replace the APN OI for the non-roaming case and the home routed roaming case when constructing the APN, and the APN-FQDN upon which to perform a DNS resolution. See 3GPP TS 23.003 [3] and 3GPP TS 29.303 [38].

The contents of the APN-OI-Replacement AVP shall be formatted as a character string composed of one or more labels separated by dots (".").

7.3.33   All-APN-Configurations-Included-Indicator

The All-APN-Configurations-Included-Indicator AVP is of type Enumerated. The following values are defined:

All_APN_CONFIGURATIONS_INCLUDED   (0)

   MODIFIED_ADDED_APN_CONFIGURATIONS_INCLUDED (1)

7.3.34   APN-Configuration-Profile

The APN-Configuration-Profile AVP is of type Grouped. It shall contain the information related to the user's subscribed APN configurations for EPS.

The AVP format shall conform to:

   APN-Configuration-Profile ::= <AVP header: 1429 10415>

         { Context-Identifier }

         [Additional-Context-Identifier]

         { All-APN-Configurations-Included-Indicator }

         1*{APN-Configuration}

         *[AVP]

The Subscription-Data AVP associated with an IMSI contains one APN-Configuration-Profile AVP.

Each APN-Configuration-Profile AVP contains one or more APN-Configuration AVPs.

Each APN-Configuration AVP describes the configuration for a single APN.

Therefore, the cardinality of the relationship between IMSI and APN is one-to-many.

The Context-Identifier AVP shall identify the per subscriber's default APN configuration.

If present, the Additional-Context-Identifier AVP shall identify another default APN configuration, only for those subscriptions containing both, APNs with an IP-based PDN type and APNs with a Non-IP PDN type; in this case, each of those two default APN configurations shall have a different PDN type category (i.e. one default APN with an IP-based PDN type, and another default APN with a Non-IP PDN type).

7.3.35   APN-Configuration

The APN-Configuration AVP is of type Grouped. It shall contain the information related to the user's subscribed APN configurations. The Context-Identifier in the APN-Configuration AVP shall identify that APN configuration, and it shall not have a value of zero. Furthermore, the Context-Identifier in the APN-Configuration AVP shall uniquely identify the EPS APN configuration per subscription. For a particular EPS user having multiple APN configurations, the Service-Selection AVP values shall be unique across APN-Configuration AVPs.

The AVP format shall conform to:

   APN-Configuration ::= <AVP header: 1430 10415>

         { Context-Identifier }

         * 2 [Served-Party-IP-Address]

         { PDN-Type }

         { Service-Selection}

         [EPS-Subscribed-QoS-Profile]

         [VPLMN-Dynamic-Address-Allowed]

         [MIP6-Agent-Info]

         [Visited-Network-Identifier]

      [PDN-GW-Allocation-Type]

        [3GPP-Charging-Characteristics]

        [AMBR]

        *[Specific-APN-Info]

        [APN-OI-Replacement]

        [SIPTO-Permission]

        [LIPA-Permission]

        [Restoration-Priority]

        [SIPTO-Local-Network-Permission]

        [WLAN-offloadability]

        [Non-IP-PDN-Type-Indicator]

        [Non-IP-Data-Delivery-Mechanism]

        [SCEF-ID]

        [SCEF-Realm]

        [Preferred-Data-Mode]

        [PDN-Connection-Continuity]

        [RDS-Indicator]

        *[AVP]

The AMBR included in this grouped AVP shall include the AMBR associated to this specific APN configuration (APN-AMBR).

The Served-Party-IP-Address AVP may be present 0, 1 or 2 times. These AVPs shall be present if static IP address allocation is used for the UE, and they shall contain either of:

- an IPv4 address, or

- an IPv6 address/prefix, or

- both, an IPv4 address and an IPv6 address/prefix.

For the IPv6 prefix, the lower 64 bits of the address shall be set to zero.

The PDN-GW-Allocation-Type AVP applies to the MIP6-Agent-Info AVP. Therefore, it shall not be present if MIP6-Agent-Info is not present.

The APN-OI-Replacement included in this grouped AVP shall include the APN-OI-Replacement associated with this APN configuration. This APN-OI-Replacement has higher priority than UE level APN-OI-Replacement.

The Visited-Network-Identifier AVP indicates the PLMN where the PGW was allocated, in case of dynamic PGW assignment.

    NOTE: If interworking with MAP is needed, the Context-Identifier will be in the range of 1 and 50.

The Non-IP-Data-Delivery-Mechanism shall only be present when Non-IP-PDN-Type-Indicator is set to TRUE (1).

The SCEF-ID AVP and the SCEF-Realm AVP shall only be present when Non-IP-PDN-Type-Indicator is set to TRUE (1), and Non-IP-Data-Delivery-Mechanism is set to SCEF-BASED-DATA-DELIVERY (1).

The RDS-Indicator may be present when Non-IP-PDN-Type-Indicator is set to TRUE (1), and Non-IP-Data-Delivery-Mechanism is set to SCEF-BASED-DATA-DELIVERY (1).

Absence of PDN-Connection-Continuity AVP indicates that the handling is left to local VPLMN policy.

7.3.36 Service-Selection

The Service-Selection AVP is of type of UTF8String. This AVP shall contain either the APN Network Identifier (i.e. an APN without the Operator Identifier) per 3GPP TS 23.003 [3], clauses 9.1 & 9.1.1, or this AVP shall contain the wild card value per 3GPP TS 23.003 [3], clause 9.2.1, and 3GPP TS 23.008 [30], clause 2.13.6).

The contents of the Service-Selection AVP shall be formatted as a character string composed of one or more labels separated by dots ("."), or as the wild card APN, i.e., consisting of only one ASCII label, "*".

This AVP is defined in IETF RFC 5778[20].

7.3.37 EPS-Subscribed-QoS-Profile

The EPS-Subscribed-QoS-Profile AVP is of type Grouped. It shall contain the bearer-level QoS parameters (QoS Class Identifier and Allocation Retention Priority) associated to the default bearer for an APN (see 3GPP TS 23.401 [2], clause 4.7.3).

AVP format

> EPS-Subscribed-QoS-Profile ::= <AVP header: 1431 10415>
>
> > { QoS-Class-Identifier }
> >
> > { Allocation-Retention-Priority }
> >
> > *[AVP]

NOTE: QoS-Class-Identifier is defined in 3GPP TS 29.212 [10] as an Enumerated AVP. The values allowed for this AVP over the S6a/S6d interface are only those associated to non-GBR bearers, as indicated in 3GPP TS 23.008 [30]; e.g., values QCI_1, QCI_2, QCI_3 and QCI_4, which are associated to GBR bearers, cannot be sent over S6a/S6d.

7.3.38 VPLMN-Dynamic-Address-Allowed

The VPLMN-Dynamic-Address-Allowed AVP is of type Enumerated. It shall indicate whether for this APN, the UE is allowed to use the PDN GW in the domain of the HPLMN only, or additionally, the PDN GW in the domain of the VPLMN.. If this AVP is not present, this means that the UE is not allowed to use PDN GWs in the domain of the VPLMN. The following values are defined:

NOTALLOWED (0)

ALLOWED (1)

7.3.39 STN-SR

The STN-SR AVP is of type OctetString and shall contain the Session Transfer Number for SRVCC. See 3GPP TS 23.003 [3] for the definition of STN-SR. This AVP contains an STN-SR, in international number format as described in ITU-T Rec E.164 [41], encoded as a TBCD-string. See 3GPP TS 29.002 [24] for encoding of TBCD-strings. This AVP

shall not include leading indicators for the nature of address and
the numbering plan; it shall contain only the TBCD-encoded digits of the address.

7.3.40 Allocation-Retention-Priority

The Allocation-Retention-Priorit AVP is of typeGrouped and is defined in 3GPP TS 29.212 [10]. It shall indicate the
Priority of Allocation and Retention for the corresponding APN configuration.

AVP format

> Allocation-Retention-Priority ::= <AVP header: 1034 10415>
>
> > { Priority-Level }
> >
> > [Pre-emption-Capability]
> >
> > [Pre-emption-Vulnerability]

If the Pre-emption-Capability AVP is not present in the Allocation-Retention-Priority AVP, the default value shall be
PRE-EMPTION_CAPABILITY_DISABLED (1).

If the Pre-emption-Vulnerability AVP is not present in the Allocation-Retention-Priority AVP, the default value shall be
PRE-EMPTION_VULNERABILITY_ENABLED (0).

7.3.41 AMBR

The AMBR AVP is of type Grouped.

It shall contain the maximum requested bandwidth for Uplink and Downlink traffic. The Max-Requested-Bandwidth-
(UL/DL) AVPs shall encode the bandwidth value in bits per second, having an upper limit of 4294967295 bits per
second. The Extended-Max-Requested-BW-(UL/DL) AVPs shall encode the bandwidth value in kilobits per second,
having an upper limit of 4294967295 kilobits per second.

When the maximum bandwidth value to be set for UL (or DL, respectively) traffic is lower than 4294967296 bits per
second, the Max-Requested-Bandwidth-UL (or -DL, respectively) AVP shall be present, and set to the requested
bandwidth value in bits per second, and the Extended-Max-Requested-BW-UL (or -DL, respectively) AVP shall be
absent.

When the maximum bandwidth value to be set for UL (or DL, respectively) traffic is higher than 4294967295 bits per
second, the Max-Requested-Bandwidth-UL (or DL, respectively) AVP shall be present, and set to its upper limit
4294967295, and the Extended-Max-Requested-BW-UL (or -DL, respectively) shall be present, and set to the requested
bandwidth value in kilobits per second.

AVP format

> AMBR ::= <AVP header: 1435 10415>
>
> > { Max-Requested-Bandwidth-UL }
> >
> > { Max-Requested-Bandwidth-DL }
> >
> > [Extended-Max-Requested-BW-UL]
> >
> > [Extended-Max-Requested-BW-DL]
> >
> > *[AVP]

7.3.42 MIP-Home-Agent-Address

The MIP-Home-Agent-Address AVP is of type Address and is defined in IETF RFC 4004 [27]. This AVP shall contain
either IPv4 or IPv6 address of the PDN-GW and this IP address shall be used as the PDN-GW IP address.

7.3.43 MIP-Home-Agent-Host

The MIP-Home-Agent-Host is of type Grouped and is defined in IETF RFC 4004 [27]. This AVP shall contain a FQDN of the PDN-GW which shall be used to resolve the PDN-GW IP address using the Domain Name Service function.

MIP-Home-Agent-Host grouped AVP is composed by Destination-Host and Destination-Realm AVPs.

Destination-Host shall contain the hostname of the PDN-GW, formatted as described in 3GPP TS 29.303 [38], clause 4.3.2.

Destination-Realm shall be formatted as:

    epc.mnc<MNC>.mcc<MCC>.3gppnetwork.org

where MNC and MCC values indicate the PLMN where the PDN-GW is located.

7.3.44 PDN-GW-Allocation-Type

The PDN-GW-Allocation-Type AVP is of type Enumerated. It shall indicate whether the PDN GW address included in MIP6-Agent-Info has been statically allocated (i.e. provisioned in the HSS by the operator), or dynamically selected by other nodes. The following values are defined:

    STATIC (0)

    DYNAMIC (1)

7.3.45 MIP6-Agent-Info

The MIP6-Agent-InfoAVP is of type Grouped and is defined in IETF RFC 5447 [26]. This AVP shall contain the identity of the PDN-GW. This AVP is used to convey the identity of the PDN-GW between the MME/SGSN and the HSS regardless of the specific mobility protocol used (GTP or PMIPv6). The identity of PDN-GW is either an IP address transported in MIP-Home-Agent-Address or an FQDN transported in MIP-Home-Agent-Host. FQDN shall be used if known to the MME/SGSN/HSS.

AVP format

```
        MIP6-Agent-Info ::= < AVP Header: 486 >
                *2[ MIP-Home-Agent-Address ]
                [ MIP-Home-Agent-Host ]
                [ MIP6-Home-Link-Prefix ]
                *[ AVP ]
```

Within the MIP6-Agent-Info AVP, if static address allocation is used, there may be either:

-    an IPv4 address or an IPv6 address of the PGW contained in one MIP-Home-Agent-Address AVP;

-    both IPv4 address and IPv6 address of the PGW contained in two MIP-Home-Agent-Address AVPs.

The AVP MIP6-Home-Link-Prefix is not used in S6a/S6d, but it is included here to reflect the complete IETF definition of the grouped AVP.

7.3.46 RAT-Frequency-Selection-Priority-ID

The RAT-Frequency-Selection-Priority-ID AVP is of type Unsigned32 and shall contain the subscribed value of Subscriber Profile ID for RAT/Frequency Priority. For details, see 3GPP TS 23.401 [2] and 3GPP TS 23.060 [12] . The coding is defined in 3GPP TS 36.413 [19]. Values shall be in the range of 1 to 256.

7.3.47 IDA-Flags

The IDA-Flags AVP is of type Unsigned32 and it shall contain a bit mask. The meanings of the bits are defined in table 7.3.47/1:

Table 7.3.47/1: IDA-Flags

Bit	Name	Description
0	Network Node area restricted	This bit, when set, shall indicate that the complete Network Node area (SGSN area) is restricted due to regional subscription.
Note: Bits not defined in this table shall be cleared by the sending SGSN and discarded by the receiving HSS.		

7.3.48 PUA-Flags

The PUA-Flags AVP is of type Unsigned32 and it shall contain a bit mask. The meanings of the bits are defined in table 7.3.48/1:

Table 7.3.48/1: PUA-Flags

bit	name	Description
0	Freeze M-TMSI	This bit, when set, shall indicate to the MME that the M-TMSI needs to be frozen, i.e. shall not be immediately re-used.
1	Freeze P-TMSI	This bit, when set, shall indicate to the SGSN that the P-TMSI needs to be frozen, i.e. shall not be immediately re-used.
Note: Bits not defined in this table shall be cleared by the sending HSS and discarded by the receiving MME or SGSN.		

7.3.49 NOR-Flags

The NOR-Flags AVP is of type Unsigned32 and it contains a bit mask. The meaning of the bits is defined in table 7.3.49/1:

Table 7.3.49/1: NOR-Flags

bit	name	Description
0	Single-Registration-Indication	This bit, when set, indicates that the HSS shall send Cancel Location to the SGSN. An SGSN shall not set this bit when sending NOR.
1	SGSN area restricted	This bit, when set, shall indicate that the complete SGSN area is restricted due to regional subscription.
2	Ready for SM from SGSN	This bit, when set, shall indicate that the UE is present or the UE has memory capacity available to receive one or more short messages via SGSN.
3	UE Reachable from MME	This bit, when set, shall indicate that the UE has become reachable again from MME.
4	Reserved	The use of this bit is deprecated. This bit shall be discarded by the receiving HSS.
5	UE Reachable from SGSN	This bit, when set, shall indicate that the UE has become reachable again from SGSN.
6	Ready for SM from MME	This bit, when set, shall indicate that the UE is present or the UE has memory capacity available to receive one or more short messages via MME.
7	Homogeneous Support of IMS Voice Over PS Sessions	This bit, when set, shall indicate that the Homogeneous Support of IMS Voice Over PS Sessions is updated.
8	S6a/S6d-Indicator	This bit, when set, shall indicate that the NOR message is sent on the S6a interface, i.e. the message is from the MME or the MME part on the combined MME/SGSN. This bit, when cleared, indicates that the NOR message is sent on the S6d interface, i.e. the message is from the SGSN or the SGSN part on the combined MME/SGSN.
9	Removal of MME Registration for SMS	This bit, when set, shall indicate that the MME requests to remove its registration for SMS.
NOTE 1:	The S6a/S6d-Indicator flag shall be used together with Homogeneous Support of IMS Voice Over PS Sessions flag, i.e. if the Homogeneous Support of IMS Voice Over PS Sessions bit is set, the S6a/S6d-Indicator bit shall be set if the message is sent from the MME or the MME part on the combined MME/SGSN, and shall be cleared if the message is sent from the SGSN or the SGSN part on the combined MME/SGSN. This S6a/S6d-Indicator bit shall be discarded by the receiving HSS if the Homogeneous Support of IMS Voice Over PS Sessions bit is not set.	
NOTE 2:	Bits not defined in this table shall be cleared by the sending MME or SGSN and discarded by the receiving HSS.	

7.3.50 User-Id

The User-Id AVP shall be of type UTF8String. It shall contain the leading digits of an IMSI (i.e. MCC, MNC, leading digits of MSIN, see 3GPP TS 23.003 [3], clause 2.2) formatted as a character string. Within a HSS, a User-Id identifies a set of subscribers, each with identical leading IMSI digits.

7.3.51 Equipment-Status

The Equipment-Status AVP is of type Enumerated, and shall contain the status of the mobile equipment. The following values are defined:

WHITELISTED (0)

BLACKLISTED (1)

GREYLISTED (2)

7.3.52 Regional-Subscription-Zone-Code

The Regional-Subscription-Zone-Code AVP is of type OctetString. It shall contain a Zone Code (ZC) as defined in 3GPP TS 23.003 [3], clause 4.4. Up to 10 Zone Codes per VPLMN can be defined as part of the users's subscription data.

NOTE 1: Each zone code represents a collection of tracking area or routing areas (defined by the operator of the VPLMN) where the user is allowed, or disallowed, to roam. The determination of which areas are actually allowed, and which ones are not allowed, is done by the serving node (MME/SGSN) in an implementation-dependent manner.

NOTE 2: The description of RSZI in 3GPP TS 23.003 [3] is applicable, in the context of this specification, not only to location areas, but also to routing and tracking areas.

7.3.53 RAND

The RAND AVP is of type OctetString. This AVP shall contain the RAND. See 3GPP TS 33.401 [5].

7.3.54 XRES

The XRES AVP is of type OctetString. This AVP shall contain the XRES. See 3GPP TS 33.401 [5].

7.3.55 AUTN

The AUTN AVP is of type OctetString. This AVP shall contain the AUTN. See 3GPP TS 33.401 [5].

7.3.56 KASME

The KASME AVP is of type OctetString. This AVP shall contain the K_ASME. See 3GPP TS 33.401 [5].

7.3.57 Confidentiality-Key AVP

The Confidentiality-Key is of type OctetString, and shall contain the Confidentiality Key (CK).

7.3.58 Integrity-Key AVP

The Integrity-Key is of type OctetString, and shall contain the Integrity Key (IK).

7.3.59 Kc AVP

The Kc AVP is of type OctetString, and shall contain the Ciphering Key (Kc).

7.3.60 SRES

The SRES AVP is of type OctetString. This AVP shall contain the SRES. See 3GPP TS 33.102 [18].

7.3.61 Void

7.3.62 PDN-Type

The PDN-Type AVP is of type Enumerated and indicates the address type of the PDN, when it is IP-based.

NOTE: There are certain PDNs that can be accessed in Non-IP mode, and those are identified by a specific PDN type indicator in their APN configuration settings (see clause 7.3.204).

The following values are defined:The following values are defined:

IPv4 (0)

This value shall be used to indicate that the PDN can be accessed only in IPv4 mode.

IPv6 (1)

This value shall be used to indicate that the PDN can be accessed only in IPv6 mode.

IPv4v6 (2)

This value shall be used to indicate that the PDN can be accessed both in IPv4 mode, in IPv6 mode, and also from UEs supporting dualstack IPv4v6.

IPv4_OR_IPv6 (3)

This value shall be used to indicate that the PDN can be accessed either in IPv4 mode, or in IPv6 mode, but not from UEs supporting dualstack IPv4v6. It should be noted that this value will never be used as a requested PDN Type from the UE, since UEs will only use one of their supported PDN Types, i.e., IPv4 only, IPv6 only or IPv4v6 (dualstack). This value is only used as part of the APN subscription context, as an authorization mechanism between HSS and MME.

7.3.63   Trace-Data AVP

The Trace-Data AVP is of type Grouped. This AVP shall contain the information related to trace function.

AVP format

Trace-Data ::= <AVP header: 1458 10415>

{Trace-Reference}

{Trace-Depth}

{Trace-NE-Type-List}

[Trace-Interface-List]

{Trace-Event-List}

[OMC-Id]

{Trace-Collection-Entity}

[MDT-Configuration]

*[AVP]

7.3.64   Trace-Reference AVP

The Trace-Reference AVP is of type OctetString. This AVP shall contain the concatenation of MCC, MNC and Trace ID, where the Trace ID is a 3 byte Octet String. See 3GPP TS 32.422 [23].

The content of this AVP shall be encoded as octet strings according to table 7.3.64/1.

See 3GPP TS 24.008 [31], clause 10.5.1.13, PLMN list, for the coding of MCC and MNC. If MNC is 2 digits long, bits 5 to 8 of octet 2 are coded as "1111".

Table 7.3.64/1: Encoding format for Trace-Reference AVP

8	7	6	5	4	3	2	1	
MCC digit 2				MCC digit 1				octet 1
MNC digit 3				MCC digit 3				octet 2
MNC digit 2				MNC digit 1				octet 3
Trace ID								octet 4
								octet 5
								octet 6

7.3.65 Void

7.3.66 Void

7.3.67 Trace-Depth AVP

The Trace-Depth AVP is of type Enumerated. The possible values are those defined in 3GPP TS 32.422 [23] for Trace Depth.

7.3.68 Trace-NE-Type-List AVP

The Trace-NE-Type-List AVP is of type OctetString. Octets are coded according to 3GPP TS 32.422 [23].

7.3.69 Trace-Interface-List AVP

The Trace-Interface-List AVP is of type OctetString. Octets are coded according to 3GPP TS 32.422 [23].

7.3.70 Trace-Event-List AVP

The Trace-Event-List AVP is of type OctetString. Octets are coded according to 3GPP TS 32.422 [23].

7.3.71 OMC-Id AVP

The OMC-Id AVP is of type OctetString. Octets are coded according to 3GPP TS 29.002 [24].

7.3.72 GPRS-Subscription-Data

The GPRS-Subscription-Data AVP is of type Grouped. It shall contain the information related to the user profile relevant for GPRS.

AVP format:

> GPRS-Subscription-Data ::= <AVP header: 1467 10415>

>> { Complete-Data-List-Included-Indicator }

>> 1*50{PDP-Context}

>> *[AVP]

NOTE: The max number of PDP-Context   AVP aligns with the
value of maxNumOfPDP-Contexts as defined in 3GPP TS 29.002 [24].

7.3.73   Complete-Data-List-Included-Indicator

The Complete-Data-List-Included-Indicator AVP is of type Enumerated. The following values are defined:

All_PDP_CONTEXTS_INCLUDED (0)

MODIFIED_ADDED_PDP CONTEXTS_INCLUDED (1)

7.3.74   PDP-Context

The PDP-Context AVP is of type Grouped. For a particular GPRS user having multiple PDP Context configurations, the Service-Selection AVP values may be the same for different PDP-Context AVPs.

AVP format

    PDP-Context ::= <AVP header: 1469 10415>

            { Context-Identifier }

            { PDP-Type }

            [PDP-Address]

            { QoS-Subscribed }

            [VPLMN-Dynamic-Address-Allowed]

            { Service-Selection }

            [3GPP-Charging-Characteristics]

            [Ext-PDP-Type]

            [Ext-PDP-Address]

            [AMBR]

            [APN-OI-Replacement]

            [SIPTO-Permission]

            [LIPA-Permission]

            [Restoration-Priority]

            [SIPTO-Local-Network-Permission]

            [Non-IP-Data-Delivery-Mechanism]

            [SCEF-ID]

            *[AVP]

The Ext-PDP-Address AVP may be present only if the PDP-Address AVP is present. If the Ext-PDP-Address AVP is present, then it shall not contain the same address type (IPv4 or IPv6) as the PDP-Address AVP.

When PDP-Type takes the value Non-IP (HEX 02), the Ext-PDP-Type AVP shall be absent.

The AMBR included in this grouped AVP shall include the AMBR associated to the APN included in the PDP-Context AVP (APN-AMBR).

The APN-OI-Replacement included in this grouped AVP shall include the APN-OI-Replacement associated to the APN included in the PDP-Context. This APN-OI-Replacement has higher priority than UE level APN-OI-Replacement.

The Non-IP-Data-Delivery-Mechanism shall only be present when PDP-Type takes the value Non-IP (HEX 02).

The SCEF-ID shall only be present when Non-IP-Data-Delivery-Mechanism takes the value SCEF-BASED-DATA-DELIVERY (1).

7.3.75 PDP-Type

The PDP-Type AVP is of type OctetString. Octets are coded according to 3GPP TS 29.002 [24]. The allowed values are one of IPv4 encoded as HEX (21) or IPv6 encoded as HEX (57) or Non-IP encoded as HEX (02).

7.3.75A Ext-PDP-Type

The Ext-PDP-Type AVP is of type OctetString. Octets are coded according to 3GPP TS 29.002 [24] and 3GPP TS 29.060 [39] and shall contain the value of IPv4v6.

7.3.76 Void

7.3.77 QoS-Subscribed

The QoS-Subscribed AVP is of type OctetString. Octets are coded according to 3GPP TS 29.002 [24] (octets of QoS-Subscribed, Ext-QoS-Subscribed, Ext2-QoS-Subscribed, Ext3-QoS-Subscribed and Ext4-QoS-Subscribed values are concatenated).

7.3.78 CSG-Subscription-Data

The CSG-Subscription-Data AVP is of type Grouped. This AVP shall contain the CSG-Id, and may contain the associated Visited-PLMN-Id, an associated expiration date and the APNs which are allowed to be accessed via Local IP Access from the CSG.

If the Visited-PLMN-Id is not present, the CSG-Subscription-Data corresponds to the registered PLMN (i.e. the visited PLMN) of the MME or the SGSN.

AVP format

CSG-Subscription-Data ::= <AVP header: 1436 10415>

{ CSG-Id }

[Expiration-Date]

*[Service-Selection]

[Visited-PLMN-Id]

*[AVP]

7.3.79 CSG-Id

The CSG-Id AVP is of type Unsigned32. Values are coded according to 3GPP TS 23.003 [3]. Unused bits (least significant) shall be padded with zeros.

7.3.80 Expiration-Date

The Expiration-Date AVP is of type Time (see IETF RFC 6733 [61]) and contains the point in time when subscription to the CSG-Id expires.

7.3.81 Roaming-Restricted- Due-To- Unsupported-Feature

The Roaming-Restricted-Due-To-Unsupported-Feature AVP is of type Enumerated and indicates that roaming is restricted due to unsupported feature. The following value is defined:

Roaming-Restricted-Due-To-Unsupported-Feature (0)

7.3.82 Specific-APN-Info AVP

The Specific-APN-Info AVP is of type Grouped. It shall only be present in the APN configuration when the APN is a wild card APN. It shall contain the APN which is not present in the subscription context but the UE is authorized to connect to and the identity of the registered PDN-GW.

The AVP format shall conform to:

Specific-APN-Info ::= <AVP header: 1472 10415>

{ Service-Selection }

{ MIP6-Agent-Info }

[Visited-Network-Identifier]

*[AVP]

7.3.83 Alert-Reason AVP

The Alert-Reason AVP is of type Enumerated. The following values are defined:

UE_PRESENT (0)

UE_MEMORY_AVAILABLE (1)

7.3.84 LCS-Info

The LCS-Info AVP is of type Grouped. This AVP shall contain the following LCS related information for a subscriber:

- list of GMLCs in the HPLMN that are permitted to issue a call/session unrelated or call/session related MT-LR location request for this UE;

- privacy exception list that is applicable only over the S6d interface;

- MO-LR list.

AVP format

LCS-Info ::= <AVP header: 1473 10415>

*[GMLC-Number]

*[LCS-PrivacyException]

*[MO-LR]

*[AVP]

7.3.85 GMLC-Number

The GMLC-Number AVP is of type OctetString. This AVP shall contain the ISDN number of the GMLC in international number format as described in ITU-T Rec E.164 [41] and shall be encoded as a TBCD-string. See 3GPP TS 29.002 [24] for encoding of TBCD-strings. This AVP shall not include leading indicators for the nature of address and the numbering plan; it shall contain only the TBCD-encoded digits of the address.

7.3.86 LCS-PrivacyException

The LCS-PrivacyException AVP is of type Grouped. This AVP shall contain the classes of LCS Client that are allowed to locate any target UE.

AVP format

> LCS-PrivacyException ::= <AVP header: 1475 10415>
>
>> { SS-Code }
>>
>> { SS-Status }
>>
>> [Notification-To-UE-User]
>>
>> *[External-Client]
>>
>> *[PLMN-Client]
>>
>> *[Service-Type]
>>
>> *[AVP]

7.3.87 SS-Code

The SS-Code AVP is of type OctetString. Octets are coded according to 3GPP TS 29.002 [24].

7.3.88 SS-Status

The SS-Status AVP is of type OctetString. Octets are coded according to 3GPP TS 29.002 [24]. For details, see 3GPP TS 23.011 [29].

7.3.89 Notification-To-UE-User

The Notification- To-UE-User AVP is of type Enumerated. The following values are defined:

NOTIFY_LOCATION_ALLOWED (0)

NOTIFYANDVERIFY_LOCATION_ALLOWED_IF_NO_RESPONSE (1)

NOTIFYANDVERIFY_LOCATION_NOT_ALLOWED_IF_NO_RESPONSE (2)

LOCATION_NOT_ALLOWED (3)

7.3.90 External-Client

The External-Client AVP is of type Grouped. This AVP shall contain the identities of the external clients that are allowed to locate a target UE for a MT-LR.

AVP format

> External-Client ::= <AVP header: 1479 10415>
>
>> { Client-Identity }
>>
>> [GMLC-Restriction]
>>
>> [Notification-To-UE-User]
>>
>> *[AVP]

7.3.91 Client-Identity

The Client-Identity AVP is of type OctetString and it shall contain the ISDN number of the external client in international number format as described in ITU-T Rec E.164 [41] and shall be encoded as a TBCD-string. See 3GPP TS 29.002 [24] for encoding of TBCD-strings. This AVP shall not include leading indicators for the nature of address and the numbering plan; it shall contain only the TBCD-encoded digits of the address.

7.3.92   GMLC-Restriction

The GMLC-Restriction AVP is of type Enumerated. The following values are defined:

GMLC_LIST (0)

HOME_COUNTRY (1)

7.3.93   PLMN-Client

The PLMN-Client AVP is of type Enumerated. The following values are defined:

BROADCAST_SERVICE (0)

O_AND_M_HPLMN (1)

O_AND_M_VPLMN (2)

ANONYMOUS_LOCATION (3)

TARGET_UE_SUBSCRIBED_SERVICE (4)

7.3.94   Service-Type

The Service-Type AVP is of type Grouped. This AVP shall contain the identities of the service type of the clients that are allowed to locate a target UE for an MT-LR.

AVP format

        Service-Type ::= <AVP header: 1483 10415>

                { ServiceTypeIdentity }

                [GMLC-Restriction]

                [Notification-To-UE-User]

                *[AVP]

7.3.95   ServiceTypeIdentity

The ServiceTypeIdentity AVP is of type Unsigned32. For details on the values of this AVP, see 3GPP TS 29.002 [24].

7.3.96   MO-LR

The MO-LR AVP is of type Grouped. This AVP shall contain the classes of MO-LR for which a subscription exists for a particular UE.

AVP format

        MO-LR ::= <AVP header: 1485 10415>

                { SS-Code }

                { SS-Status }

> *[AVP]

7.3.97 Void

7.3.98 Trace-Collection-Entity AVP

The Trace-Collection-Entity AVP is of type Address and contains the IPv4 or IPv6 address of the Trace Collection Entity, as defined in 3GPP TS 32.422 [23], clause 5.9.

7.3.99 Teleservice-List

The Teleservice-List AVP is of type Grouped. This AVP shall contain the service codes for the short message related teleservice for a subscriber:

AVP format

> Teleservice-List ::= <AVP header: 1486 10415>
>
> > 1 * { TS-Code }* [AVP]

7.3.100 TS-Code

The TS-Code AVP is of type OctetString. Octets are coded according to 3GPP TS 29.002 [24].

7.3.101 Call-Barring-Info

The Call-Barring-Info AVP is of type Grouped. This AVP shall contain the service codes for the short message related call barring services for a subscriber:

AVP format

> Call-Barring-Info ::= <AVP header: 1488 10415>
>
> > { SS-Code }
> >
> > { SS-Status }
> >
> > * [AVP]

7.3.102 SGSN-Number

The SGSN-Number AVP is of type OctetString and it shall contain the ISDN number of the SGSN. For further details on the definition of this AVP, see 3GPP TS 23.003 [3]. This AVP contains an SGSN-Number in international number format as described in ITU-T Rec E.164 [41] and shall be encoded as a TBCD-string. See 3GPP TS 29.002 [24] for encoding of TBCD-strings. This AVP shall not include leading indicators for the nature of address and the numbering plan; it shall contain only the TBCD-encoded digits of the address.

7.3.103 IDR-Flags

The IDR-Flags AVP is of type Unsigned32 and it shall contain a bit mask. The meaning of the bits shall be as defined in table 7.3.103/1:

Table 7.3.103/1: IDR-Flags

bit	name	Description
0	UE Reachability Request	This bit when set shall indicate to the MME or the SGSN that the HSS is awaiting a Notification of UE Reachability.
1	T-ADS Data Request	This bit, when set, shall indicate to the MME or SGSN that the HSS requests the support status of "IMS Voice over PS Sessions", and the RAT Type and timestamp of the last radio contact with the UE.
2	EPS User State Request	This bit, when set, shall indicate to the MME or the SGSN that the HSS requests the MME or the SGSN for the current user state.
3	EPS Location Information Request	This bit, when set, shall indicate to the MME or the SGSN that the HSS requests the MME or SGSN for location information
4	Current Location Request	This bit when set shall indicate to the MME or the SGSN that the HSS requests the MME or SGSN to provide the most current location information by paging the UE if the UE is in idle mode. This bit is used only in combination with the"EPS Location Information Request" bit.
5	Local Time Zone Request	This bit when set shall indicate to the MME or the SGSN that the HSS requests the MME or SGSN to provide information on the time zone of the location in the visited network where the UE is attached.
6	Remove SMS Registration	This bit when set shall indicate to the MME that it shall consider itself unregistered for SMS.
7	RAT-Type Requested	This bit when set shall indicate to the MME or the SGSN that the HSS requests the MME or SGSN to provide the RAT Type that corresponds to the requested EPS Location Information. This bit is used only in combination with the"EPS Location Information Request" bit.
8	P-CSCF Restoration Request	This bit, when set, shall indicate to the MME or SGSN that the HSS requests the execution of the HSS-based P-CSCF restoration procedures, as described in 3GPP TS 23.380 [51] subclause 5.4.
NOTE:		Bits not defined in this table shall be cleared by the sending HSS and discarded by the receiving MME or SGSN.

7.3.104   ICS-Indicator

The ICS-Indicator AVP is of type Enumerated. The meaning of the values is defined in 3GPP TS 23.292 [34] and 3GPP TS 23.216 [35]. The following values are defined:

FALSE (0)

TRUE (1)

7.3.105   Visited-Network-Identifier

The Visited-Network-Identifier AVP contains the identity of the network where the PDN-GW was allocated, in the case of dynamic PDN-GW assignment.

The AVP shall be encoded as:

mnc<MNC>.mcc<MCC>.3gppnetwork.org

7.3.106 IMS-Voice-Over-PS- Sessions-Supported

The IMS-Voice-Over-PS-Sessions-Supported AVP is of type Enumerated. The following values are defined:

NOT_SUPPORTED (0)

> This value indicates that "IMS Voice over PS Sessions" is not supported by the UE's most recently used TA or RA in the serving node.

SUPPORTED (1)

> This value indicates that "IMS Voice over PS Sessions" is supported by the UE's most recently used TA or RA in the serving node.

7.3.107 Homogeneous-Support-of-IMS-Voice-Over-PS-Sessions

The Homogeneous-Support-of-IMS-Voice-Over-PS-Sessions AVP is of type Enumerated. The following values are defined:

NOT_SUPPORTED (0)

> This value indicates that "IMS Voice over PS Sessions" is not supported, homogeneously, in any of the TAs or RAs associated to the serving node.

SUPPORTED (1)

> This value indicates that "IMS Voice over PS Sessions" is supported, homogeneously, in all of the TAs or RAs associated to the serving node.

If this AVP is not present in the command, it indicates that there is no homogeneous support of IMS Voice Over PS Sessions on all the TA/RAs of the serving node, or that the homogeneity of this support is unkown to the serving node.

7.3.108 Last-UE-Activity-Time

The Last-UE-Activity-Time AVP is of type Time (see IETF RFC 6733 [61]), and contains the point of time of the last radio contact of the serving node (MME or SGSN) with the UE.

7.3.109 GMLC-Address

The GMLC-Address AVP is of type Address and shall contain the IPv4 or IPv6 address of the V-GMLC associated with the serving node.

7.3.110 EPS-User-State

The EPS-User-State AVP is of type Grouped. It shall contain the information related to the user state in the MME and/or the SGSN.

AVP format

> EPS-User-State ::= <AVP header:1495 10415>
>
> > [MME-User-State]
> >
> > [SGSN-User-State]
> >
> > *[AVP]

7.3.111 EPS-Location-Information

The EPS-Location Information AVP is of type Grouped. It shall contain the information related to the user location relevant for EPS.

AVP format

EPS-Location-Information ::= <AVP header: 1496 10415>

> [MME-Location-Information]

> [SGSN-Location-Information]

> *[AVP]

7.3.112 MME-User-State

The MME-User-State AVP is of type Grouped. It shall contain the information related to the user state in the MME.

AVP format

MME-User-State ::= <AVP header: 1497 10415>

> [User-State]

> *[AVP]

7.3.113 SGSN-User-State

The SGSN-User-State AVP is of type Grouped. It shall contain the information related to the user state in the SGSN.

AVP format

SGSN-User-State ::= <AVP header: 1498 10415>

> [User-State]

> *[AVP]

7.3.114 User-State

The User-State AVP is of type Enumerated and indicates the user state in EPS. The following values are defined:

DETACHED (0)

> The UE is in EMM_DEREGISTERED state.

ATTACHED_NOT_REACHABLE_FOR_PAGING (1)

> The SGSN has determined from its internal data that the UE is attached to the network, but there is no EPS bearer active, and the UE is not reachable for paging. This value is only applicable to S4-SGSN.

ATTACHED_REACHABLE_FOR_PAGING (2)

> The SGSN has determined from its internal data that the UE is attached to the network, but there is no EPS bearer active; the SGSN has not determined from its internal data that the UE is not reachable for paging. This value is only applicable to S4-SGSN.

CONNECTED_NOT_REACHABLE_FOR_PAGING (3)

> The SGSN or MME has determined from its internal data that the UE is attached to the network, there is at least one EPS bearer active, and the UE is not reachable for paging.

CONNECTED_REACHABLE_FOR_PAGING (4)

> The SGSN or MME has determined from its internal data that the UE is attached to the network, there is at least one EPS bearer active, and the SGSN or MME has not determined from its internal data that the UE is not reachable for paging.

RESERVED (5)

This value should not be used by MME or SGSN over S6a/S6d.
If this value is received by the HSS from pre-rel-12 MME/SGSNs, the HSS shall consider that the UE is not reachable and use the "Network determined not reachable" state when reporting the User State to other network entities, e.g. over Sh.

NOTE: The state associated to a "Network determined not reachable" condition should also be used by HSS when reporting to the requesting entity, e.g. over Sh, that the user was found to be not reachable (for instance, if the HSS receives no answer from the MME/SGSN to the user state query).

7.3.115 MME-Location-Information

The MME-Location-Information AVP is of type Grouped. It shall contain the information related to the user location relevant for the MME.

AVP format

MME-Location-Information ::= <AVP header: 1600 10415>

> [E-UTRAN-Cell-Global-Identity]

> [Tracking-Area-Identity]

> [Geographical-Information]

> [Geodetic-Information]

> [Current-Location-Retrieved]

> [Age-Of-Location-Information]

> [User-CSG-Information]

> [eNodeB-ID]

> [Extended-eNodeB-ID]

> *[AVP]

An eNodeB-ID AVP may be present for Monitoring event reporting.

7.3.116 SGSN-Location-Information

The SGSN-Location-Information AVP is of type Grouped. It shall contain the information related to the user location relevant for the SGSN.

AVP format

SGSN-Location-Information ::= <AVP header: 1601 10415>

> [Cell-Global-Identity]

> [Location-Area-Identity]

> [Service-Area-Identity]

> [Routing-Area-Identity]

> [Geographical-Information]

> [Geodetic-Information]

> [Current-Location-Retrieved]

> [Age-Of-Location-Information]

> [User-CSG-Information]

*[AVP]

7.3.117 E-UTRAN-Cell-Global-Identity

The E-UTRAN-Cell-Global-Identity AVP is of type OctetString and shall contain the E-UTRAN Cell Global Identification of the user which identifies the cell the user equipment is registered, as specified in 3GPP TS 23.003 [3]. Octets are coded as described in 3GPP TS 29.002 [24].

7.3.118 Tracking-Area-Identity

The Tracking-Area-Identity AVP is of type OctetString and shall contain the Tracking Area Identity of the user which identifies the tracking area where the user is located, as specified in 3GPP TS 23.003 [3]. Octets are coded as described in 3GPP TS 29.002 [24].

7.3.119 Cell-Global-Identity

The Cell-Global-Identity AVP is of type OctetString and shall contain the Cell Global Identification of the user which identifies the cell the user equipment is registered, as specified in 3GPP TS 23.003 [3]. Octets are coded as described in 3GPP TS 29.002 [24].

7.3.120 Routing-Area-Identity

The Routing-Area-Identity AVP is of type OctetString and shall contain the Routing Area Identity of the user which identifies the routing area where the user is located, as specified in 3GPP TS 23.003 [3]. Octets are coded as described in 3GPP TS 29.002 [24].

7.3.121 Location-Area-Identity

The Location-Area-Identity AVP is of type OctetString and shall contain the Location Area Identification of the user which identifies the Location area where the user is located, as specified in 3GPP TS 23.003 [3]. Octets are coded as described in 3GPP TS 29.002 [24].

7.3.122 Service-Area-Identity

The Service-Area-Identity AVP is of type OctetString and shall contain the Service Area Identifier of the user where the user is located, as specified in 3GPP TS 23.003 [3]. Octets are coded as described in 3GPP TS 29.002 [24].

7.3.123 Geographical-Information

The Geographical-Information AVP is of type OctetString and shall contain the geographical Information of the user. For details and octet encoding, see 3GPP TS 29.002 [24].

7.3.124 Geodetic-Information

The Geodetic-Information AVP is of type OctetString and shall contain the Geodetic Location of the user. For details and octet encoding, see 3GPP TS 29.002 [24].

7.3.125 Current-Location-Retrieved

The Current-Location-Retrieved AVP is of type Enumerated. The following values are defined:

ACTIVE-LOCATION-RETRIEVAL (0)

This value is used when location information was obtained after a successful paging procedure for Active Location Retrieval when the UE is in idle mode or after retrieving the most up-to-date location information from the eNB when the UE is in connected mode.

7.3.126 Age-Of-Location-   Information

The Age-Of-Location-Information AVP is of type Unsigned32 and shall contain the the elapsed time in minutes since the last network contact of the user equipment. For details, see 3GPP TS 29.002 [24].

7.3.127 Active-APN

The Active-APNs AVP is of type Grouped. It shall contain information about a dynamically established APN on a serving node, so the HSS can restore it, if it is eventually lost after a node restart.

The AVP format shall conform to:

> Active-APN ::= <AVP header: 1612 10415>
>
> > { Context-Identifier }
> >
> > [Service-Selection]
> >
> > [MIP6-Agent-Info]
> >
> > [Visited-Network-Identifier]
> >
> > *[Specific-APN-Info]
> >
> > *[AVP]

7.3.128 Error-Diagnostic

The Error-Diagnostic AVP is of type Enumerated. The following values are defined:

- GPRS_DATA_SUBSCRIBED (0)

    This value shall be used when Experimental-Error is DIAMETER_ERROR_UNKNOWN_EPS_SUBSCRIPTION and there is GPRS Subscription Data for the user.

- NO_GPRS_DATA_SUBSCRIBED (1)

    This value shall be used when Experimental-Error is DIAMETER_ERROR_UNKNOWN_EPS_SUBSCRIPTION and there is not GPRS Subscription Data for the user.

- ODB_ALL_APN (2)

    This value shall be used when Experimental-Error is DIAMETER_ERROR_ROAMING_NOT_ALLOWED and the Operator Determined Barring indicates "All Packet Oriented Services Barred" (see clause 7.3.30).

- ODB_HPLMN_APN (3)

    This value shall be used when Experimental-Error is DIAMETER_ERROR_ROAMING_NOT_ALLOWED and the Operator Determined Barring indicates "Roamer Access HPLMN-AP Barred" (see clause 7.3.30).

- ODB_VPLMN_APN (4)

    This value shall be used when Experimental-Error is DIAMETER_ERROR_ROAMING_NOT_ALLOWED and the Operator Determined Barring indicates "Roamer Access to VPLMN-AP Barred" (see clause 7.3.30).

7.3.129 Ext-PDP-Address AVP

The Ext-PDP-Address AVP is of type Address and indicates an additional address of the data protocol, and it may be included when the PDP supports dual-stack (IPv4v6).

7.3.130　UE-SRVCC-　　　　Capability

The UE-SRVCC-Capability AVP is of type Enumerated. It shall indicate if the UE supports or does not support the SRVCC capability. The following values are defined:

　UE-SRVCC-NOT-SUPPORTED (0)

　　UE-SRVCC-SUPPORTED (1)

7.3.131　MPS-Priority

The MPS-Priority AVP is of type Unsigned32 and it shall contain a bit mask. The meaning of the bits shall be as defined in table 7.3.131/1:

Table 7.3.131/1: MPS-Priority

Bit	Name	Description
0	MPS-CS-Priority	This bit, when set, indicates that the UE is subscribed to the eMLPP or 1x RTT priority service in the CS domain.
1	MPS-EPS-Priority	This bit, when set, indicates that the UE is subscribed to the MPS in the EPS domain.
Note: Bits not defined in this table shall be cleared by the sending HSS and discarded by the receiving MME or SGSN.		

NOTE:　The HSS derives the information for MPS-CS-Priority from the eMLPP Subscription Data as defined in the 3GPP TS 29.002 [24] or 1x RTT priority service which is out of the scope of 3GPP.

7.3.132　VPLMN-LIPA-Allowed

The VPLMN-LIPA-Allowed AVP is of type Enumerated. It shall indicate whether the UE is allowed to use LIPA in the VPLMN where the UE is roaming. The following values are defined:

　LIPA_NOTALLOWED (0)

　　This value indicates that the UE is not allowed to use LIPA in the VPLMN where the UE is roaming.

　LIPA_ALLOWED (1)

　　This value indicates that the UE is allowed to use LIPA in the VPLMN where the UE is roaming.

7.3.133　LIPA-Permission

The LIPA-Permission AVP is of type Enumerated. It shall indicate whether the APN can be accessed via Local IP Access. The following values are defined:

　LIPA_PROHIBITED (0)

　　This value indicates that this APN is prohibited to be accessed via LIPA.

　LIPA_ONLY (1)

　　　This value indicates that this APN can be accessed only via LIPA.

　LIPA_CONDITIONAL (2)

　　This value indicates that this APN can be accessed via both non LIPA and LIPA.

7.3.134　Subscribed-Periodic-RAU-TAU-Timer

The Subscribed-Periodic-RAU-TAU-Timer AVP is of type Unsigned32 and it shall contain the subscribed periodic RAU/TAU timer value in seconds as specified in 3GPP TS 24.008 [31].

7.3.135 SIPTO-Permission

The SIPTO-Permission AVP is of type Enumerated. It shall indicate whether the traffic associated with this particular APN is allowed or not for SIPTO above RAN.

The following values are defined:

SIPTO_above_RAN _ALLOWED (0)

SIPTO_above_RAN _NOTALLOWED (1)

7.3.136 MDT-Configuration

The MDT-Configuration AVP is of type Grouped. It shall contain MDT related information as specified in 3GPP TS 32.422 [23].

The AVP format shall conform to:

MDT-Configuration ::= <AVP header: 1622 10415>

   { Job-Type }

   [Area-Scope]

   [List-Of-Measurements]

   [Reporting-Trigger]

   [Report-Interval]

   [Report-Amount]

   [Event-Threshold-RSRP]

   [Event-Threshold-RSRQ]

   [Logging-Interval]

   [Logging-Duration]

   [Measurement-Period-LTE]

   [Measurement-Period-UMTS]

   [Collection-Period-RMM-LTE]

   [Collection-Period-RRM-UMTS]

   [Positioning-Method]

   [Measurement-Quantity]

   [Event-Threshold-Event-1F]

   [Event-Threshold-Event-1I]

   *[MDT-Allowed-PLMN-Id]

   *[MBSFN-Area]

   *[AVP]

7.3.137 Job-Type

The Job-Type AVP is of type Enumerated. The possible values are those defined in 3GPP TS 32.422 [23] for Job-Type.

7.3.138 Area-Scope

The Area-Scope AVP is of type Grouped. See 3GPP TS 32.422 [23].

The AVP format shall conform to:

        Area-Scope ::= <AVP header: 1623 10415>

                *[Cell-Global-Identity]

                *[E-UTRAN-Cell-Global-Identity]

                *[Routing-Area-Identity]

                *[Location-Area-Identity]

                *[Tracking-Area-Identity]

                *[AVP]

7.3.139 List-Of-Measurements

The List-Of-Measurements AVP is of type Unsigned32 and it shall contain a bit mask. The meaning of the bits is defined in 3GPP TS 32.422 [23]. The most significant bit is bit 8 of the first octet.

7.3.140 Reporting-Trigger

The Reporting-Trigger AVP is of type Unsigned32 and it shall contain a bit mask. The meaning of the bits is defined in 3GPP TS 32.422 [23]. The most significant bit is bit 8 of the first octet.

7.3.141 Report-Interval

The Report-Interval AVP is of type Enumerated. The possible values are those defined in 3GPP TS 32.422 [23] for Report Interval

7.3.142 Report-Amount

The Report-Amount AVP is of type Enumerated. The possible values are those defined in 3GPP TS 32.422 [23] for Report Amount.

7.3.143 Event-Threshold-RSRP

The Event-Threshold-RSRP AVP is of type Unsigned32. See 3GPP TS 32.422 [23] for allowed values

7.3.144 Event-Threshold-RSRQ

The Event-Threshold-RSRQ AVP is of type Unsigned32. See 3GPP TS 32.422 [23] for allowed values

7.3.145 Logging-Interval

The Logging-Interval AVP is of type Enumerated. The possible values are those defined in 3GPP TS 32.422 [23] for Logging Interval

7.3.146 Logging-Duration

The Logging-Duration AVP is of type Enumerated. The possible values are those defined in 3GPP TS 32.422 [23] for Logging Duration

7.3.147 Relay-Node- Indicator

The Relay-Node-Indicator AVP is of type Enumerated. It shall indicate whether the subscription data belongs to a Relay Node or not (see 3GPP TS 36.300 [40]). The following values are defined:

NOT_RELAY_NODE (0)

> This value indicates that the subscription data does not belong to a Relay Node.

RELAY_NODE (1)

> This value indicates that the subscription data belongs to a Relay Node.

The default value when this AVP is not present is NOT_RELAY_NODE (0).

7.3.148 MDT-User-Consent

The MDT-User-Consent AVP is of type Enumerated. It shall indicate whether the user has given his consent for MDT activation or not (see 3GPP TS 32.422 [23]). The following values are defined:

CONSENT_NOT_GIVEN (0)

CONSENT_GIVEN (1)

The default value when this AVP is not present in ULA is CONSENT_NOT_GIVEN (0). Absence of this AVP in IDR shall be interpreted as the MDT-User-Consent has not been modified.

The presence of this subscription parameter in ULA or IDR shall be independent of the support of the Trace Function by the MME/SGSN (see subclause 7.3.10).

7.3.149 PUR-Flags

The PUR-Flags AVP is of type Unsigned32 and it shall contain a bitmask. The meaning of the bits is defined in table 7.3.149/1:

Table 7.3.149/1: PUR-Flags

bit	name	Description
0	UE Purged in MME	This bit, when set, indicates that the combined MME/SGSN has purged the UE in the MME part of the node. This bit shall not be set by a standalone SGSN.
1	UE Purged in SGSN	This bit, when set, shall indicate that the combined MME/SGSN has purged the UE in the SGSN part of the node. This bit shall not be set by a standalone MME.
NOTE:	Bits not defined in this table shall be cleared by the sending MME or SGSN and discarded by the receiving HSS.	

7.3.150 Subscribed-VSRVCC

The Subscribed-VSRVCC AVP is of type Enumerated. It shall indicate that the user is subscribed to the vSRVCC. The following value is defined:

VSRVCC_SUBSCRIBED (0)

Absence of this AVP in IDR shall be interpreted as the Subscribed-VSRVCC has not been modified.

Absence of this AVP in ULA shall be interpreted as the user is not subscribed to the vSRVCC.

7.3.151 Equivalent-PLMN- List

The Equivalent-PLMN-List AVP is of type Grouped. This AVP shall contain the equivalent PLMN IDs of the registered PLMN (i.e. the visited PLMN) of the MME or the SGSN.

AVP format

> Equivalent-PLMN-List ::= <AVP header: 1637 10415>
>
> > 1*{ Visited-PLMN-Id }
> >
> > *[AVP]

7.3.152 CLR-Flags

The CLR-Flags AVP is of type Unsigned32 and it shall contain a bit mask. The meaning of the bits shall be as defined in table 7.3.152/1:

Table 7.3.152/1: CLR-Flags

Bit	Name	Description
0	S6a/S6d-Indicator (Note 1)	This bit, when set, indicates that the CLR message is sent on the S6a interface, i.e. the message is to the MME or the MME part on the combined MME/SGSN. This bit, when cleared, indicates that the CLR message is sent on the S6d interface, i.e. the message is to the SGSN or the SGSN part on the combined MME/SGSN.
1	Reattach-Required	This bit, when set, indicates that the MME or SGSN shall request the UE to initiate an immediate re-attach procedure as described in 3GPP TS 23.401 [2] and in 3GPP TS 23.060 [12].
NOTE 1: The S6a/S6d-Indicator flag shall be used during initial attach procedure for a combined MME/SGSN. The S6a/S6d-Indicator flag may also be sent to a standalone node.		
NOTE 2: Bits not defined in this table shall be cleared by the sending HSS and discarded by the receiving MME or SGSN.		

7.3.153 UVR-Flags

The UVR-Flags AVP is of type Unsigned32 and it shall contain a bit mask. The meaning of the bits shall be as defined in table 7.3.154/1:

Table 7.3.154/1: UVR-Flags

Bit	Name	Description
0	Skip Subscriber Data	This bit, when set, indicates that the CSS may skip subscription data in UVA. If the CSG subscription data has changed in the CSS after the last successful update of the MME/SGSN, the CSS shall ignore this bit and send the updated CSG subscription data.
Bits not defined in this table shall be cleared by the sending MME or SGSN and discarded by the receiving CSS.		

7.3.154 UVA-Flags

The UVA-Flags AVP is of type Unsigned32 and it shall contain a bit mask. The meaning of the bits shall be as defined in table 7.3.156/1:

Table 7.3.156/1: UVA-Flags

Bit	Name	Description
0	Temporary Empty VPLMN CSG Subscription Data	This bit, when set, indicates that the CSS has currently no VPLMN CSG subscription data for this user but has registered the MME or SGSN, so to inform them if later changes in VPLMN CSG subscription data occur.
Bits not defined in this table shall be cleared by the sending MME or SGSN and discarded by the receiving CSS.		

7.3.155 VPLMN-CSG-Subscription-Data

The VPLMN-CSG-Subscription-Data AVP is of type Grouped. This AVP shall contain the CSG-Id, and optionally an associated expiration date.

AVP format

> VPLMN-CSG-Subscription-Data ::= <AVP header: 1641 10415>
>
>> { CSG-Id }
>>
>> [Expiration-Date]
>>
>> *[AVP]

7.3.156 Local-Time-Zone

The Local-Time-Zone AVP is of type Grouped and shall contain the Time Zone and the Daylight Saving Time (DST) adjustment of the location in the visited network where the UE is attached.

The AVP format shall conform to:

> Local-Time-Zone ::= <AVP header: 1649 10415>
>
>> { Time-Zone }
>>
>> { Daylight-Saving-Time }
>>
>> * [AVP]

7.3.157 A-MSISDN

The A-MSISDN AVP is of type OctetString. See 3GPP TS 23.003 [3] for the definition of the Additional MSISDN. This AVP contains an A-MSISDN, in international number format as described in ITU-T Rec E.164 [41], encoded as a TBCD-string. See 3GPP TS 29.002 [24] for encoding of TBCD-strings. This AVP shall not include leading indicators for the nature of address and the numbering plan; it shall contain only the TBCD-encoded digits of the address.

This AVP may be present in the Subscription-Data AVP when sent within ULA.

It may also be present in the Subscription-Data AVP, sent within an IDR, if the current value in the MME or SGSN needs to be changed.

7.3.158 Void

7.3.159 MME-Number-for-MT-SMS

The MME-Number-for-MT-SMS AVP is of type OctetString and it shall contain the ISDN number corresponding to the MME for MT SMS. For further details on the definition of this AVP, see 3GPP TS 23.003 [3]. This AVP contains an international number with the format as described in ITU-T Rec E.164 [41] and shall be encoded as a TBCD-string. See 3GPP TS 29.002 [24] for encoding of TBCD-strings.   This AVP shall not include leading indicators for the nature of address and the numbering plan; it shall contain only the TBCD-encoded digits of the address.

7.3.160 Void

7.3.161 Void

7.3.162 SMS-Register-Request

The SMS-Register-Request AVP is of type Enumerated and it shall indicate whether the MME or the SGSN requires to be registered for SMS (e.g. SGs interface not supported) or if the MME or the SGSN prefers not to be registered for SMS or if the MME or the SGSN has no preference.

The following values are defined:

SMS_REGISTRATION_REQUIRED (0)

SMS_REGISTRATION_NOT_PREFERRED (1)

NO_PREFERENCE (2)

The criteria for setting these values are defined in 3GPP TS 23.272 [44] and 3GPP TS 23.060 [12].

7.3.163 Time-Zone

The Time-Zone AVP is of type UTF8String and shall contain the time zone of the location in the visited network where the UE is attached.

It contains the offset from UTC (Coordinated Universal Time) in units of 15 minutes, as defined in 3GPP TS 22.042 [42]. It shall be expressed as positive (i.e. with the leading plus sign [+]) if the local time is ahead of or equal to UTC of day and as negative (i.e. with the leading minus sign [-]) if it is behind UTC of day.

The value contained in the Time-Zone AVP shall take into account daylight saving time, such that when the sending entity changes from regular (winter) time to daylight saving (summer) time, there is a change to the value in the Time-Zone AVP.

The contents of the Time-Zone AVP shall be formatted as a character string with the following format:

Basic format: ±n, with "n" being the number of units of 15 minutes from UTC.

For example, if the offset is +2h=+8x15mn, the value of the Time-Zone AVP will be: "+8".

7.3.164 Daylight-Saving-Time

The Daylight-Saving-Time AVP is of type Enumerated and shall contain the Daylight Saving Time (in steps of 1 hour) used to adjust for summertime the time zone of the location where the UE is attached in the visited network.

The following values are defined:

NO_ADJUSTMENT (0)

PLUS_ONE_HOUR_ADJUSTMENT (1)

PLUS_TWO_HOURS_ADJUSTMENT (2)

7.3.165 Subscription-Data-Flags

The Subscription-Data-Flags is of type Unsigned32 and it shall contain a bit mask. The meaning of the bits shall be as defined in table 7.3.165/1:

Table 7.3.165/1: Subscription-Data-   Flags

Bit	Name	Description
0	PS-And-SMS-Only-Service-Provision-Indication	This bit, when set, indicates that the subscription is for PS Only and permits CS service access only for SMS.
1	SMS-In-SGSN-Allowed-Indication	This bit, when set, indicates that SMS in SGSN for the user is allowed.
2	User Plane Integrity Protection	This bit, when set, indicates that the SGSN may decide to activate integrity protection of the user plane when GERAN is used (see 3GPP TS 43.020 [58]). The MME shall ignore it.
3	PDN-Connection-Restricted	This bit, when set, indicates to the MME that it shall not establish any non-emergency PDN connection for this user if the MME and the UE supports Attach without PDN connection. The SGSN shall ignore it.
4	Acknowledgement-Of-Downlink-NAS-Data PDUs disabled	This bit, when set, indicates to the MME that acknowledgement of downlink NAS data PDUs for Control Plane CIoT Optimization is disabled for this UE (even for APN configurations with RDS Indicator set to ENABLED (1)). When not set it indicated to the MME that acknowledgement of downlink NAS data PDUs for Control Plane CIoT Optimization is enabled (for APN configurations with RDS Indicator set to ENABLED (1)) for this UE, which is the default (see 3GPP TS 23.401 [2]). The SGSN shall ignore it.
NOTE:	Bits not defined in this table shall be cleared by the sender and discarded by the receiver of the command.	

7.3.166 Measurement-Period-LTE

The Measurement-Period-LTE AVP is of type Enumerated. The possible values are those defined in 3GPP TS 32.422 [23] for Measurement period LTE.

7.3.167 Measurement-Period-UMTS

The Measurement-Period-UMTS AVP is of type Enumerated. The possible values are those defined in 3GPP TS 32.422 [23] for Measurement period UMTS.

7.3.168 Collection-Period-RRM-LTE

The Collection-Period-RRM-LTE AVP is of type Enumerated. The possible values are those defined in 3GPP TS 32.422 [23] for Collection period for RRM measurements LTE.

7.3.169 Collection-Period-RRM-UMTS

The Collection-Period-RRM-UMTS AVP is of type Enumerated. The possible values are those defined in 3GPP TS 32.422 [23] for Collection period for RRM measurements UMTS.

7.3.170 Positioning-Method

The Positioning-Method AVP is of type OctetString. It contains one octet carrying a bit map of 8 bits. The possible values are those defined in 3GPP TS 32.422 [23] for Positioning Method.

7.3.171 Measurement-Quantity

The Measurement-Quantity AVP is of type OctetString. It contains one octet carrying a bit map of 8 bits. The possible values are those defined in 3GPP TS 32.422 [23] for Measurement quantity.

7.3.172 Event-Threshold- Event-1F

The Event-Threshold-Event-1F AVP is of type Integer32. See 3GPP TS 32.422 [23] for allowed values.

7.3.173 Event-Threshold-Event-1I

The Event-Threshold-Event-1I AVP is of type Integer32. See 3GPP TS 32.422 [23] for allowed values

7.3.174 Restoration-Priority

The Restoration-Priority AVP is of type Unsigned32. It shall indicate the relative priority of a user's PDN connection among PDN connections to the same APN when restoring PDN connections affected by an SGW or PGW failure/restart (see 3GPP TS 23.007 [43]).

Values 1 to 16 are defined, with value 1 as the highest level of priority.

7.3.175 SGs-MME-Identity

The SGs-MME-Identity AVP is of type UTF8String. This AVP shall contain the MME identity used over the SGs interface and specified in 3GPP TS 23.003 [3] subclause 19.4.2.4.

7.3.176 SIPTO-Local-Network-Permission

The SIPTO-Local-Network-Permission AVP is of type Unsigned32. It shall indicate whether the traffic associated with this particular APN is allowed or not for SIPTO at the local network.

The following values are defined:

"SIPTO at Local Network ALLOWED" 0

"SIPTO at Local Network NOTALLOWED" 1

7.3.177 Coupled-Node-Diameter-ID

The Coupled-Node-Diameter-ID AVP is of type DiameterIdentity. This AVP shall contain the S6a or S6d Diameter identity of the coupled node as specified in 3GPP TS 23.003 [3] subclause 19.4.2.4 and subclause 19.4.2.6.

7.3.178 OC-Supported-Features

The OC-Supported-Features AVP is of type Grouped and it is defined in IETF RFC 7683 [50]. This AVP is used to support Diameter overload control mechanism, see Annex C for more information.

7.3.179 OC-OLR

The OC-OLR AVP is of type Grouped and it is defined in IETF RFC 7683 [50]. This AVP is used to support Diameter overload control mechanism, see Annex C for more information.

7.3.180 ProSe-Subscription-Data

The ProSe-Subscription-Data AVP is of type Grouped. It shall contain the ProSe related subscription data. It was originally defined in 3GPP TS 29.344 [49].

AVP format

ProSe-Subscription-Data ::= <AVP header: xxx 10415>

{ ProSe-Permission }

*[AVP]

7.3.181 WLAN-offloadability

The WLAN-offloadability AVP is of type Grouped. This AVP contains WLAN offloadability for E-UTRAN or UTRAN.

AVP format:

> WLAN-offloadability ::= <AVP header: 1667>
>
>> [WLAN-offloadability-EUTRAN]
>>
>> [WLAN-offloadability-UTRAN]
>>
>> *[AVP]

7.3.182 WLAN-offloadability-EUTRAN

The WLAN-offloadability-EUTRAN AVP is of type Unsigned32 and it shall contain a bitmask. The meaning of the bits is defined in table 7.3.182/1:

Table 7.3.182/1: WLAN-offloadability-EUTRAN

bit	name	Description
0	WLAN offloadability for E-UTRAN	This bit, when set, shall indicate that the traffic associated with the APN is allowed to be offloaded to WLAN from E-UTRAN using the WLAN/3GPP Radio Interworking feature. If not set, it means the traffic associated with the APN is not allowed to be offloaded to WLAN from E-UTRAN.
NOTE:	Bits not defined in this table shall be cleared by the sending HSS and discarded by the receiving MME or SGSN.	

7.3.183 WLAN-offloadability-UTRAN

The WLAN-offloadability-UTRAN AVP is of type Unsigned32 and it shall contain a bitmask. The meaning of the bits is defined in table 7.3.183/1:

Table 7.3.183/1: WLAN-offloadability-UTRAN

bit	name	Description
0	WLAN offloadability for UTRAN	This bit, when set, shall indicate that the traffic associated with the APN is allowed to be offloaded to WLAN from UTRAN using the WLAN/3GPP Radio Interworking feature. If not set, it means the traffic associated with the APN is not allowed to be offloaded to WLAN from UTRAN.
NOTE:	Bits not defined in this table shall be cleared by the sending HSS and discarded by the receiving MME or SGSN..	

7.3.184 Reset-ID

The Reset-ID is of type OctetString. The value shall uniquely (within the HSS's realm) identify a resource in the HSS that may fail or has restarted.

In the Reset procedure, when used to add/modify/delete subscription data shared by multiple subscribers, the Reset-ID is used to identify the set of affected subscribers.

7.3.185 MDT-Allowed-PLMN-Id

The MDT-Allowed-PLMN-Id AVP is of type OctetString. This AVP shall contain the concatenation of MCC and MNC. See 3GPP TS 23.003 [3]. The content of this AVP shall be encoded as an octet string according to table 7.3.185/1.

This AVP identifies the PLMN in which the MDT data collection shall take place.

See 3GPP TS 24.008 [31], clause 10.5.1.13, PLMN list, for the coding of MCC and MNC. If MNC is 2 digits long, bits 5 to 8 of octet 2 are coded as "1111".

Table 7.3.185/1: Encoding format for MDT-Allowed-PLMN-Id AVP

8	7	6	5	4	3	2	1	
MCC digit 2				MCC digit 1				octet 1
MNC digit 3				MCC digit 3				octet 2
MNC digit 2				MNC digit 1				octet 3

7.3.186 Adjacent-PLMNs

The Adjacent-PLMNs AVP is of type Grouped. This AVP shall contain a list of PLMN IDs where an UE served by the MME/SGSN is likely to make a handover from the PLMN where the MME/SGSN is located.

AVP format:

    Adjacent-PLMNs ::= <AVP header: 1672 10415>

        1*{ Visited-PLMN-Id }

        *[AVP]

7.3.187 Adjacent-Access-Restriction-Data

The Adjacent-Access-Restriction-Data AVP is of type Grouped. This AVP shall contain a pair of PLMN ID and the associated Access Restriction Data for that PLMN.

AVP format:

    Adjacent-Access-Restriction-Data ::= <AVP header: 1673 10415>

        { Visited-PLMN-Id }

        { Access-Restriction-Data }

        *[AVP]

7.3.188 DL-Buffering-Suggested-Packet-Count

The DL-Buffering-Suggested-Packet-Count AVP is of type Integer32. It shall indicate whether extended buffering of downlink packets at the SGW, for High Latency Communication, is requested or not. When requested, it may also suggest the number of downlink packets to buffer at the SGW for this user.

The following values are defined:

"Extended DL Data Buffering NOT REQUESTED"   0

"Extended DL Data Buffering REQUESTED, without a suggested number of packets"   -1

"Extended DL Data Buffering REQUESTED, with a suggested number of packets"   > 0

"Extended DL Data Buffering REQUESTED", with
or without a suggested number of packets to be buffered for this user, indicates that extended buffering of downlink packets at the SGW is applicable to this user.

"Extended DL Data Buffering NOT REQUESTED" indicates that extended buffering of downlink packets at the SGW is not applicable to this user.

7.3.189 IMSI-Group-Id

The IMSI-Group-Id AVP shall be of type Grouped. This AVP shall contain the information about the IMSI-Group-Id.

AVP format

      IMSI-Group-Id ::= <AVP header: 1675 10415>

               { Group-Service-Id }

               { Group-PLMN-Id }

               { Local-Group-Id }

               *[AVP]

For details see 3GPP TS 23.003 [3], subclause 19.9).

7.3.190 Group-Service-Id

The Group-Service-Id AVP is of type Unsigned32 and it shall identify the specific service for which the IMSI-Group-Id is used. The following values are defined:

Table 7.3.190-1: Group-Service-Id

Value	Description
1	Group specific NAS level congestion control

Values greater than 1000 are reserved for home operator specific use. IMSI-Group-IDs with a Group-Service-Id in this range shall not be sent outside the HPLMN unless roaming agreements allow so.

7.3.191 Group-PLMN-Id

The Group-PLMN-Id AVP is of type OctetString. This AVP shall contain the concatenation of MCC and MNC. See 3GPP TS 23.003 [3]. The content of this AVP shall be encoded as an octet string according to table 7.3.191-1.

See 3GPP TS 24.008 [31], clause 10.5.1.13, PLMN list, for the coding of MCC and MNC. If MNC is 2 digits long, bits 5 to 8 of octet 2 are coded as "1111".

Table 7.3.191-1: Encoding format for Group-PLMN-Id AVP

8	7	6	5	4	3	2	1	
MCC digit 2				MCC digit 1				octet 1
MNC digit 3				MCC digit 3				octet 2
MNC digit 2				MNC digit 1				octet 3

7.3.192 Local-Group-Id

The Local-Group-Id AVP is of type OctetString. It shall contain an operator defined value, representing a group.

7.3.193 AESE-Communication-Pattern

AESE-Communication-Pattern AVP is of type Grouped and is defined in 3GPP TS 29.336 [54].

AVP format

> AESE-Communication-Pattern ::= <AVP header: 3113 10415>
>
>> [SCEF-Reference-ID]
>>
>> { SCEF-ID }
>>
>> *[SCEF-Reference-ID-for-Deletion]
>>
>> *[Communication-Pattern-Set]
>>
>> *[AVP]

At least one SCEF-Reference-ID or SCEF-Reference-ID-for-Deletion shall be present.

7.3.194 Communication-Pattern-Set

Communication-Pattern-Set AVP is of type Grouped and is defined in 3GPP TS 29.336 [54].

AVP format

> Communication-Pattern-Set ::= <AVP header: 3114 10415>
>
>> [Periodic-Communication-Indicator]
>>
>> [Communication-Duration-Time]
>>
>> [Periodic-Time]
>>
>> *[Scheduled-Communication-Time]
>>
>> [Stationary-Indication]
>>
>> [Reference-ID-Validity-Time]
>>
>> *[AVP]

If the Reference-ID-Validity-Time AVP is absent, it indicates that there is no expiration time defined for the Communication-Pattern-Set.

7.3.195 Monitoring-Event-Configuration

The Monitoring-Event-Configuration AVP is of type Grouped. It shall contain the Monitoring event configuration related subscription data. It is originally defined in 3GPP TS 29.336 [54].

For S6a/S6d interface, the Monitoring-Event-Configuration AVP format is specified as following:

AVP format:

> Monitoring-Event-Configuration ::= <AVP header: 3122 10415>
>
>> [SCEF-Reference-ID]
>>
>> { SCEF-ID }
>>
>> { Monitoring-Type }
>>
>> *[SCEF-Reference-ID-for-Deletion]

[Maximum-Number-of-Reports]

[Monitoring-Duration]

[Charged-Party]

[UE-Reachability-Configuration]

[Location-Information-Configuration]

[SCEF-Realm]

*[AVP]

When the Monitoring-Event-Configuration AVP is used over the S6a/S6d interfaces, the SCEF-Realm AVP shall be present and its value shall be obtained by the HSS from the Origin-Realm AVP of the Configuration-Information-Request command conveying the corresponding monitoring event configuration over the S6t interface from the SCEF to the HSS.

7.3.196 Monitoring-Event-Report

The Monitoring-Event-Report AVP is of type Grouped. It shall contain the Monitoring event report data. It is originally defined in 3GPP TS 29.336 [54].

For S6a/S6d interface, the Monitoring-Event-Report AVP format is specified as following:

AVP format:

Monitoring Event Report::= <AVP header: 3123 10415>

{ SCEF-Reference-ID }

[SCEF-ID]

[Reachability-Information]

[EPS-Location-Information]

[Monitoring-Type]

[Loss-Of-Connectivity-Reason]

*[AVP]

For S6a/S6d interface, when the Monitoring-Type AVP takes the value UE_REACHABILITY (1), the Reachability-Information AVP shall take the value REACHABLE_FOR_DATA (1).

7.3.197 UE-Reachability-Configuration

The UE-Reachability-Configuration AVP is of type Grouped, and it shall contain the details for configuration for UE reachability. It is originally defined in 3GPP TS 29.336 [54].

For S6a/S6d interface, the UE-Reachability-Configuration AVP format is specified as following:

AVP format:

UE-Reachability-Configuration::= <AVP header: 3129 10415>

[Reachability-Type]

[Maximum-Response-Time]

*[AVP]

NOTE: When a Maximum-Response-Time value is not received from the SCEF, the HSS can send an O&M configured desired active time value within the Maximum-Response-Time AVP.

For S6a/S6d interface, the Reachability-Type AVP shall have bit 0 ("Reachability for SMS") cleared, and it shall have bit 1 ("Reachability for Data") set.

7.3.198 eNodeB-ID

The eNodeB-ID AVP is of type OctetString, and indicates the eNodeB in which the UE is currently located. It is originally defined in 3GPP TS 29.217 [56].

7.3.199 Supported-Services

The Supported-Services AVP is of type Grouped and it shall contain the different bit masks representing the services supported by the MME/SGSN:

AVP format

> Supported-Services::= <AVP header: zzzz 10415>
>
> > [Supported-Monitoring-Events]
> >
> > *[AVP]

7.3.200 Supported-Monitoring-Events

The Supported-Monitoring-Events AVP is of type Unsigned64 and it shall contain a bit mask. The meaning of the bits shall be as defined in table 7.3.200-1:

Table 7.3.200 -1: Supported-Monitoring-Events

Bit	Name	Description
0	UE and UICC and/or new IMSI-IMEI-SV association	only used on S6t interface
1	UE-reachability	This bit shall be set if UE reachability Monitoring event is supported in the MME/SGSN
2	Location-of-the-UE	This bit shall be set if Location of the UE and change in location of the UE Monitoring event is supported in the MME/SGSN
3	Loss-of-connectivity	This bit shall be set if Loss of connectivity Monitoring event is supported in the MME/SGSN
4	Communication-failure	This bit shall be set if Communication failure Monitoring event is supported in the MME/SGSN
5	Roaming-status	only used on S6t interface
6	Availability after DDN failure	This bit shall be set if Availability after DDN failure Monitoring event is supported in the MME/SGSN
7	Idle Status Indication	This bit shall be set if Idle Status Indication reporting is supported in the MME/SGSN
NOTE:	Bits not defined in this table shall be cleared by the sender and discarded by the receiver of the command.	

7.3.201 AIR-Flags

The AIR-Flags AVP is of type Unsigned32 and it shall contain a bitmask. The meaning of the bits is defined in table 7.3.201/1:

Table 7.3.201/1: AIR-Flags

bit	name	Description
0	Send UE Usage Type	This bit, when set, indicates that the MME or SGSN requests the HSS to send the subscription parameter "UE Usage Type".
NOTE:	Bits not defined in this table shall be cleared by the sending MME or SGSN and discarded by the receiving HSS.	

7.3.202 UE-Usage-Type

The UE-Usage-Type AVP is of type Unsigned32. This value shall indicate the usage characteristics of the UE that enables the selection of a specific Dedicated Core Network (DCN). See subclause 4.3.25 of 3GPP TS 23.401 [2].

The allowed values of UE-Usage-Type shall be in the range of 0 to 255.

Values in the range of 0 to 127 are standardized and defined as follows:

>   0: Spare, for future use

> …

>   127:   Spare, for future use

Values in the range of 128 to 255 are operator-specific.

7.3.203 DRMP

The DRMP AVP is of type Enumerated and it is defined in IETF RFC 7944 [57]. This AVP allows the HSS, the CSS, the EIR and the MME/SGSN to indicate the relative priority of Diameter messages. The DRMP AVP may be used to set the DSCP marking for transport of the associated Diameter message.

7.3.204 Non-IP-PDN-Type-Indicator

The Non-IP-PDN-Type-Indicator AVP is of type Enumerated and indicates whether the APN has a Non-IP PDN type.

 The following values are defined:

>   FALSE (0)

This value indicates that the APN does not have a Non-IP PDN type and, in this case, the actual PDN type of the APN is indicated by the PDN-Type AVP inside APN-Configuration AVP.

>   TRUE (1)

This value indicates that the APN has a Non-IP PDN type and, in this case, the value indicated by the PDN-Type AVP inside APN-Configuration AVP shall be ignored.

The default value when this AVP is not present is FALSE (0).

7.3.205 Non-IP-Data-Delivery-Mechanism

The Non-IP-Data-Delivery-Mechanism AVP is of type Unsigned32 and indicates the mechanism to be used for Non-IP data delivery for a given APN. The following values are defined:

>   SGi-BASED-DATA-DELIVERY (0)

This value indicates that the Non-IP data is delivered via Point-To-Point tunnelling over the SGi interface.

>   SCEF-BASED-DATA-DELIVERY (1)

This value indicates that the Non-IP data is delivered via the SCEF.

The default value when this AVP is not present is SGi-BASED-DATA-DELIVERY (0).

7.3.206 Additional-Context-Identifier

The Additional-Context-Identifier AVP is of type Unsigned32 and indicates the identity of another default APN to be used when the subscription profile of the user contains APNs with both IP-based and non-IP PDN types.

7.3.207 SCEF-Realm

The SCEF-Realm AVP is of type DiameterIdentity and it shall contain the Diameter realm of the SCEF. For further details on the encoding of this AVP, see IETF RFC 6733 [61].

7.3.208 Subscription-Data-Deletion

The Subscription-Data-Deletion AVP is of type Grouped and indicates the shared subscription data that need to be deleted from the subscription profiles of the impacted subscribers.

AVP format

Subscription-Data-Deletion ::= <AVP header: 1685 10415>

> { DSR-Flags }
> [SCEF-ID]
> *[Context-Identifier]
> [Trace-Reference]
> *[TS-Code]
> *[SS-Code]
> *[AVP]

7.3.209 Preferred-Data-Mode

The Preferred-Data-Mode AVP is of type Unsigned32 and it shall contain a bitmask. The meaning of the bits is defined in table 7.3.209/1:

Table 7.3.209/1: Preferred-Data-Mode

bit	name	Description
0	Data over User Plane Preferred	This bit, when set, shall indicate that the User Plane is preferred for transmitting the traffic associated with the APN. If not set, it means that the User Plane is not preferred for transmitting the traffic associated with the APN.
1	Data over Control Plane Preferred	This bit, when set, shall indicate that the Control Plane is preferred for transmitting the traffic associated with the APN. If not set, it means that the Control Plane is not preferred for transmitting the traffic associated with the APN.
NOTE 1:	Bits not defined in this table shall be cleared by the sending HSS and discarded by the receiving MME.	
NOTE 2:	At least one of the bits 0 and 1 shall be set to 1. Both bits 0 and 1 may be set to 1 to indicate that both User Plane and Control Plane are preferred for transmitting the traffic associated with the APN.	
NOTE 3:	This parameter only applies to E-UTRAN and SGi PDN connections. Data over User Plane refers to PDN data transported over S1-U and Data Radio Bearer. Data over Control Plane refers to PDN data transported over NAS and Signalling Radio Bearer.	

7.3.210 Emergency-Info

The Emergency-Info AVP is of type Grouped. It shall contain the identity of the PDN-GW used for the establishment of emergency PDN connections.

The AVP format shall conform to:

Emergency-Info ::= <AVP header: 1687 10415>

> [MIP6-Agent-Info]
>
> *[AVP]

7.3.211 Load

The Load AVP is of type Grouped and it is defined in IETF draft-ietf-dime-load-03 [60]. This AVP is used to support Diameter load control mechanism, see Annex F for more information.

7.3.212 V2X-Subscription-Data

The V2X-Subscription-Data AVP is of type Group. It shall contain the V2X related subscription data.

AVP format:

> V2X-Subscription-Data ::= <AVP header: 1688 10415>
>
>> [V2X-Permission]
>>
>> [UE-PC5-AMBR]
>>
>> *[AVP]

The UE-PC5-AMBR AVP within the V2X-Subscription-Data AVP indicates the UE AMBR used for PC5 interface.

7.3.213 V2X-Permission

The V2X-Permission-Subscribed AVP is of type Unsigned32 and it shall contain a bit mask that indicates the permissions for V2X service subscribed by the user. The meaning of the bits shall be as defined in table 7.3.x2-1:

Table 7.3.x2-1: V2X-Permission

Bit	Name	Description
0	Allow V2X communication over PC5 as Vehicle UE	This bit, when set, indicates that the user is allowed to use V2X communication over PC5 as Vehicle UE in the serving PLMN.
1	Allow V2X communication over PC5 as Pedestrian UE	This bit, when set, indicates that the user is allowed to use V2X communication over PC5 as Pedestrian UE in the serving PLMN.
NOTE:	Bits not defined in this table shall be cleared by the HSS and discarded by the MME.	

7.3.214 PDN-Connection-Continuity

The PDN-Connection-Continuity AVP is of type Unsigned32 and indicates how to handle the PDN connection when the UE moves between "broadband" (WB-E-UTRAN, UTRAN) and "narrowband" (NB-IoT, GPRS, EC-GSM-IoT). The following values are defined:

MAINTAIN-PDN-CONNECTION (0)

DISCONNECT-PDN-CONNECTION-WITH-REACTIVATION-REQUEST (1)

DISCONNECT-PDN-CONNECTION-WITHOUT-REACTIVATION-REQUEST (2)

This AVP corresponds to the "PDN continuity at inter RAT mobility" field as defined in 3GPP TS 23.401 [2] table 5.7.1-1.

7.3.215 eDRX-Cycle-Length

The eDRX-Cycle-Length AVP is of type Grouped. This AVP shall contain an eDRX cycle length, along with the RAT type for which this cycle length is applicable to (e.g. E-UTRAN and NB-IOT).

AVP format:

> eDRX-Cycle-Length ::= <AVP header: 1691 10415>

    { RAT-Type }

      { eDRX-Cycle-Length-Value }

      *[AVP]

7.3.216 eDRX-Cycle-Length-Value

The eDRX-Cycle-Length-Value AVP is of type OctetString. This AVP shall contain the extended DRX cycle value subscribed for this user for a given RAT type. The contents of eDRX-Cycle-Length-Value shall consist of 1 octet.

The encoding shall be as defined in 3GPP TS 24.008 [31], clause 10.5.5.32, and it shall only contain the value of the field "eDRX value" for a given RAT type, i.e., the 4 least significant bits of the octet in this AVP shall contain bits 1-4 of octet 3 in the "Extended DRX parameter" IE (see Figure 10.5.5.32 of 3GPP TS 24.008 [31]), and the 4 most significant bits of the octet in this AVP shall be set to 0.

7.3.217 UE-PC5-AMBR

The UE-PC5-AMBR AVP is of type Unsigned32. It indicates the maximum bits delivered by UE over the PC5 interface within a period of time. The unit of UE-PC5-AMBR is bits/s.

7.3.218 Extended eNodeB-ID

The Extended eNodeB-ID AVP is of type OctetString, and indicates the eNodeB in which the UE is currently located. It is originally defined in 3GPP TS 29.217 [56].

7.3.219 MBSFN-Area

The MBSFN-Area AVP is of type Grouped. It contains a MBSFN Area ID and a Carrier Frequency (see 3GPP TS 32.422 [23]).

The AVP format shall conform to:

    MBSFN-Area ::= <AVP header: 1694 10415>

      [MBSFN-Area-ID]

      [Carrier-Frequency]

      *[AVP]

If both MBSFN-Area-ID and Carrier-Frequency values are present, a specific MBSFN area is indicated. If Carrier-Frequency value is present, but MBSFN-Area-ID is absent, all MBSFN areas on that carrier frequency are indicated. If both MBSFN-Area-ID and Carrier-Frequency are absent, any MBSFN area is indicated.

7.3.220 MBSFN-Area-ID

The MBSFN-Area-ID AVP is of type Unsigned32 and it shall contain the MBSFN Area ID value, in the range of 0..255 (see 3GPP TS 36.331 [62]).

7.3.221 Carrier-Frequency

The Carrier-Frequency AVP is of type Unsigned32 and it shall contain the Carrier Frequency value, in the range of 0..262143 (see 3GPP TS 36.331 [62]).

7.3.222 RDS-Indicator

The RDS-Indicator AVP is of type Enumerated and indicates whether the Reliable Data Service (RDS) is enabled or disabled for the APN. See 3GPP TS 23.682 [55].

The following values are defined:

DISABLED (0)

ENABLED (1)

The default value when this AVP is not present is DISABLED (0).

7.4 Result-Code and Experimental-Result Values

7.4.1 General

This section defines result code values that shall be supported by all Diameter implementations that conform to this specification.

7.4.2 Success

Result codes that fall within the Success category shall be used to inform a peer that a request has been successfully completed. The Result-Code AVP values defined in the Diameter base protocol IETF RFC 6733 [61] shall be applied.

7.4.3 Permanent Failures

Errors that fall within the Permanent Failures category shall be used to inform the peer that the request has failed, and should not be attempted again. The Result-Code AVP values defined in the Diameter base protocol IETF RFC 6733 [61] shall be applied. When one of the result codes defined here is included in a response, it shall be inside an Experimental-Result AVP and the Result-Code AVP shall be absent.

7.4.3.1 DIAMETER_ERROR_USER_UNKNOWN (5001)

This result code shall be sent by the HSS to indicate that the user identified by the IMSI is unknown

7.4.3.2 DIAMETER_ERROR_UNKNOWN_EPS_SUBSCRIPTION (5420)

This result code shall be sent by the HSS to indicate that no EPS subscription is associated with the IMSI.

7.4.3.3 DIAMETER_ERROR_RAT_NOT_ALLOWED (5421)

This result code shall be sent by the HSS to indicate the RAT type the UE is using is not allowed for the IMSI.

7.4.3.4 DIAMETER_ERROR_ROAMING_NOT_ALLOWED (5004)

This result code shall be sent by the HSS to indicate that the subscriber is not allowed to roam within the MME or SGSN area.

7.4.3.5 DIAMETER_ERROR_EQUIPMENT_UNKNOWN (5422)

This result code shall be sent by the EIR to indicate that the mobile equipment is not known in the EIR.

7.4.3.6 DIAMETER_ERROR_UNKOWN_SERVING_NODE (5423)

This result code shall be sent by the HSS to indicate that a Notify command has been received from a serving node which is not registered in HSS as the node currently serving the user.

7.4.4 Transient Failures

Result codes that fall within the transient failures category shall be used to inform a peer that the request could not be satisfied at the time it was received, but may be able to satisfy the request in the future. The Result-Code AVP values

defined in the Diameter base protocol

IETF RFC 6733 [61]shall be applied. When one of the result codes defined here is included in a response, it shall be inside an Experimental-Result AVP and the Result-Code AVP shall be absent.

7.4.4.1 DIAMETER_AUTHENTICATION_DATA_UNAVAILABLE (4181)

This result code shall be sent by the HSS to indicate that an unexpectedly transient failure occurs. The requesting node can try the request again in the future.

7.4.4.2 DIAMETER_ERROR_CAMEL_SUBSCRIPTION_PRESENT (4182)

This result code shall be sent by the HSS to indicate that the subscriber to be registered has SGSN CAMEL Subscription data.

8 User identity to HSS resolution

The User identity to HSS resolution mechanism enables the MME, SGSN (for non-roaming case) or Diameter Relay/proxy agents in the home network (for roaming case) to find the identity of the HSS that holds the subscriber data for a given user identity when multiple and separately addressable HSSs have been deployed in the home network. The resolution mechanism is not required in networks that utilise a single HSS.

This User identity to HSS resolution mechanism may rely on routing capabilitites provided by Diameter and be implemented in the home operator network within dedicated Diameter Agents (Redirect Agents or Proxy Agents) responsible for determining the HSS identity based on the provided user identity. If this Diameter based implementation is selected by the Home network operator, the principles described below shall apply.

In non-roaming case, in networks where more than one independently addressable HSS are deployed in the home network, each MME and SGSN shall be configured with the address/identity of a Diameter Agent (Redirect Agent or Proxy Agent) implementing this resolution mechanism.

For support of roaming case, Diameter Relay agents and/or Diameter Proxy agents in the home network receiving the Diameter signalling from visited networks shall be configured with the address/identity of a Diameter Agent (Redirect Agent or Proxy Agent) implementing this resolution mechanism.

To get the HSS identity that holds the subscriber data for a given user identity in the home network, the Diameter request normally destined to the HSS shall be sent to a pre-configured address/identity of a Diameter agent supporting the User identity to HSS resolution mechanism.

- If this Diameter request is received by a Diameter Redirect Agent, the Diameter Redirect Agent shall determine the HSS identity based on the provided user identity and shall return a notification of redirection towards the HSS identity, in response to the Diameter request. Multiple HSS identities may be included in the response, as specified in IETF RFC 6733 [61]. In such a case, the requesting Diameter entity shall send the Diameter request to the first HSS identity in the ordered list received in the Diameter response from the Diameter Redirect Agent. If no successful response to the Diameter request is received, the requesting Diameter entity shall send a Diameter request to the next HSS identity in the ordered list. This procedure shall be repeated until a successful response from an HSS is received. After the user identity to HSS resolution, the MME or the SGSN shall store the determined HSS identity/name/Realm and shall use it in further Diameter requests to the same user identity.

- If this Diameter request is received by a Diameter Proxy Agent, the Diameter Proxy Agent shall determine the HSS identity based on the provided user identity and - if the Diameter load control mechanism is supported (see IETF draft-ietf-dime-load-03 [60]) - optionally also based on previously received load values from Load AVPs of type HOST. The Diameter Proxy Agent shall then forward the Diameter request directly to the determined HSS. In this case, the user identity to HSS resolution decision is communicated to the MME/SGSN in the Origin-Host/Origin-Realm AVPs of the response. The MME or the SGSN may store the determined HSS identity/name/Realm and may use it in further Diameter requests to the same user identity.

In roaming case, whereas a Diameter Relay Agent is stateless, a stateful Diameter Proxy Agent in the home network may store the determined HSS identity/name/Realm and use it in further Diameter requests associated to the same user identity.

NOTE: Alternatives to the user identity to HSS resolution Diameter based implementation are outside the scope of this specification.

Annex A (normative): MME mapping table for S6a and NAS Cause Code values

When the UE initiates Attach, Tracking Area Update or Service Request, there may be the need for the MME to communicate with the HSS via S6a to retrieve authentication data and/or subscription data. If this retrieval is rejected by the HSS, the received Diameter-Result-Code values or Experimental-Result values need to be mapped to appropriate cause codes over NAS to the UE.

This mapping shall be as shown in Table A.1.

If the retrieval is successful, not needed (e.g. because data are already available) or not possible (e.g. because HSS is unavailable or overloaded), detected error conditions need to be mapped to appropriate cause codes over NAS to the UE.

This mapping shall be as shown in Table A.2.

Table A.1: Mapping from S6a error code to NAS Cause Code values

Reject indication received at MME over S6a	NAS Cause Code sent to UE
DIAMETER_ERROR_USER_UNKNOWN (5001)	#8 "EPS services and non-EPS services not allowed"
DIAMETER_ERROR_UNKNOWN_EPS_SUBSCRIPTION (5420) without Error Diagnostic, or with Error Diagnostic of GPRS_DATA_SUBSCRIBED	#15 "No suitable cells in tracking area"
DIAMETER_ERROR_UNKNOWN_EPS_SUBSCRIPTION (5420) with Error Diagnostic of NO_GPRS_DATA_SUBSCRIBED	#7 "EPS services not allowed"
DIAMETER_ERROR_RAT_NOT_ALLOWED (5421)	#15 "No suitable cells in tracking area", or #13 "Roaming not allowed in this tracking area", or #12 "Tracking area not allowed" (NOTE 1)
DIAMETER_ERROR_ROAMING_NOT_ALLOWED (5004), without Error Diagnostic	#11 "PLMN not allowed"
DIAMETER_ERROR_ROAMING_NOT_ALLOWED (5004), with Error Diagnostic of ODB_HPLMN_APN or ODB_VPLMN_APN	#14 "EPS services not allowed in this PLMN"
DIAMETER_ERROR_ROAMING_NOT_ALLOWED (5004), with Error Diagnostic of ODB_ALL_APN	#15 "No suitable cells in tracking area"
DIAMETER_AUTHORIZATION_REJECTED (5003) DIAMETER_UNABLE_TO_DELIVER (3002) DIAMETER_REALM_NOT_SERVED (3003)	#15 "No suitable cells in tracking area", or #17 "Network failure", or #42 "Severe network failure" (NOTE 1)
DIAMETER_UNABLE_TO_COMPLY (5012), DIAMETER_INVALID_AVP_VALUE (5004) DIAMETER_AVP_UNSUPPORTED (5001) DIAMETER_MISSING_AVP (5005) DIAMETER_RESOURCES_EXCEEDED (5006) DIAMETER_AVP_OCCURS_TOO_MANY_TIMES (5009) DIAMETER_AUTHENTICATION_DATA_UNAVAILABLE (4181) (NOTE 2)	#17 "Network failure" or #42 "Severe network failure" (NOTE 1)
NOTE 1: Any of those NAS Cause Code values may be sent to the UE, depending on operator's choice. NOTE 2: Any other permanent errors from the Diameter base protocol as defined in IETF RFC 6733 [61], not listed here, should be mapped to NAS Cause Code #17 "Network failure".	

**Table A.2: Mapping from detected error   condition to NAS
Cause Code values**

Condition	NAS cause code sent to UE
The MME receives a SGsAP-LOCATION-UPDATE-REJECT message from the VLR indicating in the reject cause "IMSI unknown in HLR" or if the UE has packet only subscription. Only used in the Combined Tracking and Location Area Update procedure.	#2 "IMSI Unknown in HSS"
The MME receives in Update-Location-Answer message an indication of Roaming restricted in MME due to unsupported feature	#14 "EPS services not allowed in this PLMN"
The MME cannot service an UE generated request because CS domain is not available and SMS in MME is not supported.	#18 "CS domain not available"
The value OPERATOR_DETERMINED_BARRING is received in the Subscriber-Status AVP	#15 "No suitable cells in tracking area"
The HSS indicates that due to subscription to a "regionally restricted service" the UE is not allowed to operate in the tracking area.	#12 "Tracking area not allowed"
The CSG ID of the cell from where the UE has sent the TRACKING AREA UPDATE REQUEST message is not contained in the Allowed CSG list.	#25 "Not authorized for this CSG"
The MME detects that it cannot communicate with the HSS in the HPLMN of the subscriber. How the MME detect this is implementation specific.	#15 "No suitable cells in tracking area" #14 "EPS services not allowed in this PLMN" NOTE: Any of those NAS Cause Code values may be sent to the UE, depending on operator's choice / configuration, e.g. NAS Cause Code #14 is to be sent to the UE if the network is an LTE only network.
The MME detects by internal configuration that roaming is not allowed.	#11 "PLMN not allowed"
The MME detects that it cannot send a request to the HSS due to HSS overload (see Annex C).	#22 "Congestion" #42 "Severe network failure" NOTE 1: Cause #22 should be used. In addition, the MME may ask the UE not to retry before a backoff timer expires, based on an operator policy. The eventual timer value may take into account the value received in the corresponding active overload report and operator policy.

	NOTE 2: Cause #42 may be used, for attach requests, in case of severe overload, according to operator policy.

Annex B(normative):
SGSN mapping table for S6d and NAS Cause Code values

When the UE initiates Attach, Routing Area Update or Service Request, there may be the need for the SGSN to communicate with the HSS via S6d to retrieve authentication data and/or subscription data. If this retrieval is rejected by the HSS, the received Diameter-Result-Code values or Experimental-Result valuesneed to be mapped to appropriate cause codes over NAS to the UE.

NOTE: Mapping from MAP Gr error codes to NAS Cause Code values is described in the 3GPP TS 29.010 [45].

This mapping shall be as shown in Table B.1.

If the retrieval is successful, not needed (e.g. because data are already available) or not possible (e.g. because HSS is unavailable or overloaded), detected error conditions need to be mapped to appropriate cause codes over NAS to the UE.

This mapping shall be as shown in Table and B.2.

Table B.1: Mapping from S6d error code to NAS Cause Code values

Reject indication received at SGSN over S6d	NAS Cause Code sent to UE
DIAMETER_ERROR_USER_UNKNOWN (5001)	#8 "GPRS services and non-GPRS services not allowed"
DIAMETER_ERROR_UNKNOWN_EPS_SUBSCRIPTION (5420)	#7 "GPRS services not allowed"
DIAMETER_ERROR_RAT_NOT_ALLOWED (5421)	#15 "No suitable cells in location area", or #13 "Roaming not allowed in this location area", or #12 "Location area not allowed" (NOTE 1)
DIAMETER_ERROR_ROAMING_NOT_ALLOWED (5004) , without Error Diagnostic	#11 "PLMN not allowed"
DIAMETER_ERROR_ROAMING_NOT_ALLOWED (5004), with Error Diagnostic of ODB_HPLMN_APN or ODB_VPLMN_APN	#14 "GPRS services not allowed in this PLMN"
DIAMETER_ERROR_ROAMING_NOT_ALLOWED (5004), with Error Diagnostic of ODB_ALL_APN	#15 "No suitable cells in location area"
DIAMETER_AUTHORIZATION_REJECTED (5003) DIAMETER_UNABLE_TO_DELIVER (3002)	#15 "No suitable cells in location area"
DIAMETER_UNABLE_TO_COMPLY (5012), DIAMETER_INVALID_AVP_VALUE (5004) DIAMETER_AUTHENTICATION_DATA_UNAVAILABLE (4181) and no retry takes place (NOTE 2)	#17 "Network failure"
NOTE 1: Any of those NAS Cause Code values may be sent to the UE, depending on operator's choice. NOTE 2: Any other permanent errors from the Diameter base protocol as defined in IETF RFC 6733 [61], not listed here, should be also mapped to NAS Cause Code #17 "Network failure".	

Table B.2: Mapping from detected error   condition to NAS Cause Code values

Condition	NAS cause code to UE
The SGSN receives a BSSAP+-LOCATION-UPDATE-REJECT message from the VLR indicating in the reject cause "IMSI unknown in HLR" or if the UE has packet only subscription. Only used in the Combined Routing and Location Area Update procedure.	#2 "IMSI Unknown in HLR"
The SGSN receives in Update-Location-Answer message an indication of Roaming restricted in SGSN due to unsupported feature	#14 "GPRS services not allowed in this PLMN"
The value OPERATOR_DETERMINED_BARRING is received in the Subscriber-Status AVP	#15 "No suitable cells in routing area"
The HLR indicates that due to subscription to a "regionally restricted service" the MS is not allowed to operate in the location area.	#12 "Location area not allowed"
The CSG ID of the cell from where the UE has sent the ROUTING AREA UPDATE REQUEST message is not contained in the Allowed CSG list.	#25 "Not authorized for this CSG"
The SGSN indicates that the MS has requested "SMS-only services" and the SMS services are provided by the SGSN in the PS domain.	#28 "SMS provided via GPRS in this routing area"
The SGSN detects that it cannot communicate with the HLR in the HPLMN of the subscriber. How the SGSN detect this is implementation specific.	#15 "No suitable cells in routing area" #14 "GPRS services not allowed in this PLMN" NOTE: Any of those NAS Cause Code values may be sent to the UE, depending on operator's choice / configuration, e.g. NAS Cause Code #14 is to be sent to the UE if the network is an LTE only network.
The SGSN detects by internal configuration that roaming is not allowed.	#11 "PLMN not allowed"
The SGSN detects that it cannot send a request to the HSS due to HSS overload (see Annex C).	#22 "Congestion". In addition, the MME may ask the UE not to retry before a backoff timer expires, based on an operator policy. The eventual timer value may take into account the value received in the corresponding active overload report and operator policy.

Annex C (normative): Diameter overload control mechanism

C.1 General

IETF RFC 7683 [50] specifies a Diameter overload control mechanism which includes the definition and the transfer of related AVPs between Diameter nodes.

Depending on regional/national requirements and network operator policy, priority traffic (e.g. MPS as described in 3GPP TS 22.153 [52]) shall be exempted from throttling due to Diameter overload control up to the point where requested traffic reduction cannot be achieved without throttling the priority traffic.

C.2 S6a/S6d interfaces

C.2.1 General

Diameter overload control mechanism is an optional feature.

It is recommended to make use of IETF RFC 7683 [50] on the S6a/S6d interfaces where, when applied, the MME or the SGSN shall behave as reacting nodes and the HSS as a reporting node.

C.2.2 HSS behaviour

The HSS requests traffic reduction from its clients when the HSS is in an overload situation, including OC-OLR AVP in answer commands as described in IETF RFC 7683 [50].

The HSS identifies that it is in an overload situation by implementation specific means. For example, the HSS may take into account the traffic over the S6a/d interfaces or other interfaces, the level of usage of internal resources (CPU, memory), the access to external resources, etc.

The HSS determines the specific contents of OC-OLR AVP in overload reports and the HSS decides when to send OC-OLR AVPs by implementation specific means.

C.2.3 MME/SGSN behaviour

The MME/SGSN applies required traffic reduction received in answer commands to subsequent applicable requests, as per RFC 7683 [50].

Requested traffic reduction is achieved by the MME/SGSN by implementation specific means. For example, it may implement message throttling with prioritization or a message retaining mechanism for operations that can be postponed.

Diameter requests related to priority traffic (e.g. MPS as identified by the MME/SGSN through access procedures) and emergency have the highest priority. Depending on regional/national regulatory and operator policies, these Diameter requests shall be the last to be throttled, when the MME/SGSN has to apply traffic reduction. Relative priority amongst various priority traffic (e.g. MPS) and emergency traffic is subject to regional/national regulatory and operator policies.

As a result of the need to throttle traffic, the MME or SGSN may reject Attach, Tracking Area Update or Service Requests initiated by UEs. The possible NAS causes are described in the Annex A and B.

Annex D (Informative):   Diameter overload control node behaviour

D.1   Message prioritisation over S6a/d

This clause describes possible behaviours of the MME/SGSN regarding message prioritisation as guidance and for an informative purpose when Diameter overload control is applied over S6a/d.

When the HSS is overloaded, the MME/SGSN will receive overload reports from the HSS requesting a reduction of the requests sent by the MME/SGSN. The following and not exhaustive considerations may be taken into account for the MME/SGSN throttling decisions:

- Prioritisation of requests related to priority traffic (e.g. MPS as identified by the MME/SGSN through access procedures, emergency)

- Identification of the procedures that can be deferred (e.g. UE reachable notification, purge after a long inactivity time), so to avoid to drop non deferrable procedures;

- Prioritisation of certain types of requests (i.e. between AIR, ULR, PUR, NOR) according to the context of their use, in particular:

    - Higher prioritisation of ULR commands when used in relation with mobility management (e.g. handover) for an attached user, so to avoid the interruption of the service for the user;

    - Lower prioritisation of AIR and ULR commands when related to an initial attach, so to avoid the attachment of new users;

- Skipping of optional authentication (e.g. in TAU procedures).

Annex E (normative):
Diameter message priority mechanism

E.1   General

IETF RFC 7944 [57] specifies a Diameter routing message priority mechanism that allows Diameter nodes to indicate the relative priority of Diameter messages. With this information, other Diameter nodes may leverage the relative priority of Diameter messages into routing, resource allocation, set the DSCP marking for transport of the associated Diameter message, and also abatement decisions when overload control is applied.

E.2   S6a/S6d interfaces

E.2.1   General

The Diameter message priority mechanism is an optional feature.

It is recommended to make use of IETF RFC 7944 [57] over the S6a/S6d interfaces of an operator network when the overload control defined in Annex C is applied on these S6a/d interfaces.

E.2.2   HSS, CSS, EIR behaviour

When the HSS, the CSS or the EIR supports the Diameter message priority mechanism, the HSS, the CSS, or the EIR shall comply with IETF RFC 7944 [57].

The HSS or the CSS sending a request shall determine the required priority according to its policies. When priority is required, the HSS or the CSS shall include the DRMP AVP indicating the required priority level in the request it sends, and shall prioritise the request according to the required priority level.

When the HSS or the CSS receives the corresponding response, the HSS or the CSS shall prioritise the received response according to the priority level received within the DRMP AVP if present in the response, otherwise according to the priority level of the corresponding request.

When the HSS, the CSS, or the EIR receives a request, it shall handle the request according to the received DRMP AVP priority level. For the response, the HSS, the CSS, or the EIR may modify the priority level received in the DRMP AVP according to its policies and shall handle the response according to the required priority level. If the required priority level is different from the priority level received in the request, the HSS, the CSS, or the EIR shall include the DRMP AVP in the response.If:

- the HSS, the CSS or the EIR supports using the Diameter message priority mechanism for DSCP marking purposes,

- the transport network utilizes DSCP marking, and

- message-dependant DSCP marking is possible for the protocol stack transporting Diameter,

then the HSS, the CSS or the EIR shall set the DSCP marking for transport of the request or response according to the required priority level.

When not-explicitly requested, the inclusion and priority value of the DRMP AVP in Diameter messages are implementation specific.

E.2.3 MME/SGSN behaviour

When the MME/SGSN supports the Diameter message priority mechanism, the MME/SGSN shall comply with IETF RFC 7944 [57].

The MME/SGSN sending a request shall determine the required priority according to its policies. When priority is required, the MME/SGSN shall include the DRMP AVP indicating the required priority level in the request it sends, and shall prioritise the requests according to the required priority level.

When the MME/SGSN receives the corresponding response, it shall prioritise the received response according to the priority level received within the DRMP AVP if present in the response, otherwise according to the priority level of the corresponding request.

When the MME/SGSN receives a request, it shall handle the request according to the received DRMP AVP priority level. For the response, it may modify the priority level received in the DRMP AVP according to its policies and shall handle the response according to the required priority level. If the required priority level is different from the priority level received in the request, it shall include the DRMP AVP in the response.

If:

- the MME/SGSN supports using the Diameter message priority mechanism for DSCP marking purposes,

- the transport network utilizes DSCP marking, and

- message-dependant DSCP marking is possible for the protocol stack transporting Diameter,

then the MME/SGSN shall set the DSCP marking for transport of the request or response according to the required priority level.

Diameter requests related to high priority traffic (e.g. MPS as identified by the MME/SGSN via the RRC Establishment Cause IE set to the highPriorityAccess value as per 3GPP TS 36.413 [19] or through subscription information in the MPS-Priority AVP, emergency) shall contain a DRMP AVP with a high priority of which the level value is operator dependent.

When not-explicitly requested, the inclusion and priority value of the DRMP AVP in Diameter messages are implementation specific.

Annex F (normative): Diameter load control mechanism

F.1 General

IETF draft-ietf-dime-load-03 [60] specifies a mechanism for sharing of Diameter load information. It includes the definition and the transfer of related AVPs between Diameter nodes.

F.2 S6a/S6d interfaces

F.2.1 General

Diameter load control mechanism is an optional feature.

It is recommended to make use of IETF draft-ietf-dime-load-03 [60] on the S6a/S6d interfaces where, when applied, the MME or the SGSN shall behave as receiving nodes and the HSS as a reporting node.

F.2.2 HSS behaviour

The HSS may report its current load by including a Load AVP of type HOST in answer commands as described in IETF draft-ietf-dime-load-03 [60].

The HSS calculates its current load by implementation specific means. For example, the HSS may take into account the traffic over the S6a/d interfaces or other interfaces, the level of usage of internal resources (CPU, memory), the access to external resources, etc.

The HSS determines when to send Load AVPs of type HOST by implementation specific means.

F.2.3 MME/SGSN behaviour

When performing next hop Diameter Agent selection for requests that are routed based on realm, the MME/SGSN may take into account load values from Load AVPs of type PEER received from candidate next hop Diameter nodes, as per IETF draft-ietf-dime-load-03 [60].

Annex G (informative): Change history

Change history								
Date	TSG #	TSG Doc.	CR	Rev	Subject/Comment		Old	New
2008-09	CT#41	CP-080475			V2.0.0 approved in CT#41		2.0.0	8.0.0
2008-12	CT#42	CP-080691	0001	1	S6a Vendor-Specific-Application-Id AVP		8.0.0	8.1.0
		CP-080691	0002	1	RegSub feature			
		CP-080691	0005	-	Clarification on Immediate-Response-Preferred			
		CP-080691	0006	1	Correction of the Reference of Supported Features			
		CP-080691	0007	-	Definition of RAT-Frequency-Selection-Priority			
		CP-080691	0008	2	ME Identity Check			
		CP-080703	0009	2	Gr alignment			
		CP-080971	0010	3	Closed Subscriber Group			
		CP-080691	0011	-	AVP codes			
		CP-080691	0012	1	MSISDN AVP			
		CP-080691	0013	-	Result codes			
		CP-080691	0014	-	Removal of Editor's note in ULA Flag			
		CP-080691	0015	2	Duplicated AMBR AVP and Use of Called-Station-Id			
		CP-080691	0017	-	Change of AVP to carry the APN information			
		CP-080691	0018	1	Reference to 3GPP-Charging-Characteristics			
		CP-080691	0019	-	Access Restriction Data Definition			
		CP-080691	0020	-	AMBR Definition			
		CP-080691	0021	1	AVPs Encoding			
		CP-080691	0022	1	PDN-GW Delete			
		CP-080691	0023	1	Requesting Node Type Clarification			
		CP-080691	0024	-	Authn Session State AVP			
		CP-080691	0026	2	Trace Session Activation and Deactivation			
		CP-080691	0027	1	Context-Identifier in APN-Configuration-Profile			
		CP-080691	0029	-	APN-OIReplacement			
		CP-080703	0032	-	Access Restriction			
		CP-080691	0033	1	Context Identifier clarification			
		CP-080691	0034	1	APN-Configuration correction			
		CP-080691	0037	-	Removal of Supported RAT Types			
		CP-080691	0039	1	Extension of the Terminal-Information AVP for non-3GPP accesses			
		CP-080691	0040	-	Conditionality of ULA-Flags and PUA-Flags AVPs			
		CP-080691	0042	-	Wrong Description for Complete APN Configuration Profile Withdrawal			
		CP-080691	0043	-	Purge UE Detailed Behaviour			
		CP-080691	0044	1	MME/SGSN area restricted flag cleanup			
				-	TS number in cover page corrected		8.1.0	8.1.1
2009-03	CT#43	CP-090056	0048	2	Context Identifier for Update or Removal of PDN GW		8.1.1	8.2.0
		CP-090046	0049	-	Clarification of the relationship between Subscriber-Status and ODB			
		CP-090046	0051	2	Context-Identifier in APN-Configuration-Profile			
		CP-090024	0052	-	Update of the AVP Codes			
		CP-090236	0053	2	PDN GW update for Wildcard APN			
		CP-090044	0054	1	Ready for SM			
		CP-090046	0055	-	ODB for SM			
		CP-090044	0056	2	Handling LCS Subscription Data			
		CP-090046	0057	2	Charging Characteristics			
		CP-090046	0058	2	Regional-Subscription-Zone-Code AVP Correction			
		CP-090046	0059	2	Trace Depth corrections			
		CP-090046	0060	2	Delete Subscriber Data Request procedure			
		CP-090046	0063	1	Coding definition for STN-SR			
		CP-090046	0064	-	Trace Reference in DSR			
		CP-090046	0065	1	DSR-Flags			
		CP-090046	0066	2	Clarification on All-APN-Configurations-Included-Indicator			
		CP-090046	0069	-	User-Name AVP contains only the IMSI			
		CP-090046	0070	1	MIP6-Agent-Info Definition and Usage			
		CP-090046	0075	1	Allocation Retention Priority			
		CP-090046	0076	1	APN includes only the Network Identifier			
		CP-090046	0077	-	Error Codes and ABNF Corrections			
		CP-090039	0078	4	User to HSS resolution			
		CP-090046	0079	1	Introducing the Trace-Collection-Entity AVP			
		CP-090046	0081	4	Usage of Immediate-Response-Preferred AVP			
		CP-090044	0082	3	Handling SMS Subscription Data			
		CP-090046	0083	-	SCTP version			
		CP-090046	0084	-	RFC 5447 References			
2009-06	CT#44	CP-090287	0086	1	Notification of SMS over IP Non-Delivery for E-UTRAN and UE		8.2.0	8.3.0

				Reachability		
	CP-090287	0087	1	Coding of Immediate Response Preferred AVP		
	CP-090287	0088	-	Trace Event List		
	CP-090287	0089	-	Removal of Requesting Node Type from AIR		
	CP-090287	0091	-	Regional-Subscription-Zone-Code clarification		
	CP-090287	0092	-	Clarification of PLMN encoding		
	CP-090287	0093	-	Diameter Command Codes for S6a/S6d/S13/S13'		
	CP-090287	0094	-	Update of Diameter Codes		
	CP-090287	0095	1	Formatting of APN in Service-Selection AVP		
	CP-090378	0096	3	User Data Download Indication		
	CP-090315	0097	-	Usage of Single-Registration-Indication		
	CP-090495	0098	3	ULR processing enhancement		
2009-09 CT#45	CP-090531	0100	2	Correction on APN-OI-Replacement	8.3.0	8.4.0
	Cp-090726	0101	3	GPRS subscription data over S6d		
	CP-090531	0102	1	Usage of DIAMETER_ERROR_UNKNOWN_EPS_SUBSCRIPTION		
	CP-090531	0103	6	Cancel Location for Initial Attach		
	CP-090531	0104	4	Subscriber Data Update		
	CP-090531	0105	1	Usage of Single Registration Indication		
	CP-090531	0106	2	Charging Characteristics Reference		
	CP-090531	0107	1	Alerting Reason Behaviour		
	CP-090531	0108	1	Wildcard APN		
	CP-090531	0109	-	Subscriber's NAM		
	CP-090531	0111	-	Trace ID length correction		
	CP-090531	0112	1	Subscription-Data AVP in Update Location Answer		
	CP-090531	0113	1	Default values for Allocation Retention Priority AVP		
	CP-090531	0114	-	Default APN and Wildcard APN		
	CP-090531	0115	2	Correction in behavior of DSR-Flags		
	CP-090531	0116	1	PDN Type		
	CP-090531	0118	1	Clarification on the process of skip subscriber data flag in the HSS		
	CP-090532	0119	1	Corrections on IDR ABNF and Service Type AVP		
	CP-090532	0120	1	TS-Code AVP is missing in DSR command		
	CP-090532	0123	1	Cleanup of the TS		
	CP-090532	0124	1	Format of User-Id		
	CP-090532	0125	1	GPRS Subscription Data Update		
	CP-090532	0126	2	APN-Configuration-Profile		
	CP-090532	0128	1	3GPP2-MEID AVP		
	CP-090532	0129	1	MIP6-Agent-Info AVP		
	CP-090532	0130	-	Alignment of Supported Feature concept with 29.229		
	CP-090532	0133	1	EPS Subscribed QoS		
	CP-090532	0137	1	Restruction of the TS 29.272		
	CP-090532	0138	1	Trace Depth per session		
	CP-090532	0140	-	Clarification of Unsigned32 bit flag AVPs		
	CP-090532	0141	1	Extra Regional-Subscription-Zone-Codes		
	CP-090532	0142	1	Clarification of Service-Selection AVP encoding		
	CP-090532	0143	1	User to HSS identity resolution for Diameter Proxy Agents		
	CP-090532	0144	-	RFSP coding		
2009-09 CT#45	CP-090556	0122	3	Optimization of Subscriber Data Update	8.4.0	9.0.0
	CP-090562	0131		Emergency Support in S6a		
2009-12 CT#46	CP-091030	0148	4	Clarification on Some Subscription Data List Handling in MME/SGSN	9.0.0	9.1.0
	CP-090793	0149	1	APN level APN-OI-Replacement		
	CP-090800	0150	2	ICS-Flag		
	CP-090767	0152	2	RFSP alignment in 29.272		
	CP-090801	0153	1	Notify Request for Emergency Attached UEs		
	CP-090767	0155	2	Wildcard APN		
	CP-090767	0157	1	Lifetime of Charging Characteristics after Change		
	CP-091030	0159	2	Correction on the UE initiated detach procedure		
	CP-090767	0163	2	FQDN for S6a NOR		
	CP-090767	0165	-	HPLMN-ODB AVP correction		
	CP-091032	0167		From GMLC-Address to GMLC-Number		
	CP-091030	0171	1	Static PDN GW		
	CP-091030	0177	1	Clarification on Usage of Re-Synchronization-Info AVP		
	CP-091030	0179	1	Clarification on the Number of PDP-Contexts in the GPRS-Subscription-Data AVP		
	CP-090767	0185	-	APN-Configuration-Profile usage in IDR		
	CP-091030	0187	2	IMEI encoding		
	CP-091030	0189	1	APN-Configuration Service-Selection values		
	CP-091030	0191	1	QoS attributes		
	CP-090789	0196	1	Subscription-Data clarification for UE Reachability		
	CP-091030	0198	2	Vendor Specific Application ID		
	CP-090776	0200	1	Destination Realm		
	CP-090767	0202	-	Correction to fault recovery procedure and ME identity check procedure		

		CP-090767	0204	-	Reference of 3GPP-Charging-Characteristics		
		CP-090767	0206	-	Reset procedure MME/SGSN behavior		
2010-03	CT#47	CP-100020	0181	2	Correction to Purge UE Detailed Behaviour	9.1.0	9.2.0
		CP-100020	0210		HPLMN ODB		
		CP-100048	0211	2	TADS support in S6a/S6d		
		CP-100020	0217		Cancellation-Type clarifications		
		CP-100020	0219	1	IETF References update		
		CP-100020	0221		Static PDN GW		
		CP-100046	0222	1	Addition of V-GMLC address for S6a		
		CP-100020	0223	1	Handling of UE Reachability MME Parameter		
		CP-100020	0227		Indication of PLMN ID of the selected PGW		
		CP-100040	0228		Context-Identifier in NOR		
		CP-100235	0230	5	EPS Subscriber State and Location Information Request		
		CP-100040	0233	1	Reset to Combined MME/SGSN		
		CP-100040	0234	1	NOR-Flags correction		
		CP-100040	0236	2	Indication of LCS Capabilities support over S6a/S6d		
		CP-100040	0238	1	Fix ambiguity on context id AVP		
2010-06	CT#48	CP-100264	0241	1	Service-Selection values	9.2.0	9.3.0
			0243	1	MIP6-Agent-Info		
			0245	2	Fix ambiguity on usage of the Supported-Features AVP		
			0260	1	Correction of Context-Identifier		
		CP-100277	0247	1	Dynamic information update after a Reset procedure		
			0248	1	Notify command from unknown MME		
		CP-100416	0249	4	S6a Error Codes		
		CP-100279	0258	3	URRP for SGSN		
		CP-100265	0262	3	MME mapping between Diameter error codes and NAS Cause Code values		
2010-09	CT#49	CP-100456	0268	1	Restoration of the SGSN Number in the VLR	9.3.0	9.4.0
		CP-100457	0272		QoS-Subscribed		
		CP-100457	0273		Trace-Reference AVP encoding		
		CP-100457	0284		Usage of MIP-Home-Agent-Host AVP		
		CP-100457	0285		Correction on HSS behaviour about IMEI		
		CP-100577	0275	2	NAS Cause Code values		
		CP-100463	0276		LCS Privacy Features for MME		
		CP-100443	0281	2	Correction to Delete Subscriber Data for SGSN		
		CP-100443	0283	1	Unclear Cancel-Type Setting for Single Registration and Initial Attach		
2010-09	CT#49	CP-100465	0267	1	Addition of SIPTO permissions in PS subscription data	9.4.0	10.0.0
2010-10	CT#50	CP-100689	0324	1	HSS Error Returned due to ODB	10.0.0	10.1.0
		CP-100689	0316	1	Clarification on Access Restriction Data		
		CP-100698	0297	1	Removal of Notify Messages during detach or last PDN connection deactivation via 3GPP access		
		CP-100679	0303	1	Usage of Served Party IP Address AVP inside the APN Configuration		
		CP-100679	0305	1	Usage of APN-OI-Replacement AVP		
		CP-100679	0307		AMBR clarification		
		CP-100679	0308		Store HSS Identity in MME/SGSN after successful ULA		
		CP-100679	0315	3	Fix ambiguity in the LCS related indication		
		CP-100679	0327	2	Unknown EPS Subscription		
		CP-100688	0325	1	Periodic TAU/RAU timer in HSS subscription		
		CP-100707	0313	1	Correction of Restoration flag		
		CP-100707	0319		Default APN and Wildcard APN		
		CP-100707	0322	1	Usage of PGW Allocation Type AVP		
		CP-100699	0323		Usage of STN-SR AVP		
		CP-100699	0291	3	Enhanced SRVCC		
		CP-100687	0290	4	Addition of MPS Priority in Subscription Data		
		CP-100683	0289	1	Addition of LIPA permission in Subscription Data		
		CP-100684	0288	1	SIPTO Permission for Wildcard APN		
2011-03	CT#51	CP-110087	0329	2	Minimization of Drive Tests (MDT)	10.1.0	10.2.0
		CP-110042	0330	2	Feature Flags for UE Reachability Notification and State/Location Info Retrieval		
		CP-110042	0337	3	Correction of error cause handling		
		CP-110042	0339	2	Setting of M bit AVP flag		
		CP-110042	0343	1	AMBR Correction		
		CP-110073	0332	2	Correction on PGW PLMN ID		
		CP-110088	0334	2	Relay Node Indicator		
		CP-110051	0346	1	PDP Address correction		
		CP-110051	0351	2	Ambiguity in IDR flags		
		CP-110051	0353		Homogeneous Support for IMS Voice over PS AVP missing		
2011-06	CT#52	CP-110351	0362		SGSN-Number AVP correction	10.2.0	10.3.0
		CP-110380	0357	2	MDT user consent		
		CP-110375	0363	1	Purge from Combined MME/SGSN		
2011-09	CT#53	CP-110562	0372	1	Active-APN AVP definition	10.3.0	10.4.0

		CP-110562	0374		Context-Identifier when interworking with GTPv1		
		CP-110562	0380	1	APN-AMBR for GPRS		
		CP-110565	0377		Correction on DIAMETER_AUTHORIZATION_REJECTED		
		CP-110699	0381		Correction of implementation error in TS 29.272, CR 324		
2011-09	CT#53	CP-110581	0369	2	Behaviour of HSS in abnormal case of Immediate-Response-Preferred AVP	10.4.0	11.0.0
		CP-110584	0370	3	Add vSRVCC updates to the S6a interface		
2011-12	CT#54	CP-110787	0390	1	Unknown EPS Subscription over S6d/S6a	11.0.0	11.1.0
		CP-110811	0387	2	Equivalent PLMN CSG Subscription Request		
		CP-110787	0397	1	M-bit Handling		
2012-03	CT#55	CP-120023	0409	1	GMLC-Number format	11.1.0	11.2.0
		CP-120025	0399	3	Initial Attach Indication in CLR		
		CP-120029	0406		T-ADS data request for detached UE		
		CP-120029	0410	1	Removal of Subscribed Periodic TAU/RAU timer in HSS subscription		
		CP-120037	0400		Clarification on UE-SRVCC-Capability AVP in ULR		
		CP-120037	0402		ODB clarification		
		CP-120037	0403	2	S6a location reporting		
2012-06	CT#56	CP-120240	0401	3	CSG ID and Local Time for NPLI	11.2.0	11.3.0
		CP-120413	0415	4	Ready for SM in MME		
		CP-120249	0418	1	ULR handling for combined MME/SGSN		
		CP-120249	0419		Clarification on Update of PGW ID		
2012-09	CT#57	CP-120476	0382	10	VCSG procedures over S7a/S7d	11.3.0	11.4.0
		CP-120476	0394	5	Delete CSG subscription Data over S7a /S7d		
		CP-120476	0416	4	VCSG Reset procedure over S7a/S7d		
		CP-120481	0404	5	PS additional number over S6a/S6d		
		CP-120462	0421	-	Single Registration Indication		
		CP-120462	0422	-	Zone Codes		
		CP-120462	0423	-	Clarification on Notification of UE Reachability		
		CP-120462	0428	-	CSG-Subscription-Data replacement		
		CP-120462	0430	1	Update of Homogeneous Support of IMS Over PS Sessions		
		CP-120462	0434	2	Mapping S6a and NAS cause code		
		CP-120473	0429	4	SMS in MME		
		CP-120473	0432	1	SMS in SGSN		
		CP-120480	0433	2	Local Time Zone		
2012-12	CT#58	CP-120722	0441	1	User-CSG-Information	11.4.0	11.5.0
		CP-120713	0457	1	SGSN-Number AVP		
		CP-120740	0436	1	Application ID for S7a/S7d		
		CP-120740	0443	2	Empty VCSG Subscription Data		
		CP-120742	0438	1	Notification Procedure clarification for UE with Emergency Bearer Services		
		CP-120742	0445	-	Inclusion of APN-OI Replacement in PDP Context		
		CP-120742	0450	-	Correction in the chapter of Reset-Answer (RSA) command		
		CP-120742	0452	1	UE Time Zone		
		CP-120742	0453	1	Corrections to Local Time Zone		
		CP-120742	0454	2	Clarification on IDR-Flags		
		CP-120742	0455	-	Correction of General Description of Delete Subscriber Data		
		CP-120742	0458	-	DSR-Flags		
		CP-120742	0461	1	Wrong implementation of the Daylight-Saving-Time AVP		
		CP-120736	0446	1	A-MSISDN Correction		
		CP-120732	0447	1	MME network condition to NAS cause code mapping		
		CP-120732	0448	2	SGSN network condition to NAS cause code mapping		
		CP-120732	0449	3	MME de-registration for "SMS in MME"		
		CP-120732	0451	1	Correction on Update Location Request		
		CP-120732	0459	1	Alignment of stage 3 SMS in MME with stage 2		
		CP-120741	0460	1	Use of Flag instead of Enumerated AVPs		
2013-03	CT#59	CP-130022	0466	-	Corrections to wrong references and command/AVP name	11.5.0	11.6.0
		CP-130022	0467	1	Update to Subscription-Data-Flags		
		CP-130022	0471	1	Values not allowed for QCI over S6a/S6d		
		CP-130022	0472	1	Cause Code Mapping		
		CP-130022	0470	1	Registration for SMS Request for SMS in SGSN		
		CP-130025	0474	-	MDT parameters		
2013-03	CT#59	CP-130031	0442	3	Check of Serving Node for S6a Security	11.6.0	12.0.0
		CP-130031	0468	1	MME name encoding over S6a		
		CP-130156	0475	1	SGSN indicating support of Lgd interface to HSS		
2013-06	CT#60	CP-130380	0490	1	Removal of SMS-Only AVP and Typo Corrections on Some AVP Definitions	12.0.0	12.1.0
		CP-130380	0501	2	MME identity for restoration procedures		
		CP-130380	0492	1	Definition of A New Feature-List		
		CP-130380	0488	1	UE-SRVCC-Capability Update Clarification		
		CP-130380	0483	-	Reset clarification		
		CP-130380	0481	2	AIR rejection		
		CP-130380	0479	1	Storing Last known Location Information of purged UE in HSS		

		CP-130380	0512	1	Maximum value for the subscribed periodic RAU TAU timer		
		CP-130279	0497	1	Definition of SS Status for Call Barring		
		CP-130378	0489	2	SIPTO permission for Local Network enhancements		
		CP-130288	0487	-	PS Location Info request with RAT-type		
		CP-130309	0482	-	CSS clarification		
		CP-130295	0478	-	Restoration Priority during SGW and PGW restoration procedures		
		CP-130410	0508	1	HSS handling of T-ADS for detached subscriber		
2013-09	CT#61	CP-130444	0515	-	Correction to the restoration priority levels during SGW and PGW restoration procedures	12.1.0	12.2.0
		CP-130450	0517	-	HPLMN-ODB Correction		
		CP-130463	0518	2	CancelLocation requesting reattach		
		CP-130456	0519	1	Indication of Gdd support over S6d		
		CP-130461	0520	2	Homogeneous Support Of Voice over IP		
		CP-130461	0521	1	Definition of User-State values		
		CP-130461	0522	1	Context Identifier Range Inconsistency		
2013-12	CT#62	CP-130611	0528	1	Addtion of S6aS6d-Indicator in NOR	12.2.0	12.3.0
		CP-130617	0533	1	MME Initiated Removal of MME Registration for SMS		
		CP-130624	0523	1	Combined MME/SGSN indicating the support for optimized LCS procedure		
		CP-130624	0526	1	Clarification on Description of Features for LCS		
		CP-130644	0525	1	SMS in MME		
		CP-130623	0529	1	Alert Service Center sent over S6c		
		CP-130632	0530	1	Purge Clarification		
		CP-130639	0531	1	SGSN CAMEL Subscription Indication		
2014-03	CT#63	CP-140035	0534	2	Clarification on Current-Location-Retrieved and Age-of-Location-Information	12.3.0	12.4.0
		CP-140035	0536	3	Mechanism to determine if the UE is served by the MME and SGSN parts of the same combined MME/SGSN		
		CP-140035	0537	-	Call-Barring-Info AVP		
		CP-140035	0538	-	Missing SGs-MME-Identity AVP in the ULR		
2014-06	CT#64	CP-140257	0544	1	SS-Status AVP Definition	12.4.0	12.5.0
		CP-140264	0555	3	Cause Mapping for ODB		
		CP-140264	0556	2	NOR Error User Unknown		
		CP-140254	0557	1	Enhancement for ProSe		
		CP-140413	0558	-	Correction on SGSN CAMEL Capability in Supported-Features		
		CP-140243	0540	5	Diameter overload control mechanism		
		CP-140243	0559	1	Diameter overload over S6a/d		
2014-09	CT#65	CP-140523	0564	2	Clarification on ProSe Subscription Data	12.5.0	12.6.0
		CP-140514	0565	2	WLAN offloadability defined in HSS		
		CP-140506	0567	2	P-CSCF Restoration Indication		
2014-12	CT#66	CP-140772	0569	2	Reset-ID	12.6.0	12.7.0
		CP-140772	0581	3	M-bit setting of Supported-Features AVP		
		CP-140764	0571	-	MDT PLMN List		
		CP-140764	0580	1	S6a/S6d-Indicator in NOR		
		CP-140790	0575	1	Priority Consideration for Diameter Overload Control		
2014-12	CT#66	CP-140765	0574	2	Roaming Subscription Corresponding to Specific RAT	12.7.0	13.0.0
		CP-140759	0578	2	Stored HSS Identity for HSS Restoration Procedure		
2015-03	CT#67	CP-150035	0582	1	Clarification on the usage of SV in IMEI check procedure	13.0.0	13.1.0
2015-06	CT#68	CP-150265	0583	1	Cleanup and small error corrections	13.1.0	13.2.0
		CP-150263	0584	2	Access Restriction Data per PLMN		
		CP-150279	0585	1	Alignment of using ProSe and ProSe services		
2015-09	CT#69	CP-150427	0597	-	Wrong Application-ID for S7a Diameter Application	13.2.0	13.3.0
		CP-150454	0586	3	Subscription data for extended buffering at the SGW		
		CP-150453	0587	2	Introducing IMSI-Group ID Lists to the subscription Info		
		CP-150449	0588	3	Addition of CP parameters to subscription data		
2015-12	CT#70	CP-150778	0590	9	Add MTC Monitoring support	13.3.0	13.4.0
		CP-150778	0606	1	Roaming and interaction with the IWK-SCEF		
		CP-150778	0607	4	Introducing a Bitmask to inform the HSS of the Monitoring capabilities of the MME/SGSN		
		CP-150778	0609	2	Deletion of all Monitoring events assigned to a subscriber (UE)		
		CP-150785	0598	1	DL-Buffering-Suggested-Packet-Count AVP		
		CP-150781	0600	1	Retrieval of "UE Usage Type" over S6a/S6d		
		CP-150762	0601	1	Clarification of precedence between UE-level "HO to non-3GPP access" access restriction, and APN-level "WLAN-Offloadability"		
		CP-150768	0602	4	Diameter message priority over S6a/d		
		CP-150771	0604	2	Introduction of validity time delete and replace procedure for CP sets		
		CP-150755	0611	1	ProSe in combined MME/SGSN		
		CP-150744	0614		Erroneous AVP code for some MDT parameters		
		CP-150759	0614	1	Update reference to DOIC new IETF RFC		
		CP-150776	0615	1	Mobile Terminating SMS handling for extended Idle mode DRX		
2016-03	CT#71	CP-160029	0618	2	Notifying the status of MONTE event configuration at the IWK-SCEF to the HSS	13.4.0	13.5.0

		CP-160043	0619	1	Fix the issue on HSS restart procedure		
		CP-160039	0620	1	User Plane Integrity Protection Indicator		
		CP-160029	0621	3	Configure Monitoring Event to Multiple Serving Nodes		
		CP-160033	0623	1	Allow SMS for NB-IoT UE without Combined Attach		
		CP-160045	0625	-	Adjacent PLMNs		
		CP-160045	0626	1	Invocation of Alert procedure by HSS after ULR		
		CP-160023	0629	1	Diameter message priority over S7a/d, S13, S13'		
		CP-160033	0630	2	Addition of NB-IoT radio access type to the Access-Restriction-Data feature		
		CP-160033	0631	3	New PDN-Type for Cellular IoT		
2016-03					Table 7.3.1/1 formatted	13.5.0	13.5.1
2016-06	CT#72	CP-160215	0643	1	Diameter requests for priority traffic during overload control mechanism	13.5.1	13.6.0
2016-06	CT#72	CP-160238	0628	3	Subscription Data for combined MME/SGSN	13.5.1	13.6.0
2016-06	CT#72	CP-160238	0632	1	Cause Mapping	13.5.1	13.6.0
2016-06	CT#72	CP-160238	0633	-	Correction on Service-Selection	13.5.1	13.6.0
2016-06	CT#72	CP-160238	0639	2	Group-Service-Id	13.5.1	13.6.0
2016-06	CT#72	CP-160233	0635	-	Renaming of Validity-Time AVP	13.5.1	13.6.0
2016-06	CT#72	CP-160228	0636	-	Update SMS Support for NB-IoT	13.5.1	13.6.0
2016-06	CT#72	CP-160225	0637	2	SCEF realm	13.5.1	13.6.0
2016-06	CT#72	CP-160222	0638	2	Shared Subscription data update	13.6.0	14.0.0
2016-06	CT#72	CP-160217	0640	1	Support for Non-IP PDP types	13.6.0	14.0.0
2016-06	CT#72	CP-160221	0641	1	MSISDN Removal from Subscription Profile	13.6.0	14.0.0
2016-09	CT#73	CP-160423	0645	-	PDN-Connection-Restricted flag	14.0.0	14.1.0
2016-09	CT#73	CP-160423	0647	1	Preferred Data Mode for an SGi PDN connection	14.0.0	14.1.0
2016-09	CT#73	CP-160428	0652	-	CR implementation error on ECR and ECA commands	14.0.0	14.1.0
2016-09	CT#73	CP-160426	0658	2	Current Location Retrieval	14.0.0	14.1.0
2016-09	CT#73	CP-160437	0649	1	Removal of Editor's Note on non shareable subscription data	14.0.0	14.1.0
2016-09	CT#73	CP-160437	0650	-	Removal of Editor's Note on detailed checks for shared subscription data update	14.0.0	14.1.0
2016-09	CT#73	CP-160437	0656	2	Solution to avoid high load resulting from shared subscription data update	14.0.0	14.1.0
2016-09	CT#73	CP-160433	0653	-	Change of Network Access Mode	14.0.0	14.1.0
2016-09	CT#73	CP-160432	0654	-	Usage of Supported Features	14.0.0	14.1.0
2016-09	CT#73	CP-160432	0655	-	Handling of MSISDN removal from subscription profile	14.0.0	14.1.0
2016-12	CT#74	CP-160679	0659	4	Handover of Emergency PDN Connections	14.1.0	14.2.0
2016-12	CT#74	CP-160673	0660	1	Reset-ID AVP description for shared subscription data update	14.1.0	14.2.0
2016-12	CT#74	CP-160673	0671	1	Update of "Homogeneous Support" Status	14.1.0	14.2.0
2016-12	CT#74	CP-160673	0684	1	Missing S7a/S7d application identifier	14.1.0	14.2.0
2016-12	CT#74	CP-160654	0662	1	Communication-Pattern Feature	14.1.0	14.2.0
2016-12	CT#74	CP-160681	0666	1	Load Control	14.1.0	14.2.0
2016-12	CT#74	CP-160681	0677	1	Host Load	14.1.0	14.2.0
2016-12	CT#74	CP-160665	0668	1	Dynamic Removal of UE Usage Type	14.1.0	14.2.0
2016-12	CT#74	CP-160665	0674	1	Presence of UE Usage Type in Error Responses	14.1.0	14.2.0
2016-12	CT#74	CP-160657	0670	1	Undefined Bits in Access Restriction Data	14.1.0	14.2.0
2016-12	CT#74	CP-160678	0672	1	Add V2X Subscription Data to S6a Interface	14.1.0	14.2.0
2016-12	CT#74	CP-160664	0682	-	Correction to change IETF drmp draft version to official RFC 7944	14.1.0	14.2.0
2016-12	CT#74	CP-160660	0683	1	Deletion of all monitoring events	14.1.0	14.2.0
2017-03	CT#75	CP-170028	0692	1	Maximum Response Time	14.2.0	14.3.0
2017-03	CT#75	CP-170039	0687	1	Enhanced Coverage	14.2.0	14.3.0
2017-03	CT#75	CP-170039	0688	1	Inter-RAT PDN-Continuity	14.2.0	14.3.0
2017-03	CT#75	CP-170044	0693	1	Emergency-Info AVP in ULA	14.2.0	14.3.0
2017-03	CT#75	CP-170043	0696	1	Correct UE-PC5-AMBR Format	14.2.0	14.3.0
2017-03	CT#75	CP-170036	0697	2	Removal of complete APN Configuration Profile	14.2.0	14.3.0
2017-03	CT#75	CP-170036	0698	1	Clarification of MDT User Consent	14.2.0	14.3.0
2017-03	CT#75	CP-170036	0699	1	Missing M/O values in several feature flags	14.2.0	14.3.0
2017-03	CT#75	CP-170036	0700	2	Subscription parameters for eDRX	14.2.0	14.3.0
2017-03	CT#75	CP-170036	0701	2	Support of long and short Macro eNodeB IDs	14.2.0	14.3.0
2017-03	CT#75	CP-170048	0704	-	Update of reference for the Diameter base protocol	14.2.0	14.3.0
2017-03	CT#75	CP-170048	0705	-	Handling of the Vendor-Specific-Application-Id AVP	14.2.0	14.3.0
2017-03	CT#75	CP-170048	0706	-	Cardinality of the Failed-AVP AVP in answer	14.2.0	14.3.0
2017-06	CT#76	CP-171029	0707	1	External Identifier in Subscription-Data	14.3.0	14.4.0
2017-06	CT#76	CP-171021	0709	-	Alignment of PDN-Connection-Restricted Flag handling on NAS specification	14.3.0	14.4.0
2017-06	CT#76	CP-171017	0713	1	Add MBSFN Area List to MDT Configuration parameters	14.3.0	14.4.0
2017-06	CT#76	CP-171184	0715	2	Communication Patterns without Expiry Time	14.3.0	14.4.0
2017-06	CT#76	CP-171029	0717	1	Loss Of Connectivity Reason in S6a/d IDA	14.3.0	14.4.0
2017-06	CT#76	CP-171018	0720	1	Support for signaling transport level packet marking	14.3.0	14.4.0
2017-06	CT#76	CP-171043	0718	1	Clarification of S6a/Notification-Request command for non-IP APNs	14.4.0	15.0.0
2017-06	CT#76	CP-171041	0721	-	Removal of UE-Usage-Type	14.4.0	15.0.0
2017-09	CT#77	CP-172027	0727	1	Access Restriction to NR as Secondary RAT	15.0.0	15.1.0
2017-09	CT#77	CP-172027	0728	1	Extended QoS for 5G NR	15.0.0	15.1.0
2017-09	CT#77	CP-172018	0729	1	Acknowledgements of downlink NAS data PDUs	15.0.0	15.1.0

2017-09	CT#77	CP-172018	0730	1	Reliable Data Service	15.0.0	15.1.0
2017-09	CT#77	CP-172026	0731	1	Enhancements for NAPS on Idle Status Indication	15.0.0	15.1.0
2017-09	CT#77	CP-172013	0736	-	Correction of DRMP Procedures	15.0.0	15.1.0
2017-12	CT#78	CP-173016	0743	1	Correction on subscribed eDRX parameter value	15.1.0	15.2.0
2017-12	CT#78	CP-173028	0740	1	Clarification of UE Reachability monitoring event over S6a/S6d	15.1.0	15.2.0
2017-12	CT#78	CP-173025	0741	-	Error in the DIAMETER_ERROR_EQUIPMENT_UNKNOWN name	15.1.0	15.2.0
2017-12	CT#78	CP-173025	0744	3	Active Time in Insert Subscriber Data	15.1.0	15.2.0
2017-12	CT#78	CP-173035	0746	1	Access restriction to unlicensed spectrum as secondary RAT	15.1.0	15.2.0
2017-12	CT#78	CP-173036	0747	1	Access Restrictions to NR as Secondary RAT on MM Context	15.1.0	15.2.0