

ETSI TS 129 219 V15.2.0 (2019-07)



**Digital cellular telecommunications system (Phase 2+) (GSM);
Universal Mobile Telecommunications System (UMTS);
LTE;
Policy and charging control: Spending limit reporting over Sy
reference point
(3GPP TS 29.219 version 15.2.0 Release 15)**



Reference

RTS/TSGC-0329219vf20

Keywords

GSM,LTE,UMTS

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Sous-Préfecture de Grasse (06) N° 7803/88

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Foreword

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1 Scope

The present document provides the stage 3 specification of the Sy reference point for the present release. The functional requirements and the stage 2 specifications of the Sy reference point are contained in TS 23.203 [2]. The Sy reference point lies between the Policy and Charging Rule Function (PCRF) and the Online Charging System (OCS). The internal OCS functionality for policy counter provision management pertaining to Sy is specified in TS 32.296 [16].

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 23.203: "Policy Control and Charging architecture".
- [3] Void.
- [4] IETF RFC 4005: "Diameter Network Access Server Application"
- [5] IETF RFC 4006: "Diameter Credit Control Application".
- [6] IETF RFC 5719: "Updated IANA Considerations for Diameter Command Code Allocations"
- [7] IETF RFC 2234: "Augmented BNF for syntax specifications".
- [8] 3GPP TS 29.213: "Policy and charging control signalling flows and Quality of Service (QoS) parameter mapping".
- [9] Void.
- [10] Void.
- [11] Void.
- [12] Void.
- [13] IETF RFC 791: "Transmission Control Protocol".
- [14] IETF RFC 4960: "Stream Control Transmission Protocol".
- [15] 3GPP TS 29.229: "Cx and Dx interfaces based on the Diameter protocol".
- [16] 3GPP TS 32.296: "Telecommunication management; charging management; Online Charging System (OCS) applications and interfaces".
- [17] ETSI TS 283 034 v2.2.0: "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); Network Attachment Sub-System (NASS); e4 interface based on the DIAMETER protocol".
- [18] IETF RFC 3046: "DHCP Relay Agent Information Option".
- [19] 3GPP TS 29.212: "Policy and Charging Control (PCC); Reference points".
- [20] IETF RFC 7683: "Diameter Overload Indication Conveyance".

- [21] IETF RFC 7944: "Diameter Routing Message Priority".
- [22] IETF draft-ietf-dime-load-09: "Diameter Load Information Conveyance".
- Editor's note:** The above document cannot be formally referenced until it is published as an RFC.
- [23] IETF RFC 6733: "Diameter Base Protocol".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in 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 TR 21.905 [1].

policy counter: A mechanism within the OCS to track spending applicable for a subscriber.

policy counter identifier: A reference to a policy counter in the OCS for a subscriber.

policy counter status: A label whose values are not standardized and that is associated with a policy counter's value relative to the spending limit(s) (the number of possible policy counter status values for a policy counter is one greater than the number of thresholds associated with that policy counter, i.e policy counter status values describe the status around the thresholds). This is used to convey information relating to subscriber spending from OCS to PCRF. Specific labels are configured jointly in OCS and PCRF.

spending limit: A spending limit is the usage limit of a policy counter (e.g. monetary, volume, duration) that a subscriber is allowed to consume.

spending limit report: a notification, containing the current policy counter status generated from the OCS to the PCRF via the Sy reference point.

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].

DRMP	Diameter Routing Message Priority
OCS	Online charging system
OFCS	Offline charging system
PCEF	Policy and Charging Enforcement Function
PCRF	Policy and Charging Rule Function
RCAF	RAN Congestion Awareness Function
SLA	Spending-Limit-Answer (SL-Answer)
SLR	Spending-Limit-Request (SL- Request)
SNA	Spending-Status-Notification-Answer (SN-Answer)
SNR	Spending-Status-Notification-Request (SN- Request)
STA	Session-Termination-Answer (ST-Answer)
STR	Session-Termination-Request (ST- Request)

4 Sy reference point

4.1 Overview

The Sy reference point is located between the Policy and Charging Rules Function (PCRF) and the Online Charging System (OCS). The Sy reference point enables transfer of policy counter status information relating to subscriber spending from OCS to PCRF and supports the following functions:

- Request of policy counter status reporting from PCRF to OCS and subscribe to or unsubscribe from spending limit reports (i.e. notifications of policy counter status changes).
- Notification of spending limit reports from OCS to PCRF.
- Cancellation of spending limit reporting from PCRF to OCS.

Since the Sy reference point resides between the PCRF and OCS in the HPLMN, roaming with home routed or visited access as well as non-roaming scenarios are supported in the same manner.

The stage 2 level requirements for the Sy reference point are defined in 3GPP TS 23.203 [2].

Signalling flows related to the Sy interface are specified in 3GPP TS 29.213 [8].

Refer to Annex G of 3GPP TS 29.213 [8] for Diameter overload control procedures over the Sy interface.

Refer to Annex J of 3GPP TS 29.213 [8] for Diameter message priority mechanism procedures over the Sy interface.

Refer to Annex K of 3GPP TS 29.213 [8] for Diameter load control procedures over the Sy interface.

4.2 Sy Reference model

The Sy reference point is defined between the PCRF and the OCS. The relationships between the involved functional entities are depicted in figure 4.2.1. The overall PCC architecture is depicted in clause 3a of 3GPP TS 29.213 [8]

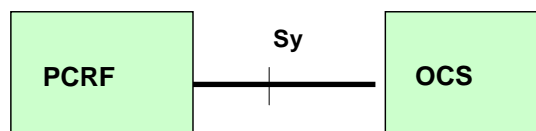


Figure 4.2.1: Sy reference model

.Figure 4.2.2: Void

4.3 Subscriber Spending Limits

Policy decisions based on spending limits is a function that allows the PCRF to make policy decisions based on the status of policy counters that are maintained in the OCS. The PCRF uses the policy counter statuses received from the OCS as input to its policy decisions, e.g. downgrade the QoS (e.g. APN-AMBR) or modify the PCC/QoS/ADC Rules.

When the status of policy counters is first required to make a policy decision for a subscriber, the PCRF uses the Initial Spending Limit Report Request procedure. The PCRF may request specific or all policy counter statuses to be reported by the OCS for the user. The OCS provides the status to the PCRF of the requested policy counters, and will notify the PCRF of any changes in the status of those policy counters. Optionally, the OCS can provide one or more pending statuses for a requested policy counter with the times that have to be applied. The pending status of a policy counter shall autonomously become the current status of a policy counter at the PCRF when the indicated corresponding time is reached. Subsequently, the provided information for pending statuses of a policy counter shall overwrite the previously received information.

NOTE 1: The mechanism for provisioning the policy counters in the OCS is out of scope of this document.

NOTE 2: A policy counter in the OCS can represent the spending for one or more services, one or more devices, one or more subscribers, etc. The representation is operator dependent. There is no explicit relationship between Charging-Key and policy counter.

The PCRF may request reporting for specific policy counter(s) that it is not currently subscribed and/or cancel reporting for specific policy counter status(es) using the Intermediate Spending Limit Report Request. The PCRF may cancel spending limit reporting for all policy counter(s) using the Final Spending Limit Report Request.

The updated subscriber profile may also trigger the PCRF sending the Initial/Intermediate/Final Spending Limit Report Request to the OCS to subscribed and/or cancel reporting for policy counter status(es). If spending limit reporting for a policy counter is enabled, the OCS shall notify the PCRF of changes in the status of this policy counter (e.g. daily spending limit of \$2 reached) and optionally pending statuses of this policy counter with the activation time (e.g. due to a billing period that will expire at midnight).

4.4 Functional elements

4.4.1 PCRF

The Policy Control and Charging Rules Function (PCRF) is a functional element that encompasses policy control decision and flow based charging control functionalities.

The PCRF may take information on the subscriber's spending status into account in its policy decisions. The PCRF may request spending limit reporting for policy counters from the OCS using the Initial or Intermediate Spending Limit Report Request procedure as specified in clause 4.5.1. The PCRF may cancel spending limit reporting for specific policy counter(s) using the Intermediate Spending Limit Report Request procedure, or for all policy counter(s) using the Final Spending Limit Report Request procedure as specified in clause 4.5.3.

The PCRF shall have at least one active IP-CAN session to be able to initiate an Sy session to be used when required for spending limit reporting for that subscriber. The PCRF shall terminate the Sy session when the last IP-CAN session for that subscriber is terminated or no IP-CAN session for the same user depends on the spending status information provided over Sy reference point.

The PCRF may use the status of each relevant policy counter as input to its policy decision as required by the decision logic.

4.4.2 OCS

The Online Charging System (OCS), for the purpose of policy decisions based on the subscriber's spending, shall:

- maintain the policy counter statuses applicable for a subscriber.
- report the policy counter status values for the subscriber when requested to the PCRF.
- when a policy counter status changes, report the change to the PCRF.

4.5 Spending Limits procedures over Sy reference point

4.5.1 Initial/Intermediate Spending Limit Report Request

4.5.1.1 General

This procedure shall be used by the PCRF to request the status of policy counters available at the OCS, and to subscribe or unsubscribe to updates of policy counters by the OCS.

This procedure is mapped to the Spending-Limit-Request/Answer commands specified in section 5.6.

Table 4.5.1.1/1: Initial/Intermediate Spending Limit Report Request

Information element name	Mapping to Diameter AVP	Cat.	Description
User Identity	Subscription-Id, Logical-Access-ID AVP, Physical-Access-ID (NOTE 1)	C	This IE shall contain the identity of the user. It shall be present in the initial request when the SL-Request-Type=INITIAL_REQUEST.
Request Type	SL-Request-Type	M	This IE shall indicate whether this is the initial or a subsequent request for the user.
Subscribed Policy Counter Identifier List	Policy-Counter-Identifier	O	This IE shall indicate the list of policy counter identifiers to be subscribed to. In the intermediate spending limit report request procedure, this list overrides a previously provisioned list. If omitted in either the Initial or Intermediate Spending Limit Report Request procedures the PCRF requests subscription to all available policy counters.
NOTE 1: The Logical-Access-ID AVP and Physical-Access-ID AVP are only applicable to Fixed Broadband Access network convergence as defined in annex A.			

Table 4.5.1.1/2: Initial/Intermediate Spending Limit Report Response

Information element name	Mapping to Diameter AVP	Cat.	Description
Policy Counter Status Report	Policy-Counter-Status-Report	O	If present, this information element shall contain a policy counter identifier, the current status value and if applicable pending policy counter statuses with the activation times.
Result	Result-Code or Experimental-Result	M	This IE shall contain the result of the operation.

4.5.1.2 Detailed behaviour of the PCRF

The PCRF shall make use of this procedure when it determines for a subscriber that

- The status of policy counter(s) to which the PCRF does not have an existing subscription for status change notifications is/are required.
- The status of one or more, but not all, policy counter(s) to which the PCRF has an existing subscription for status change notifications are no longer required.

NOTE: The Final Spending Limit Request procedure in clause 4.5.3 is used to remove all subscriptions.

In the initial request, i.e. when the request is sent for the first time for the Subscriber, the PCRF shall set the SL-Request-Type AVP to the value INITIAL_REQUEST (0). For subsequent requests for the same Subscriber, the PCRF shall set the SL-Request-Type AVP to INTERMEDIATE_REQUEST (1).

For each policy counter that the PCRF requires the current status and notifications of future status changes, the PCRF shall indicate the concerned policy counter identifiers in the request. Alternatively, the policy counter identifiers may be omitted if the PCRF requires the current status and notifications of future status changes of all available policy counters.

4.5.1.3 The behaviour of the OCS

Upon reception of the request from the PCRF, the OCS shall check if there is an ongoing Sy session associated with the received Session-Id AVP. If there is no Sy session and the SL-Request-Type AVP is set to INITIAL_REQUEST (0), an Sy session is created on the OCS. If there is an Sy session and the SL-Request-Type AVP is not set to INTERMEDIATE_REQUEST (1), the OCS shall return a response with the Result-Code set to DIAMETER_INVALID_AVP_VALUE and with the Failed-AVP AVP containing the SL-Request-Type AVP. If there is no Sy session and the SL-Request-Type AVP is not set to INITIAL_REQUEST (0), the OCS shall return a response with the Result-Code AVP set to DIAMETER_UNKNOWN_SESSION_ID.

Upon reception of the request from the PCRF provided with explicit Policy Counter Identifier(s):

If all the policy counter identifiers are known to the OCS, the OCS shall be able to subsequently notify the PCRF of any policy counter state changes and/or additions, removal or changes of pending policy counter statuses along with their activation time.

If a policy counter identifier is known by the OCS, but is not applicable to the subscriber (e.g. not provisioned), the OCS may use an operator configured policy counter status to indicate this to the PCRF.

If the OCS is configured to accept the request provided with unknown policy counter identifier(s) , and if the OCS determines that one or more policy counter identifiers are unknown, an operator configured policy counter status may be used to indicate the policy counter identifier(s) determined as unknown by OCS. The status of known policy counter identifier(s) shall be returned to the PCRF in the same procedure in this case.

Alternatively, if the OCS is configured to reject the request provided with unknown policy counter identifier(s), and if the OCS determines that one or more policy counter identifiers are unknown, the OCS shall return a response with the Experimental-Result-Code AVP set to DIAMETER_ERROR_UNKNOWN_POLICY_COUNTERS and with the Failed-AVP AVP indicating the unknown policy counter identifiers. When this failure occurs, if the SL-Request-Type AVP is set to:

- INITIAL_REQUEST (0), then the Sy session is not created.
- INTERMEDIATE_REQUEST (1), then none of the changes in the request take effect but the Sy session is maintained.

NOTE 1: In order to avoid misbehaviors due to the policy counters maintained in the Sy session, the PCRF can terminate the Sy session invoking the Final Spending Limit Request procedure in clause 4.5.3.

When the PCRF provides a new subscribed policy counter identifier list, the OCS shall remove any policy counter identifiers no longer in the list from association with the Sy session such that the OCS will no longer notify the PCRF of those policy counter state changes.

If an initial or intermediate request contains no policy counter identifiers, the OCS shall subsequently notify the PCRF of all available policy counter state changes and optionally the pending policy counter statuses with the activation times. If the OCS has no available policy counters for that subscriber during the Initial Spending Limit Report Request procedure, it sets the Experimental-Result-Code to DIAMETER_ERROR_NO_AVAILABLE_POLICY_COUNTERS. When this failure occurs, if the SL-Request-Type AVP is set to:

- INITIAL_REQUEST (0), then the Sy session is not created.
- INTERMEDIATE_REQUEST (1), then none of the changes in the request take effect but the Sy session is maintained.

NOTE 2: The PCRF can terminate the Sy session invoking the Final Spending Limit Request procedure in clause 4.5.3, or maintain the Sy session assuming that further available policy counters will be notified.

If the user identified in an initial request is not known to the OCS, the OCS shall reject the Spending Limit Report Request by including the result code of DIAMETER_USER_UNKNOWN in the Spending Limit Report Answer. In this case, the Sy session is not created.

Upon successful creation of an Sy session, the OCS shall include the current status of all subscribed policy counters (if any) in the response and set the Result-Code to DIAMETER_SUCCESS.

4.5.2 Spending Limit Report

4.5.2.1 General

This procedure shall be used by the OCS to notify the PCRF of changes in the status of subscribed policy counter(s).

This procedure is mapped to the Spending-Status-Notification-Request /Answer commands specified commands specified in section 5.6.

Table 4.5.2.1/1: Spending Limit Report Request

Information element name	Mapping to Diameter AVP	Cat.	Description
Policy Counter Status Report	Policy-Counter-Status-Report	M	If present, this information element shall contain a policy counter identifier, the current status value and if applicable pending policy counter statuses with the activation times.

Table 4.5.2.1/2: Spending Limit Report Response

Information element name	Mapping to Diameter AVP	Cat.	Description
Result	Result-Code or Experimental-Result	M	This IE shall contain the result of the operation.

4.5.2.2 The behaviour of the OCS

When the status of a specific policy counter changes or when pending statuses associated with the policy counter are added, removed or changed, the OCS shall determine the Sy sessions impacted by the change (i.e. those Sy sessions that have subscribed to status change notifications for the changed policy counter) and send a Spending-Status-Notification-Request command including the current policy counter status, and if applicable pending policy counter statuses with the activation times to the PCRF associated with each affected Sy session. The OCS shall not send the policy counter status for the same policy counter until it received the response of the previous status report of the policy counter.

If several policy counters change status at the same time, the OCS may group the status change notifications into a single Spending-Status-Notification-Request command to the PCRF by sending multiple Policy-Counter-Status-Report AVPs in the request.

4.5.2.3 Detailed behaviour of the PCRF

The PCRF shall acknowledge the request by sending a response with a Result-Code AVP set to `DIAMETER_SUCCESS` and use the status of the received policy counter(s) as input to its policy decision to apply operator defined actions, e.g. downgrade the QoS.

NOTE: The values related to the status of a policy counter (e.g. valid, invalid or any other status) are not specified. The interpretation and actions related to the values are out of scope of 3GPP.

The PCRF shall ignore an unknown policy counter status report for all unknown policy counter identifiers in an SLA or in an SNR from the OCS.

If the PCRF receives an SNR command while it has an ongoing SLR transaction with the OCS, the PCRF shall update the policy counter information based on the SNR command. When the corresponding SLA command for the ongoing SLR transaction is eventually received, the PCRF shall only update policy counter information for counters that were not provided in the previously received SNR command.

If the PCRF receives a Policy-Counter-Status-Report with one or more Pending-Policy-Counter-Information AVPs, then at the time defined by the Pending-Policy-Counter-Change-Time AVP, the pending Policy-Counter-Status shall autonomously become the current status of a policy counter. Subsequently provided information for pending statuses of a policy counter shall overwrite the previously received information. If the pending policy counter statuses are applicable to a policy counter identifier but the Pending-Policy-Counter-Information AVPs are omitted in the new policy counter status report, the PCRF shall remove all the pending policy counter statuses.

4.5.3 Final Spending Limit Report Request

4.5.3.1 General

This procedure shall be used by the PCRF to unsubscribe to any future updates of policy counters for a given subscriber by the OCS.

This procedure is mapped to the Session-Termination-Request/Answer commands specified in IETF RFC 6733 [23].

Table 4.5.3.1/1: Final Spending Limit Report Request

Information element name	Mapping to Diameter AVP	Cat.	Description
Termination Cause	Termination-Cause	M	This IE shall contain the reason why the session was terminated. It shall be set to "DIAMETER_LOGOUT".

Table 4.5.3.1/2: Final Spending Limit Report Response

Information element name	Mapping to Diameter AVP	Cat.	Description
Result	Result-Code	M	This IE shall contain the result of the operation.

4.5.3.2 Detailed behaviour of the PCRF

When the PCRF decides that policy decisions for a given user no longer depend on policy counter(s) to which the PCRF has existing subscriptions for status change notifications, the PCRF shall send the Final Spending Limit Report Request to the OCS.

4.5.3.3 The behaviour of the OCS

Upon reception of the request from the PCRF, the OCS shall check that there is an ongoing Sy session associated with the received Session-Id AVP. If there is no Sy session, the OCS shall return a response with the Result-Code AVP set to DIAMETER_UNKNOWN_SESSION_ID.

The OCS shall remove all policy counter subscriptions associated with the Sy session such that the OCS will no longer notify the PCRF of policy counter state changes and close the session by returning a response with the Result-Code AVP set to DIAMETER_SUCCESS.

4.5.4 Sy Session Termination by the OCS

If the ASR feature is supported, and the OCS decides that the Sy session for a subscriber needs to be terminated (e.g. because subscriber is removed from an OCS system), the OCS shall send the Spending-Status-Notification-Request (SNR) containing the SN-Request-Type AVP with bit 1 (Abort Session Request) set to the PCRF.

Upon receipt of the SNR containing the SN-Request-Type AVP with bit 1 set, the PCRF shall acknowledge the receipt of the SNR by sending the Spending-Status-Notification-Answer (SNA) and shall then send a Final Spending Limit Report Request as specified in subclause 4.5.3.

NOTE: The termination of the Sy session causes the H-PCRF to make the applicable policy decision and act accordingly, i.e. sessions on other interfaces such as the Rx or Gx interface will remain established, unless the policy decision causes their termination.

5 Sy protocol

5.1 Protocol support

5.1.1 Use of Diameter base protocol

The Diameter Base Protocol as specified in IETF RFC 6733 [23] 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.

With regard to the Diameter protocol defined over the Sy interface, the OCS acts as a Diameter server, in the sense that it is the network element that handles policy counter status requests for a particular realm. The PCRF acts as the Diameter client, in the sense that it is the network element requesting policy counter status to the OCS.

A Diameter routing table entry can have a different destination based on the application identifier of the command. The application identifier stored in the command header must match the value of any application identifier AVPs in the command body. Diameter agents (relay, proxy, redirection, translation agents) should use the application identifier in the command header to route to a suitable destination.

5.1.2 Void

5.1.3 Accounting functionality

Accounting functionality (Accounting Session State Machine, related command codes and AVPs) shall not be used on the Sy interface.

5.1.4 Transport protocol

Diameter messages over the Sy interface shall make use of TCP IETF RFC 791 [13] or SCTP IETF RFC 4960 [14].

5.1.5 Advertising Application Support

The Diameter application identifier assigned to the Sy interface application is 16777302.

The PCRF and OCS shall advertise support of the Diameter Sy Application by including the value of the Sy 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 [23].

5.1.6 Use of the Supported-Features AVP

The Supported-Features AVP is used during session establishment to inform the destination host about the required and optional features that the origin host supports. The client shall, in the first request in a Diameter session indicate the set of supported features. The server shall, in the first answer within the Diameter session indicate the set of features that it has in common with the client and that the server shall support within the same Diameter session. Any further command messages shall always be compliant with the list of supported features indicated in the Supported-Features AVPs during session establishment. Features that are not advertised as supported shall not be used to construct the command messages for that Diameter session. Unless otherwise stated, the use of the Supported-Features AVP on the Sy reference point shall be compliant with the requirements for dynamic discovery of supported features and associated error handling on the Cx reference point as defined in clause 7.2.1 of TS 29.229 [15].

The base functionality for the Sy reference point is the 3GPP Rel-11 standard and a feature is an extension to that functionality. If the origin host does not support any features beyond the base functionality, the Supported-Features AVP may be absent from the Sy commands. As defined in clause 7.1.1 of TS 29.229 [15], 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 TS 29.229 [15], the Supported-Features AVP is of type grouped and contains the Vendor-Id, Feature-List-ID and Feature-List AVPs. On the Sy reference point, 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 Sy reference point, the Feature-List-ID AVP shall differentiate those lists from one another.

On receiving an initial request application message, the destination host shall act as defined in clause 7.2.1 of TS 29.229 [15]. The following exceptions apply to the initial SLR/SLA command pair:

- If the PCRF supports any supported features defined for Sy, the SLR shall include the features supported by the PCRF within Supported-Features AVP(s) with the 'M' bit cleared.

NOTE 2: One instance of Supported-Features AVP is needed per Feature-List-ID.

- If the SLR command does not contain any Supported-Features AVP(s) and the OCS supports no supported features defined for Sy functionality, the OCS shall not include the Supported-Features AVP in the SLA command. In this case, both PCRF and OCS shall not use any supported features defined for Sy.

Once the PCRF and OCS have negotiated the set of supported features during session establishment, the set of common features shall be used during the lifetime of the Diameter session.

The table below defines the features applicable to the Sy interface for the feature list with a Feature-List-ID of 1.

Table 5.1.6-1: Features of Feature-List-ID 1 used on the Sy interface

Feature bit	Feature	M/O	Description
0	ASR	O	Sy Session Termination by the OCS as specified in subclause 4.5.4
Feature bit: The order number of the bit within the Feature-List AVP where the least significant bit is assigned number "0". Feature: A short name that can be used to refer to the bit and to the feature, e.g. "EPS". M/O: Defines if the implementation of the feature is mandatory ("M") or optional ("O"). Description: A clear textual description of the feature.			

5.2 Initialization and maintenance of connection and session

The Diameter protocol between the PCRF and the OCS, shall always keep the session state, and use the same Session-Id parameter for the lifetime of each Diameter session.

Each Diameter session shall identify a Sy session for a given user. In order to indicate that the session state is to be maintained, the Diameter client and server shall not include the Auth-Session-State AVP, either in the request or in the response messages (see IETF RFC 6733 [23]).

The PCRF shall link the Gx session(s) or S9 session with the Sy session at Sy session initialization and maintain that until the IP-CAN session(s) for that subscriber are terminated or no IP-CAN session for the same user depends on the spending status information provided over Sy reference point.

5.3 Sy specific AVPs

5.3.0 General

Table 5.3.0.1 describes the Diameter AVPs defined for the Sy reference point, their AVP Code values, types and possible flag values. The Vendor-Id header of all AVPs defined in the present document shall be set to 3GPP (10415).

Table 5.3.0.1: Sy specific Diameter AVPs

Attribute Name	AVP Code	Clause defined	Value Type	AVP Flag rules (Note 1)				Applicability (Note 2)
				Must	May	Should not	Must not	
Pending-Policy-Counter-Information	2905	5.3.5	Grouped	M,V	P			
Pending-Policy-Counter-Change-Time	2906	5.3.6	Time	M,V	P			
Policy-Counter-Identifier	2901	5.3.1	UTF8String	M,V	P			
Policy-Counter-Status	2902	5.3.2	UTF8String	M,V	P			
Policy-Counter-Status-Report	2903	5.3.3	Grouped	M,V	P			
SL-Request-Type	2904	5.3.4	Enumerated	M,V	P			
SN-Request-Type	2907	5.3.7	Unsigned32	V	P		M	ASR

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 [23].

NOTE 2: AVPs marked with a supported feature are applicable as described in subclause 5.1.6.

5.3.1 Policy-Counter-Identifier AVP

The Policy-Counter-Identifier AVP (AVP code 2901) is of type UTF8String, and it uniquely identifies a policy counter that is maintained per subscriber within the OCS.

5.3.2 Policy-Counter-Status AVP

The Policy-Counter-Status AVP (AVP code 2902) is of type UTF8String, and identifies the policy counter status applicable for a specific policy counter and subscriber.

NOTE: The valid values for the Policy-Counter-Status AVP are specific for each Policy-Counter-Identifier value.

The values (e.g. valid, invalid or any other status) are not specified. The interpretation and actions related to the defined values are out of scope of 3GPP.

5.3.3 Policy-Counter-Status-Report AVP

The Policy-Counter-Status-Report AVP (AVP code 2903) is of type Grouped. It is used by the OCS to report the status of a specific policy counter.

Associated pending policy counter statuses shall always be provided within Pending-Policy-Counter-Information AVPs if the pending policy counter statuses are applicable to the policy counter identifier. If there are no Pending-Policy-Counter-Information AVPs provided within the Policy-Counter-Status-Report AVP, previously provided pending counter statuses are removed. In addition, newly provided pending policy counter statuses overwrite previously provided ones.

AVP Format:

```
Policy-Counter-Status-Report ::=
    < AVP Header: 2903 >
    { Policy-Counter-Identifier }
    { Policy-Counter-Status }
    *[ Pending-Policy-Counter-Information ]
    *[ AVP ]
```

5.3.4 SL-Request-Type AVP

The SL-Request-Type AVP (AVP code 2904) is of type Enumerated, and informs the OCS whether the SLR command is being sent as part of the initial or intermediate spending limit report request procedure.

The following values are defined:

INITIAL_REQUEST (0)

This value indicates that this is the first request in the Diameter session.

INTERMEDIATE_REQUEST (1)

This value indicates that this is the second or subsequent request in the Diameter session.

5.3.5 Pending-Policy-Counter-Information AVP

The Pending-Policy-Counter-Information AVP (AVP code 2905) is of type Grouped, which contains the pending policy counter status and the active time. If multiple pending policy counter AVPs are included, they shall be sorted in order of change time.

AVP Format:

```
Pending-Policy-Counter-Information ::= < AVP Header: 2905 >
    { Policy-Counter-Status }
    { Pending-Policy-Counter-Change-Time }
    *[ AVP ]
```

NOTE: The valid values for the Pending-Policy-Counter-Information AVP are specific for each Policy-Counter-Identifier value.

5.3.6 Pending-Policy-Counter-Change-Time AVP

The Pending-Policy-Counter-Change-Time AVP (AVP code 2906) is of type Time. This value indicates the NTP time at which the pending policy counter status becomes the current status of a policy counter.

5.3.7 SN-Request-Type AVP

The SN-Request-Type AVP (AVP code 2907) shall be of type Unsigned32 and shall contain a bit mask, and informs the PCRF about the type of the Spending-Status-Notification-Request (SNR). The 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.

The following values are defined, and multiple bits may be set in combination:

Table 5.3.7-1: SN-Request-Type AVP

Bit	Name	Description
0	Normal Request	This bit, when set, indicates that the SNR is used only to convey a spending limit report as detailed in subclause 4.5.2. This shall be the default value that applies when the SN-Request-Type AVP is not included in an SNR.
1	Abort Session Request	This bit, when set, indicates that the SNR is used to request the termination of the Sy session as detailed in subclause 4.5.4

5.4 Sy re-used AVPs

Table 5.4 lists the Diameter AVPs re-used by the Sy reference point from existing Diameter Applications, reference to their respective specifications and a short description of their usage within the Sy reference point. Other AVPs from existing Diameter Applications, except for the AVPs from Diameter base protocol, do not need to be supported. The AVPs from Diameter base protocol are not included in table 5.4, but they are re-used for the Sy reference point. Unless otherwise stated, re-used AVPs shall maintain their 'M', 'P' and 'V' flag settings. Where 3GPP Radius VSAs are re-used, unless otherwise stated, they shall be translated to Diameter AVPs as described in RFC 4005 [4] with the exception that the 'M' flag shall be set and the 'P' flag may be set.

Table 5.4: Sy re-used Diameter AVPs

Attribute Name	Reference	Description
DRMP	IETF RFC 7944 [21]	Allows Diameter endpoints to indicate the relative priority of Diameter transactions.
Subscription-Id	IETF RFC 4006 [5]	The identification of the subscription (IMSI, MSISDN, etc)
Load	IETF draft-ietf-dime-load [22]	The AVP used to convey load information between Diameter nodes. This AVP and all AVPs within this grouped AVP shall have the 'M' bit cleared.
Logical-Access-ID	ETSI TS 283 034 [17]	Contains a Circuit-ID (as defined in IETF RFC 3046 [18]). The Logical Access ID may explicitly contain the identity of the Virtual Path and Virtual Channel carrying the traffic. Applicable only for Fixed Broadband Access network convergence as defined in annex A. This AVP shall have the 'M' bit cleared.
OC-OLR	IETF 7683 [20]	Contains the necessary information to convey an overload report.
OC-Supported-Features	IETF 7683 [20]	Defines the support for the Diameter overload indication conveyence by the sending node.
Physical-Access-ID	ETSI TS 283 034 [17]	Identifies the physical access to which the user equipment is connected. Includes a port identifier and the identity of the access node where the port resides. Applicable only for Fixed Broadband Access network convergence as defined in annex A. This AVP shall have the 'M' bit cleared.
Supported-Features	3GPP TS 29.229 [15]	If present in a request, this AVP informs the destination host about the features that the origin host supports. If present in an answer, this AVP informs the destination host about common features with the origin host.

5.5 Sy specific Experimental-Result-Code AVP values

5.5.1 General

IETF RFC 6733 [23] specifies the Experimental-Result AVP containing Vendor-ID AVP and Experimental-Result-Code AVP. The Experimental-Result-Code AVP (AVP Code 298) is of type Unsigned32 and contains a vendor-assigned value representing the result of processing a request. The Vendor-ID AVP shall be set to 3GPP (10415).

5.5.2 Permanent Failures

Errors that fall within the Permanent Failures category shall be used to inform the peer that the request failed, and the request should not be attempted again.

The Result-Code AVP values defined in Diameter base protocol IETF RFC 6733 [23] are applicable. Also, the following Result-Code AVP value defined in IETF RFC 4006 [5] is applicable:

DIAMETER_USER_UNKNOWN (5030)

This error shall be used by the OCS to indicate to the PCRF that the end user specified in the request is unknown to the OCS and that the Sy session cannot be created.

The following specific Sy Experimental-Result-Code value is defined for permanent failures:

DIAMETER_ERROR_UNKNOWN_POLICY_COUNTERS (5570)

This error shall be used by the OCS to indicate to the PCRF that the OCS does not recognize one or more Policy Counters specified in the request, when the OCS is configured to reject the request provided with unknown policy counter identifier(s).

5.5.3 Transient Failures

Errors that fall within the transient failures category are 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 Diameter base protocol IETF RFC 6733 [23] are applicable. Also the following specific Sy Experimental-Result-Code value is defined for transient failures:

DIAMETER_ERROR_NO_AVAILABLE_POLICY_COUNTERS (4241)

This error shall be used by the OCS to indicate to the PCRF that the OCS has no available policy counters for the subscriber.

The PCRF may retry the request based on local configuration or operator policy on receipt of a transient failure.

5.6 Sy Messages

5.6.1 Command-Code Values

This section defines the Command-Code values for the Sy interface application as allocated by IANA from the vendor-specific namespace defined in IETF RFC 5719 [6]. Every command is defined by means of the ABNF syntax IETF RFC 2234 [7], according to the rules in IETF RFC 6733 [23].

The following Command Codes are defined in this specification:

Table 5.6.1: Command-Code values for Sy

Command-Name	Abbreviation	Code	Section
Spending-Limit-Request	SLR	8388635	5.6.2
Spending-Limit-Answer	SLA	8388635	5.6.3
Spending-Status-Notification-Request	SNR	8388636	5.6.4
Spending-Status-Notification-Answer	SNA	8388636	5.6.5

In addition, the Session-Termination-Request and Session-Termination-Answer commands are reused from IETF RFC 6733 [23].

For the commands defined in this specification and reused commands, the Application-ID field shall be set to 16777302.

5.6.2 Spending-Limit-Request (SLR) command

The SLR command, indicated by the Command-Code field set to 8388635 and the 'R' bit set in the Command Flags field, is sent by the PCRF to the OCS as part of the Initial or Intermediate Spending Limit Report Request procedure.

Message Format:

```
<SL-Request> ::= <Diameter Header: 8388635, REQ, PXY >
  < Session-Id >
  [ DRMP ]
  { Auth-Application-Id }
  { Origin-Host }
  { Origin-Realm }
  { Destination-Realm }
  [ Destination-Host ]
  [ Origin-State-Id ]
  [ OC-Supported-Features ]
  *[ Supported-Features ]
  { SL-Request-Type }
  *[ Subscription-Id ]
  *[ Policy-Counter-Identifier ]
  [ Logical-Access-ID ]
  [ Physical-Access-ID ]
  *[ Proxy-Info ]
  *[ Route-Record ]
  *[ AVP ]
```

NOTE: Multiple instances of the Subscription-Id AVP in the SLR command correspond to multiple types of identifier for the same subscriber, for example IMSI and MSISDN.

5.6.3 Spending-Limit-Answer (SLA) command

The SLA command, indicated by the Command-Code field set to 8388635 and the 'R' bit cleared in the Command Flags field, is sent by the OCS to the PCRF as part of the Initial or Intermediate Spending Limit Report Request procedure.

Message Format:

```
<SL-Answer> ::= < Diameter Header: 8388635, PXY >
< Session-Id >
[ DRMP ]
{ Auth-Application-Id }
{ Origin-Host }
{ Origin-Realm }
[ Result-Code ]
[ Experimental-Result ]
[ OC-Supported-Features ]
[ OC-OLR ]
*[ Supported-Features ]
*[ Policy-Counter-Status-Report ]
[ Error-Message ]
[ Error-Reporting-Host ]
[ Failed-AVP ]
[ Origin-State-Id ]
*[ Redirect-Host ]
[ Redirect-Host-Usage ]
[ Redirect-Max-Cache-Time ]
*[ Proxy-Info ]
*[ Load ]
*[ AVP ]
```

5.6.4 Spending-Status-Notification-Request (SNR) command

The SNR command, indicated by the Command-Code field set to 8388636 and the 'R' bit set in the Command Flags field, is sent by the OCS to the PCRF as part of the Spending Limit Report procedure.

Message Format:

```
<SN-Request> ::= < Diameter Header: 8388636, REQ, PXY >
< Session-Id >
[ DRMP ]
{ Origin-Host }
{ Origin-Realm }
{ Destination-Realm }
{ Destination-Host }
{ Auth-Application-Id }
[ Origin-State-Id ]
[ OC-Supported-Features ]
*[ Policy-Counter-Status-Report ]
[ SN-Request-Type ]
*[ Proxy-Info ]
*[ Route-Record ]
*[ AVP ]
```

5.6.5 Spending-Status-Notification-Answer (SNA) command

The SNA command, indicated by the Command-Code field set to 8388636 and the 'R' bit cleared in the Command Flags field, is sent by the PCRF to the OCS as part of the Spending Limit Report procedure.

Message Format:

```
<SN-Answer> ::= < Diameter Header: 8388636, PXY >
< Session-Id >
[ DRMP ]
{ Origin-Host }
{ Origin-Realm }
[ Result-Code ]
[ Experimental-Result ]
```

```

    [ Origin-State-Id ]
    [ OC-Supported-Features ]
    [ OC-OLR ]
    [ Error-Message ]
    [ Error-Reporting-Host ]
    * [ Redirect-Host ]
    [ Redirect-Host-Usage ]
    [ Redirect-Max-Cache-Time ]
    [ Failed-AVP ]
    * [ Proxy-Info ]
    * [ AVP ]

```

5.6.6 Session-Termination-Request (STR) command

The STR command, indicated by the Command-Code field set to 275 and the 'R' bit set in the Command Flags field, is sent by the PCRF to the OCS as part of the Final Spending Limit Report Request procedure.

Message Format:

```

<ST-Request> ::= < Diameter Header: 275, REQ, PXY >
    < Session-Id >
    [ DRMP ]
    { Origin-Host }
    { Origin-Realm }
    { Destination-Realm }
    { Auth-Application-Id }
    { Termination-Cause }
    [ Destination-Host ]
    [ OC-Supported-Features ]
      [ Origin-State-Id ]
    * [ Proxy-Info ]
    * [ Route-Record ]
    * [ AVP ]

```

5.6.7 Session-Termination-Answer (STA) command

The STA command, indicated by the Command-Code field set to 275 and the 'R' bit cleared in the Command Flags field, is sent by the OCS to the PCRF as part of the Final Spending Limit Report Request procedure.

Message Format:

```

<ST-Answer> ::= < Diameter Header: 275, PXY >
    < Session-Id >
    [ DRMP ]
    { Origin-Host }
    { Origin-Realm }
    [ Result-Code ]
    [ Error-Message ]
    [ Error-Reporting-Host ]
    [ Failed-AVP ]
    [ Origin-State-Id ]
    [ OC-Supported-Features ]
    [ OC-OLR ]
    * [ Redirect-Host ]
    [ Redirect-Host-Usage ]
    [ Redirect-Max-Cache-Time ]
    * [ Proxy-Info ]
    * [ Load ]
    * [ AVP ]

```

Annex A (normative): User Identity for Fixed Broadband Access network convergence

In the Fixed Broadband Access network convergence scenario, the User Identity refers to the Subscriber Identifier as defined in TS 29.212 [19] Annex G.5.1.6.

If the User Identity is the Access Line Identifier, the Logical-Access-ID AVP and Physical-Access-ID AVP are included in the SLR command instead of the Subscription-Id AVP.

Annex B (informative): Change history

Change history							
Date	TSG #	TSG Doc.	CR	Rev	Subject/Comment	Old	New
2014-12	TSG#66	CP-140922	020	2	Update PCC architecture diagrams to include Np reference point	12.2.0	13.0.0
2015-06	TSG#68	CP-150342	0023	1	Notify a pending policy counter status change	13.0.0	13.1.0
2015-06	TSG#68	CP-150342	0026	1	Correction to pending policy counters status report	13.0.0	13.1.0
2015-06	TSG#68	CP-150342	0029	5	Including the Supported-Features AVP	13.0.0	13.1.0
2015-06	TSG#68	CP-150348	0031	1	Usage of AVPs related to user identity for convergence scenario	13.0.0	13.1.0
2015-06	TSG#68	CP-150360	0032	1	Diameter overload control over Sy	13.0.0	13.1.0
2015-06	TSG#68	CP-150363	0034	1	Correcting Hanging Paragraphs	13.0.0	13.1.0
2015-12	TSG#70	CP-150797	0040	1	Update the PCC architecture figures in 29.219	13.1.0	13.2.0
2015-12	TSG#70	CP-150630	0041	1	Update draft-ietf-dime-ovli reference to RFC 7683	13.1.0	13.2.0
2015-12	TSG#70	CP-150788	0042	3	Sy interface impacts for Race condition handling	13.1.0	13.2.0
2015-12	TSG#70	CP-150788	0046	2	Correction text for the use of the Spending-Status-Notification-Request (SNR) command on the Sy reference point	13.1.0	13.2.0
Change history							
Date	TSG #	TSG Doc.	CR	Rev	Cat	Subject/Comment	New
2016-03	TSG#71	CP-160093	0047	2	B	Diameter Message Priority over Sy interface	13.3.0
2016-12	TSG#74	CP-160614	0052	-	F	Change IETF drmp draft version to official RFC 7944	13.4.0
2016-12	TSG#74	CP-160615	0051	2	B	Diameter Load Control Mechanism	14.0.0
2016-12	TSG#74	CP-160616	0053	1	F	Diameter base protocol specification update	14.0.0
2017-03	TSG#75	CP-170076	0055	1	F	Update instance number for the Failed-AVP in answer commands	14.1.0
2017-06	TSG#76	CP-171119	0057	1	F	Reference update for draft-ietf-dime-load	14.2.0
2017-09	TSG#77	CP-172054	0062	2	B	Enhancement on Sy reference point	15.0.0
2018-03	TSG#79	CP-180049	0063	2	F	Supported-Features AVP missing in SLR/SLA's ABNF	15.1.0
2019-06	TSG#84	CP-191093	0073	1	A	Correction of OCS behaviour for unknown and unavailable Policy Counters	15.2.0

History

Document history		
V15.1.0	July 2018	Publication
V15.2.0	July 2019	Publication