

# ETSI TS 129 212 V7.1.0 (2007-06)

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*Technical Specification*

## **Universal Mobile Telecommunications System (UMTS); Policy and charging control over Gx reference point (3GPP TS 29.212 version 7.1.0 Release 7)**



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Reference

DTS/TSGC-0329212v710

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Keywords

UMTS

**ETSI**

650 Route des Lucioles  
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C  
Association à but non lucratif enregistrée à la  
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 Gx reference point for the present release. The functional requirements and the stage 2 specifications of the Gx reference point are contained in 3GPP TS 23.203 [7]. The Gx reference point lies between the Policy and Charging Rule Function and the Policy and Charging Enforcement Function.

Whenever it is possible the present document specifies the requirements for the protocol by reference to specifications produced by the IETF within the scope of Diameter. Where this is not possible, extensions to Diameter are defined within the present document.

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# 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 and/or edition number or version number) 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 29.210: "Charging Rule Provisioning over Gx Interface".
- [3] 3GPP TS 29.207: "Policy control over Gx interface".
- [4] 3GPP TS 29.208: "End-to-end Quality of Service (QoS) signalling flows".
- [5] IETF RFC 3588: "Diameter Base Protocol".
- [6] IETF RFC 3556: "Session Description Protocol (SDP) Bandwidth Modifiers for RTP Control Protocol (RTCP) Bandwidth".
- [7] 3GPP TS 23.203: "Policy Control and Charging architecture".
- [8] 3GPP TS 29.213: "Policy and charging control signalling flows and Quality of Service (QoS) parameter mapping".
- [9] IETF RFC 4006: "Diameter Credit Control Application".
- [10] 3GPP TS 29.214: "Policy and Charging Control over Rx reference point".
- [11] 3GPP TS 29.061: "Interworking between the Public Land Mobile Network (PLMN) supporting packet based services and Packet Data Networks (PDN)".
- [12] IETF RFC 4005: "Diameter Network Access Server Application".
- [13] 3GPP TS 24.008: "Mobile radio interface Layer 3 specification".
- [14] 3GPP TS 29.229: "Cx and Dx interfaces based on Diameter protocol; Protocol details".
- [15] IETF RFC 3162: "Radius and IPv6".
- [16] 3GPP TS 32.295: "Telecommunication management; Charging management; Charging Data Record (CDR) transfer".

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## 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:

**IP-CAN bearer:** IP transmission path of defined capacity, delay and bit error rate, etc.  
See 3GPP TS 21.905 [1] for the definition of bearer.

**IP-CAN session:** association between a UE and an IP network

The association is identified by a UE IP address together with a UE identity information, if available. An IP-CAN session incorporates one or more IP-CAN bearers. Support for multiple IP-CAN bearers per IP-CAN session is IP-CAN specific. An IP-CAN session exists as long as the UE IP address is established and announced to the IP network.

**IP flow:** unidirectional flow of IP packets with the same source IP address and port number and the same destination IP address and port number and the same transport protocol

Port numbers are only applicable if used by the transport protocol.

### 3.2 Abbreviations

For the purpose of the present document, the abbreviations given in 3GPP TR 21.905 [1] and the following apply:

AF	Application Function
OCS	Online charging system
OFCS	Offline charging system
PCEF	Policy and Charging Enforcement Function
PCRF	Policy and Charging Rule Function

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## 4 Gx reference point

### 4.1 Overview

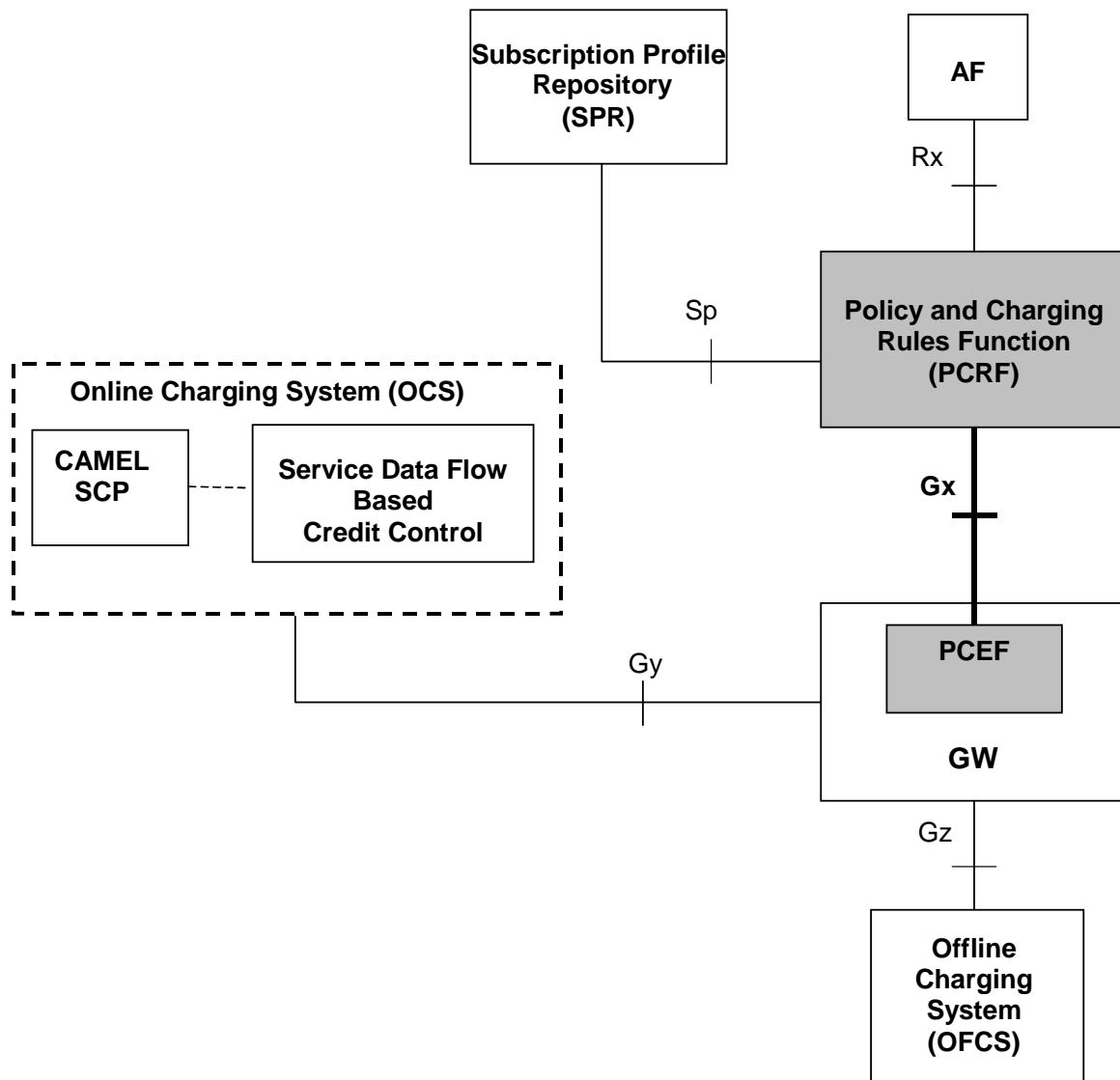
The Gx reference point is located between the Policy and Charging Rules Function (PCRF) and the Policy and Charging Enforcement Function (PCEF). The Gx reference point is used for provisioning and removal of PCC rules from the PCRF to the PCEF and the transmission of traffic plane events from the PCEF to the PCRF. The stage 2 level requirements for the Gx reference point are defined in 3GPP TS 23.203 [7].

Signalling flows related to the both Rx and Gx interfaces are specified in 3GPP TS 29.213 [8].

### 4.2 Gx Reference model

The Gx reference point is defined between the PCRF and the PCEF. The relationships between the different functional entities involved are depicted in figure 4.1.





**Figure 4.1: Gx reference point at the Policy and Charging Control (PCC) architecture**

NOTE: The details associated with the Sp reference point are not specified in this Release. The SPR's relation to existing subscriber databases is not specified in this Release.

## 4.3 PCC Rules

### 4.3.1 PCC Rule Definition

The purpose of the PCC rule is to:

- Detect a packet belonging to a service data flow.
- The service data flow filters within the PCC rule are used for the selection of downlink IP CAN bearers.
- The service data flow filters within the PCC rule are used for the enforcement that uplink IP flows are transported in the correct IP CAN bearer.
- Identify the service the service data flow contributes to.
- Provide applicable charging parameters for a service data flow.
- Provide policy control for a service data flow.

The PCEF shall select a PCC rule for each received packet by evaluating received packets against service data flow filters of PCC rules in the order of the precedence of the PCC rules.. When a packet matches a service data flow filter, the packet matching process for that packet is completed, and the PCC rule for that filter shall be applied.

There are two different types of PCC rules as defined in [7]:

- Dynamic PCC rules. Dynamically provisioned by the PCRF to the PCEF via the Gx interface. These PCC rules may be either predefined or dynamically generated in the PCRF. Dynamic PCC rules can be activated, modified and deactivated at any time.
- Predefined PCC rules. Preconfigured in the PCEF. Predefined PCC rules can be activated or deactivated by the PCRF at any time. Predefined PCC rules within the PCEF may be grouped allowing the PCRF to dynamically activate a set of PCC rules over the Gx reference point.

NOTE: The operator may define a predefined PCC rule, to be activated by the PCEF. Such a predefined rule is not explicitly known in the PCRF and not under the control of the PCRF.

A PCC rule consists of:

- a rule name;
- service identifier;
- service data flow filter(s);
- gate status;
- QoS parameters;
- charging key (i.e. rating group);
- other charging parameters.

The rule name shall be used to reference a PCC rule in the communication between the PCEF and the PCRF.

The service identifier shall be used to identify the service or the service component the service data flow relates to.

The service flow filter(s) shall be used to select the traffic for which the rule applies.

The gate status indicates whether the service data flow, detected by the service data flow filter(s), may pass (gate is open) or shall be discarded (gate is closed) in uplink and/or in downlink direction.

The QoS information includes the QoS class identifier (authorized QoS class for the service data flow) and authorized bitrates for uplink and downlink.

The charging parameters define whether online and offline charging interfaces are used, what is to be metered in offline charging, on what level the PCEF shall report the usage related to the rule, etc.

For different PCC rules with overlapping service data flow filter, the precedence of the rule determines which of these rules is applicable. PCC rule also includes Application Function record information for enabling charging correlation between the application and bearer layer if the AF has provided this information via the Rx interface. For IMS this includes the IMS Charging Identifier (ICID) and flow identifiers.

### 4.3.2 Operations on PCC Rules

For dynamic PCC rules, the following operations are available:

- Installation: to provision a PCC rules that has not been already provisioned.
- Modification: to modify a PCC rule already installed.
- Removal: to remove a PCC rule already installed.

For predefined PCC rules, the following operations are available:

- Activation: to allow the PCC rule being active.

- Deactivation: to disallow the PCC rule.

The procedures to perform these operations are further described in clause 4.5.2.

## 4.4 Functional elements

### 4.4.1 PCRF

The PCRF (Policy Control and Charging Rules Function) is a functional element that encompasses policy control decision and flow based charging control functionalities. These 2 functionalities are the heritage of the release 6 logical entities PDF and CRF respectively. The PCRF provides network control regarding the service data flow detection, gating, QoS and flow based charging (except credit management) towards the PCEF. The PCRF receives session and media related information from the AF and informs AF of traffic plane events.

The PCRF shall provision PCC Rules to the PCEF via the Gx reference point.

The PCRF PCC Rule decisions may be based on one or more of the following:

- Information obtained from the AF via the Rx reference point, e.g. the session, media and subscriber related information.
- Information obtained from the PCEF via the Gx reference point, e.g. IP-CAN bearer attributes, request type and subscriber related information.
- Information obtained from the SPR via the Sp reference point, e.g. subscriber and service related data.

NOTE: The details associated with the Sp reference point are not specified in this Release. The SPR's relation to existing subscriber databases is not specified in this Release.

- Own PCRF pre-configured information.

The PCRF shall report events to the AF via the Rx reference point.

The PCRF shall inform the PCEF through the use of PCC rules on the treatment of each service data flow that is under PCC control, in accordance with the PCRF policy decision(s). For GPRS it shall be possible to support policy control, i.e. access control and QoS control, on a per PDP context basis for the UE initiated case.

The PCRF shall be able to select the bearer control mode that will apply for the IP-CAN session and provide it to the PCEF via the Gx reference point.

Upon subscription to loss of AF signalling bearer notifications by the AF, the PCRF shall request to PCEF to be notified of the loss of resources associated to the PCC Rules corresponding with AF Signalling IP Flows, if this has not been requested previously.

### 4.4.2 PCEF

The PCEF (Policy and Charging Enforcement Function) is the functional element that encompasses policy enforcement and flow based charging functionalities. These 2 functionalities are the heritage of the release 6 logical entities PEP and TPF respectively. This functional entity is located at the Gateway (e.g. GGSN in the GPRS case, and PDG in the WLAN case). It provides control over the user plane traffic handling at the Gateway and its QoS, and provides service data flow detection and counting as well as online and offline charging interactions.

For a service data flow that is under policy control the PCEF shall allow the service data flow to pass through the Gateway if and only if the corresponding gate is open. If the PCEF receives an Authorization token and Flow Id(s) from an UE, the PCEF shall report them to the PCRF over Gx.

For a service data flow that is under charging control the PCEF shall allow the service data flow to pass through the Gateway if and only if there is a corresponding active PCC rule and, for online charging, the OCS has authorized the applicable credit with that Charging key. The PCEF may let a service data flow pass through the Gateway during the course of the credit re-authorization procedure.

If requested by the PCRF, the PCEF shall report to the PCRF when the status of the related service data flow changes. This procedure can be used to monitor an IP-CAN bearer dedicated for AF signalling traffic.

## 4.5 PCC procedures over Gx reference point

### 4.5.1 Request for PCC rules

The PCEF shall indicate, via the Gx reference point, a request for PCC rules in the following instances.

1) At IP-CAN session establishment:

- The PCEF shall send a CC-Request with CC-Request-Type AVP set to the value "INITIAL\_REQUEST". The PCEF shall supply user identification and other attributes to allow the PCRF to identify the rules to be applied. The other attributes shall include the type of IP-CAN, the type of the radio access technology (e.g. UTRAN, GERAN, WLAN) and the UE IP address. The PCEF may also include the Access-Network-Charging-Address and Access-Network-Charging-Identifier-Gx AVPs in the CC-Request. For GPRS, information about the user equipment (e.g. IMEISV), QoS negotiated, SGSN Address, SGSN country and network codes, APN, TFT and indication if the bearer is used as IMS signalling PDP context shall be provided. Furthermore, if the UE and the network support the network network-initiated bearer request procedure, the PCEF shall indicate this by supplying the Network Request Support AVP. If the UE indicated a preferred bearer control mode, the PCEF shall indicate this mode within the Bearer-Control Mode AVP.

For IP-CAN types that support multiple IP-CAN bearers (as in the case of GPRS), the PCEF shall provide the Bearer-Identifier AVP at the IP-CAN session establishment. In this case, the PCEF shall also include the Bearer-Operation AVP set to the value "Establishment".

2) At IP-CAN session modification:

IP-CAN session modification with PCEF-requested rules can occur in the following cases:

- For GPRS, when a new PDP Context is being established by the UE in an already existing PDP Session.
- For GPRS, when a PDP context is being modified and an Event trigger is met.
- For GPRS, when a PDP context is being terminated.

The PCEF shall send a CC-Request with CC-Request-Type AVP set to the value "UPDATE\_REQUEST". The PCEF may include the Access-Network-Charging-Address and Access-Network-Charging-Identifier-Gx AVPs in the CC-Request. For an IP-CAN Session modification where an existing IP-CAN Bearer is modified, the PCEF shall supply within the PCC rule request the specific event which caused the IP-CAN session modification (within the Event-Trigger AVP) and any previously provisioned PCC rule(s) affected by the IP-CAN session modification. The PCC rules and their status shall be supplied to PCRF within the Charging-Rule-Report AVP.

In the case the PCRF performs the bearer binding and:

- a new IP-CAN bearer is being established, the PCEF shall assign a new bearer identifier to this IP-CAN bearer, include this identifier within the Bearer-Identifier AVP, and include the Bearer-Operation AVP set to the value "Establishment";
- an existing IP-CAN bearer is being modified, the PCEF shall include the Bearer-Identifier AVP and the Bearer-Operation AVP set to the value "Modification". If the Event trigger that caused the IP-CAN bearer modification applies at session level (i.e. it is common to all the bearers belonging to that IP-CAN session), PCEF shall send a single CC-Request for all the affected bearers. In this case, the Bearer-Identifier AVP shall not be included to indicate that it applies to all the IP-CAN bearers in the IP-CAN session.

In the case both the PCRF and the PCEF may performs the bearer binding:

For GPRS, this applies for the mixed UE/network bearer control mode:

- If the UE request the establishment of a new IP-CAN bearer, the PCEF shall assign a new bearer identifier to this IP-CAN bearer, include this identifier within the Bearer-Identifier AVP, and include the Bearer-Operation AVP set to the value "Establishment", the UE-provided TFT filters and the requested QoS of the new IP-CAN bearer.
- If an existing IP-CAN bearer is being modified:

- If the PCEF has not yet notified the PCRF about this IP CAN bearer and the UE assigns one or more Traffic Flow template(s) within an IP CAN Bearer modification request, the PCEF shall assign a new bearer identifier to this IP-CAN bearer, and shall include the Bearer-Identifier AVP and the Bearer-Operation AVP set to the value "Establishment", the UE-provided TFT filters and the requested QoS of the new IP-CAN bearer. The PCEF shall modify the received requested QoS by removing the bandwidth required for PCC rules the PCEF has previously bound to this IP CAN bearer and indicate this modified requested QoS to the PCRF.

NOTE: The details how the bandwidth required for PCC rules the PCEF has previously bound to this IP CAN bearer are calculated are ffs, e.g. the significance of the maximum and guaranteed bandwidth per PCC rule in this calculation.

- If the PCEF has already notified the PCRF about this IP CAN bearer, the PCEF shall include the Bearer-Identifier AVP and the Bearer-Operation AVP set to the value "Modification". If the PCEF has received a new requested QoS as part of an IP CAN bearer modification request, the PCEF shall modify this received requested QoS by removing the bandwidth required for PCC rules the PCEF has previously bound to this IP CAN bearer and indicate this modified requested QoS to the PCRF.

NOTE: The details how the bandwidth required for PCC rules the PCEF has previously bound to this IP CAN bearer are calculated are ffs, e.g. the significance of the maximum and guaranteed bandwidth per PCC rule in this calculation.

If the Event trigger that caused the IP-CAN bearer modification applies at session level (i.e. it is common to all the bearers belonging to that IP-CAN session), PCEF shall send a single CC-Request for all the affected bearers. In this case, the Bearer-Identifier AVP shall not be included to indicate that it applies to all the IP-CAN bearers in the IP-CAN session. If the Event trigger that caused the IP CAN bearer modification applies at bearer level, the Charging-Rule-Report AVP shall include all the affected PCC rules.

## 4.5.2 Provisioning of PCC rules

The PCRF shall indicate, via the Gx reference point, PCC rules to be applied at the PCEF. This may be using one of the following procedures:

- PULL procedure(Provisioning solicited by the PCEF): In response to a request for PCC rules being made by the PCEF, as described in the preceding section, the PCRF shall provision PCC rules in the CC-Answer; or
- PUSH procedure(Unsolicited provisioning): The PCRF may decide to provision PCC rules without obtaining a request from the PCEF, e.g. in response to information provided to the PCRF via the Rx reference point, or in response to an internal trigger within the PCRF. To provision PCC rules without a request from the PCEF, the PCRF shall include these PCC rules in an RA-Request message. No CCR/CCA messages are triggered by this RA-Request.

For each request from the PCEF or upon the unsolicited provision the PCRF shall provision zero or more PCC rules.. The PCRF may perform an operation on a single PCC rule by one of the following means:

- To activate or deactivate a PCC rule that is predefined at the PCEF, the PCRF shall provision a reference to this PCC rule within a Charging-Rule-Name AVP and indicate the required action by choosing either the Charging-Rule-Install AVP or the Charging-Rule-Remove AVP.
- To install or modify a PCRF-provisioned PCC rule, the PCRF shall provision a corresponding Charging-Rule-Definition AVP within a Charging-Rule-Install AVP.
- To remove a PCC rule which has previously been provisioned by .the PCRF, the PCRF shall provision the name of this rule as value of a Charging-Rule-Name AVP within a Charging-Rule-Remove AVP.
- If the PCRF performs the bearer binding, the PCRF may move previously installed or activated PCC rules from one IP CAN bearer to another IP CAN bearer, as described further down.

As an alternative to providing a single PCC rule, the PCRF may provide a Charging-Rule-Base-Name AVP within a Charging-Rule-Install AVP or the Charging-Rule-Remove AVP as a reference to a group of PCC rules predefined at the PCEF. With a Charging-Rule-Install AVP, a predefined group of PCC rules is activated or moved. With a Charging-Rule-Remove AVP, a predefined group of PCC rules is deactivated.

The PCRF may combine multiple of the above PCC rule operations in a single command.

To activate a predefined PCC rule at the PCEF, the rule name within a Charging-Rule-Name AVP shall be supplied within a Charging-Rule-Install AVP as a reference to the predefined rule. To activate a group of predefined PCC rules within the PCEF (e.g. gold users or gaming services) the PCC rule base name within a Charging-Rule-Base-Name AVP shall be supplied within a Charging-Rule-Install AVP as a reference to the group of predefined PCC rules. If the PCRF performs the bearer binding, the PCRF shall indicate the IP CAN bearer where the PCC rules shall be activated using a Bearer-Identifier AVP within the Charging-Rule-Install AVP.

To install a new or modify an already installed PCRF defined PCC rule, the Charging-Rule-Definition AVP shall be used. If a PCC rule with the same rule name, as supplied in the Charging-Rule-Name AVP within the Charging-Rule-Definition AVP, already exists at the PCEF, the new PCC rule shall update the currently installed rule. If the existing PCC rule already has attributes also included in the new PCC rule definition, the existing attributes shall be overwritten. Any attribute in the existing PCC rule not included in the new PCC rule definition shall remain valid.

If the PCRF performs the bearer binding (for GPRS for "UE only" or mixed "UE/network" bearer control mode) and installs or activates a new PCC rule, the PCRF shall indicate the IP CAN bearer where the new rule shall be installed using a Bearer-Identifier AVP within the Charging-Rule-Install AVP. If the PCRF modifies an already installed PCC rule, the PCRF does not need to indicate the bearer. If the PCEF obtains an updated definition of a PCC rule within a Charging-Rule-Install AVP without a Bearer-Identifier AVP, the PCEF shall continue to apply the PCC rule to the IP CAN bearer that has previously been indicated.

If the PCRF does not perform the bearer binding and installs or activates a new PCC rule, the PCRF does not indicate the bearer within the Charging-Rule-Install AVP. The PCEF shall then perform the bearer binding and select the IP CAN bearer where the provisioned new PCC rule is applied.

If the PCRF performs the bearer binding, the PCRF may move previously installed or activated PCC rule(s) from one IP CAN bearer to another IP CAN bearer. To move such PCC rule(s), the PCRF shall indicate the new bearer using the Bearer-Identifier AVP within a Charging-Rule-Install AVP and shall indicate the charging rule(s) to be moved using Charging-Rule name AVP(s), and/or a Charging-Rule-Base-Name AVP(s), and/or Charging-Rule-Definition AVP(s) (for PCC rule(s) that are modified at the same time). The PCEF shall then apply these PCC rules at the new indicated IP CAN bearer and shall remove them from the IP CAN bearer where the rules previously had been applied.

Further details of the binding mechanism can be found in 3GPP TS 29.213 [8].

For deactivating single predefined or removing PCRF-provided PCC rules, the Charging-Rule-Name AVP shall be supplied within a Charging-Rule-Remove AVP. For deactivating a group of predefined PCC rules, the Charging-Rule-Base-Name AVP shall be supplied within a Charging-Rule-Remove AVP.

**NOTE:** When deactivating a predefined PCC rule that is activated in more than one IP-CAN bearers, the predefined PCC rule is deactivated simultaneously in all the IP-CAN bearers where it was previously activated.

If the provisioning of PCC rules fails, PCRF will be informed. It will be done by means of a new CCR command (if the installation/activation failed using a PULL mode) or in the RAA command (if the failure occurred using a PUSH mode). Depending on the cause, PCRF can decide if re-installation, modification, removal of PCC rules or any other action apply.

#### 4.5.2.1 Selecting a PCC rule for Uplink IP packets

If PCC is enabled, the PCEF shall select the applicable PCC rule for each received uplink IP packet within an IP CAN bearer (for GPRS, PDP context) by evaluating the packet against uplink service data flow filters of PCRF-provided or predefined active PCC rules of this IP CAN bearer in the order of the precedence of the PCC rules. When a PCRF-provided PCC rule and a predefined PCC rule have the same precedence, the uplink service data flow filters of the PCRF-provided PCC rule shall be applied first. When a packet matches a service data flow filter, the packet matching process for that packet is completed, and the PCC rule for that filter shall be applied. Uplink IP packets which do not match any PCC rule of the corresponding IP CAN bearer shall be silently discarded.

#### 4.5.2.2 Selecting a PCC rule and IP CAN Bearer for Downlink IP packets

If PCC is enabled, the PCEF shall select a PCC rule for each received downlink IP packet within an IP CAN session (for GPRS, PDP session) by evaluating the packet against downlink service data flow filters of PCRF-provided or predefined active PCC rules of all IP CAN bearers of the IP CAN session in the order of the precedence of the PCC

rules. When a PCRF-provided PCC rule and a predefined PCC rule have the same precedence, the downlink service data flow filters of the PCRF-provided PCC rule shall be applied first. When a packet matches a service data flow filter, the packet matching process for that packet is completed, and the PCC rule for that filter shall be applied. The Downlink IP Packet shall be transported within the IP CAN bearer where the selected PCC rule is mapped. Downlink IP packets which do not match any PCC rule of the IP CAN session shall be silently discarded.

For GPRS, TFT filters shall not be applied to assign downlink IP packets to PDP contexts if PCC is enabled for an APN.

#### 4.5.2.3 Gate function

The Gate Function represents a user plane function enabling or disabling the forwarding of service flow packets. A gate is described within a PCC rule. If the PCC rule contains Flow-Description AVP(s) applicable for uplink IP flows, it shall describe a gate for the corresponding uplink IP flows. If the PCC rule contains Flow-Description AVP(s) applicable for downlink IP flows, it shall describe a gate for the corresponding downlink IP flows. The Flow Status AVP of the PCC rule shall describe if the possible uplink and possible downlink gate is opened or closed.

The commands to open or close the gate shall lead to the enabling or disabling of the passage for corresponding IP packets. If the gate is closed all packets of the related IP flows shall be dropped. If the gate is opened the packets of the related IP flows are allowed to be forwarded.

#### 4.5.2.4 Policy enforcement for "Authorized QoS" per PCC Rule

The PCRF can provide the authorized QoS for a PCC rule to the PCEF. The Provisioning of authorized QoS per PCC Rule shall be performed using the PCC rule provisioning procedure. For a PCRF-provided PCC rule, the "Authorized QoS" shall be encoded using a QoS-Information AVP within the Charging-Rule-Definition AVP of the PCC rule. If "Authorized QoS" is provided for a PCC rule, the PCEF shall enforce the corresponding policy.

See also Clause 4.5.5.

### 4.5.3 Provisioning of Event Triggers

The PCRF may provide one or several event triggers within one or several Event-Trigger AVP to the PCEF using the PCC rule provision procedure. Event triggers may be used to determine which IP-CAN session modification or specific event causes the PCEF to re-request PCC rules. Although event trigger reporting from PCEF to PCRF can apply for an IP CAN session or bearer depending on the particular event, provisioning of event triggers will be done at session level. The Event-Trigger AVP may be provided in combination with the initial or subsequent PCC rule provisioning.

The PCRF may add new event triggers or remove the already provided ones at each request from the PCEF or upon the unsolicited provision from the PCRF. In order to do so, the PCRF shall provide the new complete list of applicable event triggers including the needed provisioned Event-Trigger AVPs in the CCA or RAR commands.

The PCRF may remove all previously provided event triggers by providing the Event-Trigger AVP set to the value NO\_EVENT\_TRIGGERS. When an Event-Trigger AVP is provided with this value, no other Event-Trigger AVP shall be provided in the CCA or RAR command. Upon reception of an Event-Trigger AVP with this value, the PCEF shall not inform PCRF of any event.

If no Event-Trigger AVP is included in a CCA or RAR operation, any previously provisioned event trigger will be still applicable.

### 4.5.4 Provisioning of charging related information for the IP-CAN session

#### 4.5.4.1 Provisioning of Charging Addresses

In combination with the initial PCC rule provisioning only, the PCRF may provide OFCS and/or OCS addresses within a Charging-Information AVP to the PCEF defining the offline and online charging system addresses respectively. These shall overwrite any predefined addresses at the PCEF. Both primary and secondary addresses for OFCS and/or OCS shall be provided simultaneously. Provisioning OFCS or OCS addresses without PCC rules for offline or online charged service data flows, respectively, shall not be considered as an error since such PCC rules may be provided in later provisioning.

#### 4.5.4.2 Provisioning of Default Charging Method

The default charging method indicates what charging method shall be used for every PCC rule where the charging method is omitted. In combination with the initial PCC rule provisioning only, the PCRF may provide default charging method within the Online AVP or Offline AVP embedded directly within the CCA command to the PCEF. The default charging method provided by the PCRF shall overwrite any predefined default charging method at the PCEF.

### 4.5.5 Provisioning and Policy Enforcement of Authorized QoS

#### 4.5.5.0 Overview

The PCRF may provide authorized QoS to the PCEF.

The authorized QoS shall be provisioned within a CCA or RAR Diameter message as QoS-Information AVP. The provisioning of the authorized QoS (which is composed of QCI and bitrates) is performed from the PCRF to the PCEF. The authorized QoS can refer to a PCC rule, or to an IP CAN bearer.

- When the authorized QoS applies to an IP CAN bearer, it shall be provisioned outside a Charging-Rule-Definition AVP and it shall also include the Bearer-Identifier AVP to indicate what bearer it applies to.
- When the authorized QoS applies to a PCC rule, it shall be provisioned within the corresponding PCC rule by including the QoS-Information AVP within the Charging-Rule-Definition AVP. The QoS-Information AVP shall not contain a Bearer-Identifier AVP.

**Editors note: It is ffs if the authorized QoS can also be provided on Diameter command level to supply bandwidths per QCI.**

The authorized QoS provides appropriate values for the resources to be enforced.

If the PCEF performs the bearer binding, the authorized QoS for a PCC rule is a request for allocating the corresponding resources. The authorized QoS per IP CAN bearer is not applicable.

If the PCRF performs the bearer binding, the authorized QoS per IP CAN bearer presents the QoS for this IP CAN bearer.

The Provisioning of authorized QoS per IP CAN bearer may be performed separate or in combination with the PCC rule provisioning procedure in Clause 4.5.2. The Provisioning of authorized QoS per PCC rule is a part of PCC rule provisioning procedure.

If the PCEF cannot allocate any of the resources as authorized by the PCRF, the PCEF should inform the PCRF using the Event-Trigger AVP with the corresponding value.

The PCEF is responsible for enforcing the policy based authorization.

#### 4.5.5.0a Provisioning of "Authorized QoS" per IP CAN Bearer

The authorized QoS per IP-CAN bearer is used if the bearer binding is performed by the PCRF (as defined in [8]).

The PCEF will request the authorization of an IP CAN bearer establishment or modification by the PCRF using the "Request for PCC rules" procedure if the related conditions outlined in Clause 4.5.1 apply. While executing this procedure, the PCEF shall apply the following QoS related procedures:

- When the UE request the establishment of a new IP-CAN bearer, the PCEF shall derive the requested QoS information and shall request a new PCC decisions using a CCR command including the requested QoS information within the QoS-Information AVP, in the CCR command to be sent to the PCRF. For GPRS, the PCEF shall use Table 5.3.17 to map the requested QoS within the IP CAN bearer establishment request to the QoS-Information AVP. The PCEF shall then wait for the corresponding CCA before replying to the IP-CAN bearer establishment request.
- If at any point of time the PCEF receives a request for a modification of an already existing IP-CAN bearer that matches event triggers supplied by the PCRF for the IP CAN session, the PCEF shall also request a new PCC decisions using a CCR command including the corresponding event triggers in the Event-Trigger AVP. If a QoS change for the existing IP-CAN bearer is requested the PCEF shall include the requested QoS information within



the QoS-Information AVP in the CCR. For GPRS, the PCEF shall use Table 5.3.17 to map the requested QoS within the IP CAN bearer modification request to the QoS-Information AVP. The PCEF shall wait for the corresponding CCA before replying to the IP-CAN bearer modification request.

When receiving a CCR with a QoS-Information AVP, the PCRF shall decide upon the requested QoS information within the CCR command. The PCRF may compare the authorized QoS derived according to Clause 6.3 of 3GPP TS 29.213 with the requested QoS. If the requested QoS is less than the authorised QoS, the PCRF may either request to upgrade the IP CAN QoS by supplying that authorised QoS in the QoS-Information AVP to the PCEF (e.g. if the PCRF has exact knowledge of the required QoS for the corresponding service), or the PCRF may only authorise the requested QoS by supplying the requested QoS in the QoS-Information AVP to the PCEF (e.g. if the PCRF only derives upper limits for the authorized QoS for the corresponding service). The PCRF shall provide a response for the CCR to the PCEF by issuing a CCA command. The PCRF may use this CCA at the same time for the solicited PCC rule provisioning procedure in Clause 4.5.2. The CCA command shall include a QoS-Information AVP at command level including the Bearer-Identifier AVP used in the corresponding CCR and the authorized QCI and bitrates.

The PCRF may also decide to modify the authorized QoS per IP CAN bearer if it receives a CCR with other event triggers, for instance if the PCRF moves PCC rules from one IP-CAN bearer to another (e.g. in GPRS due to a TFT change). The PCRF shall then provision the updated authorized QoS per IP CAN bearer in the CCA within a QoS-Information AVP at command level including the corresponding Bearer-Identifier AVP.

The PCRF may decide to modify the authorized QoS per IP CAN bearer at any time. The PCRF shall then send an unsolicited authorization to the PCEF. The unsolicited authorization is performed by sending a RAR command to the PCEF and including the QoS-Information AVP with the new authorized values per IP CAN bearer. The PCRF may use this RAR at the same time for the unsolicited PCC rule provisioning procedure in Clause 4.5.2. If the trigger to modify the authorized QoS comes from the AF, before starting an unsolicited provisioning, the PCRF may start a timer to wait for a UE requested corresponding PDP context modification. At the expiry of the timer, if no PCC rule request has previously been received by the PCRF, the PCRF should go on with the unsolicited authorization as explained above.

In addition to a provisioning of the "Authorized QoS" per IP CAN Bearer, the PCRF may also provide an authorized QoS per PCC rule.

#### 4.5.5.1 Policy enforcement for "Authorized QoS" per IP CAN Bearer

The PCEF is responsible for enforcing the policy based authorization, i.e. to ensure that the requested QoS is in-line with the "Authorized QoS" per IP CAN Bearer.

For GPRS, upon reception of an authorized QoS per IP-CAN bearer within a CCA or RAR command, the PCEF shall perform the mapping from that "Authorised QoS" information for the IP-CAN bearer into authorised UMTS QoS information according to Table 5.3.17.1. The authorised UMTS QoS information is further processed by the UMTS BS Manager within the GGSN.

If the PCEF receives a solicited authorization decision from the PCRF (i.e. a decision within a CCA) and the requested QoS received within the IP-CAN bearer establishment or modification request that triggered the corresponding request for the authorization decision does not match the authorised QoS, the PCEF shall adjust the requested QoS information to the authorised QoS information within the IP-CAN bearer establishment or modification response.

The PCEF may store the authorized QoS of an active IP-CAN bearer in order to be able to make local decisions, when the UE requests for an IP-CAN bearer modification.

When the PCEF receives an unsolicited authorisation decision from the PCRF (i.e. a decision within a RAR) with updated QoS information for an IP-CAN bearer, the PCEF shall update the stored authorised QoS. If the existing QoS of the IP-CAN bearer does not match the updated authorised QoS the PCEF shall perform a network initiated IP-CAN bearer modification to adjust the QoS to the authorised level.

If the PCEF provide authorized QoS for both, the IP-CAN bearer and PCC rule(s), the enforcement of authorized QoS of the individual PCC rules shall take place first.

#### 4.5.5.2 Policy provisioning for authorized QoS per service data flow

The Provisioning of authorized QoS per service data flow is a part of PCC rule provisioning procedure, as described in Clause 4.5.2.

If the PCRF performs the bearer binding for a service data flow, the PCRF may optionally provision an authorized QoS for that service data flow. If the PCEF performs the bearer binding for a service data flow, the PCRF shall provision an authorized QoS for that service data flow.

The authorized QoS per service data flow shall be provisioned within the corresponding PCC rule by including the QoS-Information AVP within the Charging-Rule-Definition AVP in the CCA or RAR commands. This QoS-Information AVP shall not contain a Bearer-Identifier AVP.

#### 4.5.5.3 Policy enforcement for authorized QoS per service data flow

If an authorized QoS is defined for a PCC rule, the PCEF shall limit the data rate of the service data flow corresponding to that PCC rule not to exceed the maximum requested bandwidth for the PCC rule by discarding packets exceeding the limit.

If the PCEF performs the bearer binding, the PCEF shall reserve the resources necessary for the guaranteed bitrate for the PCC rule upon receipt of a PCC rule provisioning including QoS information. The access-specific BS Manager (as included in [8]) within the PCEF receives the authorised access-specific QoS information from the Translation/mapping function. For GPRS, the mapping from the authorized QoS parameters to the UMTS QoS parameters shall be performed according to Table 5.3.17. Then the PCEF should start the needed procedures to ensure that the enforcement is according to the authorized values. This may imply e.g. for GPRS that the PCEF needs to request the establishment of new IP CAN bearer(s) or the modification of existing IP CAN bearer(s).

Upon deactivation or removal of a PCC rule, the PCEF shall free the resources reserved for that PCC rule.

If the PCRF provides authorized QoS for both, the IP-CAN bearer and PCC rule(s), the enforcement of authorized QoS of the individual PCC rules shall take place first.

#### 4.5.5.4 Coordination of authorized QoS scopes in mixed mode

For mixed mode the PCEF will request the authorization of an IP CAN bearer establishment or modification by the PCRF using the "Request for PCC rules" procedure if the related conditions outlined in Clause 4.5.1 apply. The PCEF shall then subtract the guaranteed bitrate for the PCC rule it has bound to that IP CAN bearer from the requested QoS of that IP CAN bearer and request the authorization of the remaining QoS from the PCRF within the QoS-Information AVP.

The PCRF shall authorize the bandwidth for an IP CAN bearer which is required for the PCC rules it has bound to this IP CAN bearer. The PCEF shall add to the PCRF-provisioned authorized bandwidth of an IP CAN bearer the required bandwidth of all PCC rules it has bound to that IP CAN bearer.

### 4.5.6 Indication of IP-CAN Bearer Termination Implications

If the last IP CAN bearer within an IP CAN session is being terminated, the PCEF shall apply the procedures in clause 4.5.7 to indicate the IP CAN session termination.

Otherwise, the PCRF shall apply the "Indication of IP CAN Bearer Termination Implications" procedure to inform the PCEF about implications of this bearer termination if any of the following conditions apply while the IP-CAN Session remains active:

- For GPRS, a PDP context is terminated, which has been initiated by the UE.
- PCC rule(s) are disabled due to the termination of the IP CAN bearer.

**Editor's Note: It is ffs if the indication of bearer termination is also applicable if the provisioned total QoS is reduced compared to what has been provisioned in the Authorized-QoS AVP on session level.**

The "Indication of IP-CAN Bearer Termination Implications" procedure shall be carried out as part of a Request for PCC rules at IP-CAN session modification. The PCEF shall send a CC-Request with CC-Request-Type AVP set to the value "UPDATE\_REQUEST" and shall include the following additional information:

- The PCEF shall include the Charging-Rule-Report AVP with the PCC-Rule-Status set to inactive for the affected PCC rules.

- For GPRS, when the PCRF performs bearer binding, the PCEF shall also supply the Bearer-Identifier and Bearer-Operation AVPs to indicate "Termination" of a specific bearer.

When the PCRF receives the CC-Request indicating the implications of a bearer termination, it shall acknowledge the message by sending a CC-Answer to the PCEF. The PCRF has the option to make a new PCC decision for the affected PCC Rules. Within the CC-answer, the PCRF may provision PCC rules as detailed in clause 4.5.2, e.g. to move PCC rules previously applied to the terminated IP CAN bearer to any of the remaining IP CAN bearer(s).

The PCEF shall remove all PCC rules previously applied to the terminated IP CAN bearer, which have not been moved.

Signalling flows for the IP-CAN bearer termination and details of the binding mechanism are presented in 3GPP TS 29.213 [8].

#### 4.5.7 Indication of IP-CAN Session Termination

The PCEF shall contact the PCRF when the IP-CAN session is being terminated (e.g. for GPRS when the last PDP Context within the IP-CAN session is being terminated). The PCEF shall send a CC-Request with CC-Request-Type AVP set to the value "TERMINATION\_REQUEST".

When the PCRF receives the CC-Request, it shall acknowledge this message by sending a CC-Answer to the PCEF.

NOTE: According to DCC procedures, the Diameter Credit Control session is being terminated with this message exchange.

Signalling flows for the IP-CAN session termination are presented in 3GPP TS 29.213 [8].

#### 4.5.8 Request of IP-CAN Bearer Termination

If the termination of the last IP CAN bearer within an IP CAN session is requested, the PCRF and PCEF shall apply the procedures in clause 4.5.9.

Otherwise, the PCRF may request the termination of an existing IP CAN bearer within an IP CAN session by using the PCC rule provisioning procedures in clause 4.5.2 to remove all PCRF-provisioned PCC rules and deactivate all PCC rules predefined within the PCEF, which have been applied to this IP CAN bearer. The PCRF may either completely remove these PCC rules from the IP CAN session or move them to another IP CAN bearer within the IP CAN session.

If the selected Bearer Control Mode (BCM) is UE-only, and the PCRF receives a trigger for the removal of all PCC rules bound to an IP CAN bearer from the AF, the following steps apply. In order to avoid race conditions, the PCRF should start a timer to wait for the UE-initiated termination message. If a UE-initiated termination of an IP CAN bearer is performed before timer expiry, the PCRF will receive an Indication of IP-CAN Bearer Termination Implications according to Clause 4.5.6 and shall then not perform the network-initiated termination of that IP CAN bearer. Otherwise, if the timer expires, the PCRF shall remove/deactivate all the PCC rules that have been previously installed/activated for that IP-CAN bearer.

If the selected BCM is UE-only, and the PCRF decides to remove all PCC rules bound to an IP CAN bearer due to an internal trigger or trigger from the SPR, the PCRF shall instantly remove/deactivate all the PCC rules that have been previously installed/activated on that IP-CAN bearer.

If the selected BCM is NW-only, and the PCRF removes/deactivates at the PCEF, all PCC rules bound to an IP CAN bearer (due to any trigger), the PCEF shall instantly start the procedures to terminate the related IP-CAN bearer.

NOTE: If the PCEF performs the IP CAN bearer binding, the PCRF may not be aware that it requests the termination of an IP CAN bearer by removing certain PCC rules. Further details of the binding mechanism can be found in 3GPP TS 29.213 [8].

If no more PCC rules are applied to an IP CAN bearer, the PCEF shall apply IP CAN specific procedures to terminate the IP CAN bearer, if such procedures exist for this IP CAN type. For GPRS, the GGSN shall send a PDP context deactivation request. Furthermore, the PCEF shall apply the indication of IP CAN Bearer Termination procedure in clause 4.5.6.

## 4.5.9 Request of IP-CAN Session Termination

The PCRF may request the termination of an IP CAN session by using the PCC rule provisioning procedures in clause 4.5.2 to remove all PCRF-provisioned PCC rules and deactivate all PCC rules predefined within the PCEF, which have been applied to this IP CAN session.

If the selected Bearer Control Mode (BCM) is UE-only, and the PCRF receives a trigger for the removal of all PCC rules bound to an IP CAN session from the AF, the following steps apply. In order to avoid race conditions, the PCRF should start a timer to wait for the UE-initiated termination message. If a UE-initiated termination of an IP CAN session is performed before timer expiry, the PCRF will receive an Indication of IP-CAN Session Termination according to Clause 4.5.7 and shall then not perform the network-initiated termination of that IP CAN session. Otherwise, if the timer expires, the PCRF shall remove/deactivate all the PCC rules that have been previously installed or activated for that IP-CAN session.

If the selected BCM is UE-only, and the PCRF decides to remove all PCC rules bound to an IP CAN session due to an internal trigger or trigger from the SPR, the PCRF shall instantly remove/deactivate all the PCC rules that have been previously installed or activated on that IP-CAN session.

If the selected BCM is NW-only, and the PCRF decides to remove all PCC rules bound to an IP CAN session (due to any trigger), the PCRF shall instantly remove/deactivate all the PCC rules that have been previously installed or activated on that IP-CAN session.

If no more PCC rules are applied to an IP CAN session, the PCEF shall apply IP CAN specific procedures to terminate the IP CAN session. For GPRS, the GGSN shall send a PDP context deactivation request with the teardown indicator set to indicate that the termination of the entire PDP session is requested. Furthermore, the PCEF shall apply the indication of IP CAN Session Termination procedure in clause 4.5.7.

## 4.5.10 Bearer Control Mode Selection

The PCEF may indicate, via the Gx reference point, a request for Bearer Control Mode (BCM) selection at IP-CAN session establishment or IP-CAN session modification (as a consequence of an SGSN change). It will be done using the PCC rule request procedure.

The PCEF will supply, if available, the Bearer-Control-Mode AVP and the Network-Request-Support AVP in the CC-Request with a CC-Request-Type AVP set to the value 'INITIAL\_REQUEST'. The Network-Request-Support AVP indicates the access network support of the network requested bearer control.

For GPRS, the GGSN shall only include the Network-Request-Support AVP if it supports this procedure and both the UE and the SGSN has previously indicated to the GGSN that they also support it. The Bearer-Control-Mode AVP shall be included if the GGSN received it from the SGSN.

The PCRF derives the Selected Bearer-Control-Mode AVP based on the received Network-Request-Support AVP, the Bearer-Control-Mode AVP, access network information, subscriber information and operator policy. The Selected Bearer-Control-Mode AVP shall be provided to the PCEF using the PCC Rules provision procedure at IP-CAN session establishment. The PCEF should forward it to the UE. The selected value will be applicable for the whole IP-CAN session (in GPRS, it is applicable to all PDP Contexts within the activated PDP Address/APN pair).

The BCM selection procedure can also be triggered as a consequence of a change of SGSN.

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# 5 Gx protocol

## 5.1 Protocol support

The Gx protocol in the present release is based on Gx protocol defined for Release 6 as specified in 3GPP TS 29.210 [2]. However, due to a new paradigm (DCC session for an IP-CAN session) between Release 6 and the present release, the Gx application in the present release has an own vendor specific Diameter application.

The Gx application is defined as a vendor specific Diameter application, where the vendor is 3GPP and the Application-ID for the Gx Application in the present release is xxxxxxxx. The vendor identifier assigned by IANA to 3GPP (<http://www.iana.org/assignments/enterprise-numbers>) is 10415.

NOTE: A route entry can have a different destination based on the application identification AVP of the message. Therefore, Diameter agents (relay, proxy, redirection, translation agents) must be configured appropriately to identify the 3GPP Gx application within the Auth-Application-Id AVP in order to create suitable routing tables.

**Editor's note:** Following text may need to be added if IETF does not solve the Auth-Application AVP problem by the time this application is approved:

**Due to the definition of the commands used in Gx protocol, there is no possibility to skip the Auth-Application-Id AVP and use the Vendor-Specific-Application-Id AVP instead. Therefore the Gx application identification shall be included in the Auth-Application-Id AVP.**

With regard to the Diameter protocol defined over the Gx interface, the PCRF acts as a Diameter server, in the sense that it is the network element that handles PCC Rule requests for a particular realm. The PCEF acts as the Diameter client, in the sense that it is the network element requesting PCC rules in the transport plane network resources.

## 5.2 Initialization, maintenance and termination of connection and session

The initialization and maintenance of the connection between each PCRF and PCEF pair is defined by the underlying protocol. Establishment and maintenance of connections between Diameter nodes is described in RFC 3588 [5].

After establishing the transport connection, the PCRF and the PCEF shall advertise the support of the Gx specific Application by including the value of the application identifier in the Auth-Application-Id AVP and the value of the 3GPP (10415) in the Vendor-Id AVP of the Vendor-Specific-Application-Id AVP contained in the Capabilities-Exchange-Request and Capabilities-Exchange-Answer commands. The Capabilities-Exchange-Request and Capabilities-Exchange-Answer commands are specified in the Diameter Base Protocol (RFC 3588 [5]).

The termination of the Diameter user session is specified in RFC 3588 [5] in clauses 8.4 and 8.5. The description of how to use of these termination procedures in the normal cases is embedded in the procedures description.

## 5.3 Gx specific AVPs

Table 5.3.1 describes the Diameter AVPs defined for the Gx reference point, 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 the present document shall be set to 3GPP (10415).

Table 5.3.1: Gx specific Diameter AVPs

Attribute Name	AVP Code	Clause defined	Value Type (note 2)	AVP Flag rules (note 1)				May Encr.	Acc. type
				Must	May	Should not	Must not		
Access-Network-Charging-Identifier-Gx	1022	5.3.22	Grouped	M,V	P			Y	All
Bearer-Control-Mode	1023	5.3.23	Enumerated	M,V	P			Y	All
Bearer-Identifier	1020	5.3.20	OctetString	M,V	P			Y	GPRS
Bearer-Operation	1021	5.3.21	Enumerated	M,V	P			Y	GPRS
Bearer-Usage	1000	5.3.1	Enumerated	M,V	P			Y	FFS
Charging-Rule-Install	1001	5.3.2	Grouped	M,V	P			Y	All
Charging-Rule-Remove	1002	5.3.3	Grouped	M,V	P			Y	All
Charging-Rule-Definition	1003	5.3.4	Grouped	M,V	P			Y	All
Charging-Rule-Base-Name	1004	5.3.5	UTF8String	M,V	P			Y	All
Charging-Rule-Name	1005	5.3.6	OctetString	M,V	P			Y	All
Charging-Rule-Report	1018	5.3.18	Grouped	M,V	P			Y	All
Event-Trigger	1006	5.3.7	Enumerated	M,V	P			Y	All
IP-CAN-Type	1027	5.3.27	Enumerated	M, V	P			Y	All
Guaranteed-Bitrate-DL	1025	5.3.25	Unsigned32	M,V	P			Y	All
Guaranteed-Bitrate-UL	1026	5.3.26	Unsigned32	M,V	P			Y	All
Metering-Method	1007	5.3.8	Enumerated	M,V	P			Y	All
Network-Request-Support	1024	5.3.24	Enumerated	M, V	P			Y	All
Offline	1008	5.3.9	Enumerated	M,V	P			Y	All
Online	1009	5.3.10	Enumerated	M,V	P			Y	All
Precedence	1010	5.3.11	Unsigned32	M,V	P			Y	All
Reporting-Level	1011	5.3.12	Enumerated	M,V	P			Y	All
PCC-Rule-Status	1019	5.3.19	Enumerated	M,V	P			Y	All
QoS-Class-Identifier	1028	5.3.17	Enumerated	M,V	P			Y	All
QoS_Information	1016	5.3.16	Grouped	M,V	P			Y	All
TFT-Filter	1012	5.3.13	IPFilterRule	M,V	P			Y	GPRS
TFT-Packet-Filter-Information	1013	5.3.14	Grouped	M,V	P			Y	GPRS
ToS-Traffic-Class	1014	5.3.15	OctetString	M,V	P			Y	GPRS
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 RFC 3588 [4].									
NOTE 2: The value types are defined in RFC 3588 [4].									

### 5.3.1 Bearer-Usage AVP (Applicable access type ffs)

The Bearer-Usage AVP (AVP code 1000) is of type Enumerated, and it shall indicate how the bearer is being used. If the Bearer-Usage AVP has not been previously provided, its absence shall indicate that no specific information is available. If the Bearer-Usage AVP has been provided, its value shall remain valid until it is provided the next time. The following values are defined:

#### GENERAL (0)

This value shall indicate no specific bearer usage information is available.

#### IMS\_SIGNALLING (1)

This value shall indicate that the bearer is used for IMS signalling only.

**Editor's Note:** It is for further study for what access types this AVP applies.

### 5.3.2 Charging-Rule-Install AVP (All access types)

The Charging-Rule-Install AVP (AVP code 1001) is of type Grouped, and it is used to activate, install or modify PCC rules as instructed from the PCRF to the PCEF.

For installing a new PCC rule or modifying a PCC rule already installed, Charging-Rule-Name AVP and Charging-Rule-Definition AVP shall be used.

For activating a specific PCC rule predefined at the PCEF, Charging-Rule-Name AVP shall be used as a reference for that PCC rule. The Charging-Rule-Base-Name AVP is a reference that may be used for activating a group of PCC rules predefined at the PCEF.

For GPRS scenarios where the bearer binding is performed by the PCRF, the Bearer Identifier AVP shall be included as part of Charging-Rule-Install AVP.

If present within Charging-Rule-Install AVP, the Bearer-Identifier AVP indicates that the PCC rules within this Charging-Rule-Install AVP shall be installed or activated within the IP CAN bearer identified by the Bearer-Identifier AVP.

If no Bearer-Identifier AVP is included within the Charging-Rule-Install AVP, the PCEF shall select an IP CAN bearer for each of the PCC rules within this Charging-Rule-Install AVP, were the PCC rule is installed or activated.

AVP Format:

```
Charging-Rule-Install ::= < AVP Header: 1001 >
    * [ Charging-Rule-Definition ]
    * [ Charging-Rule-Name ]
    * [ Charging-Rule-Base-Name ]
    [ Bearer-Identifier ]
    * [ AVP ]
```

### 5.3.3 Charging-Rule-Remove AVP (All access types)

The Charging-Rule-Remove AVP (AVP code 1002) is of type Grouped, and it is used to deactivate or remove PCC rules from an IP CAN session.

Charging-Rule-Name AVP is a reference for a specific PCC rule at the PCEF to be removed or for a specific PCC rule predefined at the PCEF to be deactivated. The Charging-Rule-Base-Name AVP is a reference for a group of PCC rules predefined at the PCEF to be deactivated.

AVP Format:

```
Charging-Rule-Remove ::= < AVP Header: 1002 >
    * [ Charging-Rule-Name ]
    * [ Charging-Rule-Base-Name ]
    * [ AVP ]
```

### 5.3.4 Charging-Rule-Definition AVP (All access types)

The Charging-Rule-Definition AVP (AVP code 1003) is of type Grouped, and it defines the PCC rule for a service flow sent by the PCRF to the PCEF. The Charging-Rule-Name AVP uniquely identifies the PCC rule and it is used to reference to a PCC rule in communication between the PCEF and the PCRF within one IP CAN session. The Flow-Description AVP(s) determines the traffic that belongs to the service flow.

If optional AVP(s) within a Charging-Rule-Definition AVP are omitted, but corresponding information has been provided in previous Gx messages, the previous information remains valid. If Flow-Description AVP(s) are supplied, they replace all previous Flow-Description AVP(s). If Flows AVP(s) are supplied, they replace all previous Flows AVP(s).

Flows AVP may appear if and only if AF-Charging-Identifier AVP is also present.

AVP Format:

```
Charging-Rule-Definition ::= < AVP Header: 1003 >
    { Charging-Rule-Name }
    [ Service-Identifier ]
    [ Rating-Group ]
    * [ Flow-Description ]
    [ Flow-Status ]
    [ QoS-Information ]
    [ Reporting-Level ]
    [ Online ]
    [ Offline ]
    [ Metering-Method ]
    [ Precedence ]
    [ AF-Charging-Identifier ]
```

\* [ Flows ]  
\* [ AVP ]

### 5.3.5 Charging-Rule-Base-Name AVP (All access types)

The Charging-Rule-Base-Name AVP (AVP code 1004) is of type UTF8String, and it indicates the name of a pre-defined group of PCC rules residing at the PCEF.

### 5.3.6 Charging-Rule-Name AVP (All access types)

The Charging-Rule-Name AVP (AVP code 1005) is of type OctetString, and it defines a name for PCC rule. For PCC rules provided by the PCRF it uniquely identifies a PCC rule within one IP CAN session. For PCC rules pre-defined at the PCEF it uniquely identifies a PCC rule within the PCEF.

### 5.3.7 Event-Trigger AVP (All access types)

The Event-Trigger AVP (AVP code 1006) is of type Enumerated. When sent from the PCRF to the PCEF the Event-Trigger AVP indicates an event that shall cause a re-request of PCC rules. When sent from the PCEF to the PCRF the Event-Trigger AVP indicates that the corresponding event has occurred at the gateway.

NOTE: An exception to the above is the Event Trigger AVP set to NOT\_EVENT\_TRIGGERS, that indicates that PCEF shall not notify PCRF of any event.

Whenever one of these events occurs, the PCEF shall send the related AVP that has changed together with the event trigger indication.

Unless stated for a specific value, the Event-Trigger AVP applies to all access types.

The following values are defined:

#### SGSN\_CHANGE (0)

This value shall be used in CCA and RAR commands by the PCRF to indicate that upon the change of the serving SGSN PCC rules shall be requested. When used in a CCR command, this value indicates that the PCEF generated the request because the serving SGSN changed. The new value of the serving SGSN shall be indicated in either 3GPP-SGSN-Address AVP or 3GPP-SGSN-IPv6-Address AVP. Applicable only for GPRS.

#### QOS\_CHANGE (1)

This value shall be used in CCA and RAR commands by the PCRF to indicate that upon any QoS change (even within the limits of the current authorization) at bearer level PCC rules shall be requested. When used in a CCR command, this value indicates that the PCEF generated the request because there has been a change in the requested QoS for a specific bearer (e.g. the previously maximum authorized QoS has been exceeded). The Bearer-Identifier AVP has to be provided to indicate the affected bearer. QoS-Information AVP is required to be provided in the same request with the new value.

#### RAT\_CHANGE (2)

This value shall be used in CCA and RAR commands by the PCRF to indicate that upon a RAT change PCC rules shall be requested. When used in a CCR command, this value indicates that the PCEF generated the request because of a RAT change. The new RAT type shall be provided in the 3GPP-RAT-Type AVP. Applicable only for GPRS.

#### TFT\_CHANGE (3)

This value shall be used in CCA and RAR commands by the PCRF to indicate that upon a TFT change at bearer level PCC rules shall be requested. When used in a CCR command, this value indicates that the PCEF generated the request because of a change in the TFT. The Bearer-Identifier AVP has to be provided to indicate the affected bearer. The new TFT values shall be provided in TFT-Packet-Filter-Information AVP. Applicable only for GPRS.

#### PLMN\_CHANGE (4)



This value shall be used in CCA and RAR commands by the PCRF to indicate that upon a PLMN change PCC rules shall be requested. When used in a CCR command, this value indicates that the PCEF generated the request because there was a change of PLMN. 3GPP-SGSN-MCC-MNC AVP shall be provided in the same request with the new value. Applicable only for GPRS.

#### LOSS\_OF\_BEARER (5)

This value shall be used in CCA and RAR commands by the PCRF to indicate that upon loss of bearer, GW should inform PCRF. When used in a CCR command, this value indicates that the PCEF generated the request because the bearer associated with the PCC rules indicated by the corresponding Charging Rule Report AVP was lost. The PCC-Rule-Status AVP within the Charging Rule Report AVP shall indicate that these PCC rules are temporary inactive. Applicable for those access-types that handle multiple bearers within one single IP-CAN session (e.g. GPRS).

The mechanism of indicating loss of bearer to the GW is IP-CAN access type specific. For GPRS, this is indicated by a PDP context modification request with Maximum Bit Rate (MBR) in QoS profile changed to 0 kbps.

When the PCRF performs the bearer binding, the PCEF may provide the Bearer-Identifier AVP to indicate the bearer that has been lost.

#### RECOVERY\_OF\_BEARER (6)

This value shall be in CCA and RAR commands by the PCRF used to indicate that upon recovery of bearer, GW should inform PCRF. When used in a CCR command, this value indicates that the PCEF generated the request because the bearer associated with the PCC rules indicated by the corresponding Charging Rule Report AVP was recovered. The PCC-Rule-Status AVP within the Charging Rule Report AVP shall indicate that these rules are active again. Applicable for those access-types that handle multiple bearers within one single IP-CAN session (e.g. GPRS).

The mechanism for indicating recovery of bearer to the GW is IP-CAN access type specific. For GPRS, this is indicated by a PDP context modification request with Maximum Bit Rate (MBR) in QoS profile changed from 0 kbps to a valid value.

When the PCRF performs the bearer binding, the PCEF may provide the Bearer-Identifier AVP to indicate the bearer that has been recovered.

#### IP-CAN\_CHANGE (7)

This value shall be used in CCA and RAR commands by the PCRF to indicate that upon a change in the IP-CAN type PCC rules shall be requested. When used in a CCR command, this value indicates that the PCEF generated the request because there was a change of IP-CAN type.

#### GW/PCEF\_MALFUNCTION (8)

This value shall be used in CCA and RAR commands by the PCRF to indicate that upon a failure in the enforcement of PCC rules due to GW/PCEF malfunction, the PCEF shall inform the PCRF.

When used in a CCR command, this value indicates that the PCEF generated the request due to a malfunction in the PCEF the PCC rules cannot be enforced. The affected PCC rules will be provided in the Charging-Rule-Report AVP. When PCRF performs the bearer binding, absence of the Charging-Rule-Report AVP means that all provided PCC rules for that specific bearer are affected.

#### RESOURCES\_LIMITATION (9)

This value shall be used in CCA and RAR commands by the PCRF to indicate that upon a failure to provide the required resource for the service flows described by the PCC rules, the PCEF shall inform the PCRF.

When used in a CCR command, this value indicates that the PCEF generated the request because of resource limitation. The affected PCC rules will be provided in the Charging-Rule-Report AVP. When the PCRF performs the bearer binding, the PCEF may provide the Bearer-Identifier for the affected bearer. In this case, absence of the Charging-Rule-Report AVP means that all provided PCC rules for that specific bearer are affected.

#### MAX\_NR\_BEARERS\_REACHED (10)

This value shall be used in CCA and RAR commands by the PCRF to subscribe to this event. If the PCRF subscribes to this event, the PCEF shall inform the PCRF whenever a failure in the enforcement of PCC rules occurs due to the maximum number of bearer have been reached for the IP-CAN session, PCEF shall inform PCRF.

When used in a CCR command, this value indicates that the PCEF generated the request because the PCC rules cannot be enforced since the IP-CAN session already contains the maximum number of bearers allowed. The affected PCC rules will be provided in the Charging-Rule-Report AVP.

#### QOS\_CHANGE\_EXCEEDING\_AUTHORIZATION (11)

This value shall be used in CCA and RAR commands by the PCRF to indicate that only upon a requested QoS change beyond the current authorized value(s) at bearer level PCC rules shall be requested. When used in a CCR command, this value indicates that the PCEF generated the request because there has been a change in the requested QoS beyond the authorized value(s) for a specific bearer. The Bearer-Identifier AVP has to be provided to indicate the affected bearer. QoS-Information AVP is required to be provided in the same request with the new value.

#### NO\_EVENT\_TRIGGER (12)

This value shall be used in CCA and RAR commands by the PCRF to indicate that PCRF does not require any Event Trigger notification.

### 5.3.8 Metering-Method AVP (All access types)

The Metering-Method AVP (AVP code 1007) is of type Enumerated, and it defines what parameters shall be metered for offline charging. The following values are defined:

#### DURATION (0)

This value shall be used to indicate that the duration of the service flow shall be metered.

#### VOLUME (1)

This value shall be used to indicate that volume of the service flow traffic shall be metered.

#### DURATION\_VOLUME (2)

This value shall be used to indicate that the duration and the volume of the service flow traffic shall be metered.

If the Metering-Method AVP is omitted but has been supplied previously, the previous information remains valid. If the Metering-Method AVP is omitted and has not been supplied previously, the metering method pre-configured at the PCEF is applicable as default metering method.

### 5.3.9 Offline AVP (All access types)

The Offline AVP (AVP code 1008) is of type Enumerated.

If the Offline AVP is embedded within a Charging\_Rule-Definition AVP it defines whether the offline charging interface from the PCEF for the associated PCC rule shall be enabled. The absence of this AVP within the first provisioning of the Charging-Rule-definition AVP of a new PCC rule indicates that the default charging method for offline shall be used.

If the Offline AVP is embedded within the initial CCA on command level, it indicates the default charging method for offline. The absence of this AVP within the initial CCA indicates that the charging method for offline pre-configured at the PCEF is applicable as default charging method for offline.

The following values are defined:

#### DISABLE\_OFFLINE (0)

This value shall be used to indicate that the offline charging interface for the associated PCC rule shall be disabled.

#### ENABLE\_OFFLINE (1)

This value shall be used to indicate that the offline charging interface for the associated PCC rule shall be enabled.

### 5.3.10 Online AVP (All access types)

The Online AVP (AVP code 1009) is of type Enumerated.

If the Online AVP is embedded within a Charging\_Rule-Definition AVP, it defines whether the online charging interface from the PCEF for the associated PCC rule shall be enabled. The absence of this AVP within the first provisioning of the Charging-Rule-Definition AVP of a new PCC rule indicates that the default charging method for online shall be used.

If the Online AVP is embedded within the initial CCA on command level, it indicates the default charging method for online. The absence of this AVP within the initial CCA indicates that the charging method for online pre-configured at the PCEF is applicable as default charging method for online.

The following values are defined:

DISABLE\_ONLINE (0)

This value shall be used to indicate that the online charging interface for the associated PCC rule shall be disabled.

ENABLE\_ONLINE (1)

This value shall be used to indicate that the online charging interface for the associated PCC rule shall be enabled.

### 5.3.11 Precedence AVP (All access types)

The Precedence AVP (AVP code 1010) is of type Unsigned32.

Within the Charging Rule Definition AVP, the Precedence AVP determines the order, in which the service data flow templates are applied at service data flow detection at the PCEF. A PCC rule with the Precedence AVP with lower value shall be applied before a PCC rule with the Precedence AVP with higher value.

The Precedence AVP is also used within the TFT-Packet-Filter-Information AVP to indicate the evaluation precedence of the Traffic Mapping Information filters (for GPRS the TFT packet filters) as received from the UE. The PCEF shall assign a lower value in the corresponding Precedence AVP to a Traffic Mapping Information filter with a higher evaluation precedence than to a Traffic Mapping Information filter with a lower evaluation precedence.

### 5.3.12 Reporting-Level AVP (All access types)

The Reporting-Level AVP (AVP code 1011) is of type Enumerated, and it defines on what level the PCEF reports the usage for the related PCC rule. The following values are defined:

SERVICE\_IDENTIFIER\_LEVEL (0)

This value shall be used to indicate that the usage shall be reported on service id and rating group combination level.

RATING\_GROUP\_LEVEL (1)

This value shall be used to indicate that the usage shall be reported on rating group level.

If the Reporting-Level AVP is omitted but has been supplied previously, the previous information remains valid. If the Reporting-Level AVP is omitted and has not been supplied previously, the reporting level pre-configured at the PCEF is applicable as default reporting level.

### 5.3.13 TFT-Filter AVP (GPRS access type only)

The TFT-Filter AVP (AVP code 1012) is of type IPFilterRule, and it contains the flow filter for one TFT packet filter. The TFT-Filter AVP is derived from the Traffic Flow Template (TFT) defined in 3GPP TS 24.008 [13]. The following information shall be sent:

- Action shall be set to "permit".

- Direction shall be set to "out".
- Protocol shall be set to the value provided within the TFT packet filter parameter "Protocol Identifier/Next Header Type". If the TFT packet filter parameter "Protocol Identifier/Next Header Type" is not provided within the TFT packet filter, Protocol shall be set to "ip".
- Source IP address (possibly masked). The source IP address shall be derived from TFT packet filter parameters "Source address" and "Subnet Mask". The source IP address shall be set to "any", if no such information is provided in the TFT packet filter.
- Source and destination port (single value, list or ranges). The information shall be derived from the corresponding TFT packet filter parameters. Source and/or destination port(s) shall be omitted if such information is not provided in the TFT packet filter.
- The Destination IP address shall be set to "assigned".

The IPFilterRule type shall be used with the following restrictions:

- No options shall be used.
- The invert modifier "!" for addresses shall not be used.

The direction "out" refers to downlink direction.

### 5.3.14 TFT-Packet-Filter-Information AVP (GPRS access type only)

The TFT-Packet-Filter-Information AVP (AVP code 1013) is of type Grouped, and it contains the information from a single TFT packet filter including the evaluation precedence, the filter and the Type-of-Service/Traffic Class sent from the PCEF to the PCRF. The PCEF shall include one TFT-Packet-Filter-Information AVP for each TFT packet filters applicable at a PDP context in separate TFT-Packet-Filter-Information AVPs within each PCC rule request, corresponding to that PDP context. TFT-Packet-Filter-Information AVPs are derived from the Traffic Flow Template (TFT) defined in 3GPP TS 24.008 [13].

AVP Format:

```
TFT-Packet-Filter-Information ::= < AVP Header: 1013 >
    [ Precedence ]
    [ TFT-Filter ]
    [ ToS-Traffic-Class ]
```

### 5.3.15 ToS-Traffic-Class AVP (GPRS access type only)

The ToS-Traffic-Class AVP (AVP code 1014) is of type OctetString, and it contains the Type-of-Service/Traffic-Class of a TFT packet filter as defined in 3GPP TS 24.008 [13].

### 5.3.16 QoS-Information AVP (All access types)

The QoS-Information AVP (AVP code 1016) is of type Grouped, and it defines the QoS information for an IP-CAN bearer or PCC rule. When this AVP is sent from the PCEF to the PCRF, it indicates the requested QoS information for an IP CAN bearer. When this AVP is sent from the PCRF to the PCEF, it indicates the authorized QoS for an IP CAN bearer (when appearing at CCA or RAR command level or a service flow(when included within the PCC rule).

The QoS class identifier identifies a set of IP-CAN specific QoS parameters that define QoS, excluding the applicable bitrates. It is applicable both for uplink and downlink direction.

The Maximum-Requested-Bandwidth-UL defines the maximum bit rate allowed for the uplink direction.

The Maximum-Requested-Bandwidth-DL defines the maximum bit rate allowed for the downlink direction.

The Guaranteed-Bitrate-UL defines the guaranteed bit rate allowed for the uplink direction.

The Guaranteed-Bitrate-DL defines the guaranteed bit rate allowed for the downlink direction.

The Bearer Identifier AVP shall be included as part of the QoS-Information AVP if the QoS information refers to an IP CAN bearer initiated by the UE and the PCRF performs the bearer binding. The Bearer Identifier AVP identifies this bearer.

If the QoS-Information AVP has been supplied previously but is omitted in a Diameter message or AVP, the previous information remains valid. If the QoS-Information AVP has not been supplied from the PCRF to the PCEF previously and is omitted in a Diameter message or AVP, no enforcement of the authorized QoS shall be performed.

AVP Format:

```
QoS-Information ::= < AVP Header: 1016 >
  [ QoS-Class-Identifier ]
  [ Maximum-Requested-Bandwidth-UL ]
  [ Maximum-Requested-Bandwidth-DL ]
  [ Guaranteed-Bitrate-UL ]
  [ Guaranteed-Bitrate-DL ]
  [ Bearer-Identifier ]
```

### 5.3.17 QoS-Class-Identifier AVP (All access types)

QoS-Class-Identifier AVP (AVP code 1028) is of type Enumerated, and it identifies a set of IP-CAN specific QoS parameters that define the authorized QoS, excluding the applicable bitrates for the IP-CAN bearer or service flow. The following values are defined:

The mapping of QCI to UMTS QoS parameters for GPRS is shown in the following table (coming from TS 23.203 [7] Annex A table A.3):

**Table 5.3.17.1: Gx specific Diameter AVPs**

QoS-Class- Identifier AVP Value	UMTS QoS parameters			
	Traffic Class	THP	Signalling Indication	Source Statistics Descriptor
1	Conversational	n/a	n/a	speech (NOTE)
2	Conversational	n/a	n/a	unknown
3	Streaming	n/a	n/a	speech (NOTE)
4	Streaming	n/a	n/a	unknown
5	Interactive	1	Yes	n/a
6	Interactive	1	No	n/a
7	Interactive	2	No	n/a
8	Interactive	3	No	n/a
9	Background	n/a	n/a	n/a

NOTE: The QCI values that map to "speech" should be selected for service data flows consisting of speech (and the associated RTCP) only.

### 5.3.18 Charging-Rule-Report AVP (All access types)

The Charging-Rule-Report AVP (AVP code 1018) is of types Grouped, and it is used to report the status of a PCC rule.

Charging-Rule-Name AVP is a reference for a specific PCC rule at the PCEF that has been successfully installed, modified or removed (for dynamic PCC rules), or activated or deactivated (for predefined PCC rules) because of trigger from the MS. Charging-Rule-Base-Name AVP is a reference for a group of PCC rules predefined at the PCEF that has been successfully activated or deactivated because of trigger from the MS.

AVP Format:

```
Charging-Rule-Report ::= < AVP Header: 1018 >
  * [Charging-Rule-Name]
  * [Charging-Rule-Base-Name]
  [PCC-Rule-Status]
  * [AVP]
```

Multiple instances of Charging-Rule-Report AVPs shall be used in the case it is required to report different PCC-Rule-Status values for different groups of rules within the same Diameter command.

### 5.3.19 PCC-Rule-Status AVP (All access types)

The PCC-Rule-Status AVP (AVP code 1019) is of type Enumerated, and describes the status of one or a group of PCC Rules.

The following values are defined:

#### ACTIVE (0)

This value is used to indicate that the PCC rule(s) are successfully installed (for those provisioned from PCRF) or activated (for those pre-provisioned in PCEF)

#### INACTIVE (1)

This value is used to indicate that the PCC rule(s) are removed (for those provisioned from PCRF) or inactive (for those pre-provisioned in PCEF)

#### TEMPORARY INACTIVE (2)

This value is used to indicate that, for some reason (e.g. loss of bearer), already installed or activated PCC rules are temporary disabled.

### 5.3.20 Bearer-Identifier AVP (Applicable access type GPRS)

The Bearer-Identifier AVP (AVP code 1020) is of type OctetString, and it indicates the bearer to which specific information refers.

When present within a CC-Request Diameter command, subsequent AVPs within the CC-Request refer to the specific bearer identified by this AVP.

The bearer identifier of an IP CAN bearer shall be unique within the corresponding IP CAN session. The bearer identifier shall be selected by the PCEF.

### 5.3.21 Bearer-Operation AVP (Applicable access type GPRS)

The Bearer-Operation AVP (AVP code 1021) is of type Enumerated, and it indicates the bearer event that causes a request for PCC rules. This AVP shall be supplied if the bearer event relates to an IP CAN bearer initiated by the UE.

The following values are defined:

#### TERMINATION (0)

This value is used to indicate that a bearer is being terminated.

#### ESTABLISHMENT (1)

This value is used to indicate that a new bearer is being established.

#### MODIFICATION (2)

This value is used to indicate that an existing bearer is being modified.

### 5.3.22 Access-Network-Charging-Identifier-Gx AVP (All access types)

The Access-Network-Charging-Identifier-Gx AVP (AVP code 1022) is of type Grouped. It contains a charging identifier (e.g. GCID) within the Access-Network-Charging-Identifier-Value AVP and the related PCC rule name(s) within the Charging-Rule-Name AVP(s). If the IP CAN session contains only a single IP CAN bearer, no Charging-Rule-Name AVPs or Charging-Rule-Base-Name AVPs need to be provided. Otherwise, all the Charging-Rule-Name AVPs or Charging-Rule-Base-Name AVPs corresponding to PCC rules activated or installed within the IP CAN bearer corresponding to the provided Access-Network-Charging-Identifier-Value shall be included.

The Access-Network-Charging-Identifier-Gx AVP can be sent from the PCEF to the PCRF. The PCRF may use this information for charging correlation towards the AF.

AVP Format:

```
Access-Network-Charging-Identifier-Gx ::= < AVP Header: 1022 >
    { Access-Network-Charging-Identifier-Value }
    * [ Charging-Rule-Base-Name ]
    * [ Charging-Rule-Name ]
```

### 5.3.23 Bearer-Control Mode AVP

The Bearer-Control-Mode AVP (AVP code 1023) is of type of Enumerated. When sent from PCEF to PCRF, it indicates the UE preferred bearer control mode. When sent from PCRF to PCEF, it indicates the PCRF selected bearer control mode.

If the Bearer-Control-Mode AVP has not been previously provided by the PCEF, its absence shall indicate the value UE\_ONLY. If the Bearer-Control AVP has been provided, its value shall remain valid until it is provided the next time.

**Editor's Note: If no complete procedures for a change of Bearer Control Mode due to a handover are defined in the present Release, the procedures in the previous paragraph should be simplified.**

The following values are defined:

UE\_ONLY (0)

This value is used to indicate that the UE shall request any additional bearer establishment.

NW\_ONLY (1)

This value is used to indicate that the PCEF shall request any additional bearer establishment.

UE\_NW (2)

This value is used to indicate that both the UE and PCEF may request any additional bearer establishment and add own traffic mapping information to an IP-CAN bearer.

### 5.3.24 Network Request Support AVP

The Network-Request-Support AVP (AVP code 1024) is of type of Enumerated and indicates the UE and network support of the network requested bearer control mode.

If the Network Request Support AVP has not been previously provided, its absence shall indicate the value NETWORK\_REQUEST NOT SUPPORTED. If the Network Request Support AVP has been provided, its value shall remain valid until it is provided the next time.

**Editor's Note: If no complete procedures for a change of Bearer Control Mode due to a handover are defined in the present Release, the procedures in the previous paragraph should be simplified.**

The following values are defined:

NETWORK\_REQUEST NOT SUPPORTED (0)

This value is used to indicate that the UE and the access network do not support the bearer establishment request procedure.

NETWORK\_REQUEST SUPPORTED (1)

This value is used to indicate that the UE and the access network support the bearer establishment request procedure.

### 5.3.25 Guaranteed-Bitrate-DL AVP

The Guaranteed-Bitrate-DL AVP (AVP code 1025) is of type Unsigned32, and it indicates the guaranteed bitrate in bits per second for a downlink service data flow. The bandwidth contains all the overhead coming from the IP-layer and the layers above, e.g. IP, UDP, RTP and RTP payload.

### 5.3.26 Guaranteed-Bitrate-UL AVP

The Guaranteed –Bitrate-UL AVP (AVP code 1026) is of type Unsigned32, and it indicates the guaranteed bitrate in bits per second for an uplink service data flow. The bandwidth contains all the overhead coming from the IP-layer and the layers above, e.g. IP, UDP, RTP and RTP payload.

### 5.3.27 IP-CAN-Type AVP (All access types)

The IP-CAN-Type AVP (AVP code 1027) is of type Enumerated, and it shall indicate the type of Connectivity Access Network in which the user is connected.

The IP-CAN-Type AVP shall always be present during the IP-CAN session establishment. During an IP-CAN session modification, this AVP shall be present when there has been a change in the IP-CAN type and the PCRF requested to be informed of this event. The Event-Trigger AVP with value IP-CAN CHANGE shall be provided together with the IP-CAN-Type AVP.

The following values are defined:

3GPP (0)

This value shall be used to indicate that the IP-CAN is associated with a 3GPP access and is further detailed by the 3GPP-RAT-Type AVP.

## 5.4 Gx re-used AVPs

Table 5.4 lists the Diameter AVPs re-used by the Gx reference point from existing Diameter Applications, reference to their respective specifications and short description of their usage within the Gx 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 Gx reference point. Where 3GPP Radius VSAs are re-used, they shall be translated to Diameter AVPs as described in RFC 4005 [12] with the exception that the 'M' flag shall be set and the 'P' flag may be set.



Table 5.4: Gx re-used Diameter AVPs

Attribute Name	Reference	Description	Acc. type
3GPP-RAT-Type	3GPP TS 29.061 [11]	Indicate which Radio Access Technology is currently serving the UE.	GPRS
3GPP-SGSN-Address	3GPP TS 29.061 [11]	For GPRS the IPv4 address of the SGSN	GPRS
3GPP-SGSN-IPv6-Address	3GPP TS 29.061 [11]	For GPRS the IPv6 address of the SGSN	GPRS
3GPP-SGSN-MCC-MNC	3GPP TS 29.061 [11]	For GPRS the MCC and the MNC of the SGSN	GPRS
Access-Network-Charging-Address	3GPP TS 29.214 [10]	Indicates the IP Address of the network entity within the access network performing charging (e.g. the GGSN IP address).	All
Access-Network-Charging-Identifier-Value	3GPP TS 29.214 [10]	Contains a charging identifier (e.g. GCID).	All
AF-Charging-Identifier	3GPP TS 29.214 [10]	The AF charging identifier that may be used in charging correlation. For IMS the ICID. This AVP may only be included in a Charging-Rule-Definition AVP if the SERVICE_IDENTIFIER_LEVEL reporting is being selected with the Reporting-Level AVP.	All
Called-Station-ID	IETF RFC 4005 [12]	The address the user is connected to. For GPRS the APN.	All
CC-Request-Number	IETF RFC 4006 [9]	The number of the request for mapping requests and answers	All
CC-Request-Type	IETF RFC 4006 [9]	The type of the request (initial, update, termination)	All
Charging-Information	3GPP TS 29.229 [14]	The Charging-Information AVP is of type Grouped, and contains the addresses of the charging functions in the following AVPs: <ul style="list-style-type: none"> <li>Primary-Event-Charging-Function-Name is of type DiameterURI and defines the address of the primary online charging system. The protocol definition in the DiameterURI shall be either omitted or supplied with value "Diameter".</li> <li>Secondary-Event-Charging-Function-Name is of type DiameterURI and defines the address of the secondary online charging system for the bearer. The protocol definition in the DiameterURI shall be either omitted or supplied with value "Diameter".</li> <li>Primary-Charging-Collection-Function-Name is of type DiameterURI and defines the address of the primary offline charging system for the bearer. If the GTP' protocol is applied on the Gz interface as specified in 3GPP TS 32.295 [16], the protocol definition in the DiameterURI shall be omitted. If Diameter is applied on the Gz interface, the protocol definition in DiameterURI shall be either omitted or supplied with value "Diameter". The choice of the applied protocol on the Gz interface depends upon configuration in the PCEF.</li> <li>Secondary-Charging-Collection-Function-Name is of type DiameterURI and defines the address of the secondary offline charging system for the bearer. If the GTP' protocol is applied on the Gz interface as specified in 3GPP TS 32.295 [16], the protocol definition in the DiameterURI shall be omitted. If Diameter is applied on the Gz interface, the protocol definition in DiameterURI shall be either omitted or supplied with value "Diameter". The choice of the applied protocol on the Gz interface depends upon configuration in the PCEF.</li> </ul>	All
Flow-Description	3GPP TS 29.214 [10]	Defines the service flow filter parameters for a PCC rule	All
Flows	3GPP TS 29.214 [10]	The flow identifiers of the IP flows related to a PCC rule as provided by the AF. May be only used in charging correlation together with AF-Charging-Identifier AVP.	All
Flow-Status	3GPP TS 29.214 [10]	Defines whether the service flow is enabled or disabled. The value "REMOVED" is not applicable for Gx.	All

Attribute Name	Reference	Description	Acc. type
Framed-IP-Address	IETF RFC 4005 [12]	The IPv4 address allocated for the user.	All
Framed-IPv6-Prefix	IETF RFC 4005 [12]	The IPv6 address prefix allocated for the user. The encoding of the value within this Octet String type AVP shall be as defined in IETF RFC 3162 [15], Clause 2.3. The "Reserved", "Prefix-Length" and "Prefix" fields shall be included in this order.	All
Maximum-Requested-Bandwidth-UL	3GPP TS 29.214 [10]	Defines the maximum authorized bandwidth for uplink.	All
Maximum-Requested-Bandwidth-DL	3GPP TS 29.214 [10]	Defines the maximum authorized bandwidth for downlink.	All
Rating-Group	IETF RFC 4006 [9]	The charging key for the PCC rule used for rating purposes	All
Service-Identifier	IETF RFC 4006 [9]	The identity of the service or service component the service data flow in a PCC rule relates to.	All
Subscription-Id	IETF RFC 4006 [9]	The identification of the subscription (IMSI, MSISDN, etc)	All
User-Equipment-Info	IETF RFC 4006 [9]	The identification and capabilities of the terminal (IMEISV, etc.)	All

## 5.5 Gx specific Experimental-Result-Code AVP values

### 5.5.1 General

RFC 3588 [5] 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 Success

Result Codes that fall within the Success category are used to inform a peer that a request has been successfully completed.

The Result-Code AVP values defined in Diameter BASE RFC 3588 [5] shall be applied.

### 5.5.3 Permanent Failures

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

The Result-Code AVP values defined in Diameter BASE RFC 3588 [5] are applicable. Also the following specific Gx Experimental-Result-Codes values are defined:

#### DIAMETER\_ERROR\_INITIAL\_PARAMETERS (5140)

This error shall be used when the set of bearer/session information needed in the CRF for rule selection is incomplete or erroneous for the decision to be made. (e.g. QoS, SGSN address, RAT type, TFT...)

#### DIAMETER\_ERROR\_TRIGGER\_EVENT (5141)

This error shall be used when the set of bearer/session information sent in a CCR originated due to a trigger event been met is incoherent with the previous set of bearer/session information for the same bearer/session. (e.g. event trigger met was RAT changed, and the RAT notified is the same as before)

#### DIAMETER\_PCC\_RULE\_EVENT (5142)

This error shall be used when for some reason the PCC rules cannot be installed/activated. The reason will be provided in the Event Trigger AVP value. Affected PCC-Rules will be provided in the Charging-Rule-Report AVP. Absence of the Charging-Rule-Report means that all provided PCC rules for that specific bearer/session are affected.

## 5.6 Gx Messages

### 5.6.1 Gx Application

Gx Messages are carried within the Diameter Application(s) described in clause 5.1.

Existing Diameter command codes from the Diameter base protocol RFC 3588 [5] and the Diameter Credit Control Application RFC 4006 [9] are used with the Gx specific AVPs specified in clause 5.3. The Diameter Credit Control Application AVPs and AVPs from other Diameter applications that are re-used are defined in clause 5.4. Due to the definition of these commands there is no possibility to skip the Auth-Application-Id AVP and use the Vendor-Specific-Application-Id AVP instead. Therefore the Gx application identifier shall be included in the Auth-Application-Id AVP.

In order to support both PULL and PUSH procedures, a diameter session needs to be established for each IP-CAN session. For IP-CAN types that support multiple IP-CAN bearers (as in the case of GPRS), the diameter session is established when the very first IP-CAN bearer for the IP-CAN session is established.

NOTE: Some of the AVPs included in the messages formats below are in bold to highlight that these AVPs are used by this specific protocol and do not belong to the original message definition in the DCC Application RFC 4006 [9] or Diameter Base Protocol RFC 3588 [5].

### 5.6.2 CC-Request (CCR) Command

The CCR command, indicated by the Command-Code field set to 272 and the 'R' bit set in the Command Flags field, is sent by the PCEF to the PCRF in order to request PCC rules for a bearer. The CCR command is also sent by the PCEF to the PCRF in order to indicate bearer or PCC rule related events or the termination of the IP CAN bearer and/or session.

Message Format:

```
<CC-Request> ::= < Diameter Header: 272, REQ, PXY >
  < Session-Id >
  { Auth-Application-Id }
  { Origin-Host }
  { Origin-Realm }
  { Destination-Realm }
  { CC-Request-Type }
  { CC-Request-Number }
  [ Destination-Host ]
  [ Origin-State-Id ]
  *[ Subscription-Id ]
  [ Bearer-Control-Mode ]
  [ Network-Request-Support ]
  [ Bearer-Identifier ]
  [ Bearer-Operation ]
  [ Framed-IP-Address ]
  [ Framed-IPv6-Prefix ]
  [ 3GPP-RAT-Type ]
  [ Termination-Cause ]
  [ User-Equipment-Info ]
  [ QoS-Information ]
  [ 3GPP-SGSN-MCC-MNC ]
  [ 3GPP-SGSN-Address ]
  [ 3GPP-SGSN-IPv6-Address ]
  [ Called-Station-ID ]
  [ Bearer-Usage ]
  *[ TFT-Packet-Filter-Information ]
  *[ Charging-Rule-Report]
  *[ Event-Trigger]
  [ Access-Network-Charging-Address ]
  [ Access-Network-Charging-Identifier-Gx ]
  *[ Proxy-Info ]
  *[ Route-Record ]
  *[ AVP ]
```

### 5.6.3 CC-Answer (CCA) Command

The CCA command, indicated by the Command-Code field set to 272 and the 'R' bit cleared in the Command Flags field, is sent by the PCRF to the PCEF in response to the CCR command. It is used to provision PCC rules and event

triggers for the bearer/session and to provide the selected bearer control mode for the IP-CAN session. If the PCRF performs the bearer binding, PCC rules will be provisioned at bearer level. The primary and secondary CCF and/or primary and secondary OCS addresses may be included in the initial provisioning.

Message Format:

```
<CC-Answer> ::= < Diameter Header: 272, PXY >
  < Session-Id >
  { Auth-Application-Id }
  { Origin-Host }
  { Origin-Realm }
  [ Result-Code ]
  [ Experimental-Result ]
  { CC-Request-Type }
  { CC-Request-Number }
  [ Bearer-Control-Mode ]
  * [ Event-Trigger ]
  [ Origin-State-Id ]
  * [ Charging-Rule-Remove ]
  * [ Charging-Rule-Install ]
  [ Charging-Information ]
  [ Online ]
  [ Offline ]
  [ QoS-Information ]
  [ Error-Message ]
  [ Error-Reporting-Host ]
  * [ Failed-AVP ]
  * [ Proxy-Info ]
  * [ Route-Record ]
  * [ AVP ]
```

## 5.6.4 Re-Auth-Request (RAR) Command

The RAR command, indicated by the Command-Code field set to 258 and the 'R' bit set in the Command Flags field, is sent by the PCRF to the PCEF in order to provision PCC rules using the PUSH procedure initiate the provision of unsolicited PCC rules. It is used to provision PCC rules and event triggers for the session. If the PCRF performs the bearer binding, PCC rules will be provisioned at bearer level.

**NOTE:** If the RAR command is received by the PCEF without providing any operation on PCC rules or any QoS information, the PCEF will respond with a CCR command requesting PCC rules.

Message Format:

```
<RA-Request> ::= < Diameter Header: 258, REQ, PXY >
  < Session-Id >
  { Auth-Application-Id }
  { Origin-Host }
  { Origin-Realm }
  { Destination-Realm }
  { Destination-Host }
  { Re-Auth-Request-Type }
  [ Origin-State-Id ]
  * [ Event-Trigger ]
  * [ Charging-Rule-Remove ]
  * [ Charging-Rule-Install ]
  [ QoS-Information ]
  * [ Proxy-Info ]
  * [ Route-Record ]
  * [ AVP ]
```

## 5.6.5 Re-Auth-Answer (RAA) Command

The RAA command, indicated by the Command-Code field set to 258 and the 'R' bit cleared in the Command Flags field, is sent by the PCEF to the PCRF in response to the RAR command.

Message Format:

```
<RA-Answer> ::= < Diameter Header: 258, PXY >
< Session-Id >
{ Origin-Host }
{ Origin-Realm }
[ Result-Code ]
[ Experimental-Result ]
[ Origin-State-Id ]
[ Event-Trigger ]
*[ Charging-Rule-Report]
[ Access-Network-Charging-Address ]
*[ Access-Network-Charging-Identifier-Gx ]
[ Error-Message ]
[ Error-Reporting-Host ]
*[ Failed-AVP ]
*[ Proxy-Info ]
*[ AVP ]
```

## Annex A (informative): Change history

Date	TSG #	TSG Doc.	CR	Rev	Subject/Comment	Old	New
11/11/2005					Includes the following TDOCs agreed at CT3#38: C3-050692, C3-050834, C3-050835, C3-050843, C3-050846	0.0.0	0.1.0
17/02/2006					Includes the following TDOCs agreed at CT3#39: C3-060130, C3-060131, C3-060132, C3-060140	0.1.0	0.2.0
12/05/2006					Includes the following TDOCs agreed at CT3#40: C3-060199, C3-060200, C3-060255, C3-060259, C3-060260	0.2.0	0.3.0
13/09/2006					Includes the following TDOCs agreed at CT3#41: C3-060378, C3-060379, C3-060382, C3-060434, C3-060438, C3-060439, C3-060441, C3-060443, C3-060445, C3-060536, C3-060551	0.3.0	0.4.0
09/11/2006					Includes the following TDOCs agreed at CT3#42: C3-060786, C3-060854, C3-060750, C3-060595, C3-060848, C3-060753, C3-060630, C3-060755, C3-060849, C3-060829, C3-060866, C3-060756, C3-060700, C3-060851	0.4.0	0.5.0
01/12/2006	TSG#33	CP-060636			Editorial update by MCC for presentation to TSG CT for information	0.3.0	1.0.0
22/02/2007					Includes the following TDOCs agreed at CT3#43: C3-070050, C3-070084, C3-070137, C3-070166, C3-070175, C3-070212, C3-070239, C3-070244, C3-070245, C3-070246, C3-070268	1.0.0	1.1.0
28/02/2007	TSG#35	CP-060097			Editorial update by MCC for presentation to TSG CT for approval	1.1.0	2.0.0
03-2007					MCC update to version 7.0.0 after approval at TSG CT#35	2.0.0	7.0.0
06-2007	TST#36	CP-070419	001	1	IP-CAN session specific charging	7.0.0	7.1.0
06-2007	TST#36	CP-070420	004	11	Handling of Authorized QoS	7.0.0	7.1.0
06-2007	TST#36	CP-070419	005	2	Subscription to notification of Loss of AF signalling	7.0.0	7.1.0
06-2007	TST#36	CP-070419	006	1	Routeing of Diameter commands - Gx	7.0.0	7.1.0
06-2007	TST#36	CP-070420	007	5	QoS change event	7.0.0	7.1.0
06-2007	TST#36	CP-070419	008		PCC rule without Flow-Description AVP	7.0.0	7.1.0
06-2007	TST#36	CP-070419	009	1	Addition and removal of event triggers	7.0.0	7.1.0
06-2007	TST#36	CP-070419	010	2	Metering-Method AVP	7.0.0	7.1.0
06-2007	TST#36	CP-070419	011	2	Reporting-Level AVP	7.0.0	7.1.0
06-2007	TST#36	CP-070419	012	1	PCC-Rule-Status AVP	7.0.0	7.1.0
06-2007	TST#36	CP-070419	013		Charging-Information AVP	7.0.0	7.1.0
06-2007	TST#36	CP-070419	014	1	PCC-Rule-Event AVP	7.0.0	7.1.0
06-2007	TST#36	CP-070419	015		Corrections to Reused AVPs	7.0.0	7.1.0
06-2007	TST#36	CP-070419	016	4	Precedence AVP	7.0.0	7.1.0
06-2007	TST#36	CP-070419	017	6	Mixed Mode	7.0.0	7.1.0
06-2007	TST#36	CP-070419	018	2	Correction to where binding should be	7.0.0	7.1.0
06-2007	TST#36	CP-070420	024	1	Alignment of the QoS information	7.0.0	7.1.0

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## History

<b>Document history</b>		
V7.1.0	June 2007	Publication