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NODES FOR IMPROVED CREDIT VALIDATION

TECHNICAL FIELD

- 5 The present invention discloses nodes for improved credit validation in a communications system.

BACKGROUND

- The Policy and Charging Control, PCC, architecture was introduced in 3GPP
10 Rel-7 and has been further evolved in 3GPP Rel8 and Rel9. It provides operators with advanced tools for service-aware QoS and charging control.

- For 3GPP Rel-10, there is currently a Study Item for Policy Enhancements that investigates various functional additions to the already existing
15 architecture. Currently there are 4 key issues under investigation. One of those key issues is called "QoS and gating control based on spending limits". This key issues looks into the case when the QoS (bandwidth) of an ongoing session must be throttled due to the fact that the user has reached some form of credit related limit. One example might be that the user is roaming
20 (data services while roaming is often expensive and charged per Megabyte) and has a pre-defined safety limit of e.g. 50 Euros when the bandwidth should be set to a minimum until the user has been informed and once again agreed to be charged for another 50 Euros.

- 25 In the current PCC architecture, when a new PDN-connection is set up or when it is being modified, the PCEF (i.e. PDN-GW or GGSN) always queries the PCRF over the Gx interface, i.e. the interface between PCEF and PCRF, for a policy decision prior to requesting credit from the OCS over the Gy interface, i.e. the interface between PCEF and OCS. There are two
30 alternatives defined for when credit requests over the Gy interface may take

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place according to the present 3GPP standard. One alternative is to request credits from the OCS over the Gy interface immediately at PDN-connection establishment, and another alternative is to delay the request of credit until an incoming payload packet is classified by the PCEF to an authorized service for which online charging applies.

SUMMARY

It is a purpose of the present invention to provide a solution which will provide improvements to the procedure which is used at present when a new PDN-connection is set up or when an existing PDN connection is modified.

This purpose is addressed by the present invention in that it discloses a Policy and Charging Rules Function node, a PCRF node, for a communications system. The PCRF node of the invention is equipped with an interface towards a Policy and Charging Enforcement Function node, a PCEF node, in the communications system and is arranged to use this interface to provide the PCEF node with new or updated Policy and Charging Control, PCC, rules for an end user, here referred to as a User Equipment, abbreviated as UE, in the communications system.

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According to the invention, the PCRF node is also equipped with an interface towards an Online Charging System node, an OCS node, in the communications system, and is also arranged to:

- As a result of a trigger signal which is internal or external to the PCRF node, request a credit indication for the new or updated PCC rules for the UE from the OCS node over the interface to the OCS node,
- As a result of the request, receive a credit indication for the new or updated PCC rules for the UE from the OCS node over the interface to the OCS node,

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- To provide the credit information to the PCEF node over the interface to the PCEF node.

5 In some embodiments, the PCRF node of the invention is arranged to provide the credit information to the PCEF node in a charging policy decision which the PCRF node transmits to the PCEF node.

10 In some embodiments of the PCRF node of the invention, the internal trigger signal is a timer.

In one embodiment in the PCRF node of the invention, the external trigger signal is one or more of the following:

- a session activation request from the UE,
- a session modification for the UE,
- 15 - a request for a new or changed service for the UE,
- a received update in the UE's subscription data.

20 In some embodiments, the PCRF node of the invention is arranged to request the credit indication per service, group of services or per rating group used by the UE.

In one embodiment of the PCRF node of the invention, the interface towards the OCS node is the Sy interface.

25 In one embodiment of the PCRF node of the invention, the interface towards the PCEF node is the 3GPP Gx interface.

The invention also discloses an Online Charging System node, an OCS node, in a communications system.

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The OCS node is equipped with an interface towards a Policy and Charging Rules Function node, a PCRF node, and the OCS node is arranged to receive a request for a credit indication for a service, group of services or rating group associated with one or more Policy and Charging Control rules,
5 PCC rules, for a User Equipment from the PCRF node over the interface to the PCRF node, and, as a result of said request, to transmit a credit indication for the service, group of services or rating groups for the User Equipment to the PCRF node over the interface to the PCRF node.

- 10 In some embodiments of the OCS node, the interface to the PCRF node is the Sy interface.

In addition, the invention also discloses a Policy and Charging Enforcement node, a PCEF node, for a communications system. The PCEF node is
15 equipped with an interface towards a Policy and Charging Rules node, a PCRF node, and with an interface towards an Online Charging System node, an OCS node.

The PCEF node is arranged to receive rules for Policy and Charging Control,
20 PCC rules, for a User Equipment in the communications system from the PCRF node over the Gx interface. The PCEF node is arranged to, if the PCC rules for the UE contain a credit indication that indicate that the UE has sufficient credit to utilize the service or services associated with the credit, wait for the UE to start utilizing the system, and when that happens, to
25 establish a session with the OCS node over the interface to that node. If the PCC rules received from the PCRF node contain a credit indication that indicate that the UE doesn't have sufficient credit to utilize the service or services associated with the credit, the PCEF node is arranged to establish a session with the OCS node over the Gy interface and await a decision from
30 the OCS node regarding actions to be taken with traffic from the UE.

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In some embodiments of the PCEF node, the interface to the PCRF node is the 3GPP Gx interface.

- 5 In some embodiments of the PCEF node, the interface to the OCS node is the 3GPP Gy interface.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be described in more detail in the following, with reference
10 to the appended drawings, in which

Fig 1 shows an overview of a system in which the invention is applied, and
Figs 2 and 3 show event diagrams in a system in which the invention is used.

15 DETAILED DESCRIPTION

Fig 1 shows an overview of a communications system 100 in which the invention is applied. The invention will be described by means of the system 100 in fig 1, using terminology which is taken from the 3GPP project. It should however be emphasized that the invention is also applicable within
20 systems which are "wire bound", i.e. system which use landlines.

As shown in fig 1, the system 100 comprises the following nodes or components:

- 25 - AF, 110, Application Function,
- BBERF, 125, Bearer Binding Event Reporting Function,
- OCS, 115, Online Charging System,
- PCEF, 130, Policy and Charging Enforcement Function,
- PCRF, 120, Policy and Charging Rules Function,
30 - SPR, 105, Solution Profile Repository

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- UE, 140, User Equipment, sometimes also referred to as an "end user"..

As is also shown in fig 1, in the system 100 there are interfaces between some of the nodes or components. Thus, between the PCEF 130 and the
5 PCRF 120 there is the so called Gx interface, and between the PCEF 130 and the OCS 115, there is the so called Gy interface. These interfaces are known to those skilled in the art and will therefore not be described in further detail here.

10 The present invention proposes opening up an interface between the OCS 115 and the PCRF 120, in addition to the existing interfaces in the system 100. The proposed interface (sometimes also referred to as a "reference point") between the OCS 115 and the PCRF 120 is labeled Sy interface, and is shown in bold lines in fig 1, in order to facilitate for the reader.

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One purpose of introducing the Sy interface is to address the case sometimes known as "QoS and gating control based on spending limits". This case occurs when the QoS (Quality of Service, e.g. bandwidth) of an ongoing session must be "throttled" due to the fact that the user has reached
20 some form of credit related limit. One example might be that the user is roaming (data services while roaming is often expensive and charged per Megabyte) and has a pre-defined safety or billing limit of e.g. 50 Euros. In such cases, it might be advantageous to set the bandwidth to a minimum e.g. until the user has been informed that the credit limit has been reached
25 and has agreed to be charged for another 50 Euros, or until a certain payment period, such as, for example, the present month, has ended.

In some embodiments of the present invention, the Sy interface will be initiated by the PCRF 120 at an IP-CAN session establishment for the UE
30 140 and will be used to transfer charging related information from the OCS

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115 to the PCRF 120. Based on this information, the PCRF 120 can then make policy decision, such as e.g. altering the QoS of the user. Possible other use cases of the Sy interface include:

- 5 - Notification that the UE is out of credit;
 - Notification that the UE is not out of credit;
 - Notification that the UE is currently "promoted", i.e. has a certain status within the operator's network, such as e.g. "gold client";
 - Notification that the UE has reached a certain credit threshold (e.g. 50
10 Euros).

As stated previously, it is a purpose of the present invention to provide a solution which will provide improvements to the procedure which is used at present when a new PDN connection is set up or when an existing PDN
15 connection is modified. To this end, by means of the introduction of the Sy interface, the PCRF 120 will be able to get an early credit indication from the OCS 115, possibly per service, or group of services or per so called rating group. The PCRF 120 can then indicate this over the Gx interface to the PCEF, which for example can be a PGW, PDN Gateway, or a GGSN, or will
20 be embodied in such nodes. With this information, the PCEF 130 can safely allow traffic to flow for all associated services, group of services or rating groups for which the PCRF has indicated that credit is available during the time of the credit request over Gy. This would greatly reduce the procedures associated with "QoS and gating control based on spending limits". In
25 addition, the PCEF could in an initial request over the Gx to the PCRF request early credit indications to be provided, or the PCRF could request over Sy that the OCS notifies the PCRF in case the user's account becomes empty or refilled, possibly per service, group of services or per rating group. In addition, the PCRF could notify the PCEF over the Gx interface in the

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case that there is a change in previously provided credit indications, possibly per service, group of services or per rating group.

The invention also discloses an improved PCEF node 130. The PCEF node
5 130 is, as shown in fig 1 and as mentioned above, equipped with a Gx
interface towards the PCRF node 120, and with a Gy interface towards the
Online Charging System node, the OCS node 115. The PCEF node 130 is
arranged to receive rules for Policy and Charging Control, PCC rules, for a
UE 140 in the communications system 100 from the PCRF node 120 over
10 the Gx interface. As disclosed by the invention, the PCEF node 130 is
arranged to, if the PCC rules for the UE 140 contain a credit indication that
indicate that the UE has sufficient credit to utilize the service or services
associated with the credit, wait for the UE 140 to start utilizing the system,
and when that happens, to establish a session with the OCS node over the
15 Gy interface to the OCS node. If, on the other hand, the PCC rules received
from the PCRF node 120 contain a credit indication that indicate that the UE
140 doesn't have sufficient credit to utilize the services associated with the
credit, the PCEF node 130 is arranged to establish a session with the OCS
node 115 over the Gy interface to the OCS node and to await a decision
20 from the OCS node regarding actions to be taken with traffic from the UE
140.

An example of an event sequence in a system in which the present invention
is applied will now be given with reference to fig 2, which shows events and
25 messages sent between the nodes PCEF 130, OCS 115 and PCRF 120 in
the system 100 of fig 1. Events 1-3 have been framed with dashed lines in
order to indicate that these are the events in fig 2 which are primarily related
to the present invention.

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The events and messages of fig 2 have been numbered sequentially, and are as follows:

1. The PCRF decides to install a new or modified PCC rules in the PCEF.
5 The decision is triggered either by an event external or internal to the PCRF. Examples of internal such events are timers, and examples of external such events are one or more of the following:
 - a session activation request from the UE,
 - a session modification for the UE,
 - 10 - a request for a new or changed service for the UE,
 - a received update in the UE's subscription data.
 - an update in the user's subscription from the SPR,Note that for the case of a session activation request, such as for example, an IP-CAN Session Establishment, the PCEF may have
15 specifically requested an early credit indication from the PCRF.
2. The PCRF issues a request to the OCS over the Sy interface and requests an early credit indication for the new or modified service(s).
- 20 3. The OCS responds over the Sy interface with the requested credit indicator(s).
4. The PCRF formulates a policy decision and provides this decision to the PCEF. The policy decision also includes the credit indication (possibly per
25 service, group of services, PCC rule or per rating group).
5. The PCEF acknowledges the policy decision message.
6. Because of the credit indicator(s), the PCEF knows if the account of the
30 end user is empty or not and therefore, in case the account is not empty

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i.e. the credit indication(s) was positive, does not have to request credits for the associated rating groups and/or services immediately. Potential bearer or session related signaling may take place as specified in 3GPP TS 23.203.

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7. At a later point in time, an incoming payload packet from the UE (i.e. uplink) or from an external network (i.e. downlink) is classified by the PCEF to an authorized service for which online charging applies, but where the credit request has been delayed due to a positive credit indication received in step 4. The payload is allowed to flow, but the PCEF immediately starts to measure the traffic (in time, volume or service specific units).

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8. Step 7 triggers the PCEF to perform a credit request for the associated service or rating group.

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9. Credit is granted by the OCS. The PCEF deducts the measured amount of credits that has already been consumed since step 7.

20 Another example of an event sequence in a system in which the present invention is applied will now be given with reference to fig 3, which shows events and messages sent between the nodes PCEF 130, OCS 115 and PCRF 120 in the system 100 of fig 1. Events 2 and 3 have been framed with dashed lines in order to indicate that these are the events in fig 3 which are primarily related to the present invention.

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The events and messages of fig 3 have been numbered sequentially, and are as follows:

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1. In the OCS, the account status of a UE is changed beyond a certain threshold limit. This may e.g. happen because the account is refilled or because the value of the account is exhausted.
- 5 2. The OCS transmits a Credit Report Update to the PCRF.
3. The PCRF transmits an acknowledgment, ACK, of this to the OCS.
4. The PCRF establishes a new condition for the user of the account in
10 question.
5. The PCRF transmits the Policy Decision Update to the PCEF, for example as new or updated credit indicators.
- 15 6. The PCEF transmits an acknowledgment, ACK, of this to the PCRF.

The invention is not limited to the examples of embodiments described above and shown in the drawings, but may be freely varied within the scope of the appended claims.

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CLAIMS

1. A Policy and Charging Rules Function node, a PCRF node (120), for a communications system (100), the PCRF node (120) being equipped with an interface (Gx) towards a Policy and Charging Enforcement Function node, a PCEF node (130), in the communications system (100), the PCRF node (120) being arranged to use said interface (Gx) to provide the PCEF node (130) with new or updated Policy and Charging Control, PCC, rules for a User Equipment (140) in the communications system (100), the PCRF node (120) being characterized in that it is also equipped with an interface (Sy) towards an Online Charging System node, an OCS node (115), in the communications system, and in that the PCRF node (120) is arranged to:
 - As a result of a trigger signal which is internal or external to the PCRF node (120), request a credit indication for new or updated PCC rules for the User Equipment from the OCS node (115) over the interface (Sy) to the OCS node (115),
 - As a result of said request, receive a credit indication for the new or updated PCC rules for the User Equipment from the OCS node (115) over the interface (Sy) to the OCS node (115),
 - To provide said credit information to the PCEF node (130) over the interface (Gx) to the PCEF node (130).
2. The PCRF node (120) of claim 1, being arranged to provide the credit information to the PCEF node (130) in a charging policy decision which the PCRF node (120) transmits to the PCEF node (130).
3. The PCRF node (120) of claim 1 or 2, in which the internal trigger signal is a timer.

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4. The PCRF node (120) of claim 1 or 2, in which the external trigger signal is one or more of the following:

- a session activation request from the User Equipment (140),
- a session modification for the User Equipment (140),

- 5 - a request for a new or changed service for the User Equipment (140),
 - a received update in the User Equipment's (140) subscription data.

5. The PCRF node (120) of any of claims 1-4, being arranged to request the credit indication per service, group of services or per rating group used by
10 the User Equipment (140).

6. The PCRF node (120) of any of claims 1-5, in which the interface towards the OCS node (115) is the Sy interface.

15 7. The PCRF node (120) of any of claims 1-6, in which the interface towards the PCEF node (130) is the 3GPP Gx interface.

8. An Online Charging System node, an OCS node (115), in a communications system, the OCS node (115) being characterized in that it is
20 equipped with an interface towards a Policy and Charging Rules Function node, a PCRF node (120), the OCS node (115) being arranged to receive a request for a credit indication for a service, group of services or rating group associated with one or more Policy and Charging Control rules, PCC rules, for a User Equipment (140) from the PCRF node (120) over the interface to
25 the PCRF node, and, as a result of said request, to transmit a credit indication for the service, group of services or rating groups for the User Equipment (140) to the PCRF node (120) over the interface to the PCRF node.

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9. The OCS node (115) of claim 8, in which the interface to the PCRF node (120) is the Sy interface.

10. A Policy and Charging Enforcement node, a PCEF node (130), for a
5 communications system (100), the PCEF node (130) being equipped with an
interface (Gx) towards a Policy and Charging Rules node, a PCRF node
(120), and with an interface (Gy) towards an Online Charging System node,
an OCS node (115), the PCEF node (130) being arranged to receive rules
for Policy and Charging Control, PCC rules, for a User Equipment (140) in
10 the communications system (100) from the PCRF node (120) over the
interface (Gx) to that node, the PCEF node (130) being characterized in that
it is arranged to, if the PCC rules for the User Equipment (140) contain a
credit indication that indicate that the User Equipment (140) has sufficient
credit to utilize the service or services associated with the credit, wait for the
15 User Equipment (140) to start utilizing the system, and when that happens,
to establish a session with the OCS node over the interface (Gy) to the OCS
node, and if the PCC rules received from the PCRF node (120) contain a
credit indication that indicate that the User Equipment (140) doesn't have
sufficient credit to utilize the services associated with the credit, to establish
20 a session with the OCS node (115) over the interface (Gy) to the OCS node
and await a decision from the OCS node regarding actions to be taken with
traffic from the User Equipment (140).

11. The PCEF node (130) of claim 10, in which the interface to the PCRF
25 node (120) is the 3GPP Gx interface.

12. The PCEF node (130) of claim 10, in which the interface to the OCS
node (115) is the 3GPP Gy interface.