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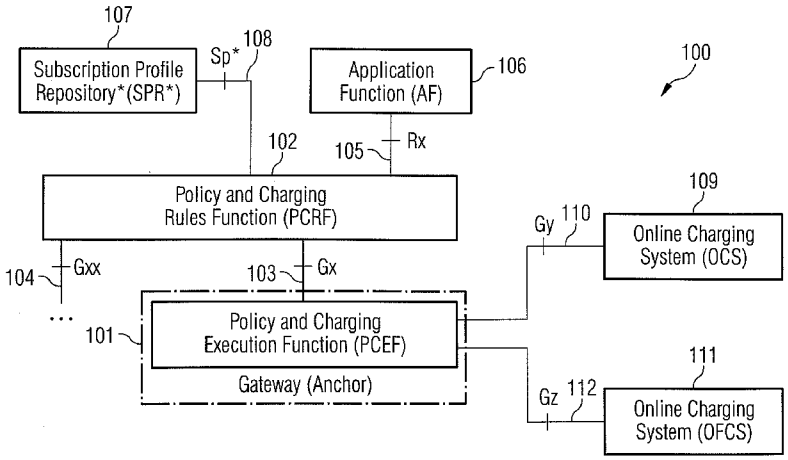
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(54) **Title**: POLICY CONTROL APPARATUS AND METHOD FOR HANDING OVER POLICY CONTROL INFORMATION

FIG 1



(57) **Abstract**: Policy Control Apparatus and method for handing over Policy Control information of a second Anchor Device to a first Anchor Device A Policy Control Apparatus (100), is described comprising an Anchor Change Detecting Device (102), a Handover Device (107) and a first Anchor Device (101). The Anchor Change Detecting Device (102) is adapted for detecting that a subscriber is changing from a second Anchor Device to the first Anchor Device (101). The Handover Device (107) is adapted for handing over Policy and Charging Control Information of the subscriber from the second Anchor Device to the first Anchor Device (10), upon detecting the subscriber is changing from the second Anchor Device to the first Anchor Device (101). (Fig. 3)

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DESCRIPTION

TITLE

POLICY CONTROL APPARATUS AND METHOD FOR HANDING OVER POLICY CONTROL INFORMATION

Technical field of the invention

The present invention relates to the technical field of communication networks. In particular the present invention relates to a Policy Control Apparatus, to a method for handing over Policy Control and Charging information of a second Anchor Device to a first Anchor Device, to a computer-readable medium, to a Broadband Remote Access Server comprising a Policy Control Apparatus and to a use of a Subscription Profile Repository Function.

Background of the invention

The document 3GPP (Third Generation Partnership Project) TS23.203, "Third Generation Partnership Project; Technical Specification Group Services and System Aspects; Policy and Charging Control Architecture", Release 8, V8.2.0, 2008-06 may specify an overall stage 2 level functionality for policy and charging control that encompasses high level functions such as flow base charging, including charging control and online credit control and policy control for IP-CAN (IP Connectivity Access Network), e.g. GPRS (General Packet Radio Service), I-WLAN (Interworking WLAN), fixed broadband, etc..

The document 3GPP TS 32.296, "3rd Generation Partnership Project; Technical Specification Group Service and System Aspects; Telecommunication management; Charging management; Online Charging System (OCS): Applications and interfaces", Release 8, V.2.0, 2008-06 may specify charging functionality and charging management in 3GPP networks.

However, no solution may be provided to allow handover of services established in a 3GPP network to a broadband access network without dedicated user and service identification e.g. DSL or WIMAX.

It may be a need to provide a more efficient handing over of services between a 3GPP network and a non-3GPP network.

Summary of the invention

According to an exemplary embodiment of the present invention a Policy Control Apparatus, a method for handing over Policy Control information of a second Anchor Device to a first Anchor Device, a computer-readable medium, a Broadband Remote Access Server and a use of a Subscription Profile Repository may be provided.

According to an exemplary embodiment of the present invention a Policy Control Apparatus may comprise an Anchor Change Detecting Device, a Handover Device and a first Anchor Device. In an example the Anchor Change Detecting Device may be adapted for detecting that a subscriber and/or a terminal may be changing from a second Anchor Device to a first Anchor Device.

In a further example the Handover Device may be adapted for handing over policy and charging control information of the subscriber from the second Anchor Device to the first Anchor Device upon detecting the subscriber may be changing from the second Anchor Device to the first Anchor Device.

According to another exemplary embodiment of the present invention, a method for handing over Policy Control information of a second Anchor Device to a first Anchor Device may be provided. The method may comprise detecting that a subscriber is changing from the second Anchor Device to the first Anchor Device. The method, for example, may

further comprise, upon detecting the subscriber may be changing from the second Anchor Device to the first Anchor Device handing over policy and charging control information of the subscriber from the second Anchor Device to the first Anchor Device.

According to yet another exemplary embodiment of the present invention, a computer-readable medium may be provided, wherein the computer-readable medium may comprise a program code, which program code may be adapted, when being executed on a processor, to carry out the method for handing over Policy Control information of a second Anchor Device to a first Anchor Device. The method may comprise detecting that a subscriber may be changing from the second Anchor Device to the first Anchor Device and upon detecting the subscriber may be changing from the second Anchor Device to the first Anchor Device, handing over policy and charging control information of the subscriber from the second Anchor Device to the first Anchor Device.

Computer-readable medium may be a floppy disk, a harddisk, an USB (Universal Serial Bus) storage device, a RAM (Random Access Memory), a ROM (Read Only Memory) and an EPROM (Erasable Programmable Read Only Memory). A computer-readable medium may also be a data communication network, e.g. the internet, which may allow downloading a program code.

According to another exemplary embodiment of the present invention, a program element may be provided, wherein the program element may be adapted, when being executed on a processor, to carry out the method for handing over Policy Control information of a second Anchor Device to a first Anchor Device. The method may comprise detecting that a subscriber may be changing from the second Anchor Device to the first Anchor Device and upon detecting the subscriber may be changing from the second Anchor Device to the first Anchor Device, handing over policy and charging control information

of the subscriber from the second Anchor Device to the first Anchor Device.

According to another exemplary embodiment of the present invention, a Broadband Remote Access Server (BRAS) may be provided, wherein the BRAS may comprise an inventive Policy Control Apparatus.

According to another exemplary embodiment of the present invention, a use of a Subscription Profile Repository function for handing over policy and charging control information of a subscriber from a second Anchor Device to a first Anchor Device may be provided. The policy and charging control information may be handed over from the second Anchor Device to the first Anchor Device upon detecting that the subscriber may be changing from the second Anchor Device to the first Anchor Device.

In other words, a Handover Device which may be adapted for handing over Policy and Charging Control Information of the subscriber from the second Anchor Device to the first Anchor Device may describe the principle that PCRF may retrieve the identifiers and charging-related context information from an extended Subscription Profile Repository SPR* and that PCRF may send the charging identifiers and charging-related context information to a new PCEF. This new PCEF may be provided, in order to differentiate between PCEF in a 3GPP network and a PCEF in a non-3GPP network.

The term ‘new’ and ‘old’ may relate to a direction of handing over a UE, a terminal or a service. Thus, the receiving PCEF may be the ‘new’ PCEF.

The information may be initially from the second Anchor device, and at the moment of handover, a Handover device may provide the identifiers and charging-related context information that may have been stored earlier and that may be present in SPR*.

This may not mean that information may be transferred directly from the second Anchor Device to the first Anchor Device. Thus, another aspect of the invention may be buffering identifiers and charging-related context information in an extended SPR during a handover.

Generally, even if only described in one direction, a handover may be conducted in either direction, i.e. a handover may be conducted from the 3GPP network to the non-3GPP network and/or from the non-3GPP network to the 3GPP network.

It may be one design principle of a 3GPP SAE (System Architecture Evolution) architecture to establish an anchor to support mobility management, Quality of Service (QoS) and Accounting Control Policy Enforcement Point (PEF).

According to another exemplary embodiment of the present invention, a program element may be provided which may be adapted, when being executed on a processor, to carry out a method comprising detecting that a subscriber may be changing from the second Anchor Device to the first Anchor Device and handing over policy and charging control information of the subscriber from the second Anchor Device to the first Anchor Device upon detecting that the subscriber is changing from the second Anchor Device to the first Anchor Device.

The concept provided in SAE may specify that an anchor may have exclusive control over a bearer. In other words, a subscriber who may initiate a service within the 3GPP network may establish a 3GPP bearer which may be associated with a corresponding service. Therefore, in a 3GPP network, when a subscriber may have established a 3GPP bearer this bearer may be associated with an anchor or with an Anchor Device, specific for the subscriber. In an example, the Anchor Device may be associated with an anchor in a network, e.g. a network gateway. Therefore, when the subscriber may change the access

technology within a 3GPP environment, still the same anchor or 3GPP bearer may be active.

A bearer may be defined as a context specific for a subscriber and/or service which may be stored in a network in order to identify a user connection. Thus, a Bearer may be an information transmission path of defined capacity, delay and bit error rate, etc. In an example, if a 3GPP user or 3GPP subscriber may access a 3GPP network via WiMAX™ a WiMAX™ bearer may be created, and if the subscriber may access the 3GPP network via GSM a GSM bearer may be created. The bearer may be the unique identification of a service and/or user in a network.

An anchor may have an exclusive control over the established bearer. Therefore, an Anchor Device may also have an exclusive control over an established bearer, i.e. the Anchor Device or a PCEF may see the identification of the service and/or of the user. The anchor point, in particular the PCEF, executes the PCRF's decisions regarding the corresponding bearer.

However, in a mobile access scenario it may happen that a subscriber may establish a 3GPP bearer, e.g. for a UMTS/3G (Universal Mobile Telecommunication System/3rd Generation), for a WiMAX™ (Worldwide Interoperability for Microwave Access) or for a GPRS (General Packet Radio Service) access. Via the corresponding access technology different services may be used. For example, an IP access service, web browsing, a voice over IP (VoIP) service, IPTV and/or a VPN (Virtual Private Network) service may be utilized.

A subscriber may expect that if a service on a 3GPP bearer may have been established, the subscriber may continuously use the service even if the subscriber may have changed to a non-3GPP bearer. A non-3GPP bearer for example may be established in a Digital Subscriber Line (DSL) network.

3GPP may define several parameters or functions for a bearer. A non-3GPP bearer, e.g. a DSL bearer, may not support these functions. Thus, it may be an aspect of the invention to introduce such parameters, as for example QoS parameter, accounting quota, in a non-3GPP network in order to increase the granularity for a connection in a 3GPP network.

The bearer of a 3GPP network may differ from the bearer of a non-3GPP network in that the granularity of a 3GPP network may be finer than the granularity of a non 3GPP network. In other words, for accounting on a BRAS a AAA architecture may be used. AAA may not allow for service flow differentiation such as service flow differentiation may be possible with PCC. This means, the granularity of PCC may be finer, e.g. identify a service data flow by means of a IP 5-tuple or other filter criteria (c.f. deep packet inspection) may be possible. The IP 5 tuple may be a filter.

Thus, when a 3GPP bearer may be established, access to an IP 5-tuple may be provided. An IP 5-tuple may comprise a source IP address, a destination IP address, a source port number, a destination port number and a protocol ID (identifier) of the protocol above IP. A non-3GPP e.g. DSL bearer may substantially only allow to provide a single monolith data flow, which may not allow to differentiate the IP 5 tuple. In other words, if a DSL connection may be established, a single data flow may be provided. The services transported via the data flow may not be differentiated. Thus, charging of individual flows, services, ports or protocols within the data flow may not be possible.

A non-3GPP network may use a non-3GPP bearer, wherein a non-3GPP network may be a broadband access network without dedicated user and service identification e.g. DSL or WIMAX.

Generally in this text, the word "non-3GPP", may be used to describe networks which may substantially only allow charging on the bearer level and may substantially not provide

charging on flow level, for example DSL, WiFi. If a connection in such a non-3GPP network may be setup, in a network control this connection may appear as a single connection with substantially no further granularity. Thus, it may be an aspect of the present invention to split such a single bearer in service streams or service flows to allow a service based charging if a handover from a network having fine granularity may happen.

WLAN, WiMAX™ may be non-3GPP networks which may be integrated in a 3GPP environment.

In the context of this document, "non-3GPP" may define a network, a network environment or a network technology which may only support mobility functionalities on higher layers of the OSI (Open Systems Interconnection) Reference Model than layer 3 or L3. For example, a "non-3GPP" network may be a network, which may support mobility on an application layer or on layer 7, e.g. SIP. A non-3GPP network may be a wire bound, fixed or wireless network.

A 3GPP network may support mobility on a network layer or on layer 3, e.g. mobile IP as defined in IP v6. On higher layers than layer 3, layer 3 mobility or network layer mobility may be invisible.

Therefore, different anchor points may exist for the same service in a 3GPP network and/or in a non 3GPP network. A handover of a service between a 3GPP network and a non-3GPP network may be characterized by a change of an anchor point. In other words, a service handover between different 3GPP access networks, e.g. between UMTS and LTE may not require an anchor point change since the service in both networks may use the same anchor point. A service handover between a 3GPP network and a non 3GPP network, e.g. between UMTS and DSL, may require an anchor change.

In other words, services may be exchanged between a 3GPP network and a non-3GPP network and vice versa. Since the granularity in both types of networks may be different, in an example, a service, e.g. an IPTV service of a defined user, which service may have been started in the 3GPP network, may not be handed over to a non-3GPP network. In the non-3GPP network, e.g. a DSL network, only a single connection may exist. In other words, a service started in the 3GPP network may not 'find' a corresponding service in the non-3GPP network.

Thus, it may also be an aspect of the present invention to break down a connection or a single bearer in a plurality of services and handle a charging and policy exchange between the services. If the service granularity of a non-3GPP network may be increased, it may be possible to hand over an IPTV service of a defined user of a 3GPP network to an IPTV service of the same user in the non-3GPP network.

In a 3GPP network a PDP context may be generated for a 3GPP bearer, for a packet-switched bearer. This may be a tunnel, e.g. GTP or PMIP (proxy mobile IP). Traffic received in a PDN GW (Packet Data Network Gate Way) may be forwarded to an application server.

In the PDN only a single anchor point may exist for managing different access technologies and for managing a handover of services between different anchor points.

A DSL connection may not be known in a PDN GW.

During authorization of a bearer and/or of a service for a subscriber, a subscriber ID (Identifier), a service ID and a flow ID may be generated. This may be seen as a service key, a service triple, service 3 tuple, or service tuple or a subscriber description /service description /flow description combination. The service key may allow identifying uniquely a service in different networks. This identifier or key may not

be limited to 3 entries as in a triple. The identifier may be a single value if an identifier for a service may be generated or be any n tuple, wherein n may be any integer value.

According to an exemplary embodiment of the present invention the service triple may be reported to the SPR* and may be stored in the SPR*. This may allow a service handover and a continuous charging/policy between a 3GPP network and a non 3GPP network. For detecting that a service may continuously be used, the service triple may be matched with an already generated service triple. The service triple may also be reported to the SPR* in a 3GPP environment.

The service triple may be reported to the SPR* on service initiation or when a service handover between a 3GPP network and a non-3GPP network may be prepared.

It may also be possible to report the service triple if predefined conditions may be met. For example, the service triple may only have to be reported to the SPR* if the corresponding subscriber may be permitted to or capable of changing an anchor. Thus, the reporting may be dependent on a subscriber ID, subscriber group ID, UE device type, etc. A subscriber only having a UMTS subscription may not need to report a service triple to the SPR*.

An anchor or anchor point may be any endpoint of a connection or of a tunnel and may not be limited to a mobility anchor.

The concept of providing an anchor may comprise exclusive control over a bearer. In other words, the anchor may be a location in a network, where services can be handled on a service level. Substantially all 3GPP access networks may generate the same anchor for a service.

An example for a non-3GPP network may be a broadband access network such as a DSL network. Another example for a non-3GPP

network may be a power-line network. Thus, handing over a service from a mobile network to a fixed power-line connection may be possible while continuously charging the corresponding subscriber.

The concept of an anchor having exclusive control over bearer may not be applicable if a handover between a 3GPP network (e.g. UMTS, LTE/EPC (Evolved Packet Core)) and a non 3GPP network, e.g. a broadband access network such as DSL may be conducted.

In order to enable a continuous accounting between a fixed access network (e.g., a non-3GPP network) and a mobile access network (e.g. a 3GPP network), more than one PEF (Policy Enforcement Function) may need to be controlled. PCC (Policy and Charging Control) may be an overall concept and PEF(Policy Enforcemnet Function) may be a part of the PCC.

Applying a handover scenario for e.g. DSL access a situation may occur, where a subscriber and/or a terminal may have established a DSL bearer which may be under control of a first PEF, e.g. PEF1, and for another subscriber and/or terminal, which may have established a 3GPP bearer, e.g. 3G, LTE/EPC which may under control of a second PEF, for example PEF2. In an example, a terminal may have established a video call or a video connection to a second terminal via 3G network and another subscriber and/or another terminal may be running an IP TV (IP Television) connection to a IP TV server, for example via a DSL network.

In other words, for the two connections, two independent PEFs may exist.

Consequently, the Policy Enforcement Function (PEF) may change in some situations or the control of more than one PEF by one Policy Control function may be needed.

Therefore, according to an exemplary embodiment of the present invention, a concept for changing a Policy Enforcement point or of changing Policy Enforcement points during mobility may be provided, which concept may include a solution for continuous charging across different access systems, in particular charging across a 3GPP access network and a broadband access network without dedicated subscriber service identification or charging across different PEFs.

SIP (Session Initiated Protocol) may be used for higher layer mobility. SIP may allow mobility management of services in a non-3GPP network, such as DSL. For mobility management mechanisms SIP may be enhanced with features which may be required in mobility environments.

In other words, by providing different anchor points for different communication network access types, may allow handling connections belonging to different communication networks differently. Thus, for example accounting for 3GPP bearer may be conducted in a 3GPP network and accounting for non-3GPP bearer may be conducted in the non-3GPP network.

However, when a service may have to be handed over from one access technology to another access technology, an exchange of policy information and/or charging information between the different networks may be required. Therefore, a Handover Device, which may be adapted for handing over policy and charging control information of a subscriber from a second Anchor Device to a first Anchor Device upon detecting the change from the subscriber from the second access network to the first access network may allow to continue a charging for a service. In particular, a service, such as a video call which may have been started in a 3GPP network may continue when the user of the video call changes into a broadband access network, which may not be able to use a 3GPP bearer.

According to another exemplary embodiment of the present invention, the first Anchor Device may be associated with a

first anchor in the first network. In an example, the first Anchor Device may be the first anchor in the first network.

The first Anchor Device may establish a bearer in the first network and thus, the first Anchor Device may exclusively control the bearer. In other words, the second anchor, the second anchor point, the second PEF or the second PCEF may not have control over the first bearer.

According to another exemplary embodiment of the present invention, the first Anchor Device may be a first Policy and Charging Execution Function (PCEF) and/or a Policy and Charging Execution Device. The PCEF may control the bearer of an associated anchor and/or of an associated network.

Allowing a change of an anchor within a network by an anchor change detecting device may allow detecting that a subscriber may intend to change the access network. Policy and Charging Enforcement Function (PCEF) may encompass service data flow detection, policy enforcement and flow-based charging functionalities. The PCEF may be located at a gateway, e.g., a GGSN (Gateway GPRS Support Node) in the GPRS case and a PDG (Packet Data Gateway) in a WLAN (Wireless Local Area Network) case.

A PCEF may provide service data flow detection, user plane traffic handling, triggering control plane session management, QoS handling and service data flow measurement as well as online charging interactions and offline charging interactions.

The possibility to detect a change between a second Anchor Device and a first Anchor Device may allow maintaining the same service in different networks, wherein a first Policy and Charging Execution Function and a second Policy and Charging Execution Function may be employed for controlling corresponding bearers.

The first Anchor Device may comprise a first Policy and Charging Execution Function. If a change to the first PCEF may be detected 3GPP bearer and non-3GPP bearer may be differentiated. The PCEF may be adapted to communicate with the Anchor Change Detecting Device via the Gx interface. Via the Gx interface the PCEF may request a PCC decision for the requested bearer from the PCRF. Already existing bearers may be transparent for the newly involved PCEF. The PCRF may provide the PCEF with already existing identifiers obtained via the extended SPR (=SPR*). Via the Gx interface the PCEF may request which may already exist for the service in the second Anchor Device for a service established in the second network. The second Anchor Device may also comprise a Policy and Charging Execution Function, wherein the second Policy and Charging Execution Function may be separate from the first PCEF.

According to another exemplary embodiment of the present invention, the first Anchor Device may be associated with a bearer selected from the group of bearers consisting of a 3GPP bearer, a bearer on layer 3 and below, a network layer bearer, a fixed broadband bearer and a DSL bearer.

If the first Anchor Device may be associated with a non-3GPP bearer the first Anchor Device may differentiate an access service of a second Anchor Device, wherein the second Anchor Device may be associated with a 3GPP bearer. Therefore, a change between a second anchor and a first anchor or a second anchor point and a first anchor point may be detected by the Policy Control Apparatus and policy and/or charging control information of a subscriber may be provided from the second Anchor Device to the first Anchor Device.

The policy and/or charging control information of a subscriber may be generated when the subscriber establishes a service and upon changing the access network the policy and/or charging control information may be distributed to the new Anchor Device or to the first Anchor Device. This may

allow a continuous charging operation since the actual policy and charging control information may be exchanged in parallel with an exchange of the access network.

In other words, the policy and/or charging control information may travel in parallel to a subscriber and/or a terminal. Thus, when the subscriber and/or the terminal may travel from one network to another network a control of a bearer may be handed over from one Anchor Device to another Anchor Device.

According to another exemplary embodiment of the present invention, the first Anchor Device may be associated with a 3GPP bearer.

According to another exemplary embodiment of the present invention, handing over policy and/or charging control information of the subscriber from the second anchor to the first anchor, i.e. from the second Anchor Device to the first Anchor Device, may comprise providing from the second Anchor Device to the first Anchor Device at least one anchor change support capability selected from the group of anchor change support capabilities consisting of a charging related information, a charging rule, offline charging identifiers and online charging identifiers. Furthermore, handing over policy and/or charging control information may comprise information about a current anchor and/or a current PCEF or of the involved, i.e. old and/or new, anchor points.

In another example, the service key or the service tuple, e.g. the service 3 tuple, may be stored in combination with the old anchor and the new anchor or with the old PCEF and the new PCEF. Thus, it may be possible to identify a service which may have been handed over between networks. The combination of the key and/or tuple and the old PCEF and the new PCEF may be stored in the SPR*. Therefore, if only a key in combination with a single PCEF may be stored and the PCEF entry may disappear, the SPR* may conclude that the service

may have been cancelled. If the combination of the key, an old PCEF and a new PCEF may exist and one PCEF may disappear, the SPR* may conclude, that a handover may have been conducted. Thus, also the direction of the handover may be detected.

A 3GPP network may have a second anchor which may be associated with a second Anchor Device. A first network, such as a non-3GPP network may comprise a first anchor which may be associated with a first Anchor Device.

An anchor change support capability may be stored in a Subscription Profile Repository (SPR). A SPR which may be adapted to store change support capabilities or which may be adapted to store a service 3-tuple, may be an extended SPR or a SPR*. The anchor change support capabilities may comprise charging related information which may allow for a smooth change of anchor points. In other words, an anchor change support capability may be information which may allow an Online and/or an Offline Charging System or an Online Charging Device and/or an Offline Charging Device to continue charging, while a subscriber, the services of which subscriber may have to be charged, changes between networks, having different anchor points. Identifier for example, may allow correlating charging information of one subscriber who may travel between different type of access networks.

According to another exemplary embodiment of the present invention the Handover Device may be a Subscription Repository Device (SPR), wherein the SPR may be adapted for storing the anchor change support capability.

If the anchor change support capability may be stored in the SPR, different Anchor Devices may access the same information even if the Anchor Devices may be associated with anchor points belonging to different access networks.

According to a further exemplary embodiment of the present invention, the Anchor Change Detecting Device may be a Policy and/or Charging Rule Function Device (PCRF). In an example the PCRF device may be adapted for saving and/or retrieving charging context information to and/or from the Handover Device and/or the SPR.

Saving and retrieving charging context information may allow to exchange policy and/or charging information between networks which may have different charging concepts or which may employ different charging concepts. In other words, charging rules belonging to a service may be adapted such, that the same charging rules can be applied in different access networks, i.e. in access networks, which base on different access technologies. For example, a 3GPP network and a non-3GPP network may be networks which may not be related to one and another. In other words, a 3GPP network and a non-3GPP network may be disjunct networks.

Therefore, substantially no charging information may be exchanged between a 3GPP network and a non-3GPP network. Due to different service flow structures, the Policy and Charging concepts may also be different.

However, since an access network may only be a physical network which may be used for accessing to the same services, policy and charging, which relate to the same predefined service may be required.

An SPR, e.g. an SPR* or an extended SPR, may allow to exchange subscription profiles on a subscriber basis, independently on the underlying network access technology. The subscription profiles may be translated into policies and into charging rules which may depend on the specific access network. By providing such a translation it may be possible to provide the same or a similar policy and/or charging rule for a service within different access networks. Thus, for example an IP TV service may continuously be charged even if

a subscriber, while using the service, may change the access network.

In other words, an SPR* may be used to translate Policy and/or Charging rules between different access networks.

According to another exemplary embodiment of the present invention, the Anchor Change Detecting Device may be adapted for detecting that a combination of a subscriber description, a service description and a flow description, associated with the second Anchor Device may exist and that the same combination may also be associated with the first Anchor Device.

The combination of a subscriber description, a service description and a flow description may be a pattern which substantially may allow uniquely and substantially unambiguously to identify a service across different access networks. Therefore, the combination of a subscriber description, a service description and a flow description may be a footprint which may allow identifying a service which a certain subscriber may use in different access networks.

If the Anchor Change Detecting Device may realize or detect that in a second network, a second Anchor Device may exist which may be associated with such a combination of a subscriber description, a service description and a flow description and the Anchor Change Detecting Device may also realize that the same combination continues in a second network and may now be associated with the first network or may be associated with the first Anchor Device, the Policy Control Apparatus may realize that a change of the same service between different access networks may have been conducted.

Thus, a service established in the second network may still be used from the same subscriber in the first network. If such a continuous service can be detected by the Policy

Control Apparatus, the inventive Policy Control Apparatus may be able to continuously charge the service independently from the type of the access network. For example, the Policy Control Apparatus may translate Policy and/or Charging rules from one network to the other.

According to another exemplary embodiment of the present invention, the Policy Control Apparatus further may comprise an Off-Line Charging Device. In an example the Off-Line Charging Device may be adapted for correlating charging data records generated by the first Anchor Device and the charging data records (CDR) generated by the second Anchor Device.

In a case when a subscriber uses the same service in different access networks, charging data records for the service may be generated in different Policy Control Apparatuses or PCEFs or PEFs. An Off-Line Charging Device, which may be adapted for correlating the charging data records may allow to continue the charging of a predefined service which may continuously used in two different networks. Off-line charging may mean that for example a bill or a ticket may be generated after the generated charging data records may have been collected, e.g. after a service may have been used.

According to another exemplary embodiment of the present invention, the Policy Control Apparatus may comprise an On-Line Charging Device, wherein the On-line Charging Device may be adapted for correlating quota consumed by a first Anchor Device and quota consumed by a second Anchor Device. Correlating quota from a first Anchor Device and a second Anchor Device may allow providing online charging for continuously used services. Online charging may mean that charging may be based on credits.

According to yet another exemplary embodiment of the present invention, at least one device selected from the group of devices consisting of an Anchor Change Detecting Device, a

Handover Device and a first Anchor Device may be implemented as a device and/or as a function located on separate apparatuses.

A device may be hardware or a processor executing a certain function loaded on the processor and distributing such devices or functions over different apparatuses may allow implementing a distributed architecture for a Policy Control Apparatus. Thus, at least one device or at least one function from the group of an Anchor Change Detecting Device, a Handover Device and a first Anchor Device may be additionally implemented with another functionality such as a gateway functionality.

Distributing functions or devices or spreading functions or devices over a plurality of separate devices may allow increasing the performance of a Policy Control Apparatus.

According to yet another exemplary embodiment of the present invention service, handed over from the second Anchor Device to the first Anchor Device may be identified by a key, a service 3 tuple, the service triple or service tuple.

Identifying a service by a service 3 tuple or by another identifier, which may substantially unambiguously identify the service, may allow to continuously charging the service, even if a anchor change may be conducted.

It has also to be noted that exemplary embodiments of the present invention and aspects of the invention have been described with reference to different subject-matters. In particular, some embodiments have been described with reference to apparatus type claims whereas other embodiments have been described with reference to method type claims. However, a person skilled in the art will gather from the above and the following description that unless other notified in addition to any combination between features belonging to one type of subject-matter also any combination

between features relating to different subject-matters in particular between features of the apparatus claims and the features of the method claims may be considered to be disclosed with this application.

These and other aspects of the present invention will become apparent from and elucidated with reference to the embodiments described hereinafter.

Exemplary embodiments of the present invention will be described in the following with reference to the following drawings.

Brief description of the drawings

Fig. 1 shows a PCC architecture according to an exemplary embodiment of the present invention.

Fig. 2A shows a handover from a 3GPP network to a DSL network before a handover has been conducted according to an exemplary embodiment of the present invention.

Fig. 2B shows a network scenario comprising a video call and an IP TV session after a handover according to an exemplary embodiment of the present invention.

Fig. 3 shows a flow diagram for a method for handing over policy control information of a second Anchor Device to a first Anchor Device according to an exemplary embodiment of the present invention.

Detailed description

The illustration in the drawings is schematic. In different drawings, similar or identical elements are provided with the same reference numerals.

Fig. 1 shows a PCC architecture according to an exemplary embodiment of the present invention. The PCC (Policy and Charging Control) architecture may be implemented in the form of a Policy Control Apparatus 100. The Policy Control Apparatus 100 comprises the Policy and Charging Execution Function 101 or Anchor Device 101, which may run or which may be located on a gateway (not shown in Fig. 1) The Anchor Device 101 may be an anchor 101 associated with a bearer of a network (not shown in Fig. 1).

The Policy and Charging Execution Function (PCEF) 101 may be a function running on a first Anchor Device 100. In an example the PCEF may run on a gateway, i.e. an anchor. The PCEF 101 is connected to the Policy and Charging Rules Function (PCRF) 102 or to the Anchor Change Detecting Device 102 via the interface Gx 103.

Other Policy and Charging Execution Function are connected to the PCRF 102 via the Gxx interface 104.

Via the Rx interface 105 the PCRF 102 is connected to the Application Function (AF) 106.

The PCRF 102 furthermore is connected to the Subscription Profile Repository* (SPR*) 107 via the interface SP* 108.

The Policy Control Apparatus 100 based on the PCC architecture further comprises an Online Charging System (OCS) 109 or an Online Charging Device 109. The Online Charging System 109 OR Online Charging Device 109 is connected to the PCEF 101 via the Gy interface 110.

Furthermore, the Policy Control Apparatus 100 comprises the Offline Charging System (OFCS) 111 or the Offline Charging Device 111. The Offline Charging Device 111 is connected to the PCEF 101 via the GZ interface 112.

The Policy Control Apparatus 100 may base on the PCC architecture (Policy and Charging Control).

Whereas in Fig. 1 a distributed architecture for a Policy Control Apparatus is shown, the components or devices of the Policy Control Apparatus 100 may be included in a single housing or in a single apparatus.

An anchor point 101 change may be a change of the Policy and Charging Execution Function (PCEF) 101. An anchor point change may happen, if a subscriber may use a service via different access networks.

A change of an anchor point 101 may affect three reference points or three interfaces in a PCC architecture 100.

In an example a change of an anchor point may affect the Gx 103, the Gy 110 and the Gz 112 reference point. Different access networks may also comprise different policy control apparatuses 100, wherein in Fig. 1 only one Policy Control Apparatus may be depicted.

Also components of the Policy Control Apparatuses may be shared. For example, a SPR 107, an AF 106 and a PCRF 102 can be shared by a first PCEF 101 associated with a first network and a second PCEF 101 associated with a second network (in Fig. 1 only a single PCEF 101 is depicted).

In an example at least two Policy Control Apparatuses 100 may share a common Subscription Profile Repository 107. Thus, an advertising access function and/or an accounting management concept for changes in access networks with changing anchor points may be provided.

In an example the functional groups which are involved in the change process of changing an anchor point may have to be provided with information in order to correctly retrieve

required charging rules to be installed on the new PCEF 101 from the PCRF (via the GX interface) 102, 103.

The functional groups involved in an anchor point change may be two different Policy and Charging Control functions 102 or the Policy and Charging Rules Function PCRF 102, the old PCEF 101 and the new PCEF 101.

The old PCEF 101 or the second Anchor Device 101 may correspond to a second anchor point or a second bearer and the new PCEF 101 or the first Anchor Device 101 may correspond to a first anchor point or a first bearer.

The second network may be a 3GPP network and the first network may be non-3GPP network, e.g. a DSL network.

Furthermore the anchor points or the Anchor Devices 101 involved in the anchor changing process may have the current off-line charging identifiers available in order to correlate charging data records (CDRs) generated by the old PCEF of the second network and the new PCEF 101 of the first network for the ongoing service sessions. The CDRs for off-line charging may be provided from the corresponding PCEF 101 to the Offline Charging Device 111 via the reference point Gz 112.

Furthermore the old PCEF and the new PCEF, which may be involved in the anchor changing process, may have to be provided with information in order to have the current on-line charging identifiers available in order to release and request quota from OCS (Online Charging System) 109 and also to allow for a converged charging there, i.e. for enabling the correlation between consumed quota by the old PCEFs 101 and the new PCEFs 101 via the Gy interface by the OCS 109.

In other words, the second network, for example a 3GPP network may comprise a second anchor point related to a second PCEF and a first network, for example a DSL network, may comprise a first anchor point, related with a first PCEF.

The first PCEF and the second PCEF may be connected to a shared SPR* 107. Furthermore the first PCEF and the second PCEF each are connected to the same On-line Charging System (OCS) 109 and Off-line Charging System (OFCS) 111. The first network may have a first OCS and/or a first OFCS and the second network may have a second OCS and/or a second OFCS

Since the first network and the second network may be different networks different anchor points may be established in each of the separate networks. Since different anchor points are established in different networks, also different bearers are established to provide the basis for a service.

A service in the first network and in the second network may be a video conference service, a video call, a Voice over IP (VoIP) service or an IP TV service. In order to charge the service or to provide Policy Control for the service on a service level, i.e. across different underlying physical access networks, it may make substantially no difference, whether the service is provided via the first network and/or via the second network. However, since for the service in each of the first network and the second network a different bearer, e.g. a first bearer and a second bearer, may be established, also different anchor points may be established.

Therefore, different PCEFs 101, which are associated with the anchor points have to be established. The anchor points and the PCEFs of the different networks may be disjunct and may not be connected. In order to provide a unique service or a seamless service, from a policy and charging perspective, a seamless handover between the second anchor point and the second anchor point may have to be provided when the terminal changes from the second access network or from the second network to the first network or to the first access network while maintaining the service.

In order to achieve a substantially seamless handover on a service level, charging rules on the first PCEF may be taken

over from the second PCEF. Thus, in the different networks, the service rules for charging the service may be the same. In an example, a translation of the service rules may be required, which translation may be executed by requesting a PCRF 102 via the interface Gx 103. In other words Gx may serve the provision of PCC rules. Anchor changes may be transparent to the PCEF with the exception of being provisioned with already existing identifiers/context information.

Furthermore in an Off-line Charging System 111 CDRs, generated by the second PCEF as long as the service is active in the second network are correlated with CDRs, generated by the first PCEF, as long as the service is active in the first network.

In order to provide a seamless off-line charging, CDRs generated by the second PCEF and by the first PCEF may be correlated in order to prevent that the service may be charged twice.

Similar, an on-line charging identifier may be provided to CDRs generated of the second PCEF as long as the service is active in the second network. The identifier may allow correlating the quota from the second PCEF with quota generated by the first PCEF as long as the service is active in the first network. Thus, converged charging may be allowed for on-line charging and double charging may be prevented.

In order to provide anchor change support capabilities, such as common charging rules, offline charging identifiers and/or online charging identifiers a Subscription Profile Repository, SPR* may be utilized to exchange the offline charging identifiers and/or online charging identifiers. The SPR* may comprise a subscriber related information and/or subscription related information that a PCRF 102 require for subscription based policies as well as for IP-CAN bearer level PCC rules.

The SPR provides the subscriber related information and/or the subscription related information and the IP-CAN bearer level PCC rules. A subscription profile information may comprise the subscribers allowed services, for each allowed service, a pre-emption priority , an information on the subscribers allowed QoS, including the subscribed guaranteed bandwidth QoS, the subscribers charging related information and the subscriber category. In an example a charging related information may be a location information relevant for charging. Service pre-emption priority may enable the PCRF to resolve conflicts where the activation of all requested active PCC rules for services would result in a cumulative authorized QoS which exceeds the Subscribed Guaranteed bandwidth QoS.

The SPR* in particular may further comprise subscribers charging related information, to which IP-CAN (IP Connectivity Access Network) bearer related information may be added, which allows for a smooth change of anchor points.

The subscriber's charging-related information may comprise the identifiers as already described above and/or further charging-related context information required for anchor point changes.

The PCR 102 and the SPR* 107 may interact over the extended SP reference point 108. The extended SP reference point is called SP* 108.

The PCEF 101 may also be adapted to work with a non-3GPP network. An example for a non-3GPP may be a DSL network. In order to work with a non-3GPP network, such as a DSL network, the PCEF 101 may be adapted to be available on a Broadband Remote Access Server (BRAS). A BRAS may be a connection end point for a DSL connection and in particular for a xDSL connection such as ADSL (Asynchronous Digital Subscriber

Line), SDSL (Synchronous Digital Subscriber Line) or a HDSL (High-speed Digital Subscriber Line).

For example, in order to be compatible with a BRAS, the PCEF function may be adapted to be located on the BRAS. The BRAS, for example acts as a gateway and thus, the BRAS may act as the anchor point for the DSL access network. A BRAS may only be adapted to use AAA (Authentication, Authorization, Accounting) functionality and thus, no accounting below the bearer level is possible in DSL network. Therefore, a SPR* may be provided for non-3GPP networks.

An IP 5 tuple may comprise a source IP address, a destination IP address, a source port number, a destination port number, a protocol ID of the protocol above IP.

For example, a non-3GPP network may be a AAA based network, i.e. a network which authenticates a subscriber with using a AAA server.

The IP 5 tuple is an example for a service flow filter in a PCC rule. The standard DSL solution, which may base on AAA, may not allow the fine granularity of PCC. AAA may only handle a complete connection as one.

The PCEF 101 may run on the BRAS. Thus, it can be seen, that the PCC architecture 100 or the Policy Control Apparatus 100 may be a distributed system wherein the PCEF 101, the PCRF 102, the SPR* 107, the AF 106, the OCS 109 and/or the OFCS 111 may run on different hardware platforms, such as a BRAS, a Gateway or a charging server.

AAA server based solution may not allow a flow-based charging. A flow-based charging may allow for a differentiated charging on the level of service data flows whereas a non-3GPP network may only allow to charge on the level of a single bearer. A single bearer based network may also be an IP network in a PMIP mode (Proxy Mobile IP). A non

3GPP network may use the concept of PMIP for implementing mobility. In an example however, PMIP may be implemented for WiMAX and for WLAN and not for DSL.

When a subscriber's UE, i.e. a subscriber terminal, may try to establish an IP-CAN bearer, the PCEF 101 request a PCC authorization for the requested bearer over the Gx reference point 103 from the PCRF 102. An IP-CAN bearer may be established for GPRS by a PDP (Packet Data Protocol) context activation procedure.

The PCRF 102 then requests subscriber information, allowed services and bearer information via the SP* interface 108 from the Subscription Profile Repository SPR* 107 and potential information from the Application Function 106 .

The Sp reference point may allow the PCRF to request subscription information related to the IP-CAN transport level policies from the SPR based on a subscriber ID, a PDN identifier and possible further IP-CAN session attributes. For example, the subscriber ID can be IMSI (International Mobile Subscriber Identity). The reference point may allow the SPR to notify the PCRF when the subscription information has been changed if the PCRF has requested such notifications. The SPR may stop sending the updated subscription information when a cancellation notification request has been received from the PCRF.

The PCRF 102 then selects and where required, completes PCC rules which have to be provided to the requesting PCEF 101 or which may have to be activated in the requesting PCEF 101 for the respective bearer. These PCC rules may be returned as an authorization decision over the Gx reference point 103. The information provided via the Gx reference point 103 to the PCEF thus may comprise subscriber information, allowed services and bearer information.

Furthermore via the Gx interface potential charging context information may be provided to the PCRF 101, which charging context information may be required for an anchor change from the second anchor point to the first anchor point. This charging context information is provided from the extended SPR* 107. The PCRF 102 saves the charging context information to the SPR* and the PCRF also retrieves the charging context information from the SPR*. The PCRF saves and retrieves such context information to and from the SPR*, which charging context information may be relevant for a potential change of anchor points.

Additionally, the PCRF creates an entry for the new subscriber / service / flow description combination or the service 3 tuple in the SPR* that comprises the requesting PCEF's identifier as well as the charging context information required for the anchor change, namely the IMS Charging Identifier (ICID) if present and the access network charging identifier (e.g. the EPC Charging Identifier) both exchanged during the bearer establishment and authorization procedure. The provided charging rules may need not to be saved as they may be newly derived when the anchor changes during a handover procedure.

A potential change of anchor points for which the PCRF saves charging context information to the SPR* may be charging context information which may be required, if for example a subscriber and/or a terminal conducts a handover from a mobile access network (3GPP based) to a DSL network (non-3GPP based or single bearer based). The charging context information may also be required, when a subscriber conducts a handover from a DSL network to a mobile access network. In other words, the charging context information may be information which may be required for a change of anchor points. And a change of anchor points may be required if a subscriber changes an access network between a 3GPP network and a non-3GPP network.

When a request for PCC authorization reaches the PCRF via the Gx 103 reference point, the PCRF 102 queries the SPR* 107 for a combination of a subscriber description, a service description and a flow description. In other words, this means, when a handover between a 3GPP network and a non-3GPP network may happen, a PCC authorization for the non-3GPP network may be required. In order to conduct an authorization of the subscriber in the non-3GPP network the PCRF 102 may be requested. In order to authorize a subscriber, the PCRF may request the SPR* 107 whether the same subscriber description, service description and flow description combination as requested by the bearer may already exist at another PCEF 101. In other words, by detecting that the same subscriber description, service description and flow description combination associated with a second anchor or with a second bearer exists for a PCEF associated with a first anchor or with a first bearer, a continued service may be detected.

If a subscriber description, service description and flow description combination (the same) not exist in the SPR* 107, a standard PCC procedure as defined in 3GPP TS 23.203 may be carried out. Additionally the PCRF 102 creates an entry for the new subscriber description, service description and flow description combination in the SPR* 107. The new subscriber description, service description and flow description may be associated with the new anchor, for example the first anchor.

The new subscriber description, service description and flow description combination (subscriber/service/flow description combination) in the SPR* comprises the identifier of the requesting PCEF 101, i.e. the PCEF associated with the new anchor, for example the PECF associated with the first anchor.

The subscriber description, service description and flow description combination may also comprise charging context information required for the anchor change. Charging context information required for the anchor change may be IMS (IP

Multimedia Subsystem) charging identifier (ICID) if present and the access network charging identifier, e.g. the EPC (Evolved Packet Core) charging identifier. The ICID and the EPC charging identifier are both exchanged during the bearer establishment and authorization procedure , e.g. on a GPRS bearer establishment. The provided charging rules may not need to be saved as they can be derived when the anchor changes during a handover procedure. Charging rules may not need to be saved as they can be newly requested.

If for the same subscriber description, service description and flow description combination a bearer already exits at another PCF, the PCRF or the Anchor Change Detecting Device 102 may assume or conclude, that a pending change in anchor points is conducted. In other words, if the Anchor Change Detecting Device detects that at least two different PCEF associated with two different anchors or with two different networks exist for the same subscriber description, service description and flow description combination the anchor charge detecting may assume that a service which may have been established in a second network may still be maintained while a subscriber is changing to a first network.

Thus, the Anchor Change Detecting Device may detect an anchor change, because two different anchor points exist belonging to the same subscriber description, service description and flow description combination. This may mean, that the new PCEF, the first PCEF or the PCEF which may be currently requesting PCC authorization, needs to be provided with the PCC rules and/or with the PCC information which may be relevant for continuously charging and accounting the service session which may be handed over to a new anchor point. The new anchor point may be the new PCEF. The charging and/or accounting information for the service may comprise charging rules or offline charging identifiers or online charging identifiers.

The PCC rules can be newly provided to the new PCEF, i.e. the PCEF currently requesting PCC authorization, and the PCC rules which have been activated and/or which have been installed for the corresponding old bearer may not need to be transferred from the old PCEF or second PCEF to the new PCEF or first PCEF. However, the PCC rules activated or installed for the corresponding old bearer may need to be removed after the handover and after the change of the anchor point have successfully taken place. In other words, when the service have been handed over from the second network to the first network rules, which have been activated or installed in the second network for the second bearer may have to be removed since the same rules may now have been activated for the first bearer in the first network. When a bearer may be terminated, the corresponding PCC rules may be removed.

However, the new PCEF has to be informed about the charging identifiers which have been used for the old bearer such that incorrect charging and billing can be avoided and a correct correlation of charging information is possible. For example, offline charging identifiers and online charging identifiers used for the old bearer may have to be provided for the new PCEF to allow a correct correlation of the CDRs. The new PCEF is informed about the charging identifiers which have been used for the old bearer as part of the PCRFs authorization decision which may be communicated over the GX reference point. In other words, the new PCEF may request from the PCRF an authorization decision and if the PCRF has conducted an authorization decision, PCC rules and charging identifiers are communicated over the GX reference point to the new PCEF 101.

Based on the charging identifiers passed to the PCEF the interaction with the charging systems 109, 111 via the Gy 110 reference point and the Gz 112 reference point takes place.

In case of offline charging via the Gz reference point, the new PCEF 101 generates the CDRs as required by the PCC rules.

The CDRs also comprise the charging identifiers obtained from the PCRF. The charging identifiers may be needed for a correlation and the PCEF sends the charging identifiers to the specified destination. The destination may be specified in the rules and may be the OCS or OFCS and/or the Billing system. PCEF may not send isolated identifiers but may send them in the CDRs.

After handover has been completed, the old PCEF closes all CDRs belonging to the old IP-CAN bearer and sends them to the specified offline charging destination.

Double generation of offline CDRs may be avoided by the policy control architecture.)

In case of online charging via the Gy reference point, the new PCEF 101 requests quota, e.g. units specifying the number of minutes or bytes allowed or already paid for, from the specified OCS 109. The new PCEF sends with the request the charging identifiers used by the old PCEF to the OCS 109, which identifiers the new PCEF have been obtained from the PCRF 102. The new PCEF sends the charging identifiers used by the old PCEFs and obtained from the PCRF to the OCS 109, such that a correlation or a potential quota splitting can be conducted in the OCS 109.

A potential quota splitting may have to be conducted, e.g. because a large amount of quota has been generated to the old PCEF such that the request from the new PCEF would otherwise be rejected. For example if too much money has been reserved, such that not enough money is left to do it again. This could happen if no coordination between PCEFs was introduced. A request may be rejected from the PCEF if not enough money left on subscriber account.

A transfer of quota between old PCEF and new PCEF may not be used since granted units may differ in valuation of which the PCEFs do not have knowledge such that the OCS needs to be

included in this interaction . For example if units provided as quota may have a different monetary value.

Besides, the charging identifier may be required in case that OCS also generates CDR files as part of a converged charging solution. After handover has successfully taken place, the old PCEF returns all remaining quota to the OCS by reporting the quota consumption.

Fig. 2A shows a handover from a 3GPP network to a DSL network before a handover has been conducted according to an exemplary embodiment of the present invention. In Fig. 2A a scenario is shown where the same operator operates different networks, e.g. the 3GPP network 208 and the DSL network 200. The operator may be interested to provide a common billing for services provided on both networks.

The first network is a DSL broadband access network 200. The DSL network is a non-3GPP network 200. On the first network 200 an IP service 201 has been established between an IP TV subscriber 202 and an IP TV server 203. The IP TV service 201 may use the SAE GW1 204. The SAE GW1 204 comprises the S-GW (Serving Gateway) 205. The P-GW (PDN (Public Data Network) Gateway) 206 comprises the first PCEF 207

In a second access network, the 3GPP network 208, e.g. a 3G (3^{rd} generation) or UMTS network, a subscriber uses an IP connectivity service 210. Via the second SAE GW2 209 the service connection 210, for example a video call is established between terminal A 211 and terminal B 212.

The IP TV service 201 and the video call 210 are transported via the IP network IP-NW 213.

The second SAE-GW2 209 comprises the S-GW 214 and the P-GW 215 which are connected via a S5 interface. The P-GW 215 comprises the second PCEF 216 and the Gx reference point. Thus, in Fig. 2A a use case is shown, where a video call 210

between terminal A 211 and terminal B 212 via the 3G network 208 is established. Furthermore, in a separate network, for example in a network at home, an IP TV session 201 via the DSL network 200 runs in parallel.

The PCEF 216 may be the second PCEF or the old PCEF 216 after an handover.

Fig. 2B shows a network scenario comprising a video call and an IP TV session after a handover according to an exemplary embodiment of the present invention.

Fig. 3 shows a flow diagram for a method for handing over policy control information of a second Anchor Device to a first Anchor Device according to an exemplary embodiment of the present invention.

After the video call 210, e.g. an IP service, between terminal A 211 and terminal B 212 has been handed over from the 3GPP network 208 to the DSL network 200 the video call 210 has a new PCEF 207. Once the user 211 or terminal A 211 comes home, the video call 210 should be continued by using the DSL access network 200 at home. After the handover of the video call 210 from the SAE-GW2 209 or from the old SAE-GW2 209 to the new SAE-GW1 204, the new PCEF 207 is associated with the video call 210. The PCEF 216 in Fig. 2B is the old PCEF of the video call 210.

The Policy and/or Charging rules for the video call 210 have been transferred from the old PCEF 216 to the new PCEF 207 and can be used for continuously billing the video call service 210.

It may not be assumed that the same SAE-GW is used for the video call 210 and the IP TV connection 201. If only a single SAE-GW is available in the whole network, it may be assumed, that both services use the same SAE-GW.

Due to missing mobility functions in the access, the traffic of the DSL connection comprising the IP TV connection 201 may not be separated at the DSL access. In a 3GPP network may no need exist to separate traffic of a bearer, because substantially all traffic of a bearer may be related to one single subscriber. Therefore, traffic for the video session 210 would be routed via SAE-GW1

In other words, since network connections may be handled independently in the networks, the handover on a network layer (layer 3) may not be possible, e.g. between 3GPP networks and non 3GPP networks. I.e. an anchor change may be involved when changing the network. Therefore, information about the services used in the networks may be lost and the same service may not be associated one with another. The key or the service n tuple may be an association, which may allow associating at least two services.

Thus, since a new anchor may be established on network layer when a service handover may be conducted, a SPR* may be used, which remembers the anchors and/or the PCEF and may know, which anchor may be the current or new anchor.

A charging session needs to be transferred to SAE-GW1 204. It may be seen as an aspect of the invention providing the SPR* with the charging related parameters, e.g. the service tuple. The PCRF 102 may know the SPR* 107, however the PCEF may not know the SRP*. Thus, communication between SPR* and PCEF 101 may be via the PCRF 102.

Policy and Charging Execution Function can be located in a SAE GW, and SPR can be a network element or a database in a SAE core network providing subscriber profile information over enhanced Sp reference point. A scenario may be provided, where gateways are located in different network domains and where a PCEF may be located in the non-3GPP access network gateway, so that a handover between the anchors or gateways can be executed.

Fig. 3 shows a flow diagram for a method for handing over policy control information of a second Anchor Device to a first Anchor Device.

The method starts in an idle state S 300 and comprises in a first step S301 detecting that a subscriber is changing from the second Anchor Device to the first Anchor Device.

Upon detecting that the subscriber is changing from the second Anchor Device to the first Anchor Device in a second step S301 the method comprises handing over Policy and Charging Control Information of the subscriber from the second Anchor Device to the first Anchor Device upon detecting.

In step S303 the method reaches again the idle state.

It should be noted that the term "comprising" does not exclude other elements or steps and the "a" or "an" does not exclude a plurality. Also elements described in association with different embodiments may be combined.

It should also be noted that reference signs in the claims shall not be construed as limiting the scope of the claims.

Acronyms and Terminology

AAA:	Authentication, Authorization and Accounting
BRAS:	Broadband Remote Access Server
CDR:	Charging Data Record
DSL:	Digital Subscriber Line
EPC:	Evolved Packet Core
ICID:	IMS Charging Identifier
IMS:	IP Multimedia Subsystem
IP:	Internet Protocol
IP-CAN:	IP Connectivity Access Network
PCC:	Policy and Charging Control
PCEF:	Policy and Charging Execution Function
PCRF:	Policy and Charging Control Functions
PMIP:	Proxy Mobile IP
QoS:	Quality of Service
SAE:	System Architecture Evolution
SPR:	Subscription Profile Repository

Patent claims

1. A Policy Control Apparatus (100), comprising:
an Anchor Change Detecting Device (102);
a Handover Device (107);
a first Anchor Device (101);
wherein the Anchor Change Detecting Device (102) is adapted for detecting that a subscriber is changing from a second Anchor Device to the first Anchor Device (101);
wherein the Handover Device (107) is adapted for handing over Policy and Charging Control Information of the subscriber from the second Anchor Device to the first Anchor Device (101), upon detecting the subscriber is changing from the second Anchor Device to the first Anchor Device (101).

2. The Policy Control Apparatus (100) of claim 1, wherein the first Anchor Device (101) is associated with a first anchor in a first network (204).

3. The Policy Control Apparatus (100) of claim 1 or 2, wherein the first Anchor Device (101) is a first Policy and Charging Execution Device (101) and /or a first Policy and Charging Execution Function (101).

4. The Policy Control Apparatus (100) of one of claims 1 to 3, wherein the first Anchor Device (101) is associated with a bearer selected from the group of bearers consisting of:
a non-3GPP bearer;
a fixed broadband bearer; and
a DSL bearer.

5. The Policy Control Apparatus (100) of one of claims 1 to 3, wherein the first Anchor Device (101) is associated with a 3GPP bearer.

6. The Policy Control Apparatus (100) of one of claims 1 to 5, wherein handing over Policy and Charging Control Information of the subscriber from the second Anchor Device to the first Anchor Device (101) comprises providing to the first Anchor Device (101) at least one Anchor Change Support Capability selected from the group of Anchor Change Support Capability consisting of:

a charging-related information;

an offline charging identifier; and

an online charging identifier.

7. The Policy Control Apparatus (100) of one of claims 1 to 6, wherein the Handover Device (107) is a Subscription Repository Device;

wherein the Subscription Repository Device (107) is adapted for storing the Anchor Change Support Capability.

8. The Policy Control Apparatus (100) of one of claims 1 to 7, wherein the Anchor Change Detecting Device (102) is a Policy and Charging Rule Function Device (102);

wherein the Policy and Charging Rule Function Device (102) is adapted for saving and/or retrieving charging context information to/from the Handover Device.

9. The Policy Control Apparatus (100) of one of claims 1 to 8, wherein the Anchor Change Detecting Device (102) is adapted for detecting that a combination of a subscriber description, a service description and a flow description associated with the second Anchor Device exists, which combination is associated with the first Anchor Device (101).

10. The Policy Control Apparatus (100) of one of claims 1 to 9, further comprising:

an Off-line Charging Device (111);

wherein the Off-line Charging Device (111) is adapted for correlating Charging Data Records generated by the first Anchor Device (101) and the second Anchor Device.

11. The Policy Control Apparatus of one of claims 1 to 10, further comprising:

an On-line Charging Device (109);

wherein the On-line Charging Device (109) is adapted for correlating quota consumed by the first Anchor Device (101) and the second Anchor Device.

12. The Policy Control Apparatus (100) of one of claims 1 to 11, wherein at least one device selected from the group of devices consisting of:

the Anchor Change Detecting Device (102);

the Handover Device (107); and

the first Anchor Device (101);

is implemented as a device and/or as a function located on separated apparatuses.

13. The Policy Control Apparatus (100) of one of claims 1 to 12, wherein a handed over service is identified by a service 3 tuple.

14. Method for handing over policy control information of a second Anchor Device to a first Anchor Device, the method comprising:

detecting that a subscriber is changing from the second Anchor Device to the first Anchor Device;

handing over Policy and Charging Control Information of the subscriber from the second Anchor Device to the first Anchor Device upon detecting the subscriber is changing from the second Anchor Device to the first Anchor Device.

15. A computer readable medium comprising program code, which program code is adapted , when being executed on a processor, to carry out a method comprising:

detecting that a subscriber is changing from a second Anchor Device to a first Anchor Device;

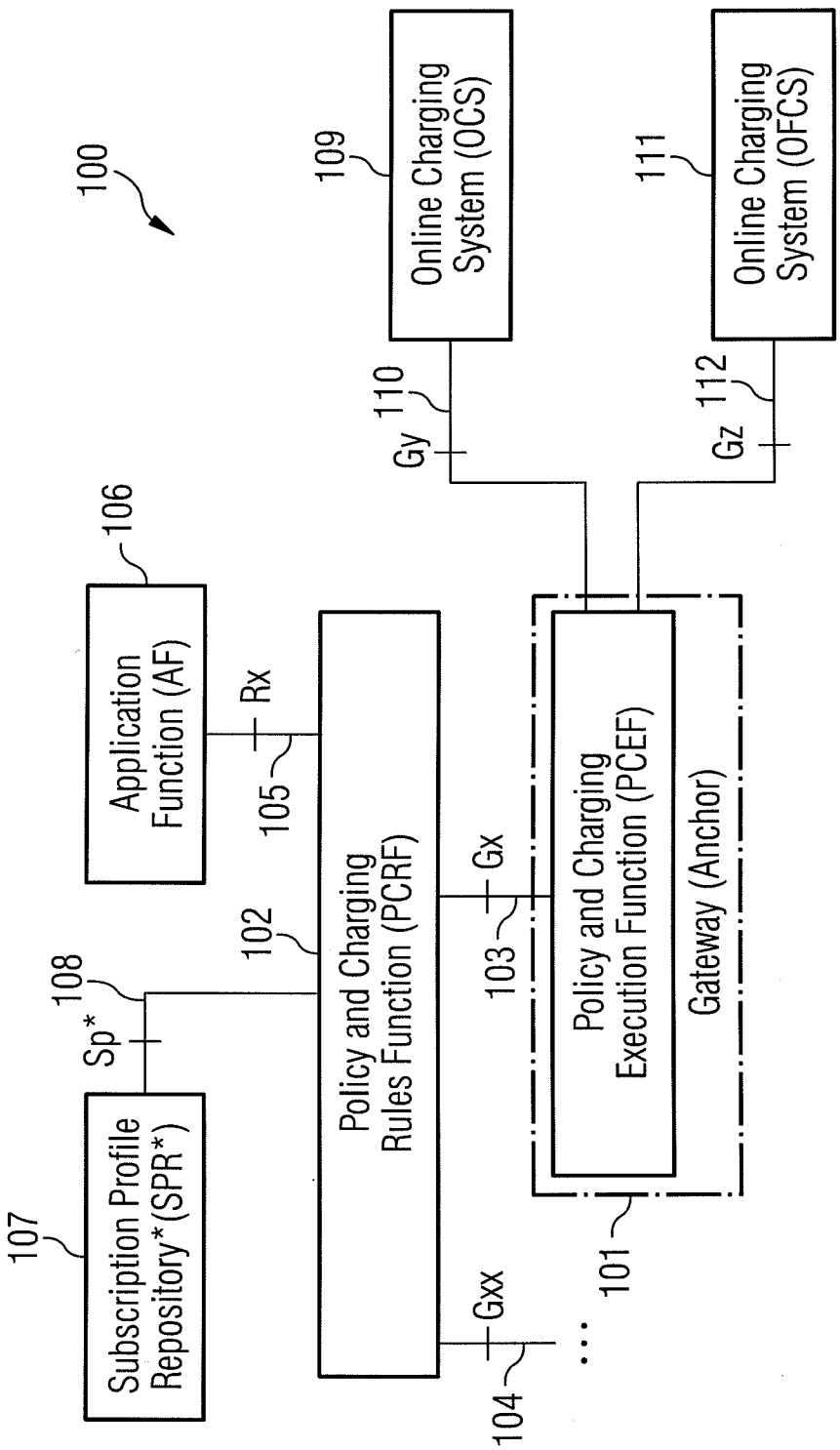
handing over Policy and Charging Control Information of the subscriber from the second Anchor Device to the first

Anchor Device upon detecting the subscriber is changing from the second Anchor Device to the first Anchor Device.

16. Broadband Remote Access Server comprising a Policy Control Apparatus of one of claims 1 to 13.

17. Use of a Subscription Profile Repository function for handing over Policy and Charging Control Information of the subscriber from a second Anchor Device to a first Anchor Device, upon detecting that the subscriber is changing from the second Anchor Device to the first Anchor Device.

FIG 1


100
109
Online Charging System (OCS)
111
Online Charging System (OFCS)
110
Gy
112
Gz
106
Application Function (AF)
Rx
105
102
Policy and Charging Rules Function (PCRF)
Gx
103
Policy and Charging Execution Function (PCEF)
Gateway (Anchor)
108
Sp*
107
Subscription Profile Repository*(SPR*)
Gxx
104
101

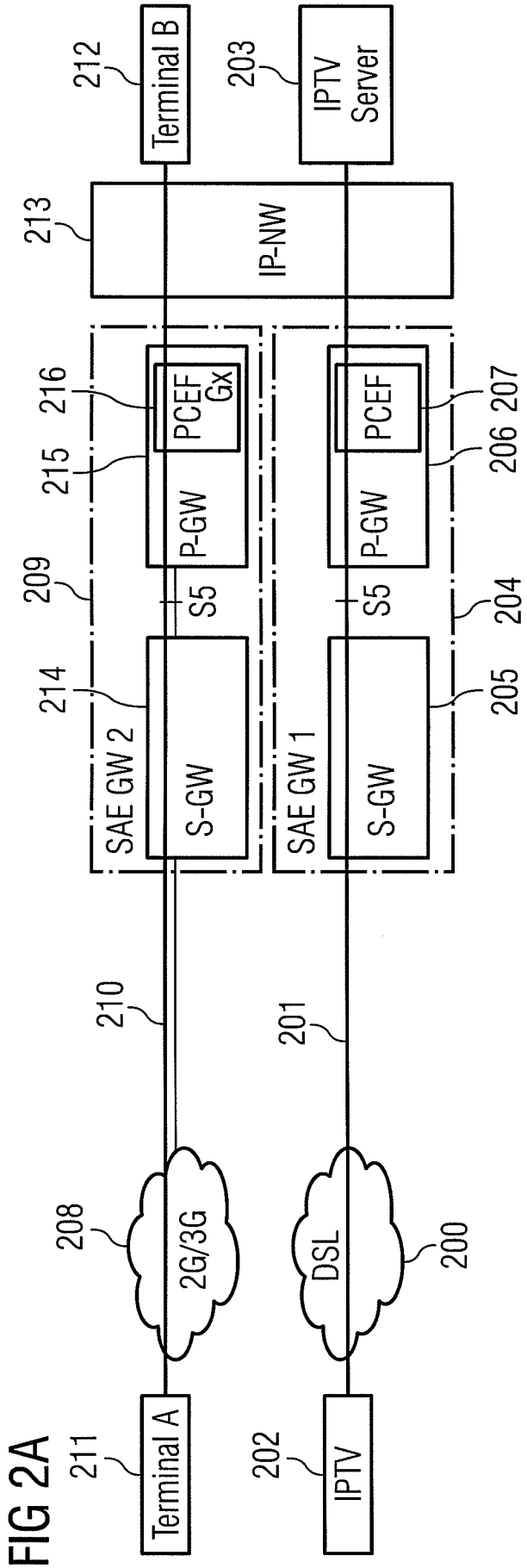

212
Terminal B
203
IPTV Server
213
IP-NW
216
215
PCEF Gx
P-GW
209
S5
214
SAE GW 2
S-GW
210
208
2G/3G
211
Terminal A
PCEF
207
206
204
205
SAE GW 1
S-GW
201
DSL
200
202
IPTV

FIG 2A

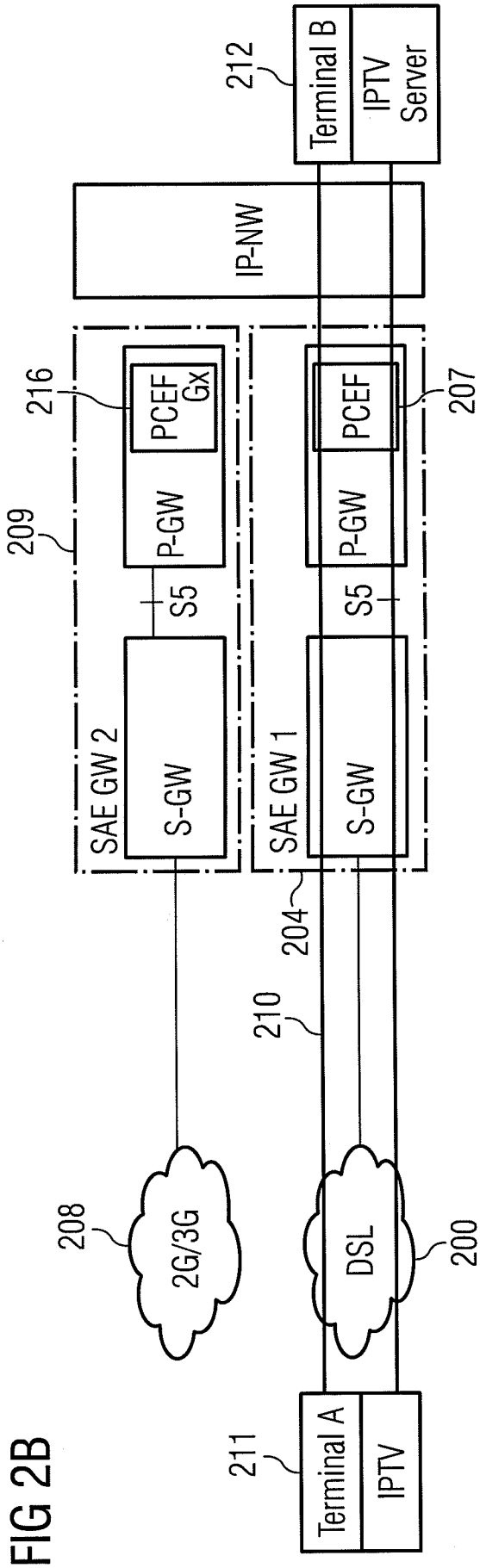
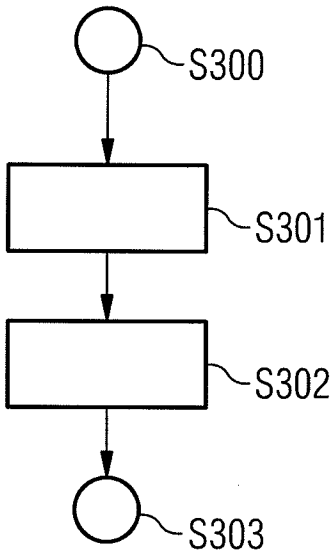

212
Terminal B
IPTV Server
IP-NW
216
PCEF Gx
P-GW
209
S5
SAE GW 2
S-GW
208
2G/3G
211
Terminal A
IPTV
PCEF
207
204
SAE GW 1
S-GW
210
DSL
200

FIG 2B

FIG 3



INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2008/065156

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04W36/12

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H04W H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2008/094401 A (LUCENT TECHNOLOGIES INC [US]; FEDER PERETZ MOSHE [US]; LIVANOS KONSTAN) 7 August 2008 (2008-08-07)	1-3,5,6, 8,10-15, 17
Y	abstract page 5, line 33 - page 7, line 35 page 8, line 25 - page 10, line 21	4,7,9,16
Y	WO 2007/038947 A (ERICSSON TELEFON AB L M [SE]; RYDNELL GUNNAR [SE]; ROMMER STEFAN [SE];) 12 April 2007 (2007-04-12) abstract page 5, line 14 - page 9, line 25 page 11, line 6 - line 20 page 16, line 11 - page 19, line 9 page 21, line 12 - page 23, line 20 page 23, line 22 - page 24, line 14 page 24, line 16 - page 26, line 15	4,7,16

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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"O" document referring to an oral disclosure, use, exhibition or other means

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
16 July 2009	30/07/2009

Name and mailing address of the ISA/	Authorized officer
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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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Y	US 2006/291419 A1 (MCCONNELL VON K [US] ET AL) 28 December 2006 (2006-12-28) abstract paragraph [0014] - paragraph [0024] paragraph [0041] - paragraph [0043]; figure 1 paragraph [0046] - paragraph [0048]; figure 1 paragraph [0053] - paragraph [0055]; figure 1	9
A	VICTOR Y.H. KUEH, MICK WILSON: "Evolution of Policy Control and Charging (PCC) Architecture for 3GPP Evolved System Architecture" IEEE VTC 2006, 63RD CONFERENCE, [Online] 18 September 2006 (2006-09-18), pages 259-263, XP002537246 ISSN: 1550-2252 ISBN: 1-7803-9392-9 Retrieved from the Internet: URL:http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=1682816> [retrieved on 2009-07-15] abstract paragraph [000I] - paragraph [00II]	1-17

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2008/065156

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