

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization

International Bureau



(43) International Publication Date  
28 May 2015 (28.05.2015)

WIPO | PCT

(10) International Publication Number  
WO 2015/077255 A1

(51) International Patent Classification:  
*H04M 15/00* (2006.01)

(21) International Application Number:  
PCT/US2014/066239

(22) International Filing Date:  
18 November 2014 (18.11.2014)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:  
14/085,779 20 November 2013 (20.11.2013) US

(71) Applicant: ORACLE INTERNATIONAL CORPORATION [US/US]; 500 Oracle Parkway, Mail Stop 50P7, Redwood Shores, CA 94065 (US).

(72) Inventor: LEE, Joseph Wonseok; 4219 Diavila Ave, Pleasanton, CA 94588 (US).

(74) Agent: HUNT, Gregory A.; Jenkins, Wilson, Taylor & Hunt, P.A., Suite 1200, University Tower, 3100 Tower Boulevard, Durham, NC 27707 (US).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY,

BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

- with international search report (Art. 21(3))
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))

(54) Title: METHODS SYSTEMS AND COMPUTER READABLE MEDIA FOR PROVIDING REAL TIME DATA NETWORK USAGE INFORMATION USING SUBSCRIPTION PROFILE REPOSITORY (SPR)

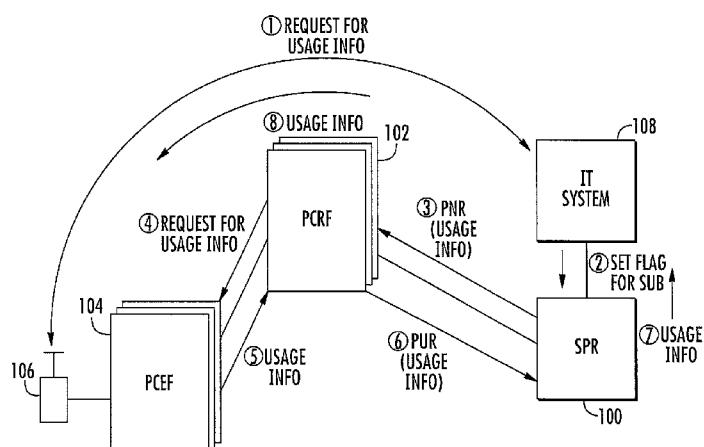


FIG. 2

(57) Abstract: A method for providing real time data network usage information using an SPR includes receiving a request for real time data network usage information. The method further includes, in response to the request, effecting a data change for the subscriber in the SPR. The method further includes, at the SPR, in response to the data change, sending a notification of the change to a policy and changing rules function (PCRF). The method further includes, at the PCRF, in response to the notification of the data change, requesting real time data network usage information from at least one policy and charging enforcement function (PCEF) serving the subscriber. The method further includes, at the PCRF, receiving the data network usage information from the at least one serving PCEF. The method further includes providing an indication of the real time data network usage information to the SPR.

WO 2015/077255 A1

METHODS SYSTEMS AND COMPUTER READABLE MEDIA FOR  
PROVIDING REAL TIME DATA NETWORK USAGE INFORMATION USING  
SUBSCRIPTION PROFILE REPOSITORY (SPR)

5

PRIORITY CLAIM

This application claims the benefit of U.S. Patent Application Serial No. 14/085,779, filed November 20, 2013, the disclosure of which is incorporated herein by reference in its entirety.

10

TECHNICAL FIELD

The subject matter described herein relates to providing real time data network usage information to data network subscribers. More particularly, the subject matter described herein relates to methods, systems, and computer readable media for providing real time data network usage information using an SPR.

BACKGROUND

In data communications networks, it is desirable for data communications networks subscribers to be able to obtain, in real time, current data network usage information. For example, if a data network subscriber subscribes to use five gigabytes of data per month, it may be desirable for the subscriber to be able to obtain, in real time, the subscriber's current data network usage, so that the subscriber can purchase data capacity and/or change his or her data network usage behavior.

One approach for providing data network usage information may be to use a subscription profile repository (SPR). In long term evolution (LTE) networks, the SPR stores a subscriber's data network usage profile, i.e., the data allocation to which the subscriber subscribes and also usage information. However, the usage information in SPR is typically only updated when a data network session terminates. It may be desirable for the subscriber to obtain data network usage information in real time while the subscriber is participating in one or more data network sessions. Waiting until session termination to obtain this information may not be desirable in some instances.

Another option for providing data network usage information to a subscriber may be to obtain the data network usage information from the policy control and enforcement function (PCEF). However, the PCEF that serves a particular subscriber is determined dynamically. An information 5 technology (IT) system that a subscriber contacts to obtain network usage information may not have current PCEF information for a subscriber. Thus, having an IT system obtain data network usage information directly from the PCEF may not be possible due to the lack of knowledge of the serving PCEF. It is also not desirable to retrieve fast changing dynamic state data 10 (such as current byte count of a session) using an IT interface.

Even if the PCEF could be queried by an IT system for a subscriber's data network usage information, the PCEF may not have a complete view of the subscriber's data network usage allocation. In this scenario, the PCRF is the usage manager, the PCEF is the usage tracker, and the SPR is the 15 long term storage of usage information. When a user session first comes up, the usage manager reads from storage the usage information and calculates what's available for the session. For example, a subscriber's the monthly limit may be 5GB and the subscriber has used 1GB. So the usage manager (the PCRF) knows that 4GB is available for the user session. The 20 PCRF may not allocate the entire amount to the usage tracker (the PCEF). The PCRF may allocate to the tracker 100MB to be tracked. When the subscriber uses up the amount, 100MB, the tracker reports it to the manager, which may then allocate another 100MB chunk. It may happen a few times during the life time of the session. Continuing the example here, 25 the subscriber may be using the 4th 100MB chunk. The usage manager is the only one that knows this – 1.3GB of the monthly allowance is used and the user is in the process of consuming another 100MB chunk. Even if the IT system is able to connect to the PCEF and retrieve the snapshot, the only thing the IT system can identify is how much of the 100MB chunk is used, 30 e.g., 60M. On the other hand, the PCRF as the usage manager will perform necessary calculations of the previous chunks consumed before writing the final value to the SPR. Thus, contacting the PCEF alone may not provide a complete picture of the subscriber's data network usage.

Yet another problem of obtaining usage information directly from a PCEF is that the user may have multiple concurrent sessions served by different PCEFs. In such a case, if the IT system contacts a single PCEF, the IT system will not have all of the subscriber's current network usage. For 5 a direct interface to provide an accurate usage count, the IT system would be required to have direct interfaces to any PCEF that could possibly serve a subscriber. Such a solution is not scalable or practical.

Providing current data network usage information may be useful to a subscriber and a network operator. For example, if the current session will 10 cause the subscriber to exceed his data allocation, the subscriber may wish to have this information during the session so that the subscriber can terminate the session or purchase additional data network capacity. The network operator may desire to offer the subscriber the opportunity to purchase additional data network usage quota before the current quota is 15 exceeded.

Accordingly, in light of these difficulties, there exists a need for methods, systems, and computer readable media for providing real time data network usage information using an SPR.

20

## SUMMARY

The subject matter described herein relates to methods, systems, and computer readable media for providing real time data network usage information using an SPR. One method includes receiving a request for real time data network usage information. The method further includes, in 25 response to the request, effecting a data change for the subscriber in the SPR. The method further includes, at the SPR, in response to the data change, sending a notification of the change to a policy and changing rules function (PCRF). The method further includes, at the PCRF, in response to the notification of the data change, requesting real time data network usage 30 information from at least one policy and charging enforcement function (PCEF) serving the subscriber. The method further includes, at the PCRF, receiving the data network usage information from the at least one serving

PCEF. The method further includes providing an indication of the real time data network usage information to the SPR.

As used herein, the term "real time data network usage information" refers to a snapshot of data network usage information that is current at the 5 time it was obtained. For example, a snapshot of real time data network usage information may be the value of a network usage counter maintained by a PCEF at the time a request for such information is received by the PCEF and after the PCEF has had time to process the request. It is understood that the data network usage information may change at a rate of 10 thousands of bytes per second. Thus, the real time data network usage information obtained using the mechanisms described herein may not be the exact current data network usage count by the time the information is provided back to the subscriber. However, the term "real time data network usage information" is intended to include data network usage information 15 obtained at the request of a subscriber or a network operator that is more current than the data network usage information obtained at the time of the last session termination involving the subscriber.

The subject matter described herein can be implemented in software in combination with hardware and/or firmware. For example, the subject 20 matter described herein can be implemented in software executed by a processor. In one exemplary implementation, the subject matter described herein can be implemented using a non-transitory computer readable medium having stored thereon computer executable instructions that when executed by the processor of a computer control the computer to perform 25 steps. Exemplary computer readable media suitable for implementing the subject matter described herein include non-transitory computer-readable media, such as disk memory devices, chip memory devices, programmable logic devices, and application specific integrated circuits. In addition, a computer readable medium that implements the subject matter described 30 herein may be located on a single device or computing platform or may be distributed across multiple devices or computing platforms.

## BRIEF DESCRIPTION OF THE DRAWINGS

The subject matter described herein will now be explained with reference to the accompanying drawings of which:

5 Figure 1 is a network diagram illustrating a system for providing real time data network usage information using an SPR according to an embodiment of the subject matter described herein;

Figure 2 is a network diagram illustrating an exemplary message flow for providing real time data network usage information using an SPR according to an embodiment of the subject matter described herein;

10 Figure 3 is a block diagram illustrating exemplary components of an IT system for providing real time data network usage information using an SPR according to an embodiment of the subject matter described herein;

15 Figure 4 is a block diagram illustrating exemplary components of an SPR for providing real time data network usage information using the SPR according to an embodiment of the subject matter described herein;

Figure 5 is a block diagram illustrating exemplary components of a PCRF for providing real time data network usage information using an SPR according to an embodiment of the subject matter described herein;

20 Figure 6 is a block diagram illustrating exemplary components of a PCEF for providing real time data network usage information using an SPR according to an embodiment of the subject matter described herein;

Figure 7 is a flow chart illustrating exemplary steps performed by an IT system in providing real time data network usage information using an SPR according to an embodiment of the subject matter described herein;

25 Figure 8 is a flow chart illustrating exemplary steps performed by an SPR in providing real time data network usage information using the SPR according to an embodiment of the subject matter described herein;

Figure 9 is a flow chart illustrating exemplary steps performed by a PCRF in providing real time data network usage information according to an embodiment of the subject matter described herein; and

30 Figure 10 is a flow chart illustrating exemplary steps performed by a PCEF in providing real time data network usage information using an SPR according to an embodiment of the subject matter described herein.

## DETAILED DESCRIPTION

The subject matter described herein includes methods, systems, and computer readable media for providing real time data network usage information using an SPR. Figure 1 is a network diagram illustrating an exemplary network architecture in which the subject matter described herein may operate. Referring to Figure 1, a subscription profile repository (SPR) 100 stores subscription information for data network subscribers. SPR 100 may communicate with one or more policy and charging rules functions (PCRFs) 102 to provide policy information for data network subscribers to PCRFs 102. PCRFs 102 install policies for subscribers on policy and charging enforcement functions (PCEFs) 104. PCEFs 104 maintain data network usage information for subscribers and enforce policies. When a subscriber, such as subscriber 106, desires to obtain real time data network usage information, the subscriber may contact an information technology (IT) system 108 associated with the subscriber's mobile operator or other data network service provider. One possible solution for providing the policy information to the subscriber is to have IT system 108 obtain the information from SPR 100. However, SPR 100 is not updated frequently enough to provide real time data network usage information. Another possible solution is to have IT system 108 obtain the data network usage information directly from a PCEF 104. However, because the PCEF that serves a particular subscriber is dynamically assigned, IT system 108 may not have the visibility to directly contact the PCEF serving the subscriber.

In light of these difficulties, a mechanism for triggering updating of the data network usage information maintained by SPR 100 is provided. Figure 2 illustrates a method and system for providing real time data network usage information regarding a subscriber according to an embodiment of the subject matter described herein. Referring to Figure 2, in step 1, subscriber 106 requests data network usage information from IT system 108. In step 2, IT system 108 sets a flag for the subscriber with SPR 100. Setting a flag in the profile of the subscriber effects a data change in the subscriber's profile. Effecting a data change in the subscriber's profile triggers an existing mechanism of the SPR to notify the PCRF serving the subscriber of the data

change. This mechanism is the push notification request (PNR) message sent from SPR 100 to serving PCRF 102. The following illustrates exemplary fields that may be included in a push notification request message:

5

```
< Push-Notification-Request > ::= < Diameter
Header: 309, REQ, PXY, 16777217 >
    < Session-Id >
10    { Vendor-Specific-Application-Id }
    { Auth-Session-State }
    { Origin-Host }
    { Origin-Realm }
    { Destination-Host }
    { Destination-Realm }
    *[ Supported-Features ]
    { User-Identity }
    [ Wildcarded-Public-Identity ]
    [ Wildcarded-IMPU ]
    [ User-Name ]
    [ User-Data ]
    *[ AVP ]
    *[ Proxy-Info ]
    *[ Route-Record ]
20
25
```

The above illustrated format for the push notification request message is specified by "3rd Generation Partnership Project; Technical Specification Group Core Network and Terminals; Sh Interface Based on the Diameter Protocol; Protocol Details," TR 29.329 (Release 12) (2013), the disclosure of which is incorporated herein by reference in its entirety. In the above illustrated message format, part of the user data AVP may be used to communicate to PCRF **102** that the message is a request for updated data network usage information for the subscriber identified by the subscriber identification field.

35 The purpose of the PNR request is to notify a Diameter client by a Diameter server of changes in user data maintained by the server. In this instance, SPR 100 is serving as the Diameter server and PCRF 102 is serving as the Diameter client. It should be emphasized that SPR 100 maintains current serving PCRF information for the subscriber and thus it is

not necessary for IT system 108 to have direct access to serving PCRF information.

In response to receiving the PNR message, PCRF 102 recognizes the PNR message as a request for real time data network usage information and contacts the PCEF serving the subscriber in step 4. PCRF 102 maintains serving PCEF information for a subscriber because PCRF 102 is the node that installs policies on the PCEF for the subscriber.

PCEF 104 receives the request for usage information and, in step 5, provides the usage information to the serving PCRF 102. PCEF 104 knows the current real time usage count for the subscriber because PCEF 104 enforces policies, including data network usage policies, for the subscriber. Because the usage information was requested in response to the PNR message, rather than waiting for the termination of the data session, PCEF 104 can provide the current usage information, even while the subscriber is participating in one or more data sessions.

In step 6, PCRF **102** provides the real time data network usage information to SPR **100** via a profile-update request (PUR) message. SPR **100** receives the PUR message and, in step 7, provides the real time usage information to IT system **108**. The following illustrated exemplary fields may be included in a PUR message:

```
< Profile-Update-Request > ::= < Diameter Header: 307, REQ, PXY, 16777217 >
25                                     < Session-Id >
{ Vendor-Specific-Application-Id }
{ Auth-Session-State }
{ Origin-Host }
{ Origin-Realm }
[ Destination-Host ]
{ Destination-Realm }
* [ Supported-Features ]
{ User-Identity }
[ Wildcarded-Public-Identity ]
[ Wildcarded-IMPU ]
30                                     [ User-Name ]
* { Data-Reference }
{ User-Data }
* [ AVP ]
* [ Proxy-Info ]
* [ Route-Record ]
35
40
```

In the above listed example, the PUR message includes a user data AVP value. The user data AVP value may be used to carry the current data network usage information for the subscriber. However, the subject matter described herein is not limited to using a PUR message to communicate the current data network usage information from the PCRF to the SPR. As stated above, any proprietary or non-proprietary message for carrying this information may be used without departing from the scope of the subject matter described herein.

In step 8, IT system **108** provides the real time data network usage information to subscriber **106**. Thus, using the steps illustrated in Figure 2, real time subscriber data network usage information can be provided in response to a request from the subscriber, even while the subscriber is participating in a data session by triggering the SPR to obtain updated data network usage information in real time.

The subject matter described herein is not limited to providing or obtaining real time data network usage information in response to a request from the subscriber. In an alternate scenario, the data or mobile network operator may obtain data network usage information in the real time for the subscriber using the steps illustrated in Figure 2. One reason that the network operator may desire to obtain this information in real time is so that the network operator can take action if the subscriber is at or near a threshold while the subscriber is participating in one or more data network sessions. For example, the network operator may desire to send the subscriber a message where the subscriber can purchase additional data network capacity if the subscriber's allocation of data network capacity is about to be exceeded. In another example, the data network operator may simply notify the subscriber, while the subscriber is participating in one or more data network sessions, that the subscriber's data network capacity allocation is about to be exceeded.

Figure 3 is a block diagram illustrating an exemplary architecture for IT system **108** for providing real time data network usage information using an SPR according to an embodiment of the subject matter described herein.

Referring to Figure 3, IT system **108** includes a subscriber interface **300** for interfacing with subscribers and an SPR interface **302** for interfacing with an SPR. Subscriber interface **300** may be any suitable interface, such as a hypertext transfer protocol (HTTP) interface for web communications with the subscriber or an interactive voice response (IVR) interface if the subscriber contacts IT system **108** via a telephone call. In another example, subscriber interface **300** may be an SMS interface for communicating with the subscriber via SMS. SPR interface **302** may be any suitable interface through which IT system **108** can effect the data change in SPR **100** that triggers SPR **100** to obtain updated data network usage information for a subscriber. For example, SPR interface **302** may be a database related interface where IT system **108** can effect subscriber data changes by writing data to subscriber profiles stored in the subscriber profile data repository maintained by SPR **100**. The components in IT system **108** may be implemented or executed by one or more processors **304**.

Figure 4 is a block diagram illustrating an exemplary architecture for SPR **100** for providing real time data network usage information according to an embodiment of the subject matter described herein. Referring to Figure 4, SPR **100** includes an IT system interface **400** for interacting with IT system **108**. IT system interface **400** may receive commands from IT system **108** to effect data changes for subscriber profiles stored in subscriber profile data repository **402**. Subscriber profile repository **402** may store profiles for each subscriber. Profile **404** for subscriber A is shown as an example. In the illustrated example, profile **404** includes the data network allowance for the subscriber (5 GB), the data network usage for the subscriber (3.5 GB). SPR **100** may maintain a list of systems that are interested in being notified of the data change. When the user session first started, the serving PCRF retrieves the subscriber profile from the SPR and at that time 'subscribed' to the change notification. The SPR, upon data change, sends notifications to systems that had subscribed previously. In this example, the serving PCRF is PCRF1, which subscribes to receive data change notifications for the subscriber.

As stated above, without some triggering mechanism for updating the data network usage information maintained by SPR **100** more frequently than at session terminations, the usage information stored by SPR **100** may not be reflective of real time data network usage by a subscriber. One 5 exemplary triggering mechanism for triggering updates to the subscriber profile information may be provided by subscriber profile manager **405**. Subscriber profile manager **405** may detect changes in subscriber profile data, for example, when such changes are written to a subscriber profile by IT system **108**. When such a change occurs, subscriber profile manager 10 **405** may generate the PNR message referenced above for notifying the serving PCRF of the change in subscriber profile data. The PNR message may carry information PCRF **102** recognizes as a request for update subscriber data usage information.

Although the PNR message provides a convenient existing 15 mechanism for obtaining updated subscriber data network usage information, the subject matter described herein is not limited to using the PNR message to obtain this information. In an alternate implementation, a proprietary or other type of message may be sent that the PCRF recognizes as a request for updated network information and that triggers the PCRF to 20 obtain this information.

SPR **100** also includes PCRF interface **406** for communicating with PCRF **102**. PCRF interface **406** transmits the request for updated data network usage information to PCRF **102**, communicates policy-related subscriber information to PCRF **102**, receives updated data network usage 25 information from PCRF **102**, and stores the information in subscriber profile data repository **402**. The components illustrated in Figure 4 may be executed or implemented by one or more processors **408**.

Figure 5 is a block diagram illustrating an exemplary architecture for PCRF **102** for providing real time data network usage information using an 30 SPR according to an embodiment of the subject matter described herein. Referring to Figure 5, PCRF **102** includes an SPR interface **500** for communicating with an SPR **100**. SPR interface **500** may receive notifications of data changes from SPR **100** and provide those notifications

to policy engine **502**. Policy engine **502** processes received messages and determines the appropriate action. Policy engine **502** may also maintain serving PCEF information **504** for a subscriber. PCRF **102** also includes a PCEF interface **506** for communicating with PCEFs **104**. PCEF interface **506** may send the request for real time data network usage information to PCEF **104** that is serving a subscriber. One or more processors **508** may implement or execute the components of PCRF **102**.

Figure 6 is a block diagram illustrating exemplary components of PCEF **104** for providing real time data network usage information using and SPR according to an embodiment of the subject matter described herein. Referring to Figure 6, PCEF **104** includes a PCRF interface **600** for receiving policies and other messages from PCRF **102**. PCEF **104** also includes a policy enforcement engine **602** for enforcing installed policies **604** received from PCRF **102**. Policy enforcement engine **602** may also implement usage counters **606** on a per subscriber basis. Usage counter **606** maintains a current count of data network usage by each subscriber for which a policy is installed. PCEF **104** may include a subscriber data interface **608** for sending data to and from a subscriber over a data network connection. One or more processors **610** may implement or execute the components of PCEF **104**.

Figure 7 is a flow chart illustrating exemplary steps performed by IT system **108** in providing real time data network usage information for a subscriber according to an embodiment of the subject matter described herein. Referring to Figure 7, in step **700**, a request for real time data network usage information for a subscriber is received. For example, IT system **108** may receive an SMS message, an e-mail, or a telephone call from a subscriber **106** requesting real time data network usage information for the subscriber. The request may be received while one or more data sessions involving the subscriber are still in progress. Alternatively, the request may originate from the mobile network operator.

In step **702**, in response to the request, IT system **108** triggers SPR **100** to update data network usage information for the subscriber. For example, as described above, IT system **108** may set a flag in the subscriber's profile maintained by SPR **100**, where the setting of the flag

triggers SPR **100** to send a data change notification that will be interpreted by the PCRF as a request usage information for the subscriber. In step **704**, the IT system **108** receives real time data network usage information for the subscriber. For example, IT system **108** may receive a message from SPR **100** including real time data network usage information for the subscriber or read from the subscriber profile in the SPR and detect the data change.

Figure 8 is a flow chart illustrating exemplary overall steps performed by SPR **100** in providing real time data network usage information regarding a subscriber. Referring to Figure 8, in step **800**, SPR **100** receives a data change request for the subscriber. The data change request may be the message from the IT system **108** for setting a flag in the subscriber's profile. The data change request may trigger the SPR to notify the serving PCRF of the change in data for the subscriber. Accordingly, in step **802**, SPR **100** identifies the PCRF serving the subscriber. Step **802** may be performed by analyzing its own state data to determine any PCRFs that are subscribed to receive data change notifications for the subscriber. In step **804**, SPR **100** sends a PNR to the serving PCRF. The PNR may contain a parameter recognized by the PCRF as a request for usage information. In step **806**, the SPR receives a PUR containing usage information for the subscriber. In step **808**, SPR **100** provides the usage information to the IT system.

Figure 9 is a flow chart illustrating exemplary steps performed by PCRF **102** in providing real time data network usage information regarding a subscriber. Referring to Figure 9, in step **900**, PCRF **102** receives a PNR from the SPR. In step **902**, PCRF **102** identifies the PNR as a request for real time data network usage information for a subscriber. In step **904**, PCRF **102** identifies the serving PCEF(s). PCRF **102** may store information concerning the serving PCEF(s) because PCRF **102** is the node that installed the policy for the subscriber on the PCEF(s). In step **906**, PCRF **102** sends a request for real time data network usage information to the serving PCEF(s). In step **908**, PCRF **102** receives real time data network usage information from the serving PCEF(s) **104**, and in step **910** provides SPR **100** with an indication of the real time usage information via a PUR message. If multiple PCEFs are serving a subscriber, PCRF **102** may query

each of the PCEFs for the current byte count used by each session involving the subscriber and total the byte counts from all of the serving PCEFs. The indication of the real time network usage information provided in the PUR message may represent the total byte count for all of the user's current data network sessions. Even in the case of a single PCEF serving the subscriber, if the PCEF is only allocated a portion of the subscriber's data network usage quota, e.g., a 100 MB chunk of a 1 GB allocation, the PCRF may total the subscriber's usage of the current chunk with usage from all previously allocated chunks and provide the total to the SPR.

10       Figure 10 illustrates exemplary steps performed by PCEF 104 in providing real time data network usage information regarding a subscriber according to an embodiment of the subject matter described herein. The steps illustrated in Figure 10 may be performed by each of a plurality of PCEFs that are serving a subscriber at a given time. Referring to Figure 10, 15 in step 1000, PCEF 104 receives a request for real time usage information for a subscriber. The request may be received while one or more data network sessions concerning the subscriber are in progress. The request may originate from the serving PCRF 102. In step 1002, the PCEF 104 reads a data network usage counter for the subscriber. The PCEF may 20 maintain such counters because the PCEF is required, as part of its policy enforcement function, to maintain such counters. In step 1004, the PCEF provides real time data network usage information regarding the subscriber to PCRF 102. The real time data network usage information may be the current amount of data bytes used by the subscriber while one or more data 25 network sessions involving the subscriber are in progress.

Thus, by triggering updates of data network usage information maintained in the SPR, the subject matter described herein is capable of providing real time data network usage information for a subscriber. The subject matter described herein uses a modification of an existing 30 mechanism to effect the updating of the data network usage information. It will be understood that various details of the presently disclosed subject matter may be changed without departing from the scope of the presently

disclosed subject matter. Furthermore, the foregoing description is for the purpose of illustration only, and not for the purpose of limitation.

## CLAIMS

What is claimed is:

1. A method for providing real time data network usage information for a subscriber utilizing a subscription profile repository (SPR), the method comprising:
  - 5 receiving a request for real time data network usage information for a subscriber;
  - in response to the request, effecting a data change for the subscriber in an SPR;
  - 10 at the SPR, in response to the data change, requesting real time data network usage information from a policy and charging rules function (PCRF);
    - at the PCRF:
      - 15 receiving the request for real time data network usage information;
      - in response to the request, requesting real time data network usage information for the subscriber from at least one policy and charging enforcement function (PCEF);
      - 20 receiving the real time data network usage information from the at least one PCEF; and
      - providing an indication of the real time data network usage information to the SPR.
2. The method of claim 1 wherein receiving a request for real time data network usage information concerning a subscriber includes receiving the request at an information technology (IT) system of a data network operator.
  - 25
3. The method of claim 1 or claim 2 wherein receiving the request includes receiving the request via one of a phone call, a text message, or an e-mail from the subscriber.
  - 30

4. The method of any of the preceding claims wherein effecting a data change for the subscriber in the SPR includes setting a flag in a profile for the subscriber maintained by the SPR.
- 5 5. The method of any of the preceding claims wherein sending a message to the PCRF to obtain the real time usage information includes sending a push notification request (PNR) message to the PCRF.
- 10 6. The method of any of the preceding claims comprising, at the PCRF, in response to receiving the request, identifying at least one PCEF serving the subscriber, wherein the PCRF receives data network usage information from the at least one PCEF and determines a total current data network usage count for the subscriber.
- 15 7. The method of any of the preceding claims wherein providing the indication of the real time data network usage information to the SPR includes providing usage information to the SPR via a profile update request (PUR) message.
- 20 8. The method of any of the preceding claims comprising providing the real time data network usage information from the SPR to an information technology (IT) system that interacts with the subscriber.
- 25 9. The method of claim 1 wherein receiving the real time data network usage information from the at least one PCEF includes receiving a byte count from the PCEF reflecting data network usage information for the subscriber while the subscriber is participating in one or more data network sessions.
- 30 10. The method of any of the preceding claims wherein the real time data usage information comprises long term evolution (LTE) data network usage information.

11. A system for providing real time data network usage information for a subscriber utilizing a subscription profile repository (SPR), the system comprising:

5 an information technology (IT) system configured to receive a request for real time data network usage information for a subscriber and, in response to the request, to effect a data change for the subscriber;

10 an SPR configured to receive the data change from the IT system and, in response to the data change, request real time data network usage information from the subscriber; and

15 a policy and charging rules function (PCRF) configured to receive the request for real time data network usage information, in response to the request, to request real time data network usage information from at least one policy and charging enforcement function (PCEF), to receive the real time data network usage information from the at least one PCEF, and to provide the real time data network usage information to the SPR.

20 12. The system of claim 11 wherein the IT system is managed by a data network operator.

25 13. The system of claim 11 or claim 12 wherein the IT system is configured to receive the request via one of a phone call, a text message, or an e-mail from the subscriber.

14. The system of any of claims 11 to 13 wherein the IT system is configured to effect the data change for the subscriber in the SPR by setting a flag in a profile for the subscriber maintained by the SPR.

30 15. The system of any of claims 11 to 14 wherein the SPR is configured to send a push notification request (PNR) message to the PCRF to trigger the PCRF to obtain the real time data network usage information.

16. The system of any of claims 11 to 15 wherein the PCRF is configured to identify the at least one PCEF serving the subscriber, wherein the PCRF receives data network usage information from the at least one PCEF and determines a total current data network usage count for the subscriber.  
5
17. The system of any of claims 11 to 16 wherein the PCRF is configured to provide the usage information to the SPR via a profile update request (PUR) message.  
10
18. The system of any of claims 11 to 17 wherein the SPR is configured to provide the real time data network usage information to the IT system.  
15
19. The system of any of claims 11 to 18 wherein the PCRF is configured to receive a byte count from the at least one PCEF reflecting data network usage information for the subscriber while the subscriber is participating in one or more data network sessions.  
20
20. A non-transitory computer readable medium having stored thereon executable instructions that when executed by the processor of a computer control the computer to perform steps comprising:  
at a subscription profile repository (SPR):  
receiving a communication from an information technology (IT) system for effecting a data change for a subscriber in the SPR;  
25  
in response to the communication for effecting the data change, requesting real time data network usage information from a policy and charging rules function (PCRF);  
receiving a communication from the PCRF containing an indication of the real time data network usage information; and  
30  
providing the indication of the real time data network usage information to the IT system.

21. A non-transitory computer readable medium according to claim 20 having stored thereon executable instructions that when executed by the processor of a computer control the computer to perform a method according to any of claims 1 to 10.

1/10

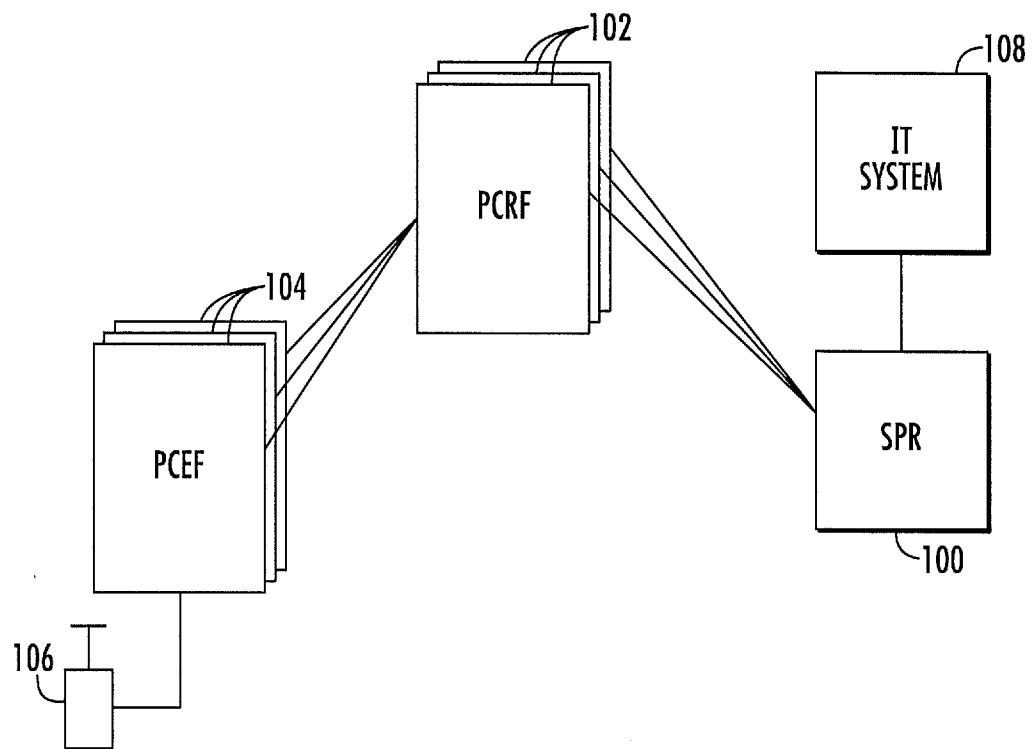


FIG. 1

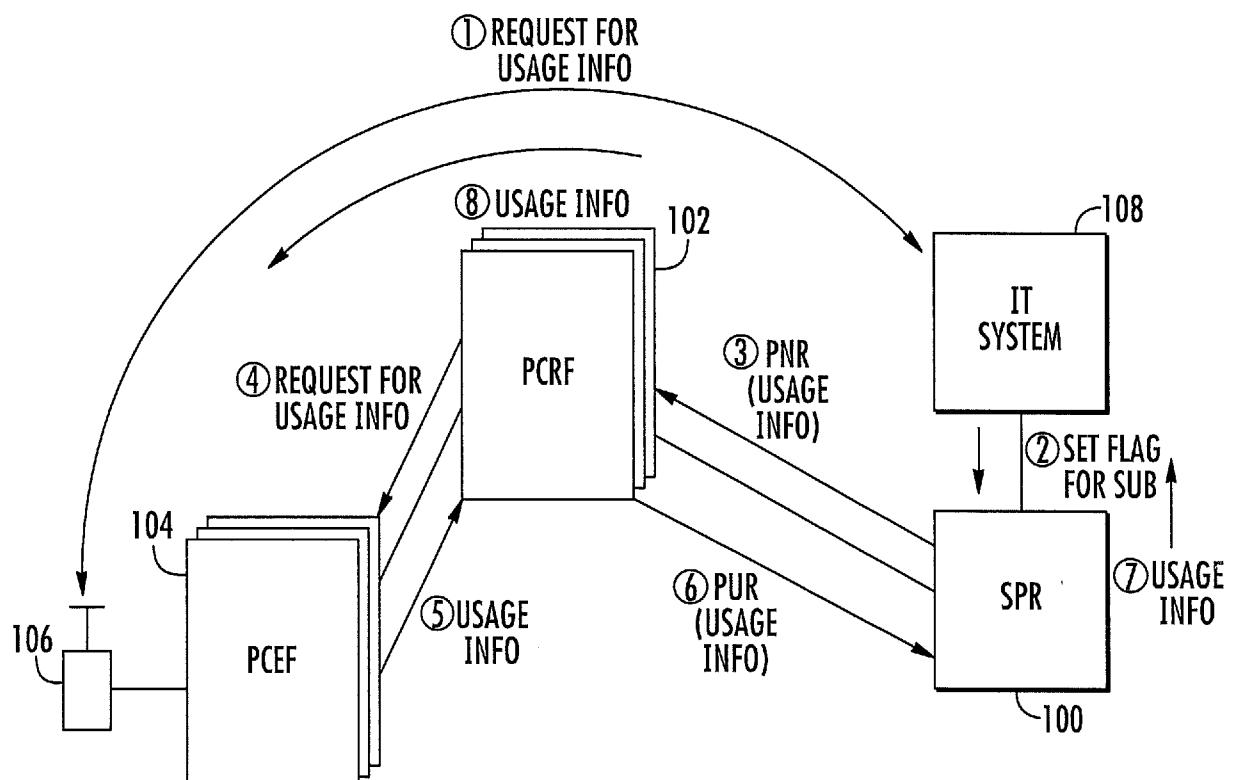


FIG. 2

3/10

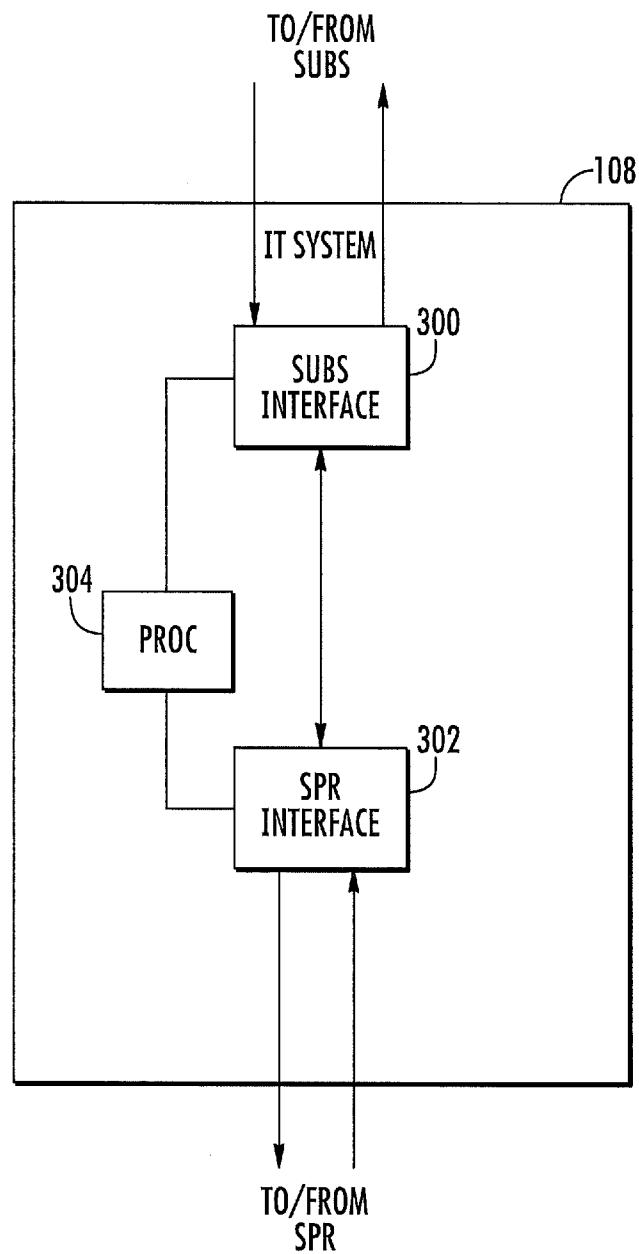


FIG. 3

4/10

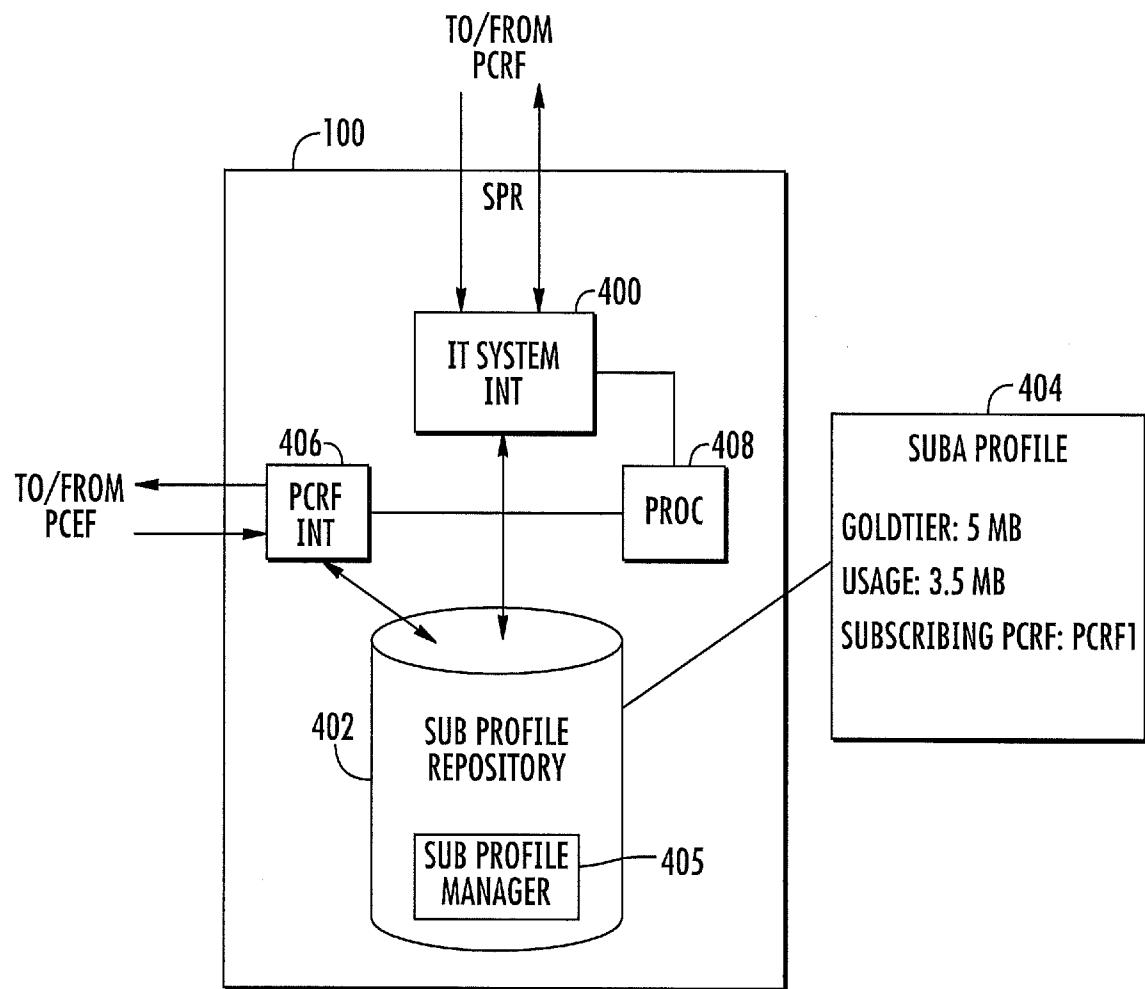


FIG. 4

5/10

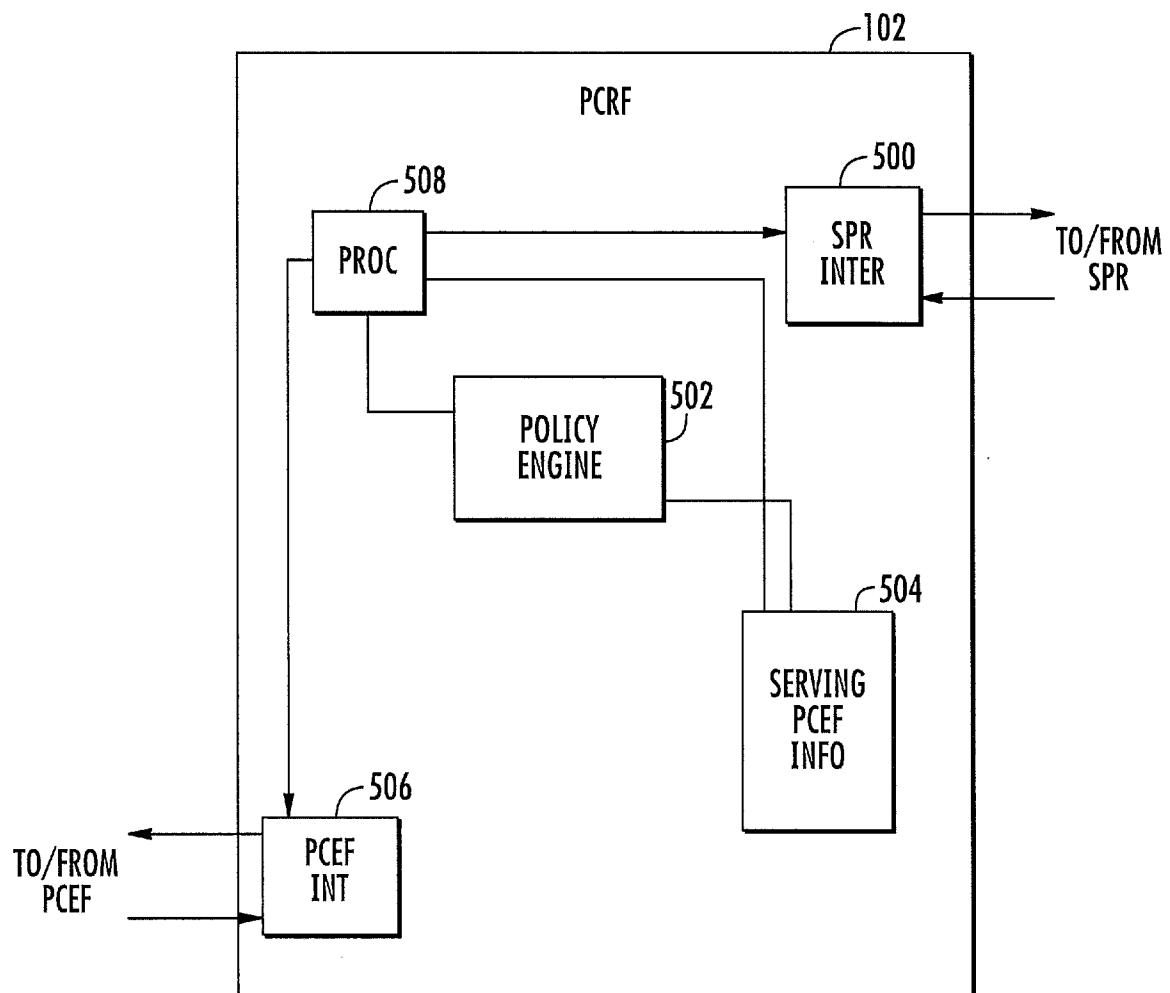


FIG. 5

6/10

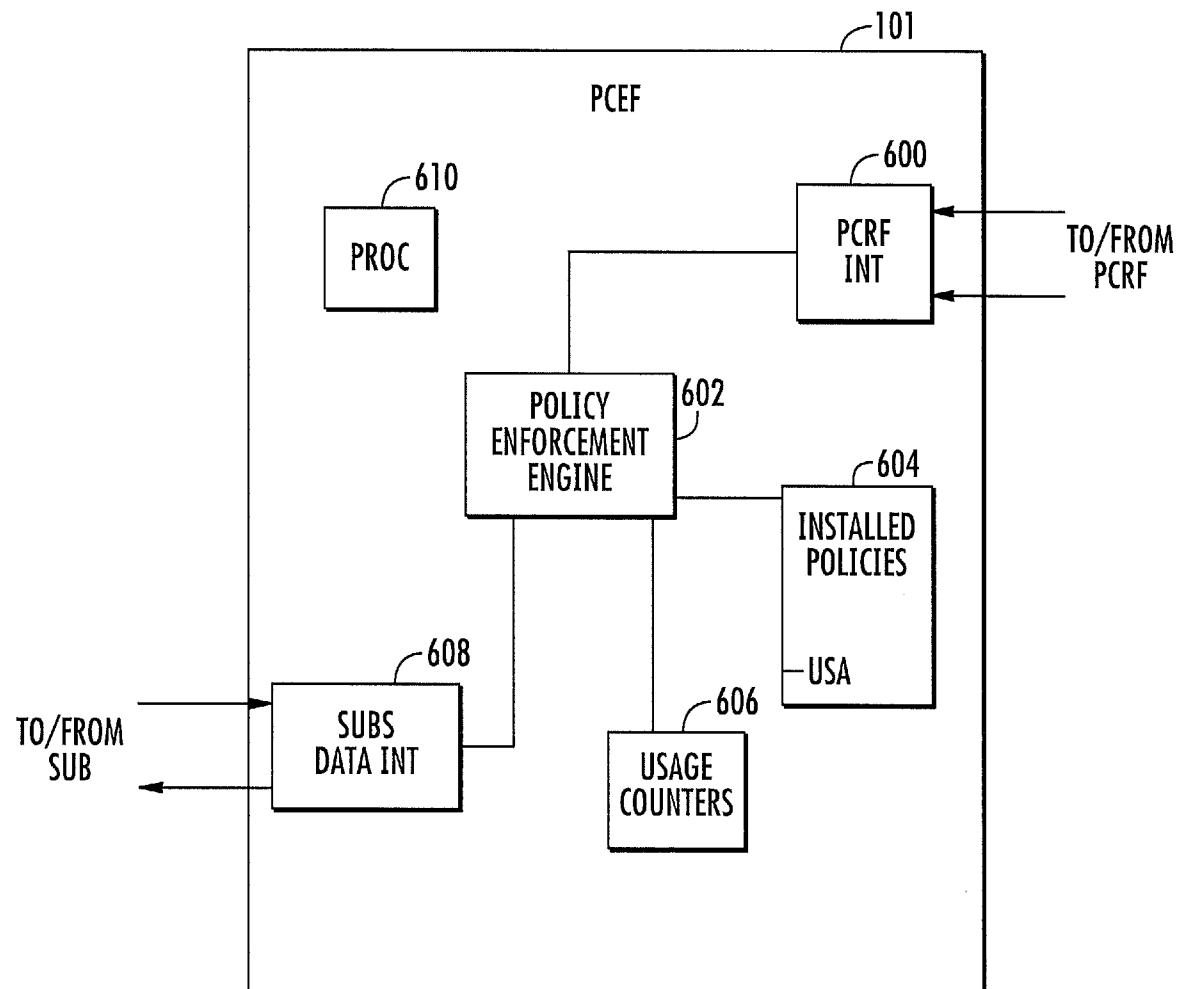


FIG. 6

7/10

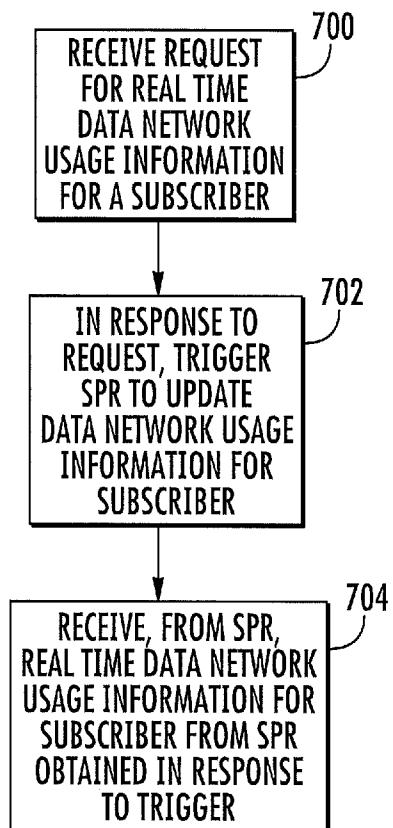


FIG. 7

8/10

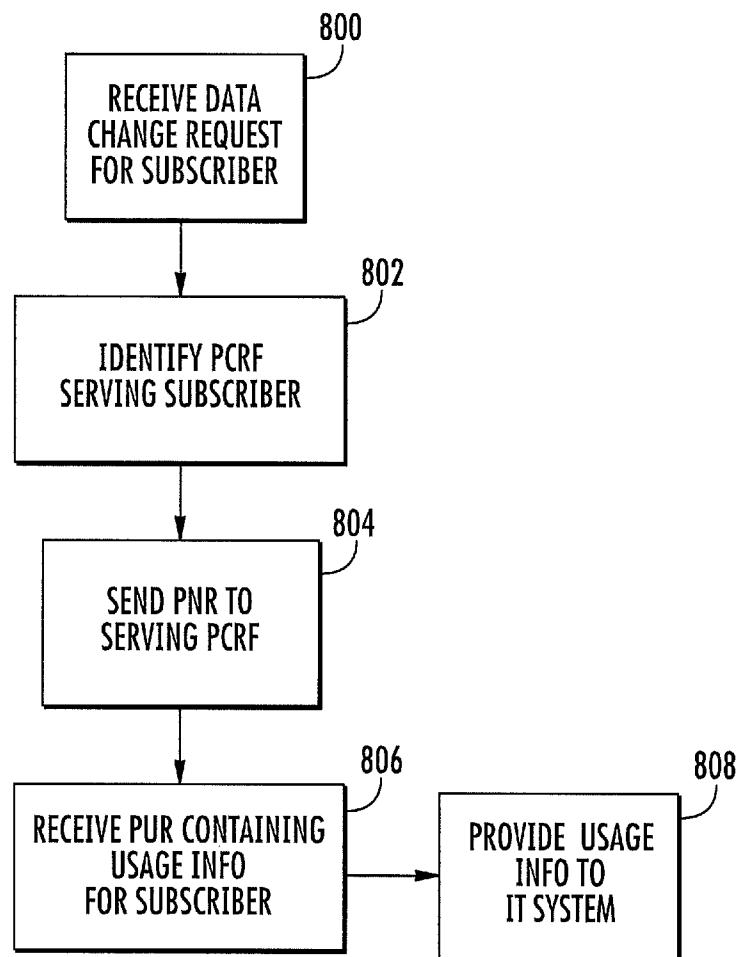


FIG. 8

9/10

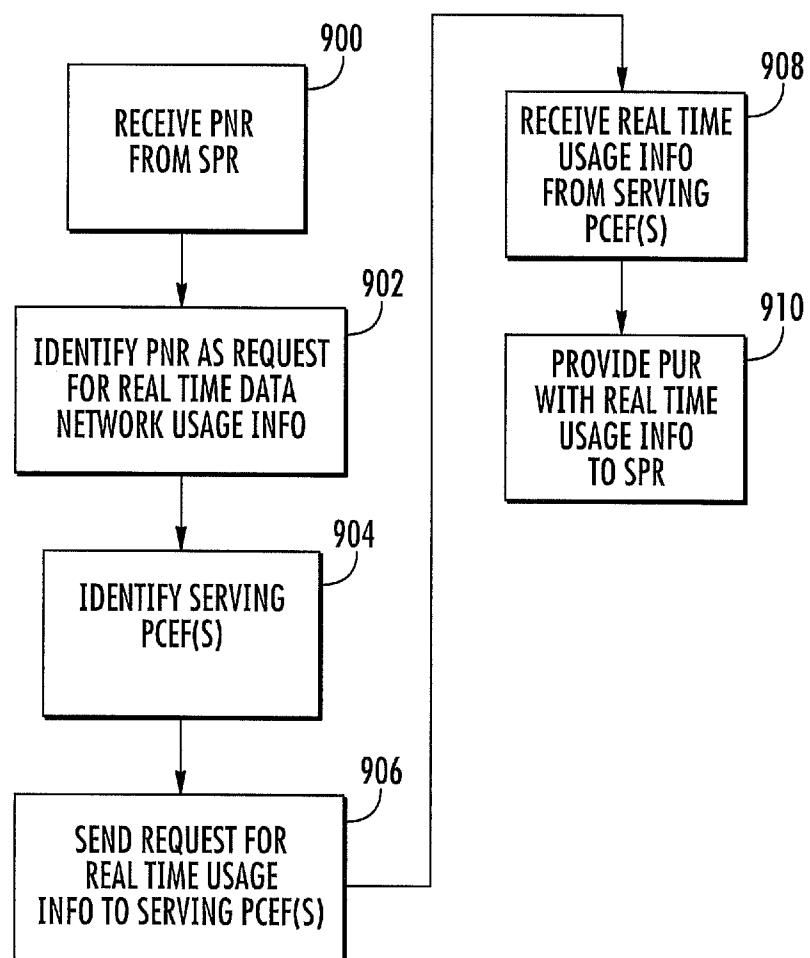


FIG. 9

10/10

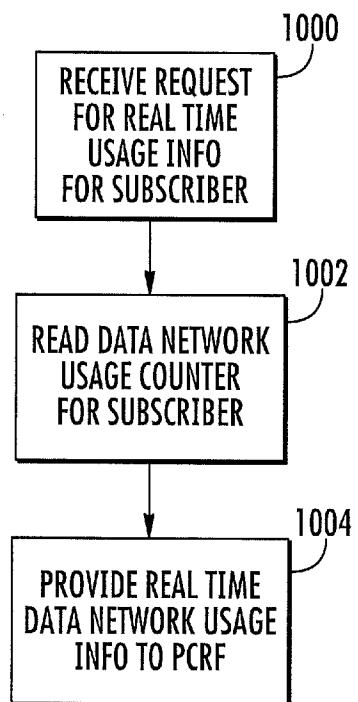


FIG. 10

# INTERNATIONAL SEARCH REPORT

International application No  
PCT/US2014/066239

**A. CLASSIFICATION OF SUBJECT MATTER**  
INV. H04M15/00  
ADD.

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)  
H04M

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 practicable, search terms used)

EPO-Internal, WPI Data

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 2 493 222 A1 (ZTE CORP [CN]) 29 August 2012 (2012-08-29) abstract paragraph [0037] - paragraph [0043] -----	1-21
A	EP 2 249 514 A1 (VODAFONE PLC [GB]) 10 November 2010 (2010-11-10) abstract figure 1 paragraph [0024] - paragraph [0050] -----	1-21
A	US 2013/258849 A1 (SHARMA RANJAN [US] ET AL) 3 October 2013 (2013-10-03) figure 1 paragraph [0039] - paragraph [0056] ----- -/-	1-21

Further documents are listed in the continuation of Box C.

See patent family annex.

\* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance  
"E" earlier application or patent but published on or after the international filing date  
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)  
"O" document referring to an oral disclosure, use, exhibition or other means  
"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
20 March 2015	30/03/2015
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer  Suciu, Radu

**INTERNATIONAL SEARCH REPORT**International application No  
PCT/US2014/066239

## C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 8 565 722 B1 (CHEUK HO YIN [US] ET AL) 22 October 2013 (2013-10-22) abstract figure 2 column 4 - column 6 -----	1-21

**INTERNATIONAL SEARCH REPORT**

Information on patent family members

International application No  
PCT/US2014/066239

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
EP 2493222	A1 29-08-2012	CN 102083035 A EP 2493222 A1 US 2012233325 A1 WO 2011063722 A1		01-06-2011 29-08-2012 13-09-2012 03-06-2011
EP 2249514	A1 10-11-2010	EP 2249514 A1 ES 2426722 T3 GB 2470071 A US 2011211465 A1		10-11-2010 24-10-2013 10-11-2010 01-09-2011
US 2013258849	A1 03-10-2013	NONE		
US 8565722	B1 22-10-2013	NONE		