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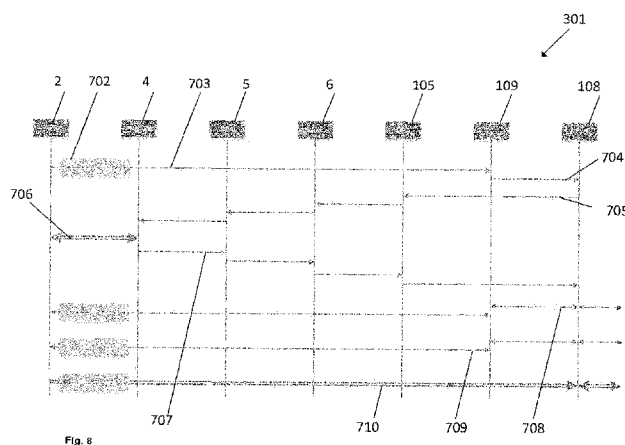
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(54) Title: A METHOD, SYSTEM AND DEVICES FOR APPLYING RESOURCE RESERVATION IN AN INTERNET PROTOCOL, IP, MULTIMEDIA COMMUNICATIONS NETWORK



(57) Abstract: Method of applying resource reservation for a multimedia communication channel between a packet gateway server comprised in an Internet Protocol, IP, multimedia communications network and an IP Private Branch Exchange, PBX, device, said method comprising the steps of receiving, by an Application Server, AS, comprised in said IP multimedia communications network, a request for establishing a communication session with said IP-PBX device, wherein said request comprises a unique identity of said IP-PBX device, instructing, by said AS, said packet gateway server via a charging and bearer policy server comprised in said IP multimedia communications network, to apply resource reservation for said multimedia communication channel based on said recognized unique identity of said IP-PBX, and applying, by said packet gateway server, said resource reservation for said multimedia communication channel between said IP-PBX device and said packet gateway server.



Title

A method, system and devices for applying resource reservation in an Internet Protocol, IP, multimedia communications network.

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Technical field

The present invention generally relates to a communication in an Internet Protocol, IP, multimedia communications network and, more specifically, to resource reservation in the multimedia communications network.

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Background

Large mobile operators in, for example, North America, where Long Term Evolution, LTE, networks are in advanced state of deployment, might benefit from proper solutions for connecting an Internet Protocol, IP, Private Branch Exchange, PBX, to a multimedia communications network, through LTE cellular mobile access. It can be expected that in general there will be a need for this service in other countries with a large geographical area as well, in particular where business operation takes place in places that are not in the vicinity of wired network connectivity. One example of a multimedia communications network that is envisaged for this invention is the IP multimedia subsystem, IMS, as specified by the 3rd Generation Partnership Project, 3GPP. Other implementations of multimedia communications networks are, however, not excluded in view of the present invention.

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It is further observed that a need arises even in areas with access to wired network connectivity. Situations are, for example, short term deployment of IP-PBX device at conferences or congresses, temporary or flexible office locations, mobile point of sales, etc. These situations may occur in urban areas. Connecting an IP-PBX device through wireless connectivity, even in areas with well-established wireline infrastructure, could be important for time-to-market aspects. Small and medium-sized enterprises can have their PBX device's quickly connected to multimedia communications networks. The need for a proper solution for connecting

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IP-PBX devices to multimedia communications networks is expected to increase along with the increasing flexibility of office locations.

5 With the ever increasing speed of the LTE data connection, connecting multiple voice and/or video telephony lines for small and medium enterprises using LTE data connection gets more and more attractive. This applies especially in an urban area where it is costly to bring the appropriate wireline connection into the building. Connecting multiple voice and/or video telephony lines for small and medium enterprises using LTE data connection constitutes also competitive means  
10 to compete with the incumbent fixed broadband operators to deliver fast and flexible service.

A PBX device is a system that connects telephone extensions to a Public Switched Telephone Network, PSTN, and provides, for example, internal  
15 communication for a business. An Internet Protocol, IP, PBX device is a PBX device with IP connectivity and may provide additional audio, video, or instant messaging communication utilizing the Transmission Control Protocol, TCP/IP protocol stack.

IP-PBX devices are typically connected to a public network by means  
20 of Session Initiation Protocol, SIP, trunking which is also known as Business Trunking. An IP-PBX device has a wireline connection or a wireless connection to a gateway server of an IP multimedia communications network. The IP-PBX devices are typically “non-registered”, which implies that SIP signalling to and/or from the IP-PBX device is handled in the IP multimedia communications network as unregistered  
25 service, through, for example, a wildcard Public Service Identity, PSI.

Mobile connectivity of IP-PBX devices are generally accomplished through IP connectivity using the “internet” Access Point Name, APN. This “internet” APN provides for a so called best effort for the quality of the connectivity. This  
30 implies that the bandwidth, latency, jitter and bit-error-rate, BER, of the mobile IP connectivity is subject to, for example, subscriber density, cell usage, backhaul capacity, etc.

A general problem with the existing solutions is that the quality of the connectivity is not guaranteed, i.e. it is associated with a best effort attempt. The dilemma of contemporary solutions for IP-PBX connectivity is summarized as follows. SIP trunking offers the opportunity for operators to bundle data and voice/video telephony services in a single IP connection to IP-PBX devices. It is not practical to provide a SIP trunk with data and voice/video telephony connectivity for an IP-PBX device of a certain, single, class quality. Doing so would have the effect that all media, i.e. voice, video, streaming and internet traffic, runs over that connection with that particular class quality.

Following the above, it is a drawback of the present invention for connecting IP-PBX devices to a multimedia communications network that the quality of such a connection is not satisfactory to the end user. That is, the quality of the connection is merely related to a best effort attempt, wherein no minimum quality threshold is set for the end user.

### Summary

It is an object to provide for methods of applying resource reservation for a multimedia communication channel between a packet gateway server and an Internet Protocol, IP, Private Branch Exchange, PBX, device, thereby providing a proper, satisfactory connection between the IP-PBX and a multimedia communications network.

It is another object to provide for an application server, a packet gateway server and a Home Subscriber Server for facilitating the resource reservation method of the multimedia communication channel in relation to the IP-PBX.

In a first aspect of the invention, there is provided a method of applying resource reservation for a multimedia communication channel between a packet gateway server comprised in an Internet Protocol, IP, multimedia communications network and an IP Private Branch Exchange, PBX, device.

The method comprises the step of receiving, by an Application Server, AS, comprised in said IP multimedia communications network, a request for establishing a communication session with said IP-PBX device, wherein said request comprises a unique identity of said IP-PBX device.

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The above identified step is followed by the steps of instructing, by said AS, said packet gateway server via a charging and bearer policy server comprised in said IP multimedia communications network, to apply resource reservation for said multimedia communication channel based on said recognized unique identity of said IP-PBX, and applying, by said packet gateway server, said resource reservation for said multimedia communication channel between said IP-PBX device and said packet gateway server.

The method is based on the insight that an IP-PBX device connects to the multimedia communications network via a packet gateway server, and that the packet gateway server should receive instructions for resource reservation for the multimedia communication channel between the IP-PBX device and the packet gateway server.

The resource reservation for the multimedia communication channel ensures that, for example, call establishment with the IP-PBX occurs with a low latency, media like voice and/or video have better Quality-of-Service, a single subscription suffices for an IP-PBX device, supporting multiple simultaneous calls, whilst also allowing generic internet access.

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In accordance with the present invention, the resource reservation may be tailored to the needs of the type of communication. For example, for voice calls other quality requirements for the multimedia communication channel are relevant as compared to a media communication session. Voice calls typically require low latency while the bandwidth setting for the voice call is typically low. Media communications sessions, however, typically require higher bandwidths, while the latency is usually of less importance.

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The present method is directed to a connection between the IP-PBX device and the multimedia communications network. As such, the present invention is related to 'non-registered' connections. This implies that signalling to and/or from the IP-PBX device is handled in the multimedia communications network as  
5 unregistered service, through, for example, wildcard Public Service Identities, PSI's.

The Application Server can recognize that the request for establishing a communication session is initiated by, or intended for, the IP-PBX device by detecting the unique identity in the received request. The application server is able to  
10 recognize that the unique identity is to, and/or from, a device that is unregistered to the multimedia communications network. Based on the type of communication session to be established, the AS may instruct, via the charging and bearer policy server, the packet gateway server to apply specific resource reservation for the multimedia communication channel.

15 The unique identity is, for example, a domain name, an E.164 number, a Unique Resource Identifier, URI, a phone number or the like.

In accordance with the present invention, the IP-PBX device may be an  
20 end user device or may be directed to a router type of device to which one or more IP-PBX end user devices are connected. The latter will be explained in more detail with reference to one of the examples of the invention.

It is noted that in the present description, the multimedia  
25 communications network is often referred to as the IP Multimedia Subsystem, IMS, network as specified by 3GPP. Other types of multimedia communications networks are however also covered by the wording of the claims as appended, such as an Evolved Packets System, EPS, network, a Universal Mobile Telecommunications System, UMTS, network and a General Packet Radio Service, GPRS, network.

30 In accordance with the present invention, the resource reservation may be directed to any of latency, jitter, bandwidth, bit-error-rate, etc.

In an example, the step of applying said resource reservation for said multimedia communication channel comprises establishing, by said packet gateway server, at least two bearers over said multimedia communication channel between said packet gateway server and said IP-PBX device, wherein each of said at least two bearers is associated with different Quality-of-Service requirements.

The AS and/or the charging and bearer policy server could decide to set up two or more specific bearers between the IP-PBX device and the multimedia communications network, each of which having different Quality-of-Service, QoS, requirements, such that each of these bearers can effectively be used for a type of service required by the end user of the IP-PBX. For example, in the case of a voice call, a different bearer is used in comparison with a data connection used for, for example, a video call.

The different bearers could be associated with a Quality-of-Service Class Identifier, QCI, 1 – 9. QCI may be a mechanism used in 3GPP Long Term Evolution networks to ensure bearer traffic is allocated appropriate Quality of Service. Different bearer traffic requires different QoS and therefore different QCI values, with 9 different QCI values currently specified.

Examples of the QoS parameters include Guaranteed Bit Rate (GBR) or non-Guaranteed Bit Rate (non-GBR), Priority Handling, Packet Delay Budget and Packet Error Loss rate. This overall mechanism is called QCI. The QoS concept as used in LTE networks is class-based, where each bearer type is assigned one QCI by the multimedia communications network. The QCI is a scalar that is used within the access network as a reference to node specific parameters that control packet forwarding treatment, for example scheduling weight, admission thresholds and link-layer protocol configuration.

According to 3GPP TS 23.203, QCI values are standardized and associated with QCI characteristics, in term of packet forwarding treatment that the bearer traffic receives edge-to-edge between the end user, in the present case for example the IP-PBX device, and the packet gateway server. Scheduling priority, packet delay budget and packet error loss rate are the set of characteristics defined

by the 3GPP standard and they should be understood as guidelines for the pre-configuration of node specific parameters to ensure that applications/services mapped to a given QCI receive the same level of QoS in multi-vendor environments as well as in roaming scenarios. The QCI characteristics are not signalled on any interface.

The following table illustrates some of the standardized characteristics as defined in the 3GPP TS 23.203 standard "Policy and Charging Control Architecture".

| QCI | Resource type | Priority | Packet Delay Budget | Packet Error Loss | Example Services                                                                            |
|-----|---------------|----------|---------------------|-------------------|---------------------------------------------------------------------------------------------|
| 1   | GBR           | 2        | 100ms               | 10 <sup>-2</sup>  | Conversational voice                                                                        |
| 2   | GBR           | 4        | 150ms               | 10 <sup>-3</sup>  | Conversational video                                                                        |
| 3   | GBR           | 3        | 50ms                | 10 <sup>-3</sup>  | Real Time Gaming                                                                            |
| 4   | GBR           | 5        | 300ms               | 10 <sup>-6</sup>  | Non-Conversational Video (Buffered Streaming)                                               |
| 5   | Non-GBR       | 1        | 100ms               | 10 <sup>-6</sup>  | IMS Signalling                                                                              |
| 6   | Non-GBR       | 6        | 300ms               | 10 <sup>-6</sup>  | Video (Buffered Streaming) TCP-based (for example, www, email, chat, ftp, p2p and the like) |
| 7   | Non-GBR       | 7        | 100ms               | 10 <sup>-3</sup>  | Voice, Video (Live Streaming), Interactive Gaming                                           |
| 8   | Non-GBR       | 8        | 300ms               | 10 <sup>-6</sup>  | Video (Buffered Streaming) TCP-Based (for example, www, email, chat, ftp, p2p and the like) |
| 9   | Non-GBR       | 9        | 300ms               | 10 <sup>-6</sup>  | Video (Buffered Streaming) TCP-Based (for example, www, email, chat, ftp, p2p and the like) |

**Table 1: CQI values**

According to the present invention, each of these different CQI values may be used for the resource reservation.

In an example, the unique identity of the IP-PBX device is stored in a Home Subscriber Server, HSS, comprised by the multimedia communications network.

5           The method then comprises the initial steps of receiving, by a Mobility Management Entity, MME, comprised in said multimedia communications network, a request from said IP-PBX device, retrieving, by said MME, said unique identity from said HSS, and forwarding, by said MME, said request towards said application server.

10           The advantage of this example is that the unique identity of the IP-PBX device is stored, and maintained, centrally.

15           Here, the MME could further retrieve the unique identity from the HSS using Diameter messages, wherein said diameter messages comprise any of a domain name and an IP address of said IP-PBX device, and wherein said HSS is arranged to provide said unique identity based on any of said domain name and said IP address comprised in said diameter messages.

20           In a further example, the multimedia communication channel is between said packet gateway server and an Integrated Access Device, IAD, said IAD being integrated in said Internet Protocol, IP, Private Branch Exchange, PBX device, said IAD being arranged for serving a plurality of IP PBX's, wherein said plurality of IP PBX's could be single User Equipment,

25           The method comprises the step of aggregating, by said IAD, connectivity requirements for each of said PBX's to said packet gateway server using said multimedia communication channel.

30           The above is an example of an IP-PBX device which is used as a sort of router. That is, multiple end user IP-PBX's are connected to the IP-PBX device, more specifically the IAD, and the IAD has a functional connection to the multimedia communications network.

The insight of the inventor that the deployment of multiple bearers between the IAD and the multimedia communications network, each of which having its own quality requirements, is especially beneficial in case multiple IP-PBX's are connected to the IAD. The advantage hereof is that each IP-PBX is able to use a single dedicated bearer for its data and/or voice communication.

In a second aspect, the invention provides for a method of instructing a packet gateway server comprised in an IP multimedia communications network to apply resource reservation for a multimedia communication channel between said packet gateway server and an Internet Protocol, IP, Private Branch Exchange, PBX device.

Here, the method comprises the steps of receiving, by an Application Server, AS, comprised in said IP multimedia communications network, a request for establishing a communication session with said IP-PBX device, wherein said request comprises a unique identity of said IP-PBX device, and instructing, by said AS, said packet gateway server via a charging and bearer policy server comprised in said multimedia communications network, to apply resource reservation in said packet gateway server for said multimedia communication channel based on said recognized unique identity of said IP-PBX.

The inventors found that the Application Server, AS, could be used as the key server node in the multimedia communications network for connecting the IP-PBX device to the communication network. That is, the AS is able to recognize that the communication session is with the IP-PBX device, and, as a result thereof, is able to instruct the packet gateway server, via a charging and bearer policy server comprised in the multimedia communications network to apply resource reservation in the packet gateway server for the multimedia communication channel based on the recognized unique identity of the IP-PBX.

Hereto, the AS may thus be adapted such that it is able to obtain the unique identity of the IP-PBX from the request, and to recognize that that unique identity is coupled to an unregistered device, for example an unregistered IP-PBX.

In an example, the step of instructing comprises instructing said packet gateway server to establish at least two bearers over said multimedia communication channel between said packet gateway server and said IP-PBX device, wherein each of said at least two bearers is associated with different Quality-of-Service requirements.

The expressions, i.e. the wording, of the different aspects comprised by the method and devices according to the present invention should not be taken literally. The wording of the aspects is merely chosen to accurately express the rationale behind the actual function of the aspects.

In accordance with the present invention, different aspects applicable to the above mentioned examples of the method, including the advantages thereof, correspond to the aspects which are applicable to the application server and/or the Home Subscriber Server according to the present invention.

In a third aspect, the invention provides for an Application Server, AS, arranged for instructing a packet gateway server comprised in an IP multimedia communications network to apply resource reservation for a multimedia communication channel between said packet gateway server and an Internet Protocol, IP, Private Branch Exchange, PBX device.

The AS comprises receive equipment arranged for receiving a request for establishing a communication session with said IP-PBX device, wherein said request comprises a unique identity of said IP-PBX device, and instruct equipment arranged for instructing said packet gateway server, via a charging and bearer policy server comprised in said multimedia communications network, to apply resource reservation in said packet gateway server for said multimedia communication channel based on said recognized unique identity of said IP-PBX.

In an example hereof, the instruct equipment is further arranged for instructing said packet gateway server to establish at least two bearers over said multimedia communication channel between said packet gateway server and said IP-

PBX device, wherein each of said at least two bearers is associated with different Quality-of-Service requirements.

5 In a fourth aspect, there is provided a Home Subscriber Server, HSS, arranged for operation in an Internet Protocol, IP, multimedia communication network, said Home Subscriber Server comprising receive equipment arranged for receiving an Update Location Request, ULR, message from a Mobility Management Entity, MME, said message comprising any of a domain name and an address of an Internet Protocol, IP, Private Branch Exchange, PBX, determine equipment arranged  
10 for determining a unique identity, comprised by said HSS, using any of said domain name and said address, and send equipment arranged for sending an Update Location Answer, ULA to said MME, said message comprising said unique identity.

15 In a fifth aspect, there is provided a non-transitory computer-readable storage medium comprising instructions which, when executed on at least one processor, cause the at least one processor to carry out the method according to any of the examples as provided above.

20 In a sixth aspect, there is provided an Internet Protocol, IP, multimedia communication network arranged for applying resource reservation for a multimedia communication channel between a packet gateway server, comprised in said IP multimedia communications network, and an Internet Protocol, IP, Private Branch Exchange, PBX, device.

25 The communication network further comprises an Application Server, AS, comprising receive equipment arranged for receiving a request for establishing a communication session with said IP-PBX device, wherein said request comprises a unique identity of said IP-PBX device, and instruct equipment arranged for instructing said packet gateway server, via a charging and bearer policy server  
30 comprised in said IP multimedia communications network, to apply resource reservation in said packet gateway server for said multimedia communication channel based on said recognized unique identity.

The packet gateway server is arranged for applying said resource reservation for said multimedia communication channel between said IP-PBX device and said packet gateway server.

5 In a seventh aspect, there is provided an Application Server, AS, arranged for instructing resource reservation for a multimedia communication channel between a packet gateway server comprised in an IP multimedia communications network and an Internet Protocol, IP, Private Branch Exchange, PBX, device.

10 The AS comprises a receive module for receiving a request for establishing a communication session with said IP-PBX device, wherein said request comprises a unique identity of said IP-PBX device, and an instruct module for instructing said packet gateway server, via a charging and bearer policy server  
15 comprised in said IP multimedia communications network, to apply resource reservation in said packet gateway server for said multimedia communication channel based on said recognized unique identity.

20 Here, the AS may comprise process equipment arranged for recognizing that said request is from said IP-PBX device by detecting said unique identity in said request.

In an eight aspect, there is provided a Home Subscriber Server, HSS, arranged for operation in an Internet Protocol, IP, multimedia communication  
25 network, said Home Subscriber Server comprising a receive module for receiving an Update Location Request, ULR, message from a Mobility Management Entity, MME, said message comprising any of a domain name and an address of an Internet Protocol, IP, Private Branch Exchange, PBX, determine module for determining a unique identity, comprised by said HSS, using any of said domain name and said  
30 address, and a send module for sending an Update Location Answer, ULA to said MME, said message comprising said unique identity.

The above-mentioned and other features and advantages of the invention will be best understood from the following description referring to the

attached drawings. In the drawings, like reference numerals denote identical parts or parts performing an identical or comparable function or operation

#### Brief description of the drawings

5                   Figure 1 is a schematic diagram illustrating an embodiment of an access network of the Internet Protocol, IP, multimedia communication network.

                    Figure 2 is a detailed schematic diagram illustrating an embodiment of an access network of the Internet Protocol, IP, multimedia communication  
10                   network.

                    Figure 3 is a block diagram illustrating an embodiment of an IP-PBX device.

15                   Figure 4 is a block diagram illustrating another embodiment of an IP-PBX device.

                    Figure 5 is a block diagram illustrating an embodiment of an Application Server.  
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                    Figure 6 is a block diagram illustrating an embodiment of a Home Subscriber Server, HSS.

25                   Figure 7 is a schematic diagram illustrating an embodiment of the method steps.

                    Figure 8 is a signalling diagram illustrating an exchange of signals in an embodiment of the method.

30                   Detailed description

**Figure 1** is a schematic diagram illustrating an access network 1 of an embodiment of the Internet Protocol, IP, multimedia communication network. The functional devices shown in Figure 1 as well as the description here below are

related to devices as known in an Internet Protocol, IP, Multimedia Subsystem network. For example, the charging and bearer policy server shown in the form of a Policy and Charging Rules Function, PCRF, device 6 is an embodiment of the generic function to control charging and bearer policy in the packet gateway server

5 4. The Subscription Profile Repository, SPR, 7 is an embodiment of a Policy and Charging subscription database. The Packet Data Network Gateway, PDN-Gw, 4 is an embodiment of the generic packet gateway server. The example shown in figure 1 does not exclude the applicability of the method of the invention in other implementations of IP multimedia communications network.

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In addition to the above, the communication network shows a preferred allocation of functional entities to devices, i.e. nodes. For a deployed network, different functional entities may be combined in a single device. A particular functional entity may also be installed in multiple devices.

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In the present example, the IP Private Branch Exchange, PBX, device 2 intends to connect to the multimedia communications network via the PDN-Gw 4. In figure 1, the focus is directed to the access network of the communications network.

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The PCRF device 6 is responsible for determining, in real-time, policy rules in a multimedia communications network. As such, the PCRF device 6 typically plays a central role in next-generation networks. Unlike earlier policy engines that were added onto an existing network to enforce policy, the PCRF

25 device 6 operates at the network core and accesses subscriber databases, like the SPR 7 and other specialized functions, such as a charging system, in a centralized manner.

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The PCRF device 6 is the part of the network architecture that aggregates information to and from the network, operational support systems, and other sources in real time, supporting the creation of rules and then automatically making policy decisions for each registered and non-registered subscriber in the network. In the present example, the multimedia communications network offers multiple services, Quality of Service, QoS, levels, and charging rules.

It is noted that, typically, the communication signaling in a multimedia communications network is divided in a control plane 8 architecture and user plane 9 architecture. The user plane 9 carries the network user traffic and the control plane 8 handles communication session control functionality.

In the present example, the access network further comprises a Diameter Routing Agent device, DRA, 5 which is a functional element in a third generation or fourth generation network, such as a Long Term Evolution, LTE, network that provides real-time routing capabilities to ensure that messages are routed to the correct element in a network.

Typically, the access node of the access network, for example LTE, is a Radio Base Station, RBS, also known as eNodeB, depending on the technology applied.

According to the present example, the IP-PBX device 2 is provisioned in a Home Subscriber Server, HSS, 12 as a subscriber in the multimedia communications network. The subscription of the IP-PBX does typically not comprise a single E.164 number but another type of subscriber entity, for example an Uniform Resource Identifier, URI.

During an attachment procedure of the IP-PBX device 2, the Mobility Management Entity, MME, 11 receives subscriber information from the HSS 12. The information is typically contained in an Update Location Answer, ULA, message. One parameter normally contained in the ULA is the Mobile Station International Subscriber Directory Number, MSISDN. The ULA may contain a subscriber identity instead of an MSISDN, for the purpose of the IP-PBX attachment procedure to the multimedia communications network. This identity may have the form of a domain name, rather than an E.164 number. The IP-PBX device identity is used in the functional signalling between the MME, the Serving Gateway, S-Gw, 13 the PDN-Gw 4 and the PCRF device 6.

The above-described requirement entails that the information flow between the MME 11 and HSS 12, specifically the Diameter messages that carry the subscriber identity, need to be capable of identifying the subscriber, i.e. the IP-PBX device 2, through a domain name, as opposed to through a phone number, for example an MSISDN or an E.164 number.

According to the present invention, an Application Server, AS (not shown in figure 1), receives a request for establishing a communication session with the IP-PBX device 2, wherein the request comprises a unique identity of the IP-PBX device 2, for example the domain name.

The AS then recognizes the IP-PBX device 2. That is, the AS recognizes that the request is initiated from, or directed towards, a device which is not registered within the multimedia communications network. The AS then instructs, the PDN-Gw 4, via the PCRF device 6, to apply resource reservation for the multimedia communication channel 3 based on the recognized unique identity of the IP-PBX device 2. The PDN-Gw 4 will then apply the resource reservation for the multimedia communication channel 3 between the IP-PBX device 2 and the PDN-Gw 4.

The advantage of the method as described above is that the IP-PBX device 2 may gain LTE IP connectivity as a regular LTE subscriber.

**Figure 2** is a detailed schematic diagram illustrating an embodiment of an access network 101 of the Internet Protocol, IP, multimedia communication network.

Now referring to figure 2. The IP-PBX device 2 uses the IP connectivity it has obtained from the network in accordance with figure 1, whenever a voice call is established with the IP-PBX device 2. Typically a request for establishing a communication session, for example a Session Initiation Protocol, SIP, request, arrives at the SIP trunking Application Server, ST-AS 108.

The Interconnection Border Control Functions device 109, through which the call is routed, reserves a through connection in the Transition Gateway, TrGw, 110. The Service Data Flow, SDF, 102, 103, 104 that will be used for the user plane of this call is not yet established. Likewise, the IP-PBX device 2 has not yet  
5 received an updated Traffic flow template, TFT, indicating to the IP-PBX device 2 which bearer shall be used for this flow. The IP-PBX device 2 will receive an updated TFT once the required SDF has been established.

According to the present invention, the ST-AS 108 could create a  
10 Quality-of-Service Class Identifier 1, QCI1, SDF 102, 103, 104 bearer 3 for the user plane of this call. More specifically, the ST-AS 108 instructs the PDN-Gw 4, via the PCRF device 6, to create a specific SDF 102, 103, 104. In practice, the PCRF device 6 maps the SDF to a dedicated bearer 3 at the PDN-Gw 4. The specific SDF may be multiplexed with other SDF's 102, 103, 104 on to the same dedicated bearer 3.

15 The ST-AS 108 hereto contacts the PCRF device 6 that is in control of the PDN-Gw 4 for this IP-PBX PDN Connection. When the IP-PBX device 2 had gained IP connectivity through the IMS APN, the PDN-Gw 4 selects a PCRF device 6. The signalling between PDN-Gw 4 and the PCRF device 6 traverses a Diameter  
20 Routing Agent device, DRA, 5. The DRA 5 keeps track of which PCRF device 6 is assigned to a certain user. The ST-AS 108 is in this case taking the role of Application Function, AF. AF is the term to identify the functional entity that provides policy control towards the PDN-Gw 4, via PCRF device 6.

25 According to the present invention, the DRA 5 (or alternatively DRA 105) may be able to define a logical relation between a user and a PCRF device 6, in addition to being able to define a logical relation between a user and a PCRF device 6. Although the IP-PBX device 2 does not register in the IMS network, we may still use a Wildcard IP Multimedia Public Identity, W-IMPU, for identifying the user.  
30 Hence, the ST-AS 108 uses the W-IMPU for signalling towards the DRA 5.

The ST-AS 108 can hence instruct the PDN-Gw 4, via the PCRF device 6, to establish the required SDF 102, 103, 104 for the call. The ST-AS 108 keeps track of the concurrent number of SDFs 102, 103, 104, and mapping to

dedicated EPS bearer(s) 3, for this IP-PBX device 2 and could limit this number to a designated maximum. This practically limits the number of simultaneous calls that can be established with the IP-PBX device 2.

5                   **Figure 3** is a block diagram illustrating an embodiment of an IP-PBX device 2. Here, two variants are depicted which are both capable of being deployed in a method according to the present invention.

Both of the IP-PBX devices shown in figure 3 comprise a mobile  
10 connectivity module 206, 207, and an IP-PBX application 208, 209. The IP-PBX device shown on the left side of figure 3 comprises a Universal Serial Bus, USB, stick 204, which provides an Application Programming Interface, API. The mobile connectivity module 207 in the IP-PBX device comprises application software for the mobile connectivity. More specifically, it separates the IP-PBX application software  
15 from the mobile connectivity.

The API offered by the USB stick 204 offers the capability to establish a PDN connection to the IMS APN as referred to here above, and comprises the functionality to receive an indication from the MME that a dedicated  
20 bearer has been established. This functionality includes also the receiving of traffic flow templates, TFT, which indicates to the mobile connectivity module 207 which bearer shall be used for a specific application, such as a media session or a signalling session.

25                   Alternatively, as shown on the right side of figure 3, the IP-PBX device may comprise a built-in LTE modem, which provides the same capability as the USB stick 204.

The advantage of the IP-PBX device according to the present  
30 invention, is that the IP-PBX devices are allowed to receive mobile IP connectivity through LTE, including Quality-of-Service for voice as well as video communication.

**Figure 4** is a block diagram illustrating another embodiment of an IP-PBX device 301. Here, the IP-PBX device 301 acts as a sort of router type. The

IP-PBX device 201 comprises an Integrated Access Device, IAD, 302, which IAD 302 is arranged for aggregating 301 connectivity requirements for each of said PBX's 303, 304, 305, 306 to the packet gateway server using a multimedia communication channel.

5

Based on the above, the IAD 302 serves a multitude of phone connections, i.e. PBX's 303, 304, 305, 306, but the IAD 302 itself comprises merely a single Universal Integrated Circuit Card, UICC 307. The IAD 302 comprises software for establishing mobile data connections, wherein each phone connection  
10 comprises software for supporting a single phone connection. In fact, each IP-PBX 303, 304, 305, 306 constitutes a single entity from an IMS functional point of view.

It is noted that, in the present case, the UICC 307 is related to a single subscription. Hence, a single connection between the IP-PBX device  
15 comprising the UICC and the access network is established.

**Figure 5** is a block diagram illustrating an embodiment of an Application Server, AS, 108 arranged for instructing a packet gateway server comprised in an IP multimedia communications network to apply resource  
20 reservation for a multimedia communication channel between said packet gateway server and an Internet Protocol, IP, Private Branch Exchange, PBX device.

The AS 108 comprises a control unit 406 and a memory 405, which control unit 406 is connected to process equipment 403, resource reservation  
25 module 404 receive equipment 401 and instruct equipment 408.

Incoming data packets or messages pass through the input terminal 402 before they reach the receive equipment 401, or a receiving module. Outgoing data packets or messages pass or are sent by the instruct equipment 408, or a  
30 instruct module, via the output terminal 407.

The receive equipment 401 is arranged for receiving a request for establishing a communication session with said IP-PBX device, wherein said request comprises a unique identity of said IP-PBX device. The instruct equipment 408 is

arranged for instructing the packet gateway server, via a charging and bearer policy server comprised in said IP multimedia communications network, to apply resource reservation in said packet gateway server for said multimedia communication channel based on said recognized unique identity of said IP-PBX device.

5

As such, the recognized unique identity of the IP-PBX device forms the trigger for the AS 108 to instruct the packet gateway server. The recognized unique identity is thus the deciding factor on whether the resource reservation is to be applied or not.

10

**Figure 6** is a block diagram illustrating an embodiment of a Home Subscriber Server, HSS 12, arranged for operation in an Internet Protocol, IP, multimedia communication network.

15

The HSS 12 comprises a control unit 506 and a memory 505, which control unit 506 is connected to determine equipment 503, unique identities table 504, receive equipment 501 and send equipment 508.

Incoming data packets or messages pass through the input terminal 502 before they reach the receive equipment 501, or a receiving module. Outgoing data packets or messages pass or are sent by the send equipment 508, or a send module, via the output terminal 507.

The HSS 12 comprises receive equipment 501 arranged for receiving an Update Location Request, ULR, message from a Mobility Management Entity, MME, said message comprising any of a domain name and an address of an Internet Protocol, IP, Private Branch Exchange, PBX. The HSS 12 further comprises determine equipment 503 arranged for determining a unique identity, comprised by said HSS 12, using any of said domain name and said address. The HSS 12 further comprises send equipment 508 arranged for sending an Update Location Answer, ULA to said MME, said message comprising said unique identity.

**Figure 7** is a schematic diagram illustrating an embodiment of the method steps 601. The method 601 is directed to applying resource reservation for a

multimedia communication channel between a packet gateway server comprised in an Internet Protocol, IP, multimedia communications network and an IP Private Branch Exchange, PBX, device.

- 5                   The method 601 comprises the steps of
- receiving 602, by an Application Server, AS, comprised in said IP multimedia communications network, a request for establishing a communication session with said IP-PBX device, wherein said request comprises a unique identity of said IP-PBX device;
  - 10               - recognizing 603 that said request is from said IP-PBX device by detecting said unique identity in said request
  - instructing 604, by said AS, said packet gateway server via a charging and bearer policy server comprised in said IP multimedia communications network, to apply resource reservation for said multimedia communication channel
  - 15               based on said recognized unique identity of said IP-PBX, and
  - applying 605, by said packet gateway server 4, said resource reservation for said multimedia communication channel between said IP-PBX device and said packet gateway server.

20                   **Figure 8** is a signalling diagram illustrating an exchange of signals 701 in an embodiment of the method.

In the present example, the method starts by the IP-PBX device 2 sending a request for establishing a communication session, i.e. SIP Invite message  
25   704, over a default EPS bearer 702 established between the PND-Gw 4 and the IP-PBX device 2.

The SIP invite message 704 travels multiple nodes in the multimedia communications network before it reaches the SIP trunking application server 108.  
30   The SIP invite message 704 comprises a unique identity of the IP-PBX device 2. The unique identity is a clear reference to the IP-PBX device 2.

As such, by detecting the unique identity of the IP-PBX device 2, the application server 108 instructs 705 the PDN-GW 4 to apply resource reservation for

the multimedia communication channel. In the present case, the instructions comprise the establishment of a dedicated bearer 706 between the IP-PBX device 2 and the PDN-Gw 4.

5                   The PDN-Gw acknowledges 707 that the resource reservation is effectuated by sending an acknowledgment message to the application server 108. The call establishment process continues 708 in a normal manner over the default EPS bearer 702.

10                   The difference with the prior art is that the user plane media is transported over the dedicated bearer 706 which is established between the IP-PBX device 2 and the PDN-Gw 4. That is, the resource reservation is accomplished by establishing the dedicated bearer 706, i.e. the communication channel, between the IP-PBX 2 and the PDN-Gw 4.

15                   The essence of the present invention is that the application server 108 is able to apply resource control procedures for achieving Quality-of-Service for communication sessions in the multimedia communications network with the IP-PBX device 2.

20                   The advantage of the present invention is that a proper solution is provided in which IP-PBX devices 2 are able to efficiently communicate with other IP-PBX devices or with registered users in the network. That is, the communication channel established between the IP-PBX device and the packet gateway server also  
25 provides Quality-of-Service parameters, such that certain levels of services can be guaranteed to the IP-PBX devices.

                  It is a further advantage that the communication channel is utilized properly. That is, the amount of, and the type of, resource reservation of the  
30 communication channel between the IP-PBX device and the packet gateway server is coupled to the type of request with the IP-PBX device. As such, a proper communication channel, having appropriate QoS parameters, is established between the IP-PBX device and the packet gateway server.

The present invention is not limited to the embodiments as disclosed above, and can be modified and enhanced by those skilled in the art beyond the scope of the present invention as disclosed in the appended claims without having to apply inventive skills.

## CLAIMS

1. Method of applying resource reservation for a multimedia communication channel (3) between a packet gateway server (4) comprised in an Internet Protocol, IP, multimedia communications network and an IP Private Branch Exchange, PBX, device (2), said method comprising the steps of:

- receiving (602), by an Application Server, AS (108), comprised in said IP multimedia communications network, a request for establishing a communication session with said IP-PBX device (2), wherein said request comprises a unique identity of said IP-PBX device (2);

- instructing (604), by said AS (108), said packet gateway server (4) via a charging and bearer policy server (6) comprised in said IP multimedia communications network, to apply resource reservation for said multimedia communication channel (3) based on said recognized unique identity of said IP-PBX device (2), and

- applying (605), by said packet gateway server (4), said resource reservation for said multimedia communication channel (3) between said IP-PBX device (2) and said packet gateway server (4).

2. Method of applying resource reservation according to claim 1, wherein said step of applying said resource reservation for said multimedia communication channel (3) comprises:

- establishing, by said packet gateway server (4), at least two bearers over said multimedia communication channel (3) between said packet gateway server (4) and said IP-PBX device (2), wherein each of said at least two bearers is associated with different Quality-of-Service requirements.

3. Method of applying resource reservation according to any of the previous claims, wherein said multimedia communication channel (3) is between said packet gateway server (4) and an Integrated Access Device, IAD (302), said IAD being integrated in said Internet Protocol, IP, Private Branch Exchange, PBX device (2), said IAD (302) being arranged for serving a plurality of IP PBX's, said method comprising the step of:

- aggregating, by said IAD (302), connectivity requirements for each of said PBX's to said packet gateway server (4) using said multimedia communication channel (3).

5 4. Method of applying resource reservation according to claim 3, wherein said resource reservation is further associated with said connectivity requirements of each of said PBX's.

5. Method of instructing a packet gateway server (4) comprised in an  
10 IP multimedia communications network to apply resource reservation for a multimedia communication channel (3) between said packet gateway server (4) and an Internet Protocol, IP, Private Branch Exchange, PBX device (2), said method comprising the steps of:

- receiving, by an Application Server, AS (108), comprised in said IP  
15 multimedia communications network, a request for establishing a communication session with said IP-PBX device (2), wherein said request comprises a unique identity of said IP-PBX device (2);

- instructing, by said AS (108), said packet gateway server (4) via a  
charging and bearer policy server (6) comprised in said IP multimedia  
20 communications network, to apply resource reservation in said packet gateway server (4) for said multimedia communication channel (3) based on said recognized unique identity of said IP-PBX (2).

6. Method of instructing a packet gateway server (4) according to claim  
25 5, wherein said step of instructing comprises:

- instructing said packet gateway server (4) to establish at least two  
bearers over said multimedia communication channel (3) between said packet  
gateway server (4) and said IP-PBX device (2), wherein each of said at least two  
bearers is associated with different Quality-of-Service requirements.

30

7. Application Server, AS (108), arranged for instructing a packet  
gateway server (4) comprised in an IP multimedia communications network to apply  
resource reservation for a multimedia communication channel (3) between said

packet gateway server (4) and an Internet Protocol, IP, Private Branch Exchange, PBX device (2), said AS (108) comprising:

- receive equipment (401) arranged for receiving a request for establishing a communication session with said IP-PBX device (2), wherein said request comprises a unique identity of said IP-PBX device (2), and

- instruct equipment (408) arranged for instructing said packet gateway server (4), via a charging and bearer policy server (6) comprised in said IP multimedia communications network, to apply resource reservation in said packet gateway server (4) for said multimedia communication channel (3) based on said recognized unique identity of said IP-PBX (2).

8. Application server, AS (108), in accordance with claim 7, wherein said instruct equipment (408) is further arranged for:

- instructing said packet gateway server (4) to establish at least two bearers over said multimedia communication channel (3) between said packet gateway server (4) and said IP-PBX device (2), wherein each of said at least two bearers is associated with different Quality-of-Service requirements.

9. Home Subscriber Server, HSS (12), arranged for operation in an Internet Protocol, IP, multimedia communication network, said Home Subscriber Server comprising:

- receive equipment (501) arranged for receiving an Update Location Request, ULR, message from a Mobility Management Entity, MME, said message comprising any of a domain name and an address of an Internet Protocol, IP, Private Branch Exchange, PBX;

- determine equipment (503) arranged for determining a unique identity, comprised by said HSS (12), using any of said domain name and said address;

- send equipment (508) arranged for sending an Update Location Answer, ULA to said MME, said message comprising said unique identity.

10. A non-transitory computer-readable storage medium comprising instructions which, when executed on at least one processor, cause the at least one processor to carry out the method according to any of the claims 1 – 6.

11. Internet Protocol, IP, multimedia communication network arranged for applying resource reservation for a multimedia communication channel (3) between a packet gateway server (4), comprised in said IP multimedia communications network, and an Internet Protocol, IP, Private Branch Exchange, PBX, device (2), said communication network further comprising:

- an Application Server, AS (108), comprising:
  - receive equipment (401) arranged for receiving a request for establishing a communication session with said IP-PBX device (2), wherein said request comprises a unique identity of said IP-PBX device (2);
  - instruct equipment (408) arranged for instructing said packet gateway server (4), via a charging and bearer policy server (6) comprised in said IP multimedia communications network, to apply resource reservation in said packet gateway server (4) for said multimedia communication channel (3) based on said recognized unique identity, and wherein
- said packet gateway server (4) is arranged for applying said resource reservation for said multimedia communication channel (3) between said IP-PBX device (2) and said packet gateway server (4).

12. Application Server, AS (108), arranged for instructing resource reservation for a multimedia communication channel (3) between a packet gateway server (4) comprised in an IP multimedia communications network and an Internet Protocol, IP, Private Branch Exchange, PBX, device (2), said AS (108) comprising:

- receive module for receiving a request for establishing a communication session with said IP-PBX device (2), wherein said request comprises a unique identity of said IP-PBX device (2);
- instruct module for instructing said packet gateway server (4), via a charging and bearer policy server (6) comprised in said IP multimedia communications network, to apply resource reservation in said packet gateway server (4) for said multimedia communication channel (3) based on said recognized unique identity.

13. Home Subscriber Server, HSS (12), arranged for operation in an Internet Protocol, IP, multimedia communication network, said Home Subscriber Server comprising:

- receive module for receiving an Update Location Request, ULR, message from a Mobility Management Entity, MME, said message comprising any of a domain name and an address of an Internet Protocol, IP, Private Branch Exchange, PBX;
- determine module for determining a unique identity, comprised by said HSS (12), using any of said domain name and said address;
- 10 - send module for sending an Update Location Answer, ULA to said MME, said message comprising said unique identity.

1 / 8

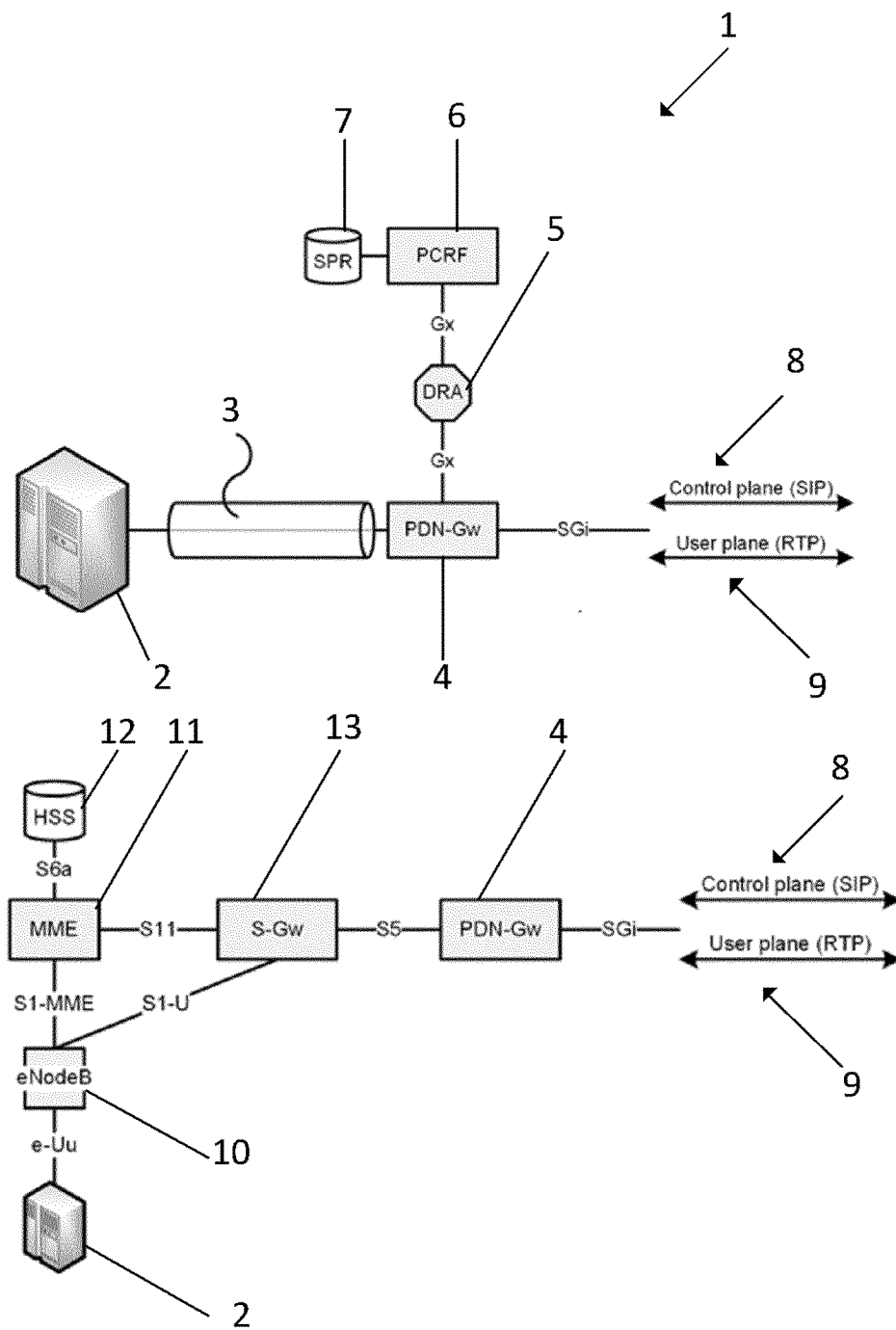


Fig. 1

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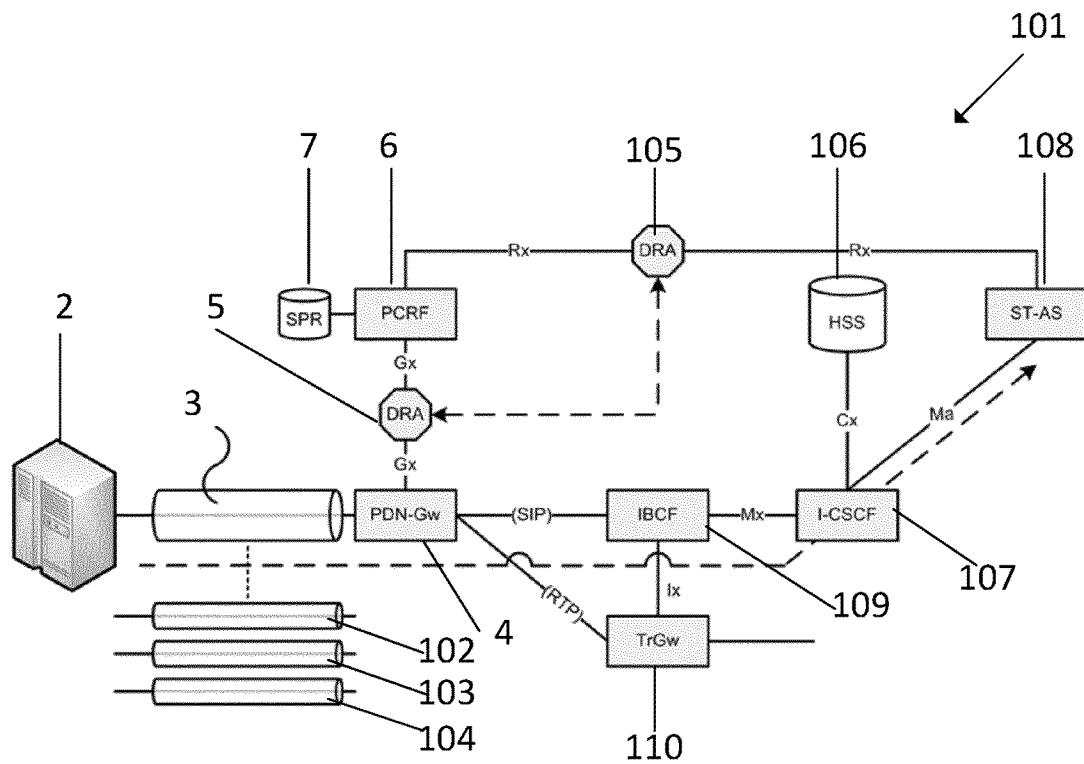


Fig. 2

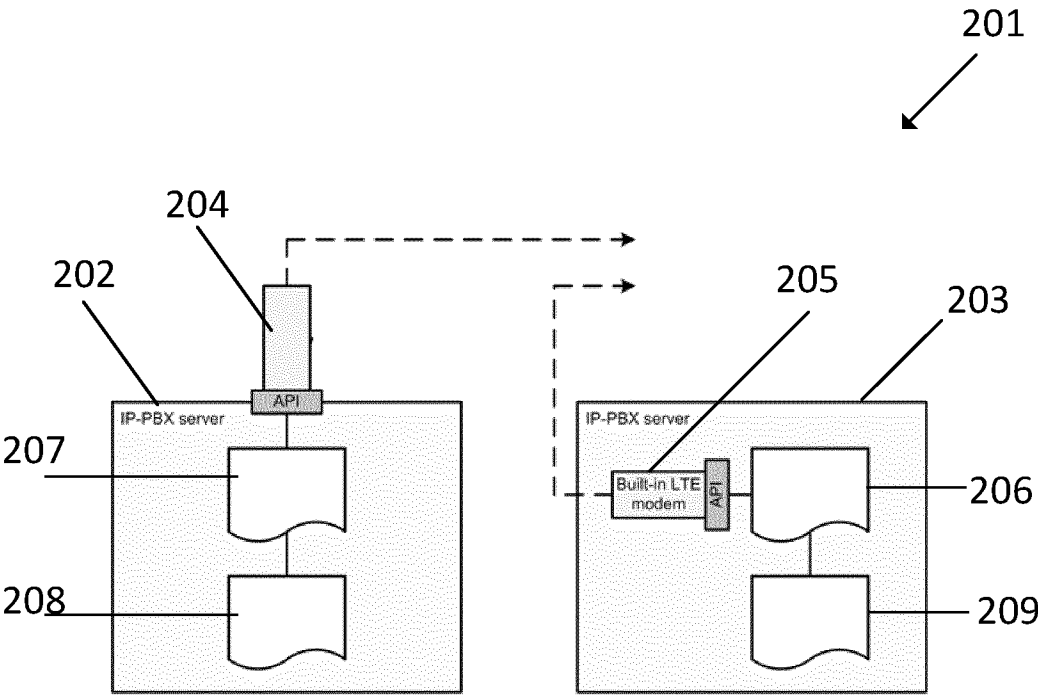


Fig. 3

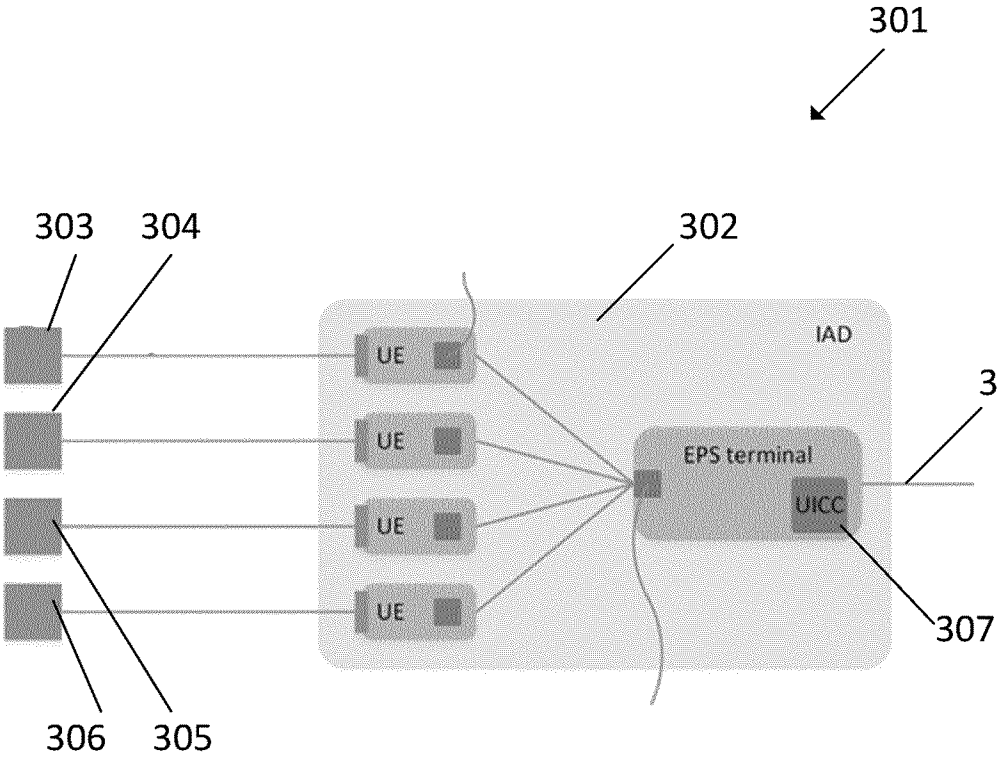


Fig. 4

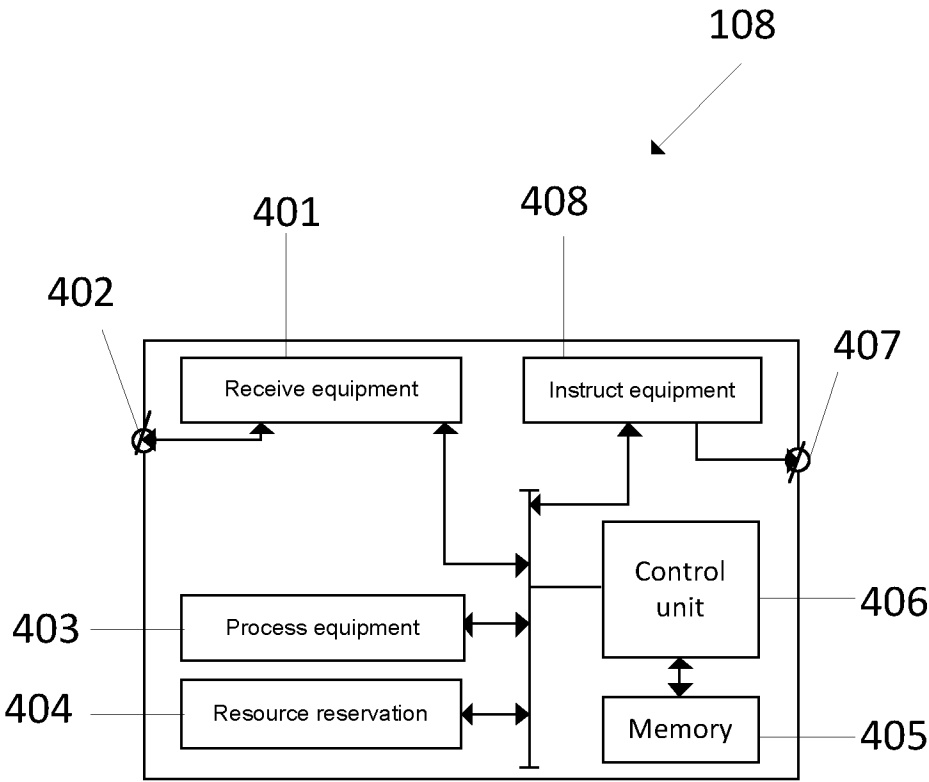


Fig. 5

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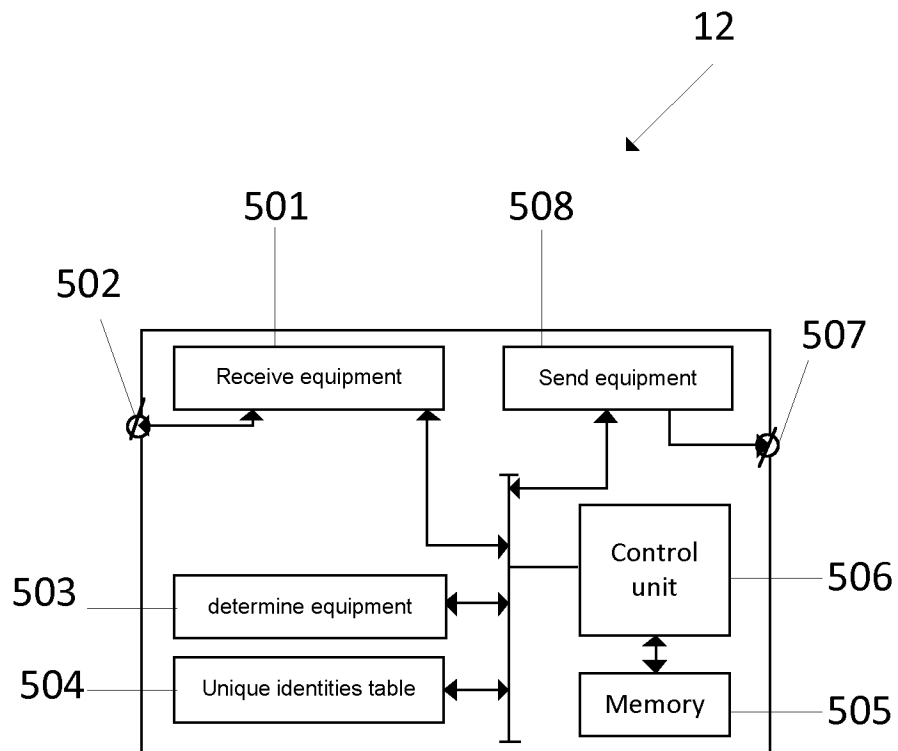


Fig. 6

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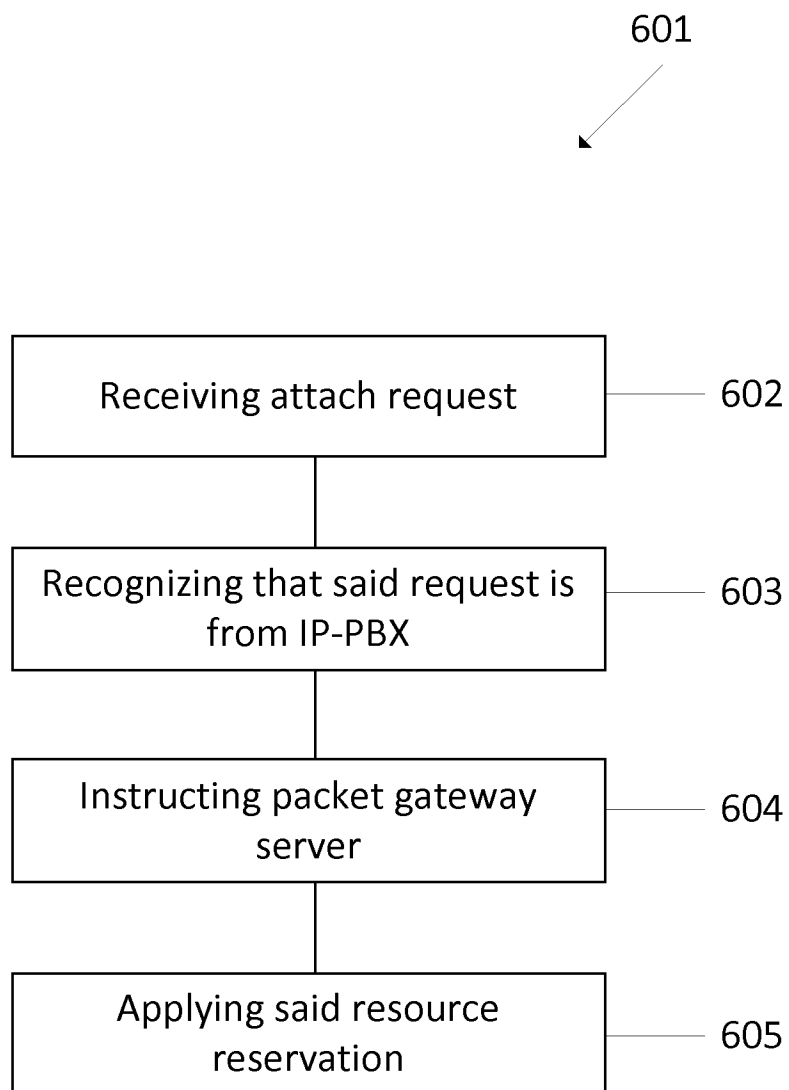


Fig. 7

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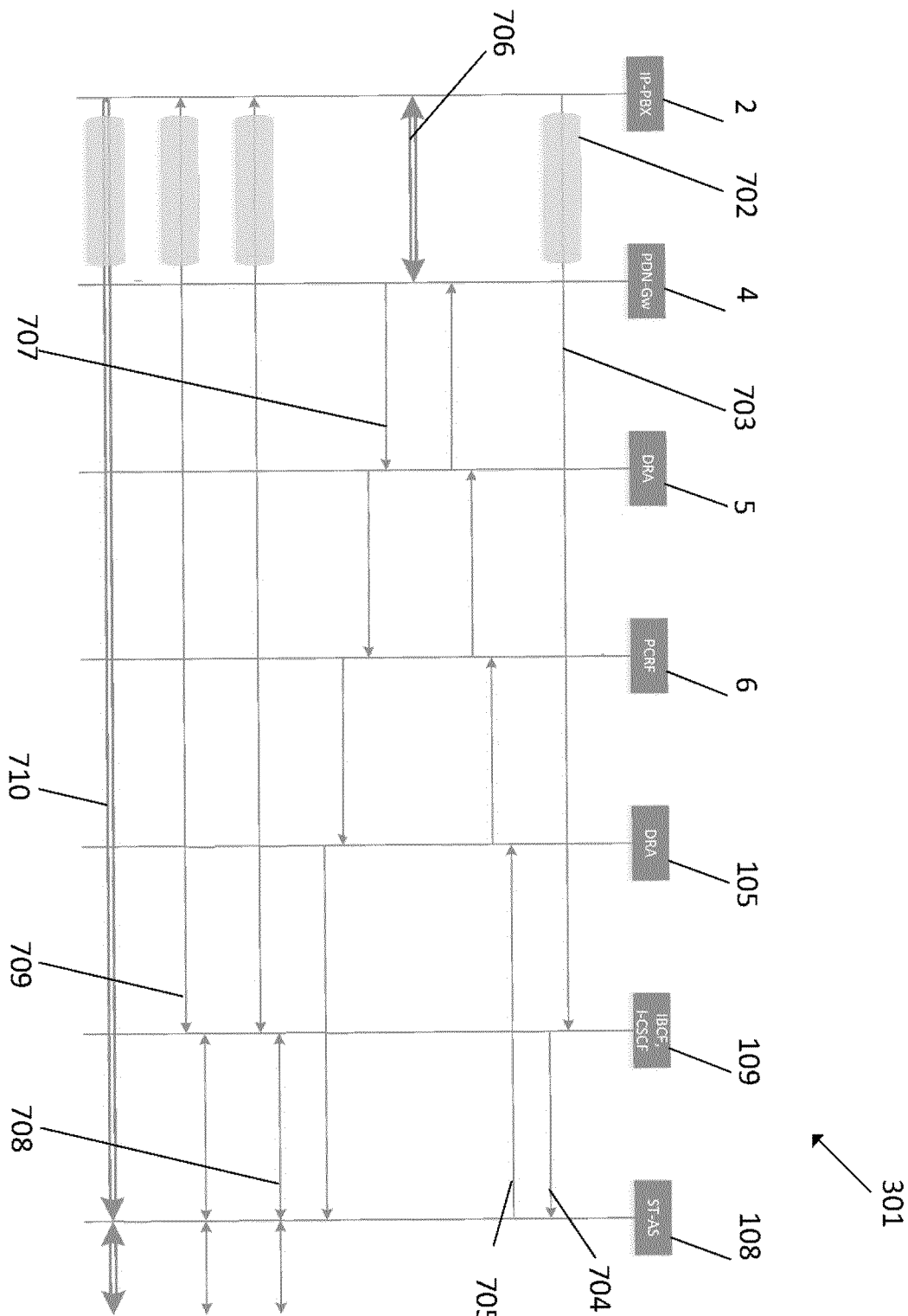


Fig. 8

## INTERNATIONAL SEARCH REPORT

International application No  
PCT/EP2015/081358

A. CLASSIFICATION OF SUBJECT MATTER  
INV. H04L29/06  
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)  
H04L

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         | US 2015/127759 A1 (SIEGEL STEVEN A [US] ET AL) 7 May 2015 (2015-05-07)                                                                                                                                                       | 1,5,7,<br>10-12       |
| Y         | paragraph [0033] - paragraph [0036]<br>paragraph [0047] - paragraph [0048]<br>paragraph [0068] - paragraph [0071]<br>paragraph [0074]<br>paragraph [0081] - paragraph [0091]<br>paragraph [0119] - paragraph [0121]<br>----- | 2-4,6,8               |
| Y         | US 2011/106971 A1 (SIEGEL STEVEN ALAN [US] ET AL) 5 May 2011 (2011-05-05)                                                                                                                                                    | 2-4,6,8               |
| A         | paragraph [0021] - paragraph [0040]<br>-----                                                                                                                                                                                 | 1,5,7,<br>10-12       |



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

9 September 2016

Date of mailing of the international search report

07/11/2016

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2  
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Fax: (+31-70) 340-3016

Authorized officer

Iapichino, Giuliana

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/EP2015/081358

## Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:  
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-8, 10-12

### Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

**FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210**

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-8, 10-12

Method for providing different QoS to different services requested by a IP-PBX device connected to an IMS network.

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2. claims: 9, 13

Method for storing and maintaining centrally the identity of an unregistered device to the IMS network, such as a IP-PBX device.

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# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2015/081358

| Patent document<br>cited in search report | Publication<br>date | Patent family<br>member(s) | Publication<br>date         |
|-------------------------------------------|---------------------|----------------------------|-----------------------------|
| US 2015127759                             | A1                  | 07-05-2015                 | NONE                        |
| -----                                     |                     |                            |                             |
| US 2011106971                             | A1                  | 05-05-2011                 | US 2011106971 A1 05-05-2011 |
|                                           |                     | US 2013148652 A1           | 13-06-2013                  |
| -----                                     |                     |                            |                             |