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(54) **Title:** METHOD, APPARATUS AND CORE NETWORK NODES FOR POLICY AND CHARGING CONTROL

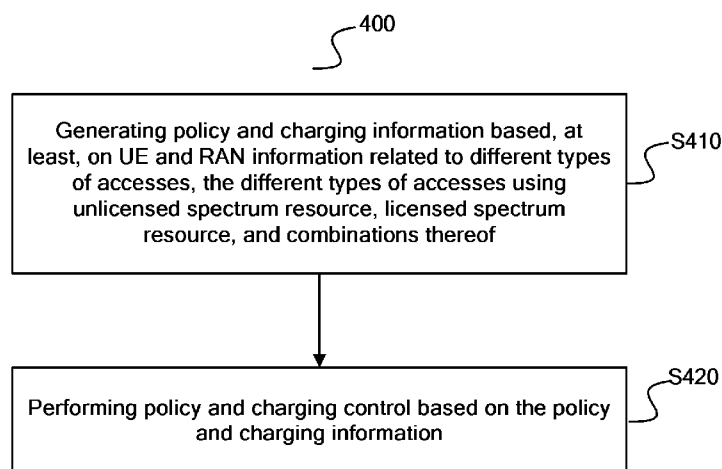


Fig. 4

(57) **Abstract:** The present disclosure relates to methods, apparatus, and core network nodes for policy and charging control. The method includes: generating policy and charging information based, at least, on User Equipment (UE) and Radio Access Network (RAN) information related to different types of accesses using unlicensed spectrum resource, licensed spectrum resource, and combinations thereof; and performing policy and charging control based on the policy and charging information.

METHOD, APPARATUS AND CORE NETWORK NODES FOR POLICY AND CHARGING CONTROL

TECHNICAL FIELD

5 The disclosure generally relates to policy and charging control, and more particularly, to method, apparatus, and core network nodes for policy and charging control.

BACKGROUND

10 Policy and Charging Control (PCC) is introduced in 3G packet core and evolves continually in 4G packet core for efficient traffic management and charging control. In addition, PCC is extended to manage traffic from WLAN (Wireless Local Area Networks) access. Existing PCC mechanisms are designed for accesses using licensed spectrum resource, such as LTE
15 (Long Term Evolution)/LTE-Advanced (LTE-A) access, and access using unlicensed spectrum resource, such as WLAN access.

As technology develops, diverse applications or services put quite different requirements on future networks. It would be quite difficult or cost impossible to carry various traffic from people and/or machine by a
20 single uniform access network to fulfill such extremely diverse requirements. The existing licensed spectrum is far from enough to provide satisfied user experience and/or cost efficiency. Thus, access technologies utilizing spectrum on a license-exempt basis may continue to play a role in the data traffic management. Recently, there are several new trends in
25 aggregation between the 3rd Generation Partnership Project (3GPP) access and non-3GPP access to fulfill the increasingly diverse requirements to future networks.

In the upcoming 5G Era, mobile network operators will deploy various access networks, e.g. access networks using licensed spectrum
30 resource, access networks using unlicensed spectrum resource, and access networks using both the licensed and unlicensed spectrum resources.

It is desirable to provide a PCC solution for such new heterogeneous

access technology environment.

SUMMARY

This summary is provided to introduce a selection of concepts in a simplified form that are further described below in the detailed description. This summary is not intended to identify key features or essential features of the claimed subject matter, nor is it intended to be used in isolation as an aid in determining the scope of the claimed subject matter.

In a first aspect of the present disclosure, there is provided a method for policy and charging control including: generating policy and charging information based, at least, on User Equipment (UE) and Radio Access Network (RAN) information related to different types of accesses, the different types of accesses using unlicensed spectrum resource, licensed spectrum resource, and combinations thereof; and performing policy and charging control based on the policy and charging information.

In an example, the UE and RAN information related to the different types of accesses may include UE's capability of supporting the different types of accesses and RAN's capability of supporting the different types of accesses.

In an example, the policy and charging information may include: one or more traffic routing rules specifying which traffic is to be routed over any one of the licensed and/or unlicensed spectrum resources of the different types of accesses; and one or more policy and charging rules specifying the policy and charging control for traffic routed over any one of the licensed and/or unlicensed spectrum resources of the different types of accesses.

In an example, said performing policy and charging control based on the policy and charging information may include: forwarding the one or more traffic routing rules to UE, from a core network (CN) node through a RAN node; and enforcing the one or more traffic routing rules at UE, and enforcing the one or more policy and charging rules at a further CN node.

In an example, performing policy and charging control based on the

policy and charging information may further include: enforcing the one or more traffic routing rules at the further CN node.

In an example, the different types of accesses using unlicensed spectrum resource, licensed spectrum resource, and combinations thereof
5 may include standalone LTE-Unlicensed (LTE-U), LTE WLAN Aggregation (LWA) and Licensed Assisted Access (LAA).

In an example, the different types of accesses using unlicensed spectrum resource, licensed spectrum resource, and combinations thereof may include standalone LTE-Unlicensed (LTE-U), LTE WLAN
10 Aggregation (LWA) and Licensed Assisted Access (LAA), and the one or more traffic routing rules may specify which traffic is to be routed over any one of standalone LTE-U access, LTE access of LWA, WLAN access of LWA, LTE and WLAN combined access of LWA, licensed bearer of LAA, unlicensed bearer of LAA, and licensed and unlicensed combined
15 bearer of LAA.

In an example, the UE and RAN information related to different types of accesses may be collected by a RAN node and transmitted to a CN node in charge of generating the policy and charging information.

In an example, forwarding the one or more traffic routing rules to UE,
20 from the CN node through the RAN node, may include transmitting, from a Policy and Charging Rules Function (PCRF) node to a Policy and Charging Enforcement Function (PCEF) node, the one or more traffic routing rules, and transmitting from the PCEF node, to the UE through the RAN node, the one or more traffic routing rules.

25 In an example, enforcing the one or more policy and charging rules at a CN node may include receiving, at a Policy and Charging Enforcement Function (PCEF) node from a Policy and Charging Rules Function (PCRF) node, the one or more policy and charging rules, and enforcing the one or more policy and charging rules at the PCEF node.

30 In a second aspect of the present disclosure, there is provided an apparatus for policy and charging control including: a generating unit configured to generate policy and charging information based, at least, on

User Equipment (UE) and Radio Access Network (RAN) information related to different types of accesses, the different types of accesses using unlicensed spectrum resource, licensed spectrum resource, and combinations thereof; and a performing unit configured to perform policy and charging control based on the policy and charging information.

In an example, the UE and RAN information related to the different types of accesses may include UE's capability of supporting the different types of accesses and RAN's capability of supporting the different types of accesses.

In an example, the policy and charging information may include: one or more traffic routing rules specifying which traffic is to be routed over any one of the licensed and/or unlicensed spectrum resources of the different types of accesses; and one or more policy and charging rules specifying the policy and charging control for traffic routed over any one of the licensed and/or unlicensed spectrum resources of the different types of accesses.

In an example, the performing unit may be configured to perform policy and charging control by forwarding the one or more traffic routing rules to UE, to be enforced therein, through a RAN node and enforcing the one or more policy and charging rules.

In an example, the performing unit may be further configured to perform policy and charging control by also enforcing the one or more traffic routing rules.

In an example, the different types of accesses using unlicensed spectrum resource, licensed spectrum resource, and combinations thereof may include standalone LTE-Unlicensed (LTE-U), LTE WLAN Aggregation (LWA) and Licensed Assisted Access (LAA).

In an example, the different types of accesses using unlicensed spectrum resource, licensed spectrum resource, and combinations thereof may include standalone LTE-Unlicensed (LTE-U), LTE WLAN Aggregation (LWA) and Licensed Assisted Access (LAA), and the one or more traffic routing rules may specify which traffic is to be routed over

any one of standalone LTE-U access, LTE access of LWA, WLAN access of LWA, LTE and WLAN combined access of LWA, licensed bearer of LAA, unlicensed bearer of LAA, and licensed and unlicensed combined bearer of LAA.

5 In an example, the UE and RAN information related to different types of accesses may be collected by a RAN node.

In an example, the generating unit may be a Policy and Charging Rules Function (PCRF) node and the performing unit may be a Policy and Charging Enforcement Function (PCEF) node.

10 In a third aspect of the present disclosure, there is provided a core network node for generating information for policy and charging control and including: a generator unit configured to generate policy and charging information based, at least, on User Equipment (UE) and Radio Access Network (RAN) information related to different types of accesses, the
15 different types of accesses using unlicensed spectrum resource, licensed spectrum resource, and combinations thereof; and a transmitter configured to transmit the policy and charging information to a further core network node in charge of performing policy and charging control.

In an example, the UE and RAN information related to the different
20 types of accesses may include UE's capability of supporting the different types of accesses and RAN's capability of supporting the different types of accesses.

In an example, the policy and charging information may include: one or more traffic routing rules specifying which traffic is to be routed over
25 any one of the licensed and/or unlicensed spectrum resources of the different types of accesses; and one or more policy and charging rules specifying the policy and charging control for traffic routed over any one of the licensed and/or unlicensed spectrum resources of the different types of accesses.

30 In an example, the core network node may further include a receiver configured to receive, from a RAN node, the UE and RAN information related to the different types of accesses.

In an example, the core network node may be a Policy and Charging Rules Function (PCRF) node.

In an example, the further core network node may be a Policy and Charging Enforcement Function (PCEF) node.

5 In a fourth aspect of the present disclosure, there is provided a core network node for performing policy and charging control and including: a receiver configured to receive, from a further core network node in charge of generating information for policy and charging control, policy and charging information based, at least, on User Equipment (UE) and Radio
10 Access Network (RAN) information related to different types of accesses, the different types of accesses using unlicensed spectrum resource, licensed spectrum resource, and combinations thereof; and an enforcer unit configured to perform policy and charging control based on the received policy and charging information.

15 In an example, the received policy and charging information may include: one or more traffic routing rules specifying which traffic is to be routed over any one of the licensed and/or unlicensed spectrum resources of the different types of accesses; and one or more policy and charging rules specifying the policy and charging control for traffic routed over any
20 one of the licensed and/or unlicensed spectrum resources of the different types of accesses.

In an example, the core network node may further include a transmitter configured to forward, to a UE through a RAN node, the one or more traffic routing rules, and the enforcer unit may be configured to
25 enforce the one or more policy and charging rules.

In an example, the enforcer unit may be further configured to enforce the one or more traffic routing rules.

In an example, the one or more policy and charging rules may be enforced to trigger a flexible charging for traffic over at least one of
30 licensed and unlicensed access spectrum resources.

In an example, the core network node may be a Policy and Charging Enforcement Function (PCEF) node.

In an example, the further core network node may be a Policy and Charging Rules Function (PCRF) node.

BRIEF DESCRIPTION OF THE DRAWINGS

5 The above and other objects, features and advantages of the present disclosure will be clear from the following detailed description about the non-limited embodiments of the present disclosure taken in conjunction with the accompanied drawings, in which:

Fig. 1 is a schematic diagram illustrating LWA architecture.

10 Fig. 2 is a schematic diagram illustrating LAA access.

Fig. 3 is a schematic diagram illustrating standalone LTE-U access.

Fig. 4 is a flow chart illustrating a method for policy and charging control according to an embodiment of the present disclosure.

15 Fig. 5 is a block diagram illustrating an apparatus for policy and charging control according to an embodiment of the present disclosure.

Fig. 6 is a diagram illustrating a policy and charging control process according to an embodiment of the present disclosure.

20 Fig. 7 is a block diagram illustrating a core network node for generating information for policy and charging control according to an embodiment of the present disclosure.

Fig. 8 is a block diagram illustrating a core network node for performing policy and charging control according to an embodiment of the present disclosure.

DETAILED DESCRIPTION OF EMBODIMENTS

25 In the following detailed description, reference is made to the accompanying drawings, which form a part thereof. In the drawings, similar symbols typically identify similar components, unless context dictates otherwise. The illustrative examples or embodiments described in the detailed description, drawings, and claims are not meant to be limiting. 30 Other examples or embodiments may be utilized, and other changes may be made, without departing from the scope of the subject matter presented

here. It will be readily understood that aspects of this disclosure, as generally described herein, and illustrated in the figures, can be arranged, substituted, combined, and designed in a wide variety of different configurations, all of which are explicitly contemplated and make part of
5 this disclosure.

In the upcoming 5G Era, mobile network operators will deploy various access networks using licensed spectrum resource, unlicensed spectrum resource, and/or combinations thereof. Examples of such access networks include, but not limited to, access networks using licensed
10 spectrum resource (e.g. 5G new-Radio Access Technology (new-RAT) and LTE/LTE-A), access networks using unlicensed spectrum resource (e.g. WLAN and standalone LTE-U), and access networks using both the licensed and unlicensed spectrum resources (e.g. LWA and LAA).

3GPP has introduced several interworking solutions between 3GPP
15 networks and WLAN in previous releases. These enable moving data bearers to WLAN where the 3GPP core network (CN) acts as the anchor point, and the decisions for selecting WLAN are mostly carried out by policies in the user terminal. In Rel-12, 3GPP also introduced RAN rules and assistance which help in making better traffic steering decisions, with
20 more RAN control. In Rel-13, a Work Item has been approved and is aimed at improving LTE-WLAN Radio Level Integration and Interworking.

Fig. 1 is a schematic diagram illustrating LWA architecture 100. As shown in Fig. 1, there are licensed spectrum resource over which e.g. a
25 LTE link between eNB 120 and UE 110 is established and unlicensed spectrum resource over which e.g. a WLAN link between WLAN termination 130 and the UE 110 is established. Each of the UE and the WLAN termination has a respective LWA function block. LWA introduces data aggregation where a data bearer can be served by the LTE link and/or
30 WLAN link. Particularly, in addition to Master Cell Group (MCG) bearer carried by LTE spectrum resource and switched bearer carried by WLAN spectrum resource, LWA supports split bearer operation on downlink in

which a bearer is configured to use both LTE and WLAN spectrum resources. For split bearer operation, Packet Data Convergence Protocol (PDCP) sublayer supports in-sequence delivery of upper layer Protocol Data Units (PDUs) based on dual connectivity reordering procedure. LWA supports transmission of uplink PDCP PDUs on LTE. Accordingly, the LWA architecture 100 provides a better control and utilization of both the licensed and unlicensed spectrum resources and increases the aggregate throughput and system capacity. It is supposed to be transparent to CN and will be built upon the 3GPP Rel-12 Dual Connectivity split-bearer framework.

LWA may have different deployments, such as separated LTE and WLAN deployment with WLAN termination implemented by Access Point (AP), separated LTE and WLAN deployment with WLAN termination implemented by Access Controller (AC), and collocated LTE and WLAN deployment.

Besides leveraging WLAN access technology, the industry is considering to extend LTE access technology to unlicensed spectrum resource as well. Two different access technologies are under discussion, e.g. LTE-U/LAA and standalone LTE-U.

Fig. 2 is a schematic diagram illustrating LAA access 200. In LAA, unlicensed spectrum resource is used as performance booster managed by licensed spectrum resource. The existing carrier aggregation framework used among licensed carriers is reused and extended to unlicensed carriers. Since the reliability of licensed spectrum resource may be different from the reliability of unlicensed spectrum resource, information with different reliability requirements may be put on unlicensed and licensed bearers differently. Generally, licensed spectrum Primary Cell (Uplink (UL) and Downlink (DL)) is considered as appropriate for reliable control signaling, mobility management signaling, as well as robust/real-time user data with strict LTE Quality Of Service (QoS) requirement, while unlicensed spectrum Secondary Cell is considered as appropriate for best effort data, and it can be DL-only.

Fig. 3 is a schematic diagram illustrating standalone LTE-U access 300. As shown in Fig. 3, traffic may be routed over unlicensed spectrum resource (DL/UL). Standalone LTE-U is another alternative to extend LTE technology to unlicensed spectrum. In contrast to LTE-U/LAA, the standalone LTE-U can be operated independently with any licensed access technology or assistance. Therefore, it could be Mobile Network Operator (MNO) independent deployment and operation, while it could fall back to MNO network (both UL and DL) at coverage loss or national/international roaming situation. The standalone LTE-U is targeted to compete with independent WLAN access technology. Given that standalone LTE-U is operated totally in unlicensed spectrum resource, it may have lower QoS than LTE or LAA, while its cost can be much lower than LTE or LAA.

In a network environment where various access networks such as standalone LTE-U, LWA and LAA as described above as well as 5G new-RAT, LTE/LTE-A, and WLAN etc. are deployed, the existing PCC solutions encounter some problems.

For example, LAA can use unlicensed spectrum resource in addition to licensed spectrum resource, i.e. certain carrier is operated in unlicensed spectrum, so that it cannot be protected against interference from other unlicensed spectrum resource users. If mission critical Machine-Type Communications (MTC) traffic is carried by such carrier, service quality may not be well guaranteed at certain condition. However traditional LTE is operated in licensed spectrum with good radio resource guarantee. It is unfair to apply the existing PCC solutions to charge a user with the same rate regardless traffic is routed over unlicensed spectrum resource, licensed spectrum resource, or combination thereof. Standalone LTE-U is totally operated in unlicensed spectrum, where almost no spectrum resource can be guaranteed. This is completely different from traditional LTE, so that the existing PCC solutions are not suitable for standalone LTE-U. In LWA, WLAN and LTE are aggregated seamlessly from radio level for better user experience, radio resource utilization and less interference. WLAN access of LWA is different from traditional WLAN

access, e.g. standalone or integrated with Evolved Packet Core (EPC) by S2a, S2b or S2c interface. That is, the same IP traffic flow can be conveyed by LTE access and WLAN access simultaneously in LWA, which is not possible in any of the traditional accesses such as LTE/LTE-A and WLAN. These differences are not considered in any of the existing PCC solutions.

A specific scenario is assumed for illustration, where new access technology like LWA is deployed and supported by UE, while PCRF at network side isn't aware of such situation and couldn't differentiate between traditional WLAN access and WLAN access of LWA, and then the PCRF doesn't prioritize WLAN access of LWA over traditional WLAN access in network discovery information provided to UE. If traffic is routed over traditional WLAN access instead of WLAN access of LWA, user experience may be scarified during Hand Over (HO) to LTE or other WLAN AP. Furthermore, it is unfair to apply the existing PCC solutions to charge a user with the same rate regardless of the traffic is routed over WLAN access of LWA or traditional WLAN access. Furthermore, if PCRF doesn't know that UE supports LWA and the LWA network is available, traffic can only be steered to traditional WLAN bearer or LTE bearer. In this case, no traffic can be conveyed by split bearer operation, i.e. over LTE bearer and WLAN bearer simultaneously, and the dual connection capability will be wasted. Similarly, as compared to traditional LTE operated in licensed spectrum, standalone LTE-U or LAA operated fully or partially in unlicensed spectrum may not guarantee the same level of user experience. Licensed and unlicensed spectrum means big difference to network operators from economic perspective. It would be problematic to perform policy and charging control with the same rules regardless of licensed spectrum based LTE access and unlicensed spectrum based LTE access.

Embodiments of the present disclosure provide methods, apparatus and core network nodes for policy and charging control, in order to adapt the policy and charging control to a network environment in which

different types of accesses networks using unlicensed spectrum resource, licensed spectrum resource, and combinations thereof, e.g. standalone LTE-U, LWA and LAA, are deployed.

Fig. 4 is a flow chart illustrating a method 400 for policy and charging control according to an embodiment of the present disclosure.

At step S410, policy and charging information is generated based, at least, on UE and RAN information related to different types of accesses using unlicensed spectrum resource, licensed spectrum resource, and combinations thereof.

In an embodiment, the UE and RAN information related to the different types of accesses may include UE's capability of supporting the different types of accesses and RAN's capability of supporting the different types of accesses.

In an embodiment, the different types of accesses using unlicensed spectrum resource, licensed spectrum resource, and combinations thereof may include: standalone LTE-U, LWA and LAA.

In an embodiment, the policy and charging information may include: one or more traffic routing rules specifying which traffic is to be routed over any one of the licensed and/or unlicensed spectrum resources of the different types of accesses; and one or more policy and charging rules specifying the policy and charging control for traffic routed over any one of the licensed and/or unlicensed spectrum resources of the different types of accesses. In an embodiment, the different types of accesses using unlicensed spectrum resource, licensed spectrum resource, and combinations thereof may include: standalone LTE-U, LWA and LAA, and the one or more traffic routing rules may specify which traffic is to be routed over any one of standalone LTE-U access, LTE access of LWA, WLAN access of LWA, LTE and WLAN combined access of LWA, licensed bearer of LAA, unlicensed bearer of LAA, and licensed and unlicensed combined bearer of LAA.

In an embodiment, the UE and RAN information related to different types of accesses may be collected by the RAN node and transmitted to a

CN node in charge of generating the policy and charging information. This enables the network side to be aware of the UE and RAN capability of supporting the different types of accesses. For example, if LWA is deployed and supported by UE, the network side will be aware of such
5 situation. As such, traffic can be conveyed by split bearer operation when necessary, thereby the dual connection capability will not be wasted.

At step S420, policy and charging control is performed based on the policy and charging information.

In an embodiment, this step S420 may include: forwarding the one or
10 more traffic routing rules to UE, from a core network node through a RAN node; and enforcing the one or more traffic routing rules at UE, and enforcing the one or more policy and charging rules at a further CN node.

As an example, forwarding the one or more traffic routing rules to UE, from the CN node through the RAN node, may include: transmitting, from
15 a PCRF node to a PCEF node, the one or more traffic routing rules, and transmitting from the PCEF node to the UE through the RAN node, the one or more traffic routing rules.

As an example, enforcing the one or more policy and charging rules at a further CN node may include receiving, at a PCEF node from a PCRF
20 node, the one or more policy and charging rules, and enforcing the one or more policy and charging rules at the PCEF node.

In an embodiment, this step S420 may further include: enforcing the one or more traffic routing rules at the further CN node.

In contrast to the existing PCC solutions, which charge a user with
25 the same rate regardless of the traffic is routed over licensed or unlicensed spectrum resource, embodiments of the present disclosure take account of UE and RAN information related to different types of accesses using unlicensed spectrum resource, licensed spectrum resource, and combinations thereof when generating policy and charging information.
30 Accordingly, differences between unlicensed spectrum resource, licensed spectrum resource, and combinations thereof of the different types of accesses are considered in policy and charging control. This enables the

embodiments of the present disclosure to provide a flexible policy and charging control in a network environment in which different types of accesses networks using unlicensed spectrum resource, licensed spectrum resource, and combinations thereof, e.g. standalone LTE-U, LWA and
5 LAA, are deployed.

Fig. 5 is a block diagram illustrating an apparatus 500 for policy and charging control according to an embodiment of the present disclosure.

Referring to Fig. 5, the apparatus 500 may include a generating unit 510 and a performing unit 520.

10 The generating unit 510 may be configured to generate policy and charging information based, at least, on UE and RAN information related to different types of accesses using unlicensed spectrum resource, licensed spectrum resource, and combinations thereof.

In an embodiment, the UE and RAN information related to the
15 different types of accesses may include UE's capability of supporting the different types of accesses and RAN's capability of supporting the different types of accesses.

In an embodiment, the different types of accesses using unlicensed spectrum resource, licensed spectrum resource, and combinations thereof
20 may include standalone LTE-U, LWA and LAA.

In an embodiment, the policy and charging information may include: one or more traffic routing rules specifying which traffic is to be routed over any one of the licensed and/or unlicensed spectrum resources of the different types of accesses; and one or more policy and charging rules
25 specifying the policy and charging control for traffic routed over any one of the licensed and/or unlicensed spectrum resources of the different types of accesses. In an embodiment, the different types of accesses using unlicensed spectrum resource, licensed spectrum resource, and combinations thereof may include standalone LTE-U, LWA and LAA, and
30 the one or more traffic routing rules may specify which traffic is to be routed over any one of standalone LTE-U access, LTE access of LWA, WLAN access of LWA, LTE and WLAN combined access of LWA,

licensed bearer of LAA, unlicensed bearer of LAA, and licensed and unlicensed combined bearer of LAA.

In an embodiment, the UE and RAN information related to different types of accesses may be collected by a RAN node and may reach the
5 generating unit 510.

In an embodiment, the generating unit 510 may be a PCRF node.

The performing unit 520 may be configured to perform policy and charging control based on the policy and charging information.

In one embodiment, the performing unit 520 may be configured to
10 perform policy and charging control by forwarding the one or more traffic routing rules to UE, to be enforced therein, through a RAN node and enforcing the one or more policy and charging rules. In one embodiment, the performing unit 520 may be further configured to perform policy and charging control by also enforcing the one or more traffic routing rules.

15 In one embodiment, the performing unit 520 may be a PCEF node.

Fig. 6 is a diagram illustrating a policy and charging control process
600 according to an embodiment of the present disclosure. In this embodiment, the process 600 is performed in a network environment in which different types of accesses networks using unlicensed spectrum
20 resource, licensed spectrum resource, and combinations thereof may be deployed. In this embodiment, said different types of accesses networks include, but not limited to, standalone LTE-U, LWA and LAA as described above. Any other access networks such as 5G new-RAT, LTE/LTE-A, and WLAN may also be deployed. As shown in Fig. 6, this
25 network environment involves UE 40, RAN node 30, and CN nodes including Mobility Management Entity (MME) 50, PCEF 20, PCRF 10, Subscription Profile Repository (SPR) 60, and Application Function (AF) 70.

At step S610, UE 40 reports its capability of supporting LWA, LAA
30 and standalone LTE-U to the RAN node 30.

As an example, UE 40 may report its capability of supporting LWA, LAA and standalone LTE-U to the RAN node 30 by a message during

connection establishment process. The message may include LWA capability indication, LAA capability indication, and LTE-U capability indication associated to UE 40. The RAN node 30 may be implemented by a RAN Control-Plane (C-plane) function such as eNB.

5 At step S620, the RAN node 30 collects the UE and RAN capability of supporting LWA, LAA and standalone LTE-U.

As an example, the RAN node 30 may store the UE capability of supporting LWA, LAA and standalone LTE-U reported by UE 40, and determine its RAN capability of supporting LWA, LAA and standalone
10 LTE-U. In an example, the RAN node 30 may further measure radio load status or radio resource utilization on licensed spectrum and/or unlicensed radio spectrum supported by RAN.

At step S630, the RAN node 30 transmits the collected UE and RAN capability of supporting LWA, LAA and standalone LTE-U to PCRF 10.

15 In an embodiment, the RAN node 30 may transmit the collected UE and RAN capability of supporting LWA, LAA and standalone LTE-U to a PCRF node 10 via a CN C-plane function such as MME 50.

As an example, the RAN node 30 may report the collected UE and RAN capability of supporting LWA, LAA and standalone LTE-U to the
20 MME 50 by a message including UE capability indication on standalone LTE-U, LAA and LWA and RAN capability indication on standalone LTE-U, LAA, and LWA. The message may further include load status and/or radio resource utilization on licensed and/or unlicensed radio spectrum supported by RAN.

25 MME 50 may forward the UE and RAN capability of supporting LWA, LAA and standalone LTE-U received from the RAN node 30 to PCRF 10 by a message. In an example, the message may be sent from MME 50 to PCRF 10 directly. Alternatively, the message may be relayed to PCRF 10 by intermediate CN C-Plane and/or User-Plane (U-plane)
30 function such as Serving Gateway/PDN Gateway (S/P-GW). In this case, the related interface between MME and S/P-GW, and interface between S/P-GW and PCRF may be extended to convey UE and RAN capability of

supporting LWA, LAA and standalone LTE-U, and the load status and/or radio resource utilization on licensed and/or unlicensed radio spectrum supported by RAN.

At step S640, PCRF 10 may interact with SPR 60 to obtain user
5 subscription information on utilization of standalone LTE-U, LWA, and LAA access networks.

At step S650, PCRF 10 may interact with AF 70, which may be operated by an Over-The-Top Service Provider (OTT SP), as indicated in user related information to obtain a network service requirement on
10 various access networks, such as standalone LTE-U, LWA, LAA, to convey traffic.

As an example, the network service requirement may be obtained from AF 70 directly or indirectly through intermediate function such as Service Creation Environment Function (SCEF).

15 In an example, AF may reply to PCRF 10, likely through an Access Network Discovery and Selection Function (ANDSF), network service requirement such as preference/requirement of OTT SP on network selection. For example, the preference/requirement may include a list of preferred access networks, associated traffic service description
20 information, and related UE ID/IP information.

At step S660, PCRF 10 generates one or more traffic routing rules and one or more policy and charging control rules based, at least, on UE and RAN capability of supporting different types of accesses such as LWA, LAA and standalone LTE-U.

25 For example, the one or more traffic routing rules and the one or more policy and charging control rules may be generated based on the UE and RAN capability of supporting the different types of accesses such as LWA, LAA and standalone LTE-U and the radio load status and/or radio resource utilization on licensed spectrum and/or unlicensed radio spectrum
30 supported by RAN, operator policy on utilization of the unlicensed and licensed spectrum resources of the different types of accesses, the subscription information obtained from SPR 60 in step S640 and/or the

network service requirement obtained from AF 70 in step S650.

In an example, the one or more traffic routing rules specify which traffic is to be routed over any one of the licensed and/or unlicensed spectrum resources of different types of accesses such as LWA, LAA and standalone LTE-U. For example, besides traditional accesses such as LTE/LTE-A and WLAN, PCRF 10 can determine specific traffic to be routed over standalone LTE-U access, specific traffic to be routed over LTE access of LWA, specific traffic to be routed over WLAN access of LWA, specific traffic to be routed over LTE and WLAN combined access of LWA, specific traffic to be routed over licensed bearer of LAA, specific traffic to be routed over unlicensed bearer of LAA, and specific traffic to be routed over licensed and unlicensed combined bearer of LAA.

With such traffic routing rules, traffic can be routed in a flexible manner among the licensed and/or unlicensed spectrum resources of the different types of accesses. For example, if LWA is deployed and supported by UE, PCRF at network side will be aware of such situation and can differentiate between traditional WLAN access and WLAN access of LWA, so that PCRF can prioritize WLAN access of LWA over traditional WLAN access in network discovery information provided to UE to provide a better user experience. As another example, mission critical MTC traffic may be not allowed to be routed over unlicensed spectrum resource of LAA in order to guarantee the service quality.

Accordingly, traffic routed over accesses such as LWA, LAA and standalone LTE-U can be charged separately and/or differently from traffic routed over traditional accesses such as LTE/LTE-A and WLAN.

In an example, the one or more policy and charging rules specify the policy and charging control for traffic routed over any one of the licensed and/or unlicensed spectrum resources of the different types of accesses.

For examples, the one or more policy and charging rules may specify:

1) according to the operator policy and the UE capability of supporting different types of accesses such as LWA, LAA and standalone LTE-U, traffic related to a predefined Application (APP) may be routed

over unlicensed LTE access, e.g. standalone LTE-U, and charged by a very low rate or free of charge; and traffic related to another predefined APP will be carried by any one of the licensed bearer of LAA, unlicensed bearer of LAA, and licensed and unlicensed combined bearer of LAA, and
5 charged with high rate and most strictly controlled data rate or QoS;

2) according to requirements of OTT operators, traffic related to a predefined group of users involved in the OTT service may be routed over licensed LTE access with strictly controlled data rate or QoS control, and charged with high rate; and traffic related to another predefined group of
10 users involved in the OTT may be routed over unlicensed LTE access, e.g. standalone LTE-U, which is free of data rate or QoS control and charge;

3) according to UE capability of supporting different types of accesses such as LWA, LAA and standalone LTE-U and the radio access network situation such as the radio load status and/or radio resource
15 utilization on licensed spectrum and/or unlicensed radio spectrum supported by RAN, if LWA is supported by UE and available, WLAN access of LWA is prioritized over independent WLAN access to carry traffic for a predefined user, and this traffic is less strictly controlled than traffic over LTE access of the LWA, and charged with lower rate than
20 traffic over LTE access of LWA, and if LTE-U is supported by UE and available, LTE-U is prioritized over licensed LTE to carry traffic for another predefined user, and this traffic is less strictly controlled than traffic over licensed LTE access, and charged with lower rate than traffic over licensed LTE access.

25 With such policy and charging rules, policy and charging control may be performed differently for traffic routed over the licensed and/or unlicensed spectrum resources of the different types of accesses. For example, traffic routed over standalone LTE-U may be charged by a very low rate or free of charge. As another example, traffic routed over licensed
30 LTE access may be charged with high rate and constrained at a strictly controlled data rate or QoS. This is more flexible and reasonable than the existing policy and charging control solutions which charge a user with the

same rate without considering the difference between licensed spectrum resource, unlicensed spectrum resource, and combination thereof.

At step S670, PCRF 10 provides the one or more traffic routing rules and the one or more policy and charging rules to PCEF 20.

5 As an example, PCRF 10 may provide the one or more traffic routing rules and the one or more policy and charging rules to PCEF 20 by a response message which may include following information:

1) one or more traffic routing rules, in which for routing access information, the following new values are defined: standalone LTE-U
10 access, LTE access of LWA, WLAN access of LWA, LTE and WLAN combined access of LWA, licensed bearer of LAA, unlicensed bearer of LAA, and licensed and unlicensed combined bearer of LAA;

2) one or more policy and charging rules, in which following new value or indicator is defined for user location report: LWA indicator or
15 both LWA involved LTE cell info and LWA involved WLAN SSID info to be reported to inform PCRF that the access is LWA supported; for allowed access type, the following new values are defined: e.g. standalone LTE-U access, LTE access of LWA, WLAN access of LWA, LTE and WLAN combined access of LWA, licensed bearer of LAA, unlicensed bearer of
20 LAA, licensed and unlicensed combined bearer of LAA; and separated and/or different charging key values can be defined for traffic over different types of accesses, e.g. standalone LTE-U, LWA, and LAA.

In addition, the message may include 3) IP-CAN bearer and/or session related policy in which for default network based IP flow
25 management (NBIFOM) access, following values are defined: standalone LTE-U access, LTE access of LWA, WLAN access of LWA, both LTE and WLAN access of LWA, LAA access.

At step S680, PCEF 20 forwards the one or more traffic routing rules to UE 40 through the RAN node 30. For example, the PCEF 20 forwards
30 the one or more traffic routing rules to MME 50, MME 50 sends a message including the one or more traffic routing rules to the RAN node 30 to confirm related information has been received, the RAN node 30 replies

the UE 40 with a message to confirm related information has been received, and MME 50 forwards the one or more traffic routing rules to UE 40 by a Non-Access Stratum (NAS) message which is extended to convey enhanced traffic routing rule. In an alternative embodiment, the one or
5 more traffic routing rules may be provided directly to the RAN node 30 from PCRF 10 and forwarded from the RAN node 30 to UE 40.

After the traffic routing rules are forwarded to UE 40, bearer is established between UE and CN, as shown in Fig. 6.

At step S690, UE 40 enforces the one or more traffic routing rules.

10 In an example, based on the received traffic routing rules and/or the UE local settings, UE 40 may accept the traffic routing rules and steer traffic over the licensed and/or unlicensed spectrum resources of the different types of accesses, e.g. standalone LTE-U, LWA and LAA, in accordance with the traffic routing rules.

15 For example, UE 40 may distribute upper layer user traffic among available licensed and/or unlicensed spectrum resources of the different types of accesses. Particularly, certain user traffic may be steered to standalone LTE-U access, certain user traffic may be steered to primary carriers of LAA, certain user traffic may be steered to secondary carriers
20 of LAA, certain user traffic may be steered to LTE access of LWA, certain user traffic may be steered to WLAN access of LWA, and certain user traffic may be steered to LTE and WLAN combined access of LWA.

By forwarding the one or more traffic routing rules to UE, from a CN node through a RAN node and enforcing the one or more traffic routing
25 rules at UE, the flexible and reasonable traffic routing may be achieved.

At step S611, PCEF 20 may enforce the one or more traffic routing rules and enforces the one or more policy and charging rules. For example, a CN U-plane function such as S/P-GW (in which PCEF 20 may be located) in EPC may intercept the user traffic and enforce the policy and charging
30 rule to realize a flexible charging for traffic over licensed and/or unlicensed spectrum resource of the different types of accesses, e.g. standalone LTE-U, LWA and LAA, and then the traffic may be routed

continually to an application server.

By enforcing the one or more traffic routing rules also at the CN node such as PCEF 20, traffic not complying with the traffic routing rules may be blocked or otherwise not allowed, in order to provide a stricter traffic
5 routing.

At step S612, UE 40 sends a service request such as HTTP request to AF 70 through bearers or tunnels established between UE 40 and CN.

At step S613, AF 70 provides a service response to UE 40. For example, the application server may provide an application layer response
10 message to UE 40, and an OTT service may be provided to the UE 40.

It should be noted that the order in which the steps may be performed is not limited to the order as described above. In some embodiments, step S640 may be performed before step S630 and step S650 may be performed after step S630, as shown in Fig. 6. In some embodiments, step S611 may
15 be performed before step S690. In some embodiments, steps S611 and S690 may be simultaneously.

Fig. 7 is a block diagram illustrating a core network node 700 for generating information for policy and charging control according to an embodiment of the present disclosure.

Referring to Fig. 7, the core network node 700 may include a
20 generator unit 720 and a transmitter 710. The generator unit 720 may be configured to generate policy and charging information based, at least, on UE and RAN information related to different types of accesses, the different types of accesses using unlicensed spectrum resource, licensed
25 spectrum resource, and combinations thereof. The transmitter 710 may be configured to transmit the policy and charging information to a further core network node 800 in charge of performing policy and charging control, as illustrated in Fig. 8. In an embodiment, the further core network node 800 may be a PCEF node 20.

30 In an embodiment, the UE and RAN information related to the different types of accesses may include UE's capability of supporting the different types of accesses and RAN's capability of supporting the

different types of accesses.

In an embodiment, the policy and charging information may include: one or more traffic routing rules specifying which traffic is to be routed over any one of the licensed and/or unlicensed spectrum resources of the different types of accesses; and one or more policy and charging rules specifying the policy and charging control for traffic routed over any one of the licensed and/or unlicensed spectrum resources of the different types of accesses.

In an embodiment, the core network node 700 may further include a receiver 730 configured to receive, from a RAN node, the UE and RAN information related to the different types of accesses.

In an embodiment, the core network node 700 may be a PCRF node 10.

Fig. 8 is a block diagram illustrating a core network node 800 for performing policy and charging control according to an embodiment of the present disclosure.

Referring to Fig. 8, the core network node 800 may include a receiver 810 and an enforcer unit 820. The receiver 810 may be configured to receive, from a further core network node 700 in charge of generating information for policy and charging control and illustrated in Fig. 7, policy and charging information based, at least, on UE and RAN information related to different types of accesses using unlicensed spectrum resource, licensed spectrum resource, and combinations thereof. In an embodiment, the further core network node 700 may be a PCRF node 10. The enforcer unit 820 may be configured to perform policy and charging control based on the received policy and charging information.

In an embodiment, the received policy and charging information may include: one or more traffic routing rules specifying which traffic is to be routed over any one of the licensed and/or unlicensed spectrum resources of the different types of accesses; and one or more policy and charging rules specifying the policy and charging control for traffic routed over any one of the licensed and/or unlicensed spectrum resources of the different

types of accesses.

In an embodiment, the core network node 800 may further include a transmitter 830 configured to forward, to UE through a RAN node, the one or more traffic routing rules, wherein the enforcer unit 820 may be
5 configured to enforce the one or more policy and charging rules.

In an embodiment, the enforcer unit 820 may be further configured to enforce the one or more traffic routing rules.

In an embodiment, the one or more policy and charging rules are enforced to trigger a flexible charging for traffic over at least one of
10 licensed and unlicensed access spectrum resources.

In an embodiment, the core network node 800 may be a PCEF node
20.

According to a further aspect of the present disclosure, there is provided a computer program product comprising instructions that, in
15 response to execution of the instructions by a computing device, cause the computing device to perform any of the steps or embodiments of the method described above. According to a still further aspect of the present disclosure, there is provided a non-transitory computer readable medium comprising instructions that, in response to execution of the instructions
20 by a computing device, cause the computing device to perform any of the steps or embodiments of the method described above.

Embodiments of the present disclosure are applicable for various access networks which include not only the traditional LTE/LTE-A and WLAN, but also standalone LTE-U, LWA and LAA. They are in line with
25 the existing 3GPP network architecture, e.g. PCC framework, and can be evolved to be in line with 5G radio access networks.

Embodiments of the present disclosure can be implemented in a simple and feasible manner on the basis of the existing network architecture, e.g. by enhancing the existing interfaces and network
30 functions.

The foregoing description gives only the embodiments of the present disclosure and is not intended to limit the present disclosure in any way.

Thus, any modification, substitution, improvement or the like made within the teaching and principle of the present disclosure should be encompassed by the scope of the present disclosure.

CLAIMS

1. A method (400, 600) for policy and charging control comprising:
generating (S410, S660) policy and charging information based, at
5 least, on User Equipment “UE” and Radio Access Network “RAN”
information related to different types of accesses, the different types of
accesses using unlicensed spectrum resource, licensed spectrum resource,
and combinations thereof; and
performing (S420) policy and charging control based on the policy
10 and charging information.
2. The method of claim 1, wherein the UE and RAN information
related to the different types of accesses comprises UE's capability of
supporting the different types of accesses and RAN's capability of
supporting the different types of accesses.
- 15 3. The method of claim 1 or 2, wherein the policy and charging
information comprises:
one or more traffic routing rules specifying which traffic is to be
routed over any one of the licensed and/or unlicensed spectrum resources
of the different types of accesses; and
20 one or more policy and charging rules specifying the policy and
charging control for traffic routed over any one of the licensed and/or
unlicensed spectrum resources of the different types of accesses.
4. The method of claim 3, wherein said performing (S420) policy and
charging control based on the policy and charging information comprises:
25 forwarding (S670, S680) the one or more traffic routing rules to UE
(40), from a core network “CN” node (10) through a RAN node (30); and
enforcing (S690) the one or more traffic routing rules at UE, and
enforcing (S611) the one or more policy and charging rules at a further CN
node (20).
- 30 5. The method of claim 4, wherein said performing (S420) policy and
charging control based on the policy and charging information further
comprises:

enforcing (S611) the one or more traffic routing rules at the further CN node (20).

6. The method of any of claims 1-2, wherein the different types of accesses using unlicensed spectrum resource, licensed spectrum resource, and combinations thereof comprise standalone LTE-Unlicensed “LTE-U”,
5 LTE WLAN Aggregation “LWA” and Licensed Assisted Access “LAA”.

7. The method of any of claims 3-5 wherein the different types of accesses using unlicensed spectrum resource, licensed spectrum resource, and combinations thereof comprise standalone LTE-Unlicensed “LTE-U”,
10 LTE WLAN Aggregation “LWA” and Licensed Assisted Access “LAA”;
and

wherein said one or more traffic routing rules specify which traffic is to be routed over any one of standalone LTE-U access, LTE access of LWA, WLAN access of LWA, LTE and WLAN combined access of LWA,
15 licensed bearer of LAA, unlicensed bearer of LAA, and licensed and unlicensed combined bearer of LAA.

8. The method of any of claims 1-7, wherein the UE and RAN information related to different types of accesses is collected by a RAN node (30) and transmitted to a CN node (10) in charge of generating the
20 policy and charging information.

9. The method of claim 4, wherein forwarding (S670, S680) the one or more traffic routing rules to UE (40), from the CN node (10) through the RAN node (30), comprises transmitting (S670), from a Policy and Charging Rules Function “PCRF” node (10) to a Policy and Charging
25 Enforcement Function “PCEF” node (20), the one or more traffic routing rules, and transmitting (S680) from the PCEF node (20), to the UE (40) through the RAN node (30), the one or more traffic routing rules.

10. The method of claim 4, wherein enforcing (S611) the one or more policy and charging rules at a CN node (20) comprises receiving, at a
30 Policy and Charging Enforcement Function “PCEF” node (20) from a Policy and Charging Rules Function “PCRF” node (10), the one or more policy and charging rules, and enforcing the one or more policy and

charging rules at the PCEF node (20).

11. An apparatus (500) for policy and charging control comprising:

a generating unit (510) configured to generate policy and charging information based, at least, on User Equipment “UE” and Radio Access
5 Network “RAN” information related to different types of accesses, the different types of accesses using unlicensed spectrum resource, licensed spectrum resource, and combinations thereof; and

a performing unit (520) configured to perform policy and charging control based on the policy and charging information.

10 12. The apparatus of claim 11, wherein the UE and RAN information related to the different types of accesses comprises UE's capability of supporting the different types of accesses and RAN's capability of supporting the different types of accesses.

13. The apparatus of claim 11 or 12, wherein the policy and charging
15 information comprises:

one or more traffic routing rules specifying which traffic is to be routed over any one of the licensed and/or unlicensed spectrum resources of the different types of accesses; and

one or more policy and charging rules specifying the policy and
20 charging control for traffic routed over any one of the licensed and/or unlicensed spectrum resources of the different types of accesses.

14. The apparatus of claim 13, wherein said performing unit (520) is configured to perform policy and charging control by forwarding the one or more traffic routing rules to a UE (40), to be enforced therein, through a
25 RAN node (30) and enforcing the one or more policy and charging rules.

15. The apparatus of claim 14, wherein said performing unit (520) is further configured to perform policy and charging control by also enforcing the one or more traffic routing rules.

16. The apparatus of any of claims 11-12, wherein the different types
30 of accesses using unlicensed spectrum resource, licensed spectrum resource, and combinations thereof comprise standalone LTE-Unlicensed “LTE-U”, LTE WLAN Aggregation “LWA” and Licensed Assisted Access

“LAA”.

17. The apparatus of any of claims 13-15, wherein the different types of accesses using unlicensed spectrum resource, licensed spectrum resource, and combinations thereof comprise standalone LTE-Unlicensed “LTE-U”, LTE WLAN Aggregation “LWA” and Licensed Assisted Access “LAA”; and

wherein said one or more traffic routing rules specify which traffic is to be routed over any one of standalone LTE-U access, LTE access of LWA, WLAN access of LWA, LTE and WLAN combined access of LWA, licensed bearer of LAA, unlicensed bearer of LAA, and licensed and unlicensed combined bearer of LAA.

18. The apparatus of any of claims 11-17, wherein the UE and RAN information related to different types of accesses is collected by a RAN node (30).

19. The apparatus of any of claims 11-18, wherein the generating unit (510) is a Policy and Charging Rules Function “PCRF” node (10) and the performing unit (520) is a Policy and Charging Enforcement Function “PCEF” node (20).

20. A core network node (700, 510, 10) for generating information for policy and charging control and comprising:

a generator unit (720) configured to generate policy and charging information based, at least, on User Equipment “UE” and Radio Access Network “RAN” information related to different types of accesses, the different types of accesses using unlicensed spectrum resource, licensed spectrum resource, and combinations thereof; and

a transmitter (710) configured to transmit the policy and charging information to a further core network node (20) in charge of performing policy and charging control.

21. The core network node of claim 20, wherein the UE and RAN information related to the different types of accesses comprises UE's capability of supporting the different types of accesses and RAN's capability of supporting the different types of accesses.

22. The core network node of any of claims 20 or 21, wherein the policy and charging information comprises:

one or more traffic routing rules specifying which traffic is to be routed over any one of the licensed and/or unlicensed spectrum resources
5 of the different types of accesses; and

one or more policy and charging rules specifying the policy and charging control for traffic routed over any one of the licensed and/or unlicensed spectrum resources of the different types of accesses.

23. The core network node of any of claims 20 to 22, further
10 comprising a receiver (730) configured to receive, from a RAN node (30), the UE and RAN information related to the different types of accesses.

24. The core network node of any of claims 20 to 23, wherein the core network node is a Policy and Charging Rules Function “PCRF” node (10).

25. A core network node (800, 520, 20) for performing policy and
15 charging control and comprising:

a receiver (810) configured to receive, from a further core network node (10) in charge of generating information for policy and charging control, policy and charging information based, at least, on User Equipment “UE” and Radio Access Network “RAN” information related to
20 different types of accesses, the different types of accesses using unlicensed spectrum resource, licensed spectrum resource, and combinations thereof; and

an enforcer unit (820) configured to perform policy and charging control based on the received policy and charging information.

25 26. The core network node of claim 25, wherein the received policy and charging information comprises:

one or more traffic routing rules specifying which traffic is to be routed over any one of the licensed and/or unlicensed spectrum resources of the different types of accesses; and

30 one or more policy and charging rules specifying the policy and charging control for traffic routed over any one of the licensed and/or unlicensed spectrum resources of the different types of accesses.

27. The core network node of claim 26, further comprising a transmitter (830) configured to forward, to a UE (40) through a RAN node (30), the one or more traffic routing rules; and wherein the enforcer unit (820) is configured to enforce the one or more policy and charging rules.

5 28. The core network node of claim 27, wherein the enforcer unit (820) is further configured to enforce the one or more traffic routing rules.

29. The core network node of claim 27, wherein the one or more policy and charging rules are enforced to trigger a flexible charging for traffic over at least one of licensed and unlicensed access spectrum
10 resources.

30. The core network node of any one of claims 25-29, wherein the core network node is a Policy and Charging Enforcement Function “PCEF” node (20).

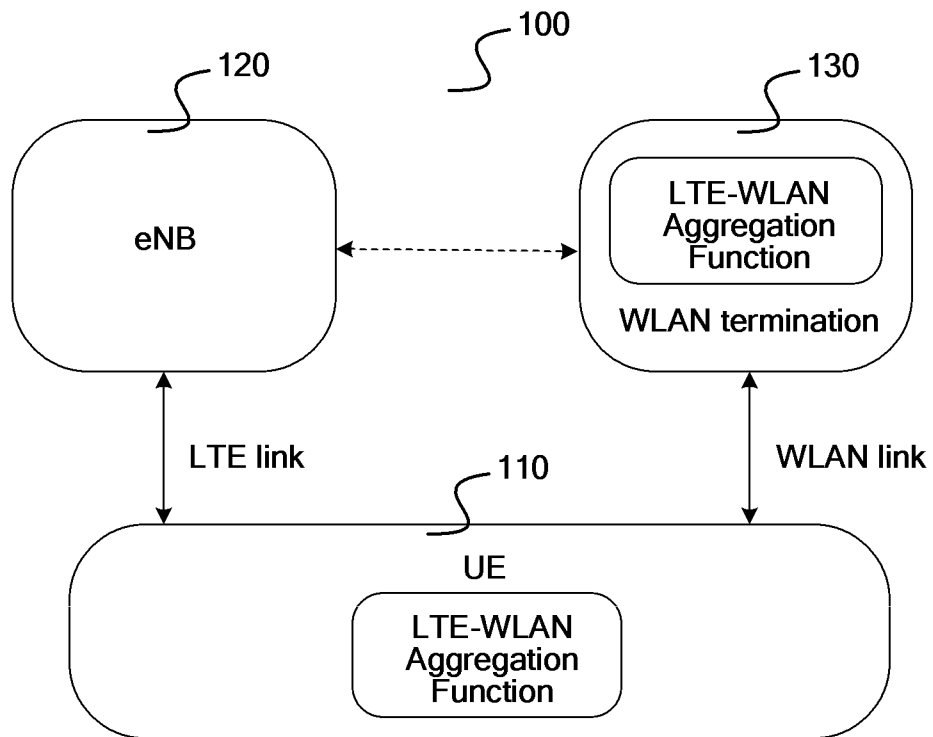


Fig. 1

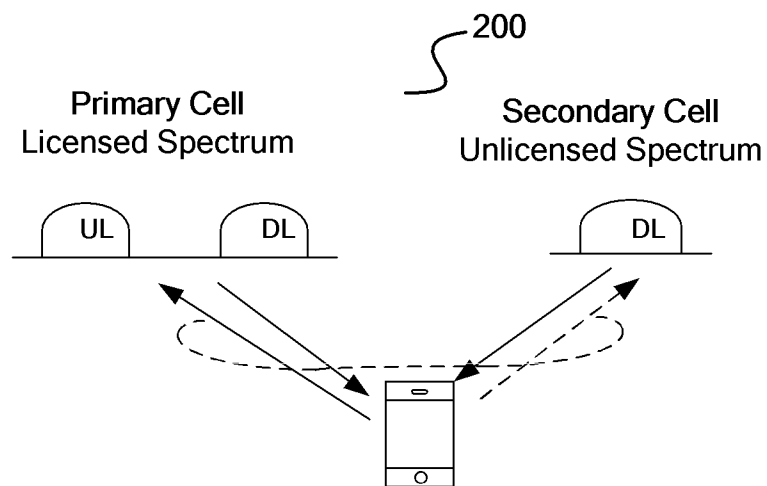


Fig. 2

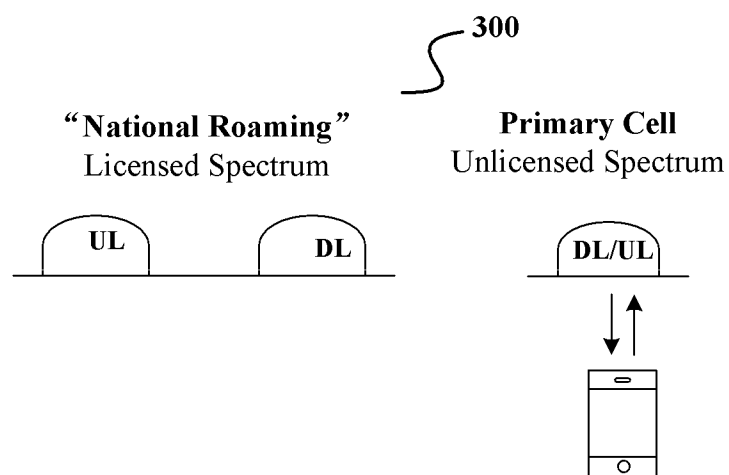


Fig. 3

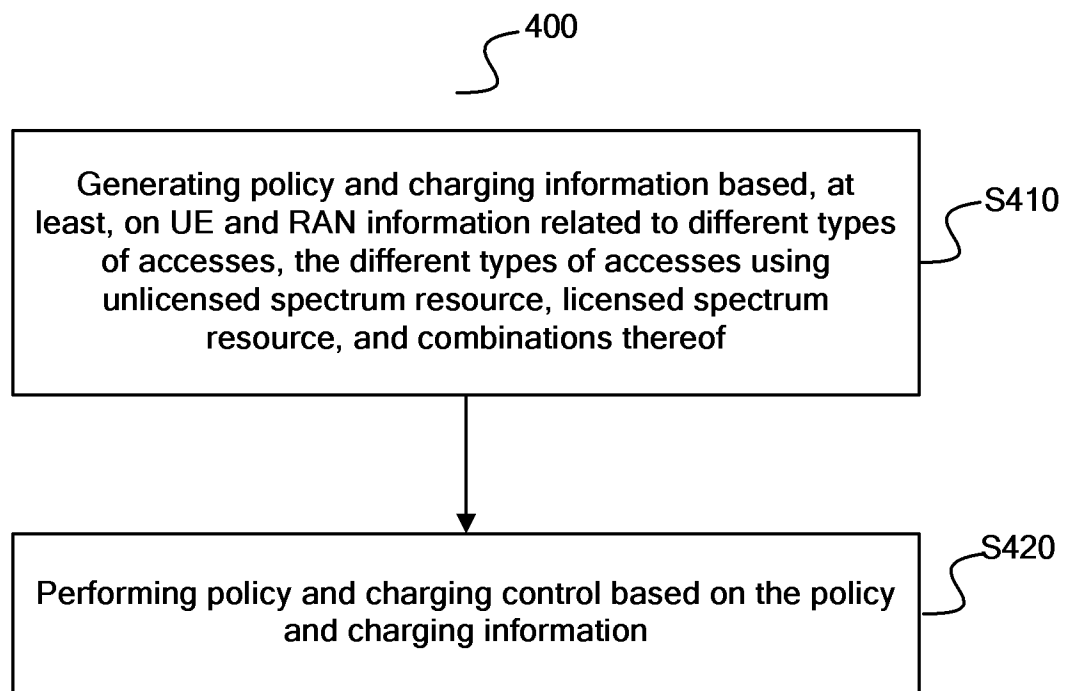


Fig. 4

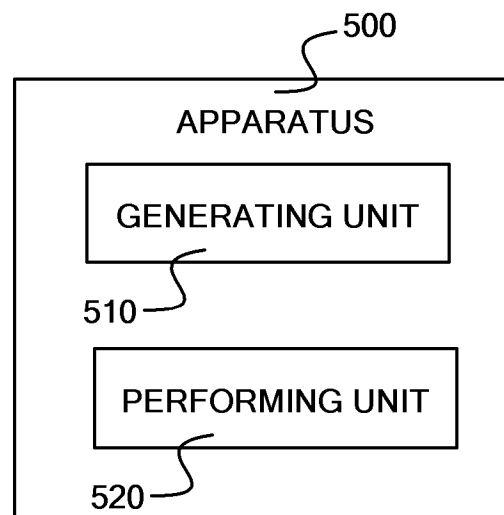


Fig.5

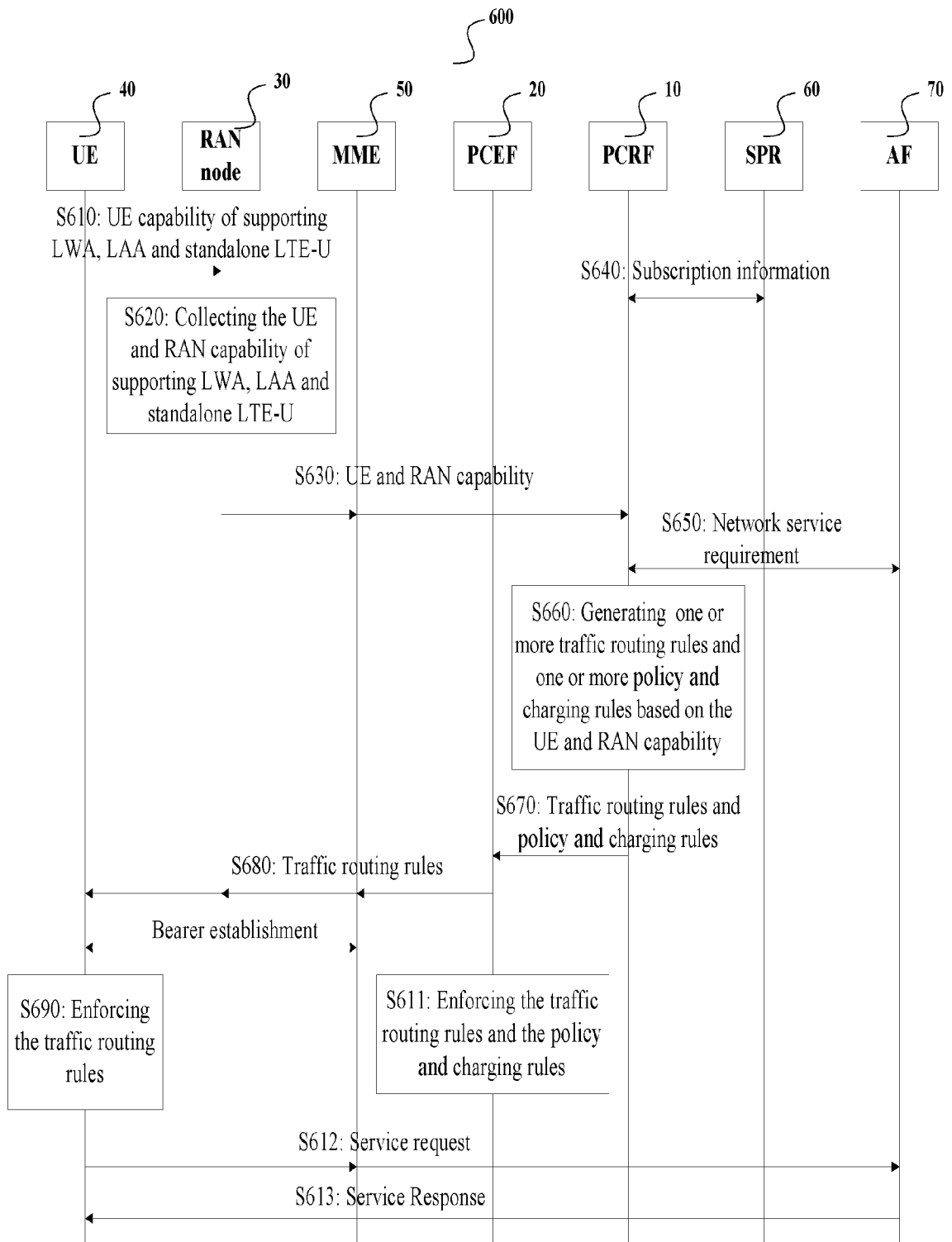


Fig. 6

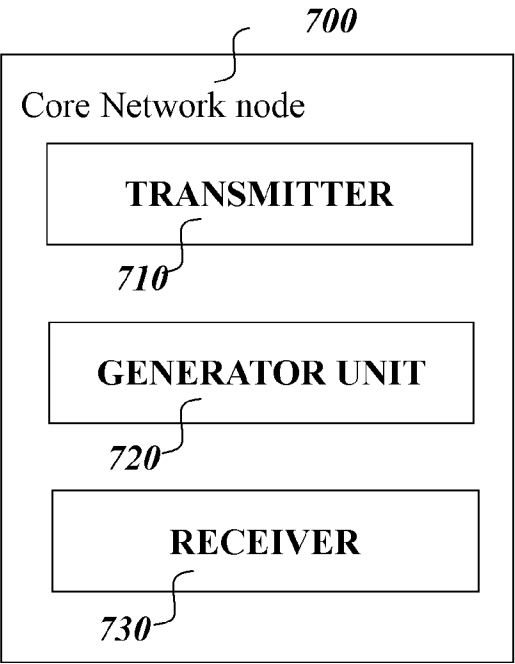


Fig. 7

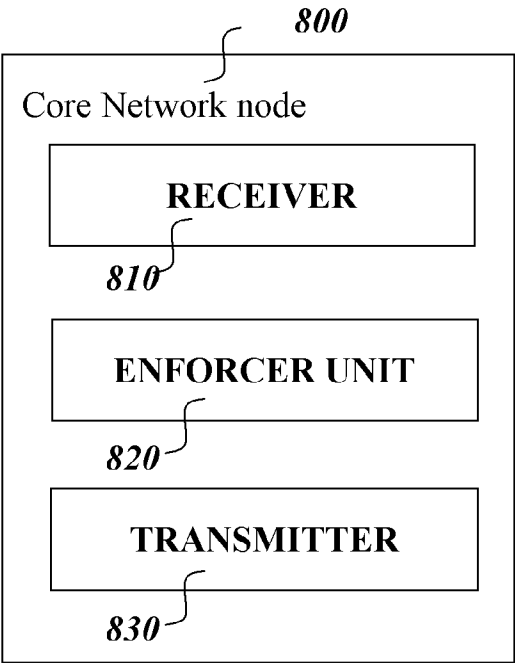


Fig. 8

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2016/078301**A. CLASSIFICATION OF SUBJECT MATTER**

H04W 4/08(2009.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H04W; H04Q

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

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

CNPAT,CNKI,WPI,EPODOC: policy, charging, control, access, unlicensed, licensed, trusted, untrusted, spectrum, traffic, route, rule, PCRF, PCEF, ANDSF

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2012142437 A1 (INTERDIGITAL PATENT HOLDINGS, INC) 18 October 2012 (2012-10-18) paragraphs 0159-0164, figure 6	1-30
A	CN 101720109 A (ZTE CORPORATION) 02 June 2010 (2010-06-02) the whole document	1-30
A	CN 104584630 A (ORANGE) 29 April 2015 (2015-04-29) the whole document	1-30
A	US 2013159521 A1 (MOTOROLA SOLUTIONS, INC.) 20 June 2013 (2013-06-20) the whole document	1-30

☐ 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

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“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

15 December 2016

Date of mailing of the international search report

29 December 2016

Name and mailing address of the ISA/CN

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/CN2016/078301

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				WO	2012033774	A2	15 March 2012
				US	2014161055	A1	12 June 2014
				US	2016183324	A1	23 June 2016
CN	101720109	A	02 June 2010	WO	2010148792	A1	29 December 2010
CN	104584630	A	29 April 2015	EP	2875670	A1	27 May 2015
				WO	2014013196	A1	23 January 2014
				US	2015215850	A1	30 July 2015
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				EP	2795938	A1	29 October 2014