(54) Title: METHODS, SYSTEMS, AND COMPUTER READABLE MEDIA FOR DYNAMICALLY CONFIGURING CUS-
TOMER PREMISES EQUIPMENT (CPE) IN A CONVERGED NETWORK
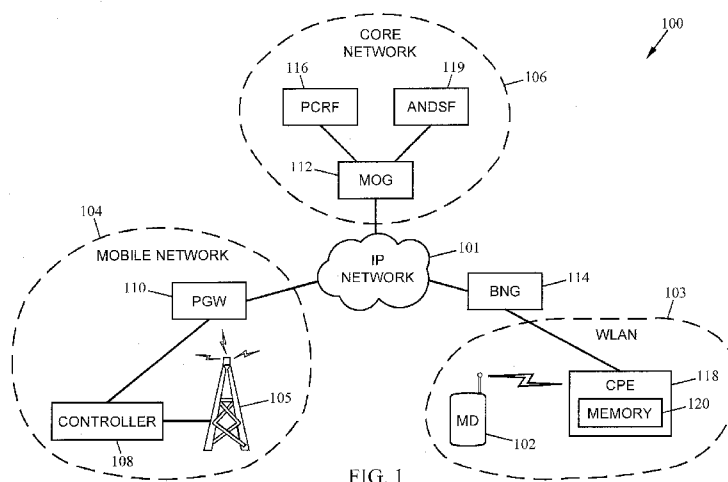
FIG. 1

(57) Abstract: Methods, systems, and computer readable media for dynamically configuring customer premises equipment (CPE) in
a converged network are disclosed. According to one aspect, the subject matter described herein comprises a method performed at a
mobility offload gateway that includes receiving cell site change notification message from a mobile network, determining, based on
the change notification message, whether user equipment (UE) can be offloaded to a Wi-Fi network, and in response to determining
that the UE can be offloaded, dynamically configuring consumer premises equipment (CPE) associated with the identified Wi-Fi
network to support a predetermined quality of service (QoS) for the UE.

DESCRIPTION

METHODS, SYSTEMS, AND COMPUTER READABLE MEDIA FOR
DYNAMICALLY CONFIGURING CUSTOMER PREMISES EQUIPMENT
(CPE) IN A CONVERGED NETWORK

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PRIORITY CLAIM

This application claims the benefit of U.S. Provisional Patent Application
No. 61/674,268, filed on July 20, 2012, the disclosure of which is incorporated
herein by reference in its entirety.

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TECHNICAL FIELD

The subject matter described herein relates to dynamic configuration of
network components. More particularly, the subject matter described herein
relates to methods, systems, and computer readable media for dynamically
15 configuring customer premises equipment (CPE) in a converged network.

BACKGROUND

When accessing network services via different access networks, it is
desirable to maintain the same quality of service (QoS) when changing from
20 one network type to another network type. For example, when a mobile device
user is at home and watching a movie on a mobile device (e.g., an iPad tablet)
and the movie is being streamed over the user's home Wi-Fi network, the
customer premises equipment (CPE) that facilitates the Wi-Fi network is
configured to provide a particular quality of service for the streaming movie
25 content. For example, the quality of service may include bandwidth and delay
parameters that ensure that the movie is streamed appropriately. When the
mobile device user leaves the Wi-Fi network (for example, by going outside and
leaving the Wi-Fi range) and wishes to continue watching the same movie, it is
desirable to release the resources associated with the Wi-Fi network as well as
30 to provision elements in the mobile network to provide the same quality of
service. If the user visits a friend's house and wants to continue watching the
same movie on the mobile device, it may be desirable to configure the

customer premises equipment at the friend's house to provide the same quality of service level.

Notably, fixed CPE equipment (e.g., such as a residential gateway that provides Internet service to residential subscribers) do not have subscriber level visibility. Thus, all of the flows communicated from the customer premises equipment to the local Wi-Fi network are treated the same without distinction. Accordingly, preferential treatment or application of quality of service by the service provider may not be possible using existing CPE equipment when a user is offloaded to a network supported by a CPE.

Thus, there exists a need for methods, systems, and computer readable media for dynamically configuring customer premises equipment in a converged network.

SUMMARY

Methods, systems, and computer readable media for dynamically configuring customer premises equipment (CPE) in a converged network are disclosed. According to one aspect, the subject matter described herein comprises a method performed at a mobility offload gateway that includes receiving cell site change notification message from a mobile network, determining, based on the change notification message, whether user equipment (UE) can be offloaded to a Wi-Fi network, and in response to determining that the UE can be offloaded, dynamically configuring consumer premises equipment (CPE) associated with the identified Wi-Fi network to support a predetermined quality of service (QoS) for the UE.

In an alternate embodiment, a method for dynamic CPE configuration includes steps performed at a mobility offload gateway. The method includes receiving, at the mobility offload gateway, a cell site change notification regarding a mobile device having an existing flow provided by a first network. The method further includes, determining, at the mobility offload gateway, and based on the cell site change notification, whether the flow for the UE can be offloaded to a Wi-Fi network. In response to determining that the flow for the UE can be offloaded, dynamically configuring CPE associated with the Wi-Fi network to support QoS for the flow.

The subject matter described herein for dynamically configuring customer premises equipment in a converged network may be implemented in hardware, software, firmware, or any combination thereof. As such, the terms "function", "module", or "node" as used herein refer to hardware, which may
5 also include software and/or firmware components, for implementing the feature being described. In one exemplary implementation, the subject matter described herein may be implemented using a computer readable medium having stored thereon computer executable instructions that when executed by a hardware based processor of a computer control the computer to perform
10 steps. Exemplary computer readable media suitable for implementing the subject matter described herein include non-transitory computer-readable media, such as disk memory devices, chip memory devices, programmable logic devices, and application specific integrated circuits. In addition, a computer readable medium that implements the subject matter described
15 herein may be located on a single device or computing platform or may be distributed across multiple devices or computing platforms.

BRIEF DESCRIPTION OF THE DRAWINGS

Preferred embodiments of the subject matter described herein will now
20 be explained with reference to the accompanying drawings, wherein like reference numerals represent like parts, of which:

Figure 1 is block diagram illustrating an exemplary system for dynamically configuring customer premises equipment in a converged network according to an embodiment of the subject matter described herein;
25 Figures 2A and 2B are message flow diagrams illustrating exemplary messaging for dynamically configuring customer premises equipment to implement quality of service for a session involving a mobile device according to an embodiment of the subject matter described herein; and

Figure 3 is a block diagram illustrating a mobility offload gateway
30 according to an embodiment of the subject matter described herein.

DETAILED DESCRIPTION

Figure 1 is block diagram illustrating an exemplary system for dynamically configuring customer premises equipment in a converged network according to an embodiment of the subject matter described herein.

5   Specifically, Figure 1 depicts an exemplary system **100** that includes a user equipment (UE) device **102**, a mobile network **104** (e.g., "mobile/cellular access network" or "radio access network"), a wireless local area network (WLAN) **103**, and a core data content network **106** (e.g., "core network") that are communicatively connected. In some embodiments, networks **103**, **104**, and

10   **106** may be communicatively connected to an Internet protocol (IP) network **101** (e.g., the Internet).

In some embodiments, UE **102** may include a mobile handset, a mobile smart phone, a tablet computer, or any other mobile device that is capable of being moved between networks of different types and capable of attaching to

15   and receiving data via networks of different types. For example, UE **102** may be an iPad or iPhone through which the user receives video download service. Although not shown, UE **102** may include a hardware based processor and a memory component configured to store quality of service parameters and/or settings provided by MOG **112**.

20   In one embodiment, WLAN **103** may include any fixed wireless network that utilizes a customer premise equipment (CPE) **118** to provide user equipment with wireless access to IP network **101** via a broadband network gateway (BNG) **114**. Examples of a WLAN include, but are not limited to, a Wi-Fi network and a WiMax network. Customer premises equipment (CPE) **118**

25   may be a residential gateway that provides access to Internet service to fixed and mobile devices within a user's residence and/or local area network. CPE **118** may also be a similar type of gateway that provides network connection services within a user's business. For example, CPE **118** may include a residential gateway, such as a wireless router, a cable modem, a DSL modem,

30   a wireless access point, and the like. In one embodiment, CPE **118** may include a hardware based processor **121** and a memory component **120** configured to store quality of service policy parameters **124** and/or settings provided by MOG **112.**

In some embodiments, mobile network **104** may comprise any type of mobile or cellular based network that is configured for providing UE **102** (when UE **102** is located within network **104**) access to IP network **101** and/or core network **106**. Examples of a mobile network may include a 3GPP radio access

5   network (RAN), a 3G RAN, a 4G RAN, a long term evolution (LTE) network, or the like. Although Figure 1 depicts UE **102** as being located within WLAN **103**, UE **102** may be moved to and served by mobile network **104** (or a similar cell or mobile network not shown in Figure 1). For example, a wireless air link may be established between a cell tower **105** and UE **102**, in the even UE **102** enters

10   or is activated within mobile network **104**. Notably, all communications (e.g., signaling path and bearer/data content path) made between UE **102** and mobile network **104** (when UE **102** is located in network **104**) is conducted via the air link (e.g., a radio connection).

In some embodiments, mobile network **104** may include a controller unit

15   **108** (e.g., a base station controller (BSC), a radio network controller, a Node B, or an evolved Node B (eNode B)) that is attached or incorporated within a base station or cell tower (e.g., cell tower **105**). Controller unit **108** may also be connected to a packet gateway (PGW) **110**, which may include any network element that connects with IP network **101** and provides data service to

20   subscribers present in the mobile network **104**. In one embodiment, PGW **110** may be an LTE network component that provides packet data services to UEs that are not in range of a Wi-Fi network and/or are not utilizing an in-range Wi-Fi network. PGW **110** may also be configured to communicatively connect mobile network **104** to core network **106** via IP network **101**. In some

25   embodiments, PGW **110** may include a policy control and enforcement function (PCEF) that communicates with PCRF node **116**.

Core network **106** (e.g., a core data content network) is a network operated by a service provider/operator and may include a mobility offload gateway (MOG) **112**, a policy and charging rules function (PCRF) node **116**, an

30   access network discovery and selection function (ANDSF) node **119**, and one or more content servers **122**. Content servers **122** may be any server located in core network **106** that is configured to provide data to an accessing UE **102** either via mobile network **104** or WLAN **103**. Exemplary content servers found

in core network 106 may include video on demand (VOD) servers, audio on demand servers, audio and video on demand (AVOD) servers, Internet protocol television (IPTV) servers, and the like.

In one embodiment, MOG 112 may be part of the network policy infrastructure that instructs other nodes in the network on policies to implement for sessions involving UEs and/or CPEs. MOG 112 may also be a standalone node, such as a mobile policy gateway (MPG), that is part of the policy infrastructure and is configured to manage i) a UE's QoS offload process from a mobile network to a WLAN (e.g., from mobile network 104 to WLAN 103) and ii) a UE's onload process from a WLAN to a mobile network (e.g., from WLAN 103 to mobile network 104).

In some embodiments, MOG 112 is further configured to connect to a policy server, such as PCRF node 116, in core network 106. PCRF node 116 may be any network element that is configured to store network policies and respond to queries from other nodes to provide such policies. In some embodiments, MOG 112 and PCRF node 116 may either be integrated together in a single node or distributed among a plurality of nodes in core network 106. In one embodiment, PCRF node 116 may be configured to store network policy rules (or "policies") and to respond to queries from other nodes to provide such policy rules. For example, PCRF node 116 may receive a query from MOG 112 requesting at least one policy rule. In one embodiment, the policy rules obtained from PCRF node 116 (instead of ANDSF node 119) may include QoS parameters or settings that can be subsequently applied to a CPE that services a user's UE in a WLAN. MOG 112 may store the policy rules provided by PCRF node 116 in a database or in memory (not shown). PCRF node 116 may also be configured to send cell site change notification messages to MOG 112 in the even UE 102 relocates to and/or from a cell in the mobile network. As used herein, a cell site change notification message may indicate that i) a UE relocates from a first cell to a second cell, ii) a UE relocates from a cell to a WLAN, and iii) a UE relocates from a WLAN to a cell.

In some embodiments, MOG 112 may also be configured to inform UE 102 of local WLAN and/or Wi-Fi networks (e.g., an existing Wi-Fi network provided to public users, such as at an airport, store, restaurant, or the like) that

are accessible and/or secure to UE **102**. For example, after receiving detected network information (e.g., data indicating recent cell sites and/or detected WLANs) from UE **102**, MOG **112** may be configured to determine the different Wi-Fi networks detected by UE **102** that are designated as secure and/or

5   trustworthy. In one embodiment, MOG **112** may accomplish this by querying ANDSF node **119**. In one embodiment, MOG **112** may be connected (or integrated) with ANDSF node **119**, which is responsible for helping UE **102** discover non-3GPP access networks (e.g., WLANs such as Wi-Fi or WiMax access networks). ANDSF node **119** may also be configured to provide policy

10   rules regarding access network connection to UE **102**. For example, the policy rules obtained from ANDSF node **119** may include QoS parameters or settings that can be subsequently applied to a CPE that services a user's UE in a WLAN. In some embodiments, MOG **112** may also be configured to provide UE **102** with secure credentials (obtained from ANDSF node **119**) to connect to

15   a local Wi-Fi network. MOG **112** may store the policy rules provided by ANDSF node **119** in a database or in memory (not shown). Internal components of MOG **112** are discussed in further detail below with regard to the description of Figure 3.

         Figures 2A and 2B are message flow diagrams illustrating exemplary

20   signaling messaging for dynamically configuring customer premises equipment to implement quality of service for a session flow involving a mobile device. As used herein, a session flow may include the communication of packets associated with a voice over IP (VoIP) call, a video call, a video streaming session, or the like. Although not shown, the session flow may include media

25   content provided to UE **102** from content server **122** shown in Figure 1. At shown in signaling **202**, a mobile dedicated bearer path is currently established for the session flow between UE **102** and PGW **110**. Notably, the established session flow is being communicated in accordance to a particular QoS level. At block **204**, UE **102** relocates from a mobile network (e.g., a LTE network) to a

30   WLAN (e.g., Wi-Fi) network while receiving QoS for the session flow. For example, the established mobile dedicated bearer **202** may be utilized by UE **102** to display a streaming movie provided by a content server in core network **106** at 10 megabytes per second of download bandwidth at the time when UE

102 leaves network **104** and/or enters an area corresponding to a different network (e.g., a Wi-Fi network).

At this time, PGW **110** may be notified of the relocation of UE **102** and may establish a Gx session (see message **206**) with PCRF **116** to determine

5   whether the new network can be used to provide the same quality of service for the communicated flow. As used herein, the Gx session may be conducted via a Diameter based Gx interface between PGW **110** and PCRF **116**. In one embodiment, the UE **102** in mobile network **104** may send a update location message to controller **108** which in turn forwards the information to PGW **110**.

10   PGW **110** may then issue a cell site change notification message to PCRF **116** (either directly or through MOG **112**) via the Gx session **206**. In response, PCRF **116** may send a cell site change notification message **208** to MOG **112**. In one embodiment, message **208** may be originated in the mobile network **104** and is forwarded by PCRF **116** to MOG **112**.

15   After receiving message **208**, MOG **112** may determine whether UE **102** can be offloaded. For example, MOG **112** may determine whether i) at least one nearby and/or local Wi-Fi network may be securely accessed by UE **102** and ii) whether any of the nearby Wi-Fi networks can provide the appropriate (e.g., previously provided and predetermined) quality of service level.

20   Afterwards, MOG **112** may send a message **212** providing UE **102** with a list of possible WLANs that UE **102** may be authorized to securely access and that may provide the requested quality of service. In one embodiment, MOG **112** may provide UE **102** with authorization credentials to access the listed WLANs in a secure manner.

25   Upon receiving message **212**, UE **102** may be configured to access a preferred list of WLANs and Wi-Fi networks stored in a local memory. The preferred list may identify each separate WLAN by the IP address of the CPE located in each respective WLAN. After UE **102** cross-references the IP addresses in preferred list with the WLAN list entries provided in message **212**

30   to select a WLAN and/or CPE (see block **214**), UE **102** sends an offload synchronization request message **216** (i.e., a "sync request") to MOG **112**. Notably, request message **216** includes the IP address of the selected CPE.

After MOG **112** and UE **102** exchange offload synchronization messaging that indicates the IP address of CPE **118**, MOG **112** initiates the process to offload UE **102** from network **104** to WLAN **103** (i.e., the selected WLAN). For example, MOG **112** may send a dynamic configuration message

5   **220** in order to configure CPE **118**. Notably, configuration message **220** includes QoS parameters or policy rules that can be used to configure CPE **118** to provide a desired and/or predetermined QoS level. Such QoS policy rules provisioned on CPE **118** may be stored in memory **120** (as QoS policy parameters or rules **124**). In some embodiments, QoS parameters **124** may

10   include specific rules or policies that indicate the manner in which the subscribers and/or UEs are to be served by CPE **118**. For example, exemplary subscriber-specific or UE-specific policy rules include bandwidth usage rules, device specific or subscriber specific priority access rules, tier-based subscription policy rules, total data quota policy rules, and the like.

15   In one embodiment, MOG **112** dynamically configures CPE **118** by sending Broadband Forum (BBF) TR-69 commands to instruct CPE **118** to accommodate the current bandwidth requirements of UE **102** by implementing the predetermined QoS for the session flow. In an alternate embodiment, MOG **112** may configure CPE **118** by sending one or more propriety

20   commands instead of sending TR-69 commands. CPE **118** may then respond to the received command(s) by providing the requested QoS to UE **102**. Thus, UE **102** is able to establish a session flow **222** that is directed to BNG **114** in accordance to the predetermined QoS.

At some later time, UE **102** may relocate by leaving the local WLAN and

25   enter a mobile network cell that is able to provide service to UE **102** (see block **224**). For example, UE **102** may leave WLAN network **103** and move back to mobile network **104**. Upon entering mobile network **104**, UE **102** re-attaches to the mobile network via the wireless infrastructure and UE **102** or controller **108** informs MOG **112** of the UE's new location (e.g., new cell site). In one

30   embodiment, UE **102** communicates with PGW **110** to establish a mobile dedicated bearer (see signaling **226**). At this time, PGW **110** may establish a Gx session (see message **228**) with PCRF **116** to determine whether the new mobile network (e.g., a new mobile network or re-entered mobile network **104**)

can be used to provide the same quality of service for the communicated session flow. In response, PCRF **116** may send a cell site change notification message **230** to MOG **112**.

5   After UE **102** establishes a mobile dedicated bearer for the session flow (e.g., dedicated bearer **226**) in accordance with the predetermined QoS, UE **102** may begin communicating packets associated with the session flow flow with PGW **110** (see signaling **232**).

In one embodiment, MOG **112** sends a message **234** to CPE **118** to lift the dynamically configured QoS from CPE **118**. For example, message **234**

10   may indicate the release of the resources associated with providing the QoS to UE **102**. In one embodiment, MOG **112** dynamically configures CPE **118** by sending BBF TR-69 commands to instruct CPE **118** to release the resources previously used to accommodate the streaming requirements of UE **102** to implement the predetermined QoS for the session flow in previously utilized

15   WLAN **103**. In one embodiment, the session flow may include a VOD session flow conducted between content server **122** and UE **102**. In an alternate embodiment, MOG **112** may instruct CPE **118** to remove the QoS by sending one or more propriety commands instead of TR-69 commands. CPE **118** may then respond to the received command by releasing the resources previously

20   utilized to provide the QoS to UE **102**.

Thus, in the example illustrated in Figures 2A and 2B, MOG **112**, which is part of the network policy infrastructure, performs the functions necessary to dynamically configure customer premise equipment to implement a required QoS for a flow.

25   Figure 3 is a block diagram of a mobility offload gateway according to an embodiment of the subject matter described herein. Referring to Figure 3, mobility offload gateway **112** includes a processor **301**, an offload determination module **302**, a network interface **303**, and a dynamic CPE configuration module **304**. Processor **301** may include any hardware based

30   processor that can be configured to execute modules **302** and **304** to perform the aforementioned offloading and onloading processes. As used herein, offloading includes the transfer of a session flow associated with a predetermined QoS from a mobile based access network to a WLAN (or Wi-Fi)

based access network, such that the QoS of the session flow between the UE and the core network is maintained or does not degrade. Similarly, as used herein, onloading includes the transfer of a session flow associated with a predetermined QoS from WLAN (or Wi-Fi) based access network to a mobile

5 based access network, such that the QoS of the session flow between the UE and the core network is at least maintained or does not degrade.

In some embodiments, network interface 303 may be configured for receiving a cell site change notification message from a mobile network. Interface 303 may also include a Diameter interface for communicating with a

10 PCRF node. Alternatively, network interface 303 may include a Diameter interface for communicating with a mobility management entity (MME) if MOG 112 is a component of a PCRF.

In some embodiments, offload determination module 302 may be configured for determining (based on the cell site change notification) whether

15 user equipment can be offloaded to a Wi-Fi network. For example, module 302 may be used to communicate with an ANDSF node to obtain offload information.

In some embodiments, MOG 112 further includes a dynamic customer premises configuration module 304 configured for dynamically configuring CPE

20 equipment associated with the identified Wi-Fi network to support a predetermined quality of service for the UE (in response to determining that the UE can be offloaded). For example, dynamic CPE configuration module 204 may configure a residential gateway associated within a Wi-Fi network to provide a specified or predetermined quality of service for a UE that the UE

25 previously utilized in an LTE network.

It will be understood that various details of the presently disclosed subject matter may be changed without departing from the scope of the presently disclosed subject matter. Furthermore, the foregoing description is for the purpose of illustration only, and not for the purpose of limitation.

30

CLAIMS

What is claimed is:

1. A method for dynamic customer premises equipment configuration, the method comprising:

    at a mobility offload gateway:

        receiving cell site change notification message from a mobile network;

        determining, based on the change notification message, whether user equipment (UE) can be offloaded to a Wi-Fi network; and

        in response to determining that the UE can be offloaded, dynamically configuring consumer premises equipment (CPE) associated with the identified Wi-Fi network to support a predetermined quality of service (QoS) for the UE.

2. The method of claim 1 wherein the mobile network comprises a long term evolution (LTE) network.

3. The method of claim 1 wherein the mobility offload gateway comprises a standalone unit that is part of the policy infrastructure in a network.

4. The method of claim 3 wherein the mobility offload gateway is a component of a policy and charging rules function (PCRF).

5. The method of claim 1 wherein determining whether the UE can be offloaded includes determining whether the UE is in range of the Wi-Fi network.

6. The method of claim 1 wherein dynamically configuring the CPE includes sending messages to a residential gateway to instruct the residential gateway to implement the quality of service for a flow.

7. The method of claim 6 comprising, in response to the UE going out of range of the Wi-Fi network, receiving a second cell site change notification message indicating that the UE is no longer connected to the Wi-Fi network, and, in response, releasing resources in the customer premises equipment for a flow.

8. A system for dynamic customer premises equipment configuration, the system comprising:

    a mobility offload gateway comprising:

a network interface for receiving cell site change notification message from a mobile network;

an offload determination module determining, based on the change notification message, whether user equipment (UE) can be offloaded to a Wi-Fi network; and

a dynamic customer premises equipment (CPE) configuration module for, in response to determining that the UE can be offloaded, dynamically configuring the CPE associated with the identified Wi-Fi network to support a predetermined QoS for the UE.

9. The system of claim 8 wherein the mobile network comprises a long term evolution (LTE) network.

10. The system of claim 8 wherein the mobility offload gateway comprises a standalone unit that is part of the policy infrastructure in a network.

11. The system of claim 10 wherein the mobility offload gateway is a component of a policy and charging rules function (PCRF).

12. The system of claim 8 wherein the offload determination module is further configured to determine whether the UE is in range of the Wi-Fi network.

13. The system of claim 8 wherein the dynamic CPE configuration module is further configured to send messages to a residential gateway to instruct the residential gateway to implement the quality of service for a flow.

14. The system of claim 13 wherein the network interface is further configured to, in response to the UE going out of range of the Wi-Fi network, receive a second cell site change notification message indicating that the UE is no longer connected to the Wi-Fi network, and, in response, configured to release resources in the customer premises equipment for the flow.

15. A non-transitory computer readable medium having stored thereon executable instructions that when executed by the processor of a computer control the computer to perform steps comprising:

at a mobility offload gateway:

receiving cell site change notification from a mobile network;

determining, based on change notification, whether user equipment (UE) can be offloaded to a Wi-Fi network; and

in response to determining that the UE can be offloaded, dynamically configuring consumer premises equipment (CPE) associated with the identified Wi-Fi network to support a predetermined quality of service (QoS) for the UE.
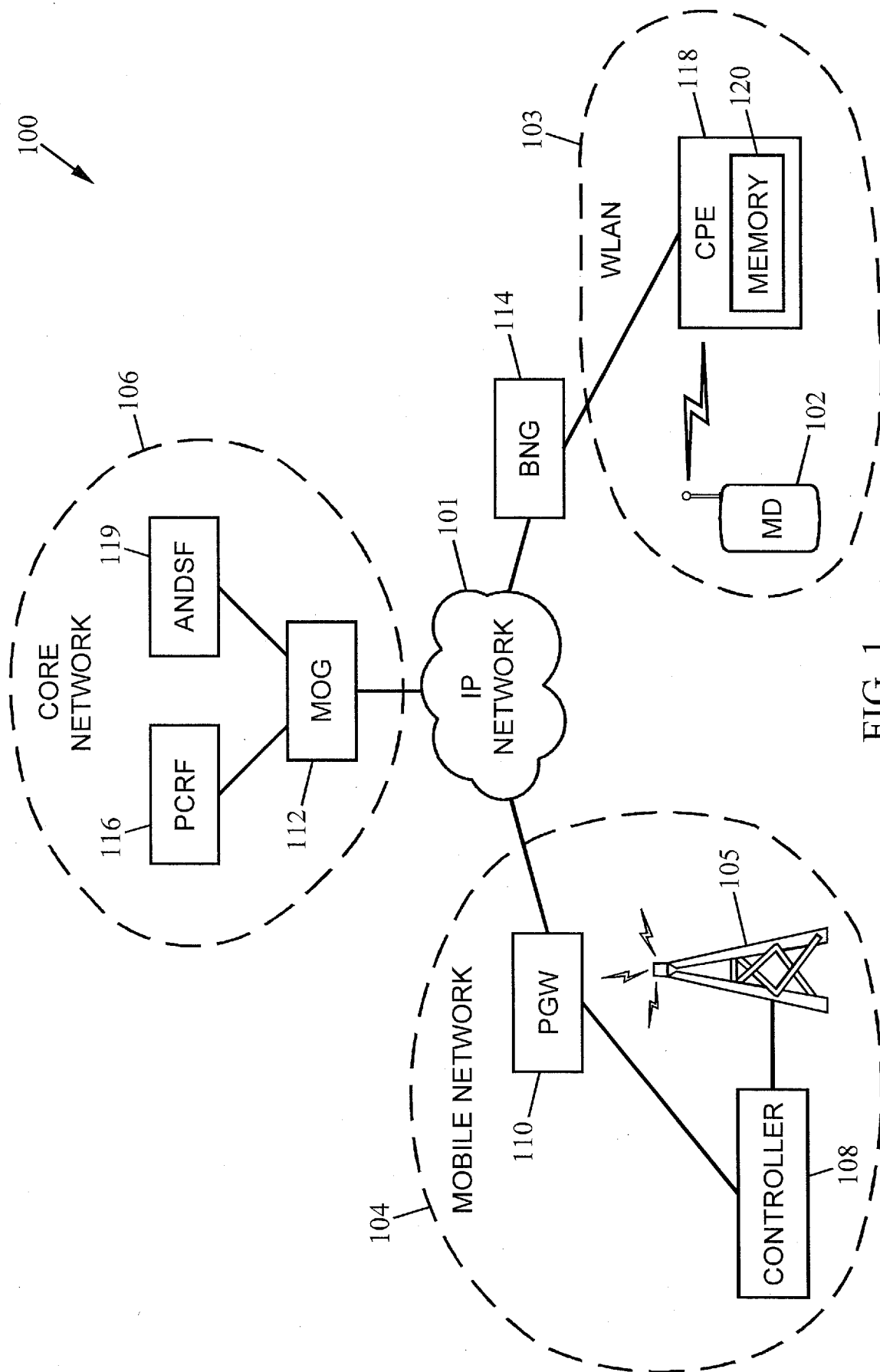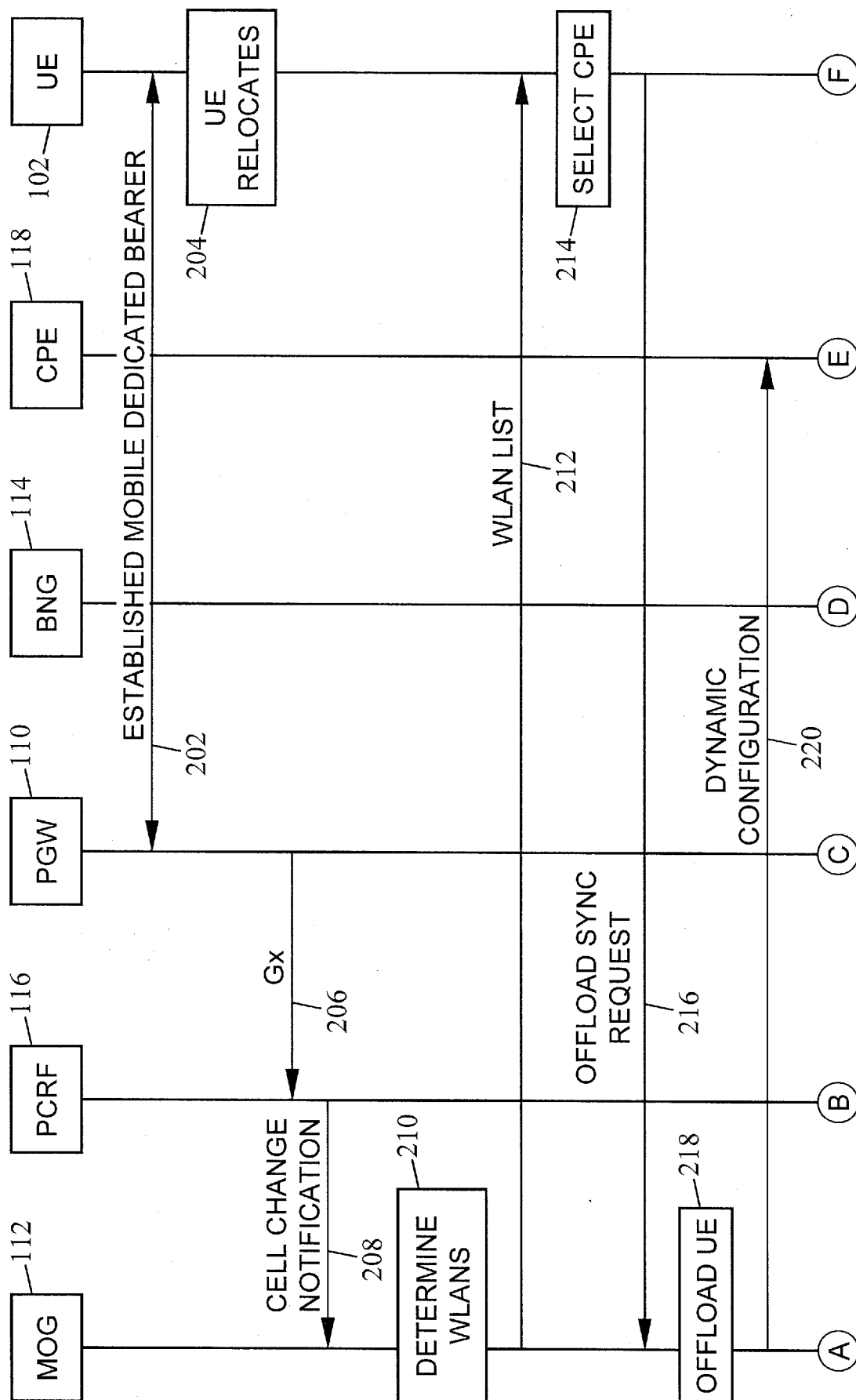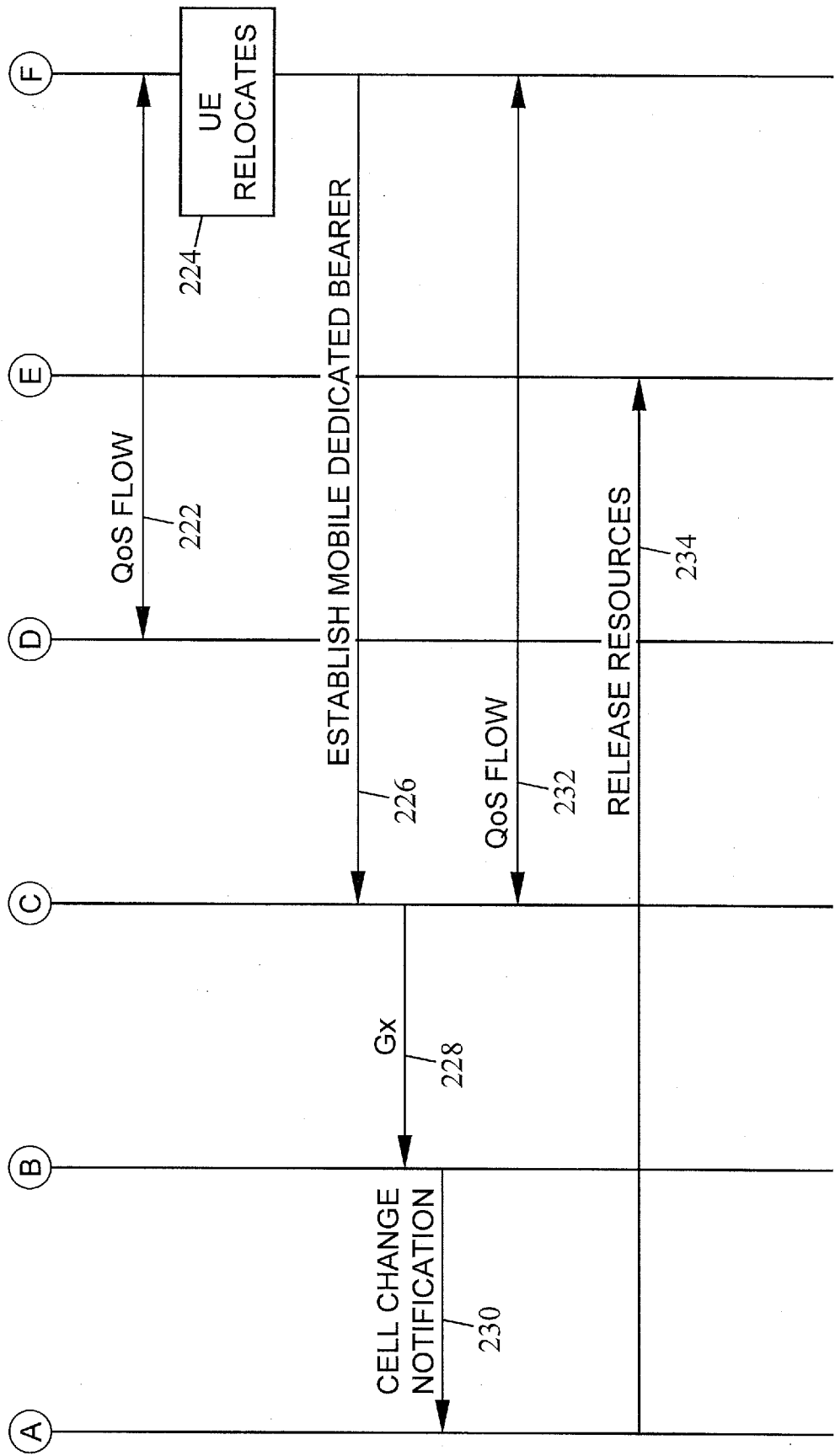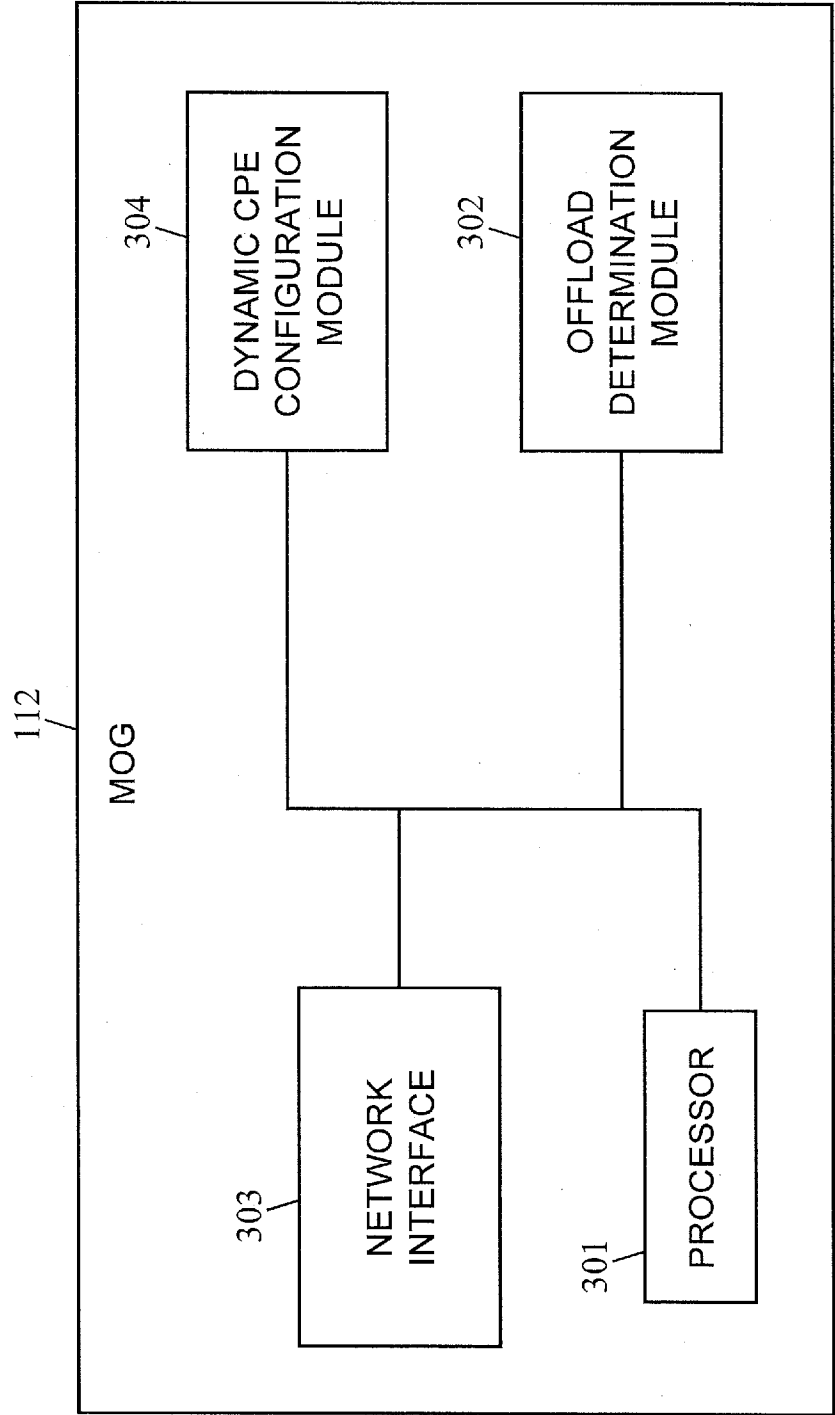
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FIG. 1

FIG. 2A

FIG. 2B

FIG. 3

A. CLASSIFICATION OF SUBJECT MATTER

H04W 88/16(2009.01)i, H04W 4/24(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 88/16; H04W 48/20; H04W 64/00; H04W 4/24

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean utility models and applications for utility models
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal) & Keywords: mobile, Wi-Fi , cell , change

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2011-0286437 A1 (MARK DAVID AUSTIN et al.) 24 November 2011 See claims 1-20 and figures 1-24.	1-2,5,8-9,12,15
A		3-4,6-7,10-11 ,13-14
A	US 2008-0137626 A1 (CHI-WON CHOI et al.) 12 June 2008 See claims 1-19 and figures 1-2.	1-15
A	US 2011-0230201 A1 (SCOTT HOTES et al.) 22 September 2011 See claims 1-39 and figures 1-13.	1-15

☐ 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 citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art "&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
26 August 2013 (26.08.2013)	**27 August 2013 (27.08.2013)**

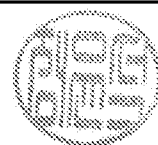| Name and mailing address of the ISA/KR
Korean Intellectual Property Office
189 Cheongsa-ro, Seo-gu, Daejeon Metropolitan City,
302-701, Republic of Korea
Facsimile No. +82-42-472-7140 | Authorized officer

JUNG Yun Seok

Telephone No. +82-42-481-8123 |

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