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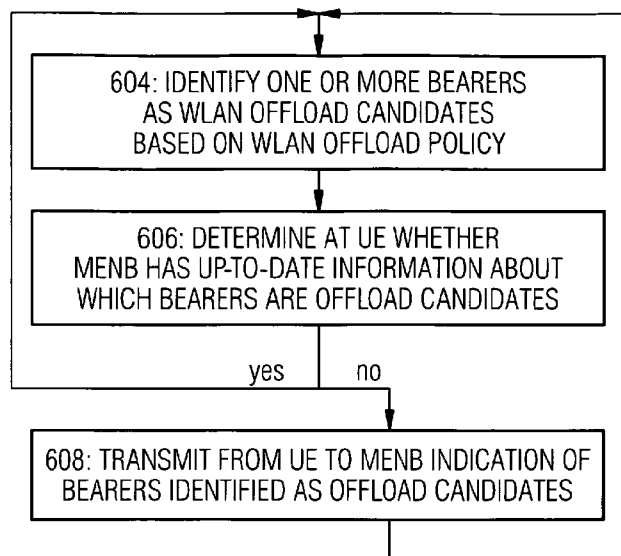
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FIG 6



(57) Abstract: A technique comprising: transmitting offload information from a communication device to a node of a radio access network to which the communication device is attached for the transfer of data between the communication device and a gateway via said radio access network, wherein said offload information comprises information about a possibility of a data transfer between said gateway and said communication device other than via said radio access network whilst said communication device is attached to said radio access network.

DESCRIPTION

TITLE

EFFECTIVE USE OF RADIO RESOURCES

5 The operation of a communication device connected to a radio access network via a wireless interface can involve the transfer via an access node outside of the radio access network of data that might otherwise have been transferred between the gateway and the communication device via the radio access network.

The inventors for the present application have identified the problem of reducing the risk of
10 the radio access network wastefully assigning radio resources to data transfers that end up happening outside the radio access network.

It is an aim of the present invention to solve this problem.

There is hereby provided a method comprising: transmitting offload information from a communication device to a node of a radio access network to which the communication
15 device is attached for the transfer of data between the communication device and a gateway via said radio access network, wherein said offload information comprises information about a possibility of a data transfer between said gateway and said communication device other than via said radio access network whilst said communication device is attached to said radio access network.

20 In one embodiment, a plurality of bearers are established for the transfer of data between said gateway and said communication device, and wherein said offload information specifies one or more of said plurality of bearers as offload candidates based on offload policy information.

In one embodiment, the method comprises receiving said offload policy information at said
25 communication device via said radio access network without being read by said radio access network.

In one embodiment, the method comprises transmitting said offload information specifying one or more bearers as offload candidates, only when the communication device is within the coverage of a radio access point outside the radio access network via which the
30 communication device is allowed to transfer data to/from the gateway.

In one embodiment, the method comprises transmitting said offload information specifying one or more bearers as offload candidates, only when the communication device is within the coverage of a radio access point outside the radio access network via which the communication device is allowed to transfer data to/from the gateway, and when all
5 predetermined conditions are met for the transfer of data between said communication device and said gateway via said radio access point outside the radio access network.

In one embodiment, the method comprises providing said offload information specifying one or more bearers as offload candidates, regardless of whether or not said
10 communication device is within the coverage of an access node outside the radio access network via which the communication device is allowed to transfer data to/from the gateway, and/or regardless of whether or not all necessary conditions for the transfer of data between said communication device and said gateway other than via the radio access network are fulfilled.

In one embodiment, said offload information includes an indication about whether the communication device is within the coverage of an access node outside the radio access network via which the communication device is allowed to transfer data to /from the gateway.
15

In one embodiment, said offload information includes an indication of whether all
20 necessary conditions for the transfer of data between said communication device and said gateway other than via the radio access network are fulfilled.

There is also hereby provided a method comprising: receiving offload information from one or more communication devices at a node of a radio access network to which the one or more communication devices are attached for the transfer of data between the one or
25 more communication devices and a gateway via said radio access network; wherein said offload information comprises information about a possibility of a data transfer between said gateway and said one or more communication devices other than via said radio access network whilst said one or more communication devices are attached to said radio access network; and making one or more decisions about the assignment of radio
30 resources within said radio access network based at least partly on said offload information.

In one embodiment, a respective one or more bearers are established for the transfer of data between said gateway and each of said one or more communication devices; and the

method comprises deciding at said radio access network node for one or more bearers a respective level of priority for effecting an increase of data throughput between said communication device and said gateway via said radio access network based at least partly on said offload information.

- 5 In one embodiment, the offload information identifies one or more bearers as offload candidates.

In one embodiment, the method comprises: receiving at said radio access network node offload policy information according to which said one or more communication devices identify one or more bearers as offload candidates; and forwarding said offload policy
10 information from said radio access network node to said one or more communication devices via said radio access network without reading said offload policy information at said radio access network node.

In one embodiment, the radio access network node also has access to offload policy information according to which said one or more communication devices identify one or
15 more bearers as offload candidates; and said offload information received from the one or more communication devices at least includes additional information about a possibility of a data transfer between said gateway and the communication devices other than via said radio access network for the one or more bearers identified as offload candidates by the offload policy information.

20 In one embodiment, the offload information identifies one or more bearers as offload candidates without indicating whether or not said communication device is within the coverage of an access node outside the radio access network via which the communication device is allowed to transfer data to/from the gateway, and without indicating whether or not all necessary conditions for the transfer of data between said
25 communication device and said gateway other than via the radio access network are fulfilled.

In one embodiment, said offload information includes an indication about whether the communication device is within the coverage of an access node outside the radio access network via which the communication device is allowed to transfer data to/from the
30 gateway.

In one embodiment, said offload information includes an indication of whether all necessary conditions for the transfer of data between said communication device and said gateway other than via the radio access network are fulfilled.

In one embodiment, the method comprises: deciding against assigning extra radio resources to a communication device for which the offload information indicates that all necessary conditions for the transfer of data between said communication device and said gateway other than via the radio access network are fulfilled, and/or deciding to assign extra radio resources to a communication device for which the offload information indicates that all necessary conditions for the transfer of data between said communication device and said gateway other than via the radio access network are not fulfilled.

10 In one embodiment, the method comprises making one or more decisions about communication device handovers within said radio access network based at least partly on said offload information.

In one embodiment, the method comprises comprising deciding at said radio access network node a respective level of handover priority for one or more communication devices based on the offload information.

There is also hereby provided an apparatus comprising: a processor and memory including computer program code, wherein the memory and computer program code are configured to, with the processor, cause the apparatus to: transmit offload information from a communication device to a node of a radio access network to which the communication device is attached for the transfer of data between the communication device and a gateway via said radio access network, wherein said offload information comprises information about a possibility of a data transfer between said gateway and said communication device other than via said radio access network whilst said communication device is attached to said radio access network.

25 In one embodiment, a plurality of bearers are established for the transfer of data between said gateway and said communication device, and wherein said offload information specifies one or more of said plurality of bearers as offload candidates based on offload policy information.

In one embodiment, the memory and computer program code are further configured to, with the processor, cause the apparatus to: receive said offload policy information at said communication device via said radio access network without being read by said radio access network.

In one embodiment, the memory and computer program code are further configured to, with the processor, cause the apparatus to: transmit said offload information specifying one or more bearers as offload candidates, only when the communication device is within the coverage of a radio access point outside the radio access network via which the communication device is allowed to transfer data to/from the gateway.

In one embodiment, the memory and computer program code are further configured to, with the processor, cause the apparatus to: transmit said offload information specifying one or more bearers as offload candidates, only when the communication device is within the coverage of a radio access point outside the radio access network via which the communication device is allowed to transfer data to/from the gateway, and when all predetermined conditions are met for the transfer of data between said communication device and said gateway via said radio access point outside the radio access network.

In one embodiment, the memory and computer program code are further configured to, with the processor, cause the apparatus to: transmit said offload information specifying one or more bearers as offload candidates, regardless of whether or not said communication device is within the coverage of an access node outside the radio access network via which the communication device is allowed to transfer data to/from the gateway, and/or regardless of whether or not all necessary conditions for the transfer of data between said communication device and said gateway other than via the radio access network are fulfilled.

In one embodiment, said offload information includes an indication about whether the communication device is within the coverage of an access node outside the radio access network via which the communication device is allowed to transfer data to /from the gateway.

In one embodiment, said offload information includes an indication of whether all necessary conditions for the transfer of data between said communication device and said gateway other than via the radio access network are fulfilled.

There is also hereby provided an apparatus comprising: a processor and memory including computer program code, wherein the memory and computer program code are configured to, with the processor, cause the apparatus to: receive offload information from one or more communication devices at a node of a radio access network to which the one or more communication devices are attached for the transfer of data between the

one or more communication devices and a gateway via said radio access network;
wherein said offload information comprises information about a possibility of a data
transfer between said gateway and said one or more communication devices other than
via said radio access network whilst said one or more communication devices are
5 attached to said radio access network; and to make one or more decisions about the
assignment of radio resources within said radio access network based at least partly on
said offload information.

In one embodiment, a respective one or more bearers are established for the transfer of
data between said gateway and each of said one or more communication devices; and the
10 wherein the memory and computer program code are further configured to, with the
processor, cause the apparatus to: decide at said radio access network node for one or
more bearers a respective level of priority for effecting an increase of data throughput
between said communication device and said gateway via said radio access network
based at least partly on said offload information.

15 In one embodiment, the offload information identifies one or more bearers as offload
candidates.

In one embodiment, the memory and computer program code are further configured to,
with the processor, cause the apparatus to: receive at said radio access network node
offload policy information according to which said one or more communication devices
20 identify one or more bearers as offload candidates; and forward said offload policy
information from said radio access network node to said one or more communication
devices via said radio access network without reading said offload policy information at
said radio access network node.

In one embodiment, the radio access network node also has access to offload policy
25 information according to which said one or more communication devices identify one or
more bearers as offload candidates; and said offload information received from the one or
more communication devices at least includes additional information about a possibility of
a data transfer between said gateway and the communication devices other than via said
radio access network for the one or more bearers identified as offload candidates by the
30 offload policy information.

In one embodiment, the offload information identifies one or more bearers as offload
candidates without indicating whether or not said communication device is within the
coverage of an access node outside the radio access network via which the

communication device is allowed to transfer data to/from the gateway, and without indicating whether or not all necessary conditions for the transfer of data between said communication device and said gateway other than via the radio access network are fulfilled

- 5 In one embodiment, said offload information includes an indication about whether the communication device is within the coverage of an access node outside the radio access network via which the communication device is allowed to transfer data to/from the gateway.

- 10 In one embodiment, said offload information includes an indication of whether all necessary conditions for the transfer of data between said communication device and said gateway other than via the radio access network are fulfilled.

- 15 In one embodiment, the memory and computer program code are further configured to, with the processor, cause the apparatus to: decide against assigning extra radio resources to a communication device for which the offload information indicates that all necessary conditions for the transfer of data between said communication device and said gateway other than via the radio access network are fulfilled, and/or decide to assign extra radio resources to a communication device for which the offload information indicates that all necessary conditions for the transfer of data between said communication device and said gateway other than via the radio access network are not fulfilled.

- 20 In one embodiment, the memory and computer program code are further configured to, with the processor, cause the apparatus to: make one or more decisions about communication device handovers within said radio access network based at least partly on said offload information.

- 25 In one embodiment, the memory and computer program code are further configured to, with the processor, cause the apparatus to: decide at said radio access network node a respective level of handover priority for one or more communication devices based on the offload information.

There is also hereby provided an apparatus configured to perform any of the above-described methods.

- 30 There is also hereby provided a computer program product comprising program code means which when loaded into a computer controls the computer to: transmit offload information from a communication device to a node of a radio access network to which the

communication device is attached for the transfer of data between the communication device and a gateway via said radio access network, wherein said offload information comprises information about a possibility of a data transfer between said gateway and said communication device other than via said radio access network whilst said communication device is attached to said radio access network.

There is also hereby provided a computer program product comprising program code means which when loaded into a computer controls the computer to: receive offload information from one or more communication devices at a node of a radio access network to which the one or more communication devices are attached for the transfer of data between the one or more communication devices and a gateway via said radio access network; wherein said offload information comprises information about a possibility of a data transfer between said gateway and said one or more communication devices other than via said radio access network whilst said one or more communication devices are attached to said radio access network; and to make one or more decisions about the assignment of radio resources within said radio access network based at least partly on said offload information.

In one embodiment of the above method, apparatus and computer program product, the transfer of data between said gateway and said communication device other than via said radio access network whilst said communication device is attached to said radio access network, comprises a transfer of data via a wireless local area network.

In one embodiment of the above method, apparatus and computer program product, said node of said radio access network is a master eNB.

Hereunder is provided, by way of example only, a detailed description of techniques related to the assignment of resources by a radio access network, with reference to the accompanying drawings, in which:

Figure 1 illustrates an example of a communication system including a radio access network;

Figure 2 illustrates some components of one example of user equipment as shown in figure 1;

Figure 3 illustrates some components of an example of an apparatus suitable for the access nodes shown in figure 1;

Figure 4 illustrates one example of offloading data transfer from a radio access network to a wireless local access network outside the radio access network;

Figure 5 illustrates one example of a dual connectivity technique for increasing the amount of radio resources available to the transfer of data between a gateway and a

5 communication device via a radio access network;

Figures 6, 9, 10, 12 and 13 illustrate respective examples of operations at a communication device;

Figures 7 and 8 illustrate one example of operations at an entity of a radio access network; and

10 Figures 11 and 14 illustrate respective further examples of operations at an entity of a radio access network.

The following description relates to the example of a radio access network designed to operate in accordance with Long Term Evolution (LTE) Release 12 or beyond, but the techniques described below are also applicable to other types of radio access networks.

15 The following description also relates to the example of using dual connectivity, but the technique described below is also applicable to other techniques for increasing the amount of radio resources available for the transfer of data between a gateway and a communication device via a radio access network, and other techniques involving managing resources within a radio access network. The following description also relates

20 to the example of offloading the transfer of data from a radio access network to a wireless local access network (WLAN), but the techniques described below are also applicable to offloading the transfer of data to other kinds of access networks outside the radio access network to which the communication device is connected.

Figure 1 schematically illustrates communication devices within radio coverage of two

25 access nodes (eNBs) 2 of a cellular E-UTRAN including a network of access nodes (eNBs) each operating one or more cells. The E-UTRAN operates in an environment in which other radio access nodes outside of the E-UTRAN also exist, which other radio access nodes may or may not be available for the transfer of data to/from a communication device whilst the communication device is connected to the E-UTRAN.

30 As mentioned above, Figure 1 only shows two access nodes of the E-UTRAN, but a large cellular radio access network can have tens of thousands of access nodes.

The eNBs 2 of the E-UTRAN are connected via an S1 interface to a Serving Gateway (S-GW) 4, and the two eNBs shown are also connected directly (i.e. other than via the S-GW 4) to each other via a X2interface. The S-GW 4 routes and forwards user packets, and also functions as the mobility anchor for the user-plane during inter-eNB handovers and as the anchor for mobility between LTE and other 3GPP technologies. The S-GW 4 is connected to a Packet Gateway (P-GW) 10. The P-GW 10 provides connectivity from UEs 8 to external packet data networks (not shown); and is the point of exit and entry of traffic for the UEs 8 connected to the E-UTRAN. The P-GW 10 functions as the anchor for mobility between 3GPP and non-3GPP technologies, such as the technology by which WLAN access point 6 of Figure 1 is operated. The S-GW 4 and P-GW 10 are components of the Evolved Packet Core (EPC), which may include additional components such as the ANDSF server (Access Network Discovery and Selection Function) discussed below, which provides information to UEs 8 about connectivity to 3GPP and non-3GPP access networks (such as WLAN).

Figure 2 shows a schematic view of an example of user equipment 8 that may be used for communicating with at least the eNBs 2 and WLAN access points 6 of Figure 1 via a wireless interface. The user equipment (UE) 8 may be used for various tasks such as making and receiving phone calls, for receiving and sending data from and to a data network and for experiencing, for example, multimedia or other content.

The UE 8 may be any device capable of at least sending or receiving radio signals to or from at least the eNBs 2 and WLAN APs 6 of Figure 1. Non-limiting examples include a mobile station (MS), a portable computer provided with a wireless interface card or other wireless interface facility, personal data assistant (PDA) provided with wireless communication capabilities, or any combinations of these or the like. The UE 8 may communicate via an appropriate radio interface arrangement of the UE 8. The interface arrangement may be provided for example by means of a radio part and associated antenna arrangement 205. The antenna arrangement may be arranged internally or externally to the UE 8, and may include a plurality of antennas capable of operating in a multi-layer transmission scheme.

The UE 8 may be provided with at least one data processing entity 203 and at least one memory or data storage entity 217 for use in tasks it is designed to perform. The data processor 213 and memory 217 may be provided on an appropriate circuit board 219 and/or in chipsets.

The user may control the operation of the UE 8 by means of a suitable user interface such as key pad 201, voice commands, touch sensitive screen or pad, combinations thereof or the like. A display 215, a speaker and a microphone may also be provided. Furthermore, the UE 8 may comprise appropriate connectors (either wired or wireless) to other devices and/or for connecting external accessories, for example hands-free equipment, thereto.

Figure 3 shows an example of apparatus for use at the network transceiving entities 2 of Figure 1. The apparatus comprises a radio frequency antenna array 301 configured to receive and transmit radio frequency signals; radio frequency interface circuitry 303 configured to interface the radio frequency signals received and transmitted by the antenna array 301 and the data processor 306. The radio frequency interface circuitry 303 may also be known as a transceiver. The apparatus also comprises an interface 309 via which it can send and receive information to and from one or more other network nodes such as the S-GW 4 and other eNBs 2. The data processor 306 is configured to process signals from the radio frequency interface circuitry 303, control the radio frequency interface circuitry 303 to generate suitable RF signals to communicate information to the UE 8 via the wireless communications link, and also to exchange information with other network nodes via the interface 309. The memory 307 is used for storing data, parameters and instructions for use by the data processor 306.

It would be appreciated that the apparatus shown in each of figures 2 and 3 described above may comprise further elements which are not directly involved with the embodiments of the invention described hereafter.

Figure 4 illustrates an example of a technique for offloading the transfer of some of a UE's data (e.g. traffic of one EPS bearer) from the E-UTRAN to another access node(s) 6 outside of the E-UTRAN while the UE 8 remains connected to the E-UTRAN. An Access Network Discovery and Selection Function (ANDSF) method can be used to inform the UE 8 about the on-/offloading policy. This ANDSF method enables offloading to be carried out even for single IP flows or applications of an EPS bearer. The ANDSF information that is sent to the UE is not modified frequently and is unknown to the E-UTRAN. An alternative offloading method is one based on "RAN rules", which can be used when ANDSF is not supported or there is no valid ANDSF rule. This is a simpler method compared to the ANDSF method, but only allows the off-loading of all IP flows or EPS bearer applications associated with an access point name (APN). The UE 8 is informed by NAS signalling about APNs to which data transfer(s) could be offloaded, but the E-UTRAN receives no similar information from the ANDSF etc..

Figure 5 illustrates an example of a dual connectivity technique for increasing the amount of radio resources available for the transfer of data between P-GW 10 and UE 8 via the E-UTRAN. Dual connectivity involves splitting or offloading a part of the UE traffic over at least two air interfaces of different adjacent E-UTRAN base stations (eNBs) 2. At the network (E-UTRAN) side, the splitting point may be located at a radio base station (eNB) 2, or from a hierarchical, architectural point of view the offloading point may also be located at a more centralized node, e.g. S-GW 4 of EPC. The two E-UTRAN base stations involved in the dual connectivity operation are referred to below as Master eNB (MeNB) 2a and Secondary eNB (SeNB) 2b. The traffic splitting may be realized by a Carrier Aggregation (CA)-type functionality where either all or a fraction of the traffic of one or more EPS (Evolved Packet System) bearers is transferred from MeNB 2a to SeNB 2b via the X2 interface between the MeNB 2a and SeNB 2b for transmission to the UE 8 from the SeNB 2b. Another offloading option involves transferring all of the traffic of one or more EPS bearers directly from the S-GW 4 to the SeNB 2b, i.e. other than via the MeNB 2a. However, even for this last option, the S1-MME control plane interface (i.e. the control plane interface between the eNB and Mobility Management Entity (MME)) for dual connectivity bearers always terminates at the MeNB 2a; and the radio resource control (RRC) is only between MeNB 2a and UE 8.

An EPS bearer can be considered as a virtual connection between two endpoints for which there is defined a quality of service (QoS), a guaranteed and maximum bit rate, and a filter specification that describes the traffic flows (IP addresses, protocols, port numbers etc.). One or more bearers can be established between two endpoints at any one time.

It is the serving eNB (as MeNB 2a) that decides whether or not to start dual connectivity operation for any EPS bearer, and one of its functions is to identify suitable bearers for dual connectivity operation.

In the following examples, all the described operations at the UE 8 occur whilst the UE 8 is in RRC connected Mode in relation to the EUTRAN.

It is also assumed in the following examples that if the MeNB 2a can somehow detect whether the UE 8 is, in principle, capable of the WLAN offloading feature, e.g. by recognizing corresponding information within the "UE Capability Information", then the MeNB 2a can request the UE 2 to provide offloading information to the MeNB 2a. This request may preferably be realized as a flag added to an existing message that is sent

anyway when the UE 8 is establishing the connection to the E-UTRAN or when the UE 8 is moving to another E-UTRAN cell. The MeNB 2a can use this information for the purpose of feature coordination. In the following examples the coordination between WLAN offloading and the dual connectivity is shown. Alternatively, if the WLAN offloading capability is not reflected by the UE Capability Information, then it is assumed that a UE 8 capable of WLAN offloading sends the offload information only when it recognizes that the serving MeNB 2a supports a feature that benefits from coordination with WLAN offloading.

The UE 8 identifies one or more bearers as current potential offload candidates regularly because of possible changes in available WLAN coverage and/or offload policy and/or its position (because this may impact other offload conditions like RSRP that are checked). The detection of a new TFT may be an additional trigger for checking the identification of bearers as current offload candidates both in this example and also the subsequent examples.

It is also assumed in the following examples that offloading information is preferably only sent to the MeNB 2a if at least one condition is true or different from 'none' (depending on the example) or if a previously sent offloading information changes.

First example

Figure 6 illustrates a first example of operations at UE for providing information to the eNB to better facilitate the identification at eNB of the most suitable bearers as candidates for dual connectivity operation; and Figures 7 and 8 illustrate a first example of related operations at the serving eNB 2 (hereafter referred to as the MeNB 2a).

At the UE 8 is stored either information received from a server about using OMA DM (Open Mobile Alliance Device Management) ANDSF and/or (for UEs not supporting ANDSF) information received by NAS signalling about APNs to be considered in RAN rules (which are pre-stored at the UE 8) . This will be referred to as WLAN offload policy from here on. Both the ANDSF signalling and the NAS signalling about APNs to be considered in RAN rules is transparent to the E-UTRAN nodes, i.e. is not configured to be read by the E-UTRAN nodes via which it is sent to the UE 8. Also stored at the UE 8 is information received from the Evolved Packet Core (EPC) about traffic flow templates (TFTs), which TFTs inform the UE how to map the UE's traffic to the established radio bearers. If no TFT is received at the UE 8, the UE 8 adopts the default option of mapping

all traffic to the mandatory default bearer. The NAS signalling of the TFTs from the EPC to the UE 8 is also transparent to the E-UTRAN nodes.

The UE 8 regularly identifies one or more bearers as current potential offload candidates based on the offload policy (STEP 604). The UE 8 then determines (STEP 606): (i) whether it has not already identified these one or more bearers as potential offload candidates to the MeNB 2a (e.g. because one or more bearers that were not previously offload candidates are now offload candidates based on the offload policy, or because the UE 8 has newly entered a cell associated with the MeNB 2a and has not yet provided any information to the MeNB 2a about offload candidates; and/or (ii) whether any bearers previously identified to the MeNB 2a as possible offload candidates are no longer offload candidates. If the determination is positive, the UE transmits (STEP 608) to the MeNB 2a information identifying the one or more bearers known by the UE 8 to be offload candidates. The transmission of this indication may comprise the use of a new information element (IE) added to an existing RRC message or included in a new RRC message. If the UE 8 can recognize that the MeNB 2a is not supporting dual connectivity (or other similar technique), the UE 8 may decide not to transmit any such indication to the MeNB 2a in order to avoid transmitting unnecessary messages over the air interface.

The new IE may, for example, take the following form.

```

WLAN-OffloadInfo ::= SEQUENCE {
    ue-Identity          BIT STRING (SIZE (16)),
    wlan-offloadInfoList WLAN-OffloadInfoList,
    ...
}

```

```

WLAN-OffloadInfoList ::= SEQUENCE (SIZE (1..maxDRB)) OF DRB-OffloadInfo

```

```

DRB-OffloadInfo ::= SEQUENCE {
    drb-Identity    INTEGER (1..32),
    wlan-offloadInfo WLAN-OffloadInfo
}

```

```

    ...
}

```

```

WLAN-OffloadInfo ::= SEQUENCE {

```

```

5      wlan-offload-candidate      BOOLEAN,
    ...
}

```

All UEs 8 served by the MeNB 2a transmit their own WLAN offload information to the
 10 MeNB, and the MeNB 2a receives this information (STEP 702) and updates its memory
 store of information about bearers currently identified by UEs as possible offload
 candidates (STEP 704). When the MeNB 2a next determines which bearers to select for
 DC operation, the MeNB 2a extracts this information from the memory store of information
 (STEP 802), and uses the information to decide on a DC priority ranking for each bearer
 15 (STEP 804). For example, the MeNB 2a may assign a respective priority ranking to each
 bearer (for all the UEs served by MeNB 2a) based on e.g. throughput size and whether or
 not each bearer is currently identified by the respective UE as a potential candidate for
 offloading traffic to WLAN. Throughput size can be a useful parameter for determining
 DC priority ranking because the higher the throughput the more benefit can be expected
 20 by configuring the bearer for DC operation. Priority list A below shows an example of
 priority rankings for 5 bearers where no account is taken of whether each bearer is a
 potential offload candidate, and priority list B shows an example of using the information
 provided by the UEs about possible offload candidates to influence the priority rankings.

25

Priority	UE-ID	DRB-ID	Throughput
1	1122	1	150000
2	3344	2	100000

Priority	UE-ID	DRB-ID	Throughput	wlan-offload-candidate
1	3344	2	100000	False
2	556	4	50000	False

3	5566	1	90000
4	5566	4	50000
5	7788	2	40000

Priority list (A)

	6			
3	7788	2	40000	False
4	1122	1	150000	True
5	5566	1	90000	True

Priority list (B)

In this example, the priority ranking for each bearer is decided primarily by whether or not the bearer is currently identified by the respective UE as a potential offload candidate (with all offload candidates ranked below other bearers), and secondarily by the size of the throughput.

One advantage of the above-described technique is that it can minimise the amount of resources and signalling wasted on dual connectivity operations for bearers whose traffic is later wholly or partially offloaded to WLAN, and for which either no traffic or only a small fraction of traffic is left for transmission to the UE via the E-UTRAN, i.e. bearers for which little or no gain can be achieved by a dual connectivity operation.

Second Example

Figure 9 illustrates a second example of operations at UE. The same step numbers are used to identify steps common to the first example. The second example of UE operations is identical to the first example illustrated in Figure 6, except that the UE 8 additionally checks (STEP 603) whether the UE 8 is within the coverage of at least one WLAN node 6 with which it is allowed to establish an association for offloading traffic, before determining what (if any) offload candidate information to transmit to the MeNB 2; and the UE 8 only transmits information about bearers identified by UE 8 as potential offload candidates under the additional condition that the UE 8 has detected at least one WLAN access point 6 with which the UE 8 is allowed to establish an association for offloading traffic. Again, these checks are carried out regularly because of possible changes to the WLAN coverage and/or offload policy.

The IE for the transfer of the offload candidate information is the same as that for the first example, but the meaning of the received information is different, which can be clarified by

adding a semantic description to the ASN.1 definition, as shown below.

```

WLAN-OffloadInfo ::= SEQUENCE {
    wlan-offload-candidate    BOOLEAN,
5      ...
    }

```

wlan-offload-candidate

Value TRUE indicates offload policies related to bearer offloading are present and that the UE currently is under allowed WLAN coverage.

Alternatively, the following definition may be used, which avoids the additional semantic description because 'WLAN-OffloadInfo' can be assigned only one of these self-explanatory values.

```

WLAN-OffloadInfo ::= ENUMERATED {
    none,
15    policy-based-wlan-candidate,
        policy-based-wlan-candidate-under-allowed-wlan-coverage,
        ...
    }

```

20

In this second example, the priority ranking list is determined by the MeNB 2a in the same way as the first example, but the MeNB 2a only receives information from the UE 8 about bearers currently identified as offload candidates when the UE 8 has detected allowed WLAN coverage. Accordingly, a bearer that is identified as an offload candidate when the UE has not detected allowed WLAN coverage will not be subject by MeNB 2a to a decrease of its priority ranking for DC. As long as no allowed WLAN coverage has been recognized by the UE 8 (indicating that no WLAN offload is possible for any bearer regardless of whether or not it is an offload candidate), the one or more bearers for that UE will therefore be treated by the MeNB 2a as non-candidates and given a relatively high

priority ranking for DC. An example of a priority ranking list for this second example is shown below. Compared to Priority List B for Example 1, Bearer 1 for UE-ID 5566 has a higher priority ranking, because although it is identified as a possible offload candidate by WLAN offload policy in the UE, the UE does not identify it as a possible offload candidate to the MeNB 2a, because the UE is not within allowed WLAN coverage. Accordingly, MeNB 2a treats this bearer as a non-candidate for WLAN offload, as reflected in the priority ranking list below.

Priority	UE-ID	DRB-ID	Throughput	wlan-offload-candidate
1	3344	2	100000	False
2	5566	1	90000	False
3	5566	4	50000	False
4	7788	2	40000	False
5	1122	1	150000	True

Third Example

Figure 10 illustrates a third example of operations at the UE 8, and Figure 11 illustrates an example of related operations at the MeNB 2a. Again, the same step numbers are used to identify steps common to the first example.

This third example is identical to the second example, except that the UE 8 sends offload information to the MeNB 2a even when the UE 8 is not within allowed WLAN coverage, and the UE 8 determines whether the MeNB 2a has up-to-date information about both (i) the bearers identified as potential offload candidates and (ii) whether the UE is within allowed WLAN coverage (STEP 610). If this determination is negative, the UE 8 transmits to the MeNB 2a both (i) an identification of the bearers identified by UE 8 as current offload candidates, and (ii) an indication of whether or not the UE 8 has detected at least one WLAN access point with which the UE is allowed to establish an association for

offloading (STEP 612). Again, the checks are carried out at UE 8 regularly because of possible changes to the WLAN coverage and/or offload policy.

For this third example, the new information element may, for example, be as follows.

```

5  WLAN-OffloadInfo ::= SEQUENCE {
        policy-based-wlan-candidate BOOLEAN,
        allowed-wlan-coverage      BOOLEAN,
        ...
    }

```

10

All UEs 8 served by the MeNB 2a transmit their own WLAN offload information of this kind to the serving eNB, and the MeNB 2a receives this information, and updates its store of information about bearers currently identified by UEs as possible offload candidates and about which UEs are within allowed WLAN coverage. When the MeNB 2a next
15 determines which bearers to select for DC operation, the MeNB 2a extracts this information from the memory store (STEP 806), and uses the information to decide on a DC priority ranking for each bearer (STEP 808).

According to one option for deciding a respective priority ranking for each bearer in this third example, the priority ranking is determined primarily on the basis of (i) whether a
20 bearer has been identified by the respective UE as an offload candidate and (ii) whether the respective UE is under allowed WLAN coverage, and secondarily based on the throughput size. The greater the number of positive indications for (i) and (ii), the higher the probability that the bearer may be offloaded to WLAN by the UE 8, and the lower the priority ranking given to the bearer by the MeNB 2a. An example of a priority ranking list
25 for the third example is illustrated below for the same five bearers.

Priority	UE-ID	DRB-ID	Throughput	Policy based WLAN candidate	WLAN coverage

1	3344	2	100000	False	False
2	5566	4	50000	False	False
3	7788	2	40000	False	False
4	5566	1	90000	True	False
5	1122	1	150000	True	True

In this example of a priority ranking list: the highest priority is given to (a) bearers that are not currently identified by the UEs 8 as offload candidates; the next highest priority is given to (b) bearers that are identified as offload candidates but for which there is no indication that the respective UE 8 is in allowed WLAN coverage; and the lowest priority is given to (c) bearers that are identified as possible offload candidates for UEs that are indicated to be in allowed WLAN coverage. Throughput size is only then used to rank bearers within each category (a), (b) and (c). According to one variation, the process of determining the priority ranking order may involve giving higher weight to the throughput size, such that a bearer that is an offload candidate may be assigned a priority ranking above a bearer that is not an offload candidate, if the throughput for the offload candidate is greater than the throughput for the non-candidate by more than a predetermined threshold amount.

As mentioned above, the priority ranking list is updated each time the MeNB 2a receives updated information from the UEs that it serves. However, the 'Policy Based WLAN offload candidate' indication for any bearer tends not to change as much as the 'WLAN coverage' indication for a bearer, because the UE typically moves relatively frequently between regions where it can detect an allowed WLAN access point 6 and regions where it cannot detect an allowed WLAN access point 6.

The second example has the advantage over the third example that it involves less signalling, because signalling is bound to an 'additional condition'; but the third example has the advantage over the second example that the MeNB 2a can generate a better priority ranking list because the MeNB 2a is informed both about which bearers are candidates for WLAN offloading (based on the offload policy decided at the EPC) and also about which UEs are under allowed WLAN coverage.

Fourth Example

Figure 12 illustrates a fourth example of operations at UE 8. The same step numbers are used to identify steps common to the first and second examples. This fourth example is the same as the second example, except that the UE 8 also evaluates whether all further conditions for offloading traffic to WLAN are fulfilled (STEP 605). Again, this evaluation and the subsequent identification of current offload candidates (conditional on the outcome of STEP 605) are carried out regularly because of possible changes to the WLAN coverage and/or offload policy and/or UE 8 position.

The UE 8 sends information/updates about which bearers are offload candidate bearers only if the evaluation by the UE 8 of all further actual offload conditions (as specified by ANDSF and/or the RAN rules) indicate that offloading traffic to WLAN should be initiated by the UE 8. The IE for the transferred information may be the same as that for the first example, but the meaning of the received information is different, which can be clarified by adding semantic description, as shown below:

```
WLAN-OffloadInfo ::= SEQUENCE {
    wlan-offload-candidate    BOOLEAN,
    ...
}
```

wlan-offload-candidate

Value TRUE indicates that the bearer fulfils all necessary conditions to initiate offloading to WLAN by the UE.

Alternatively, as shown below, another definition can be used that avoids the additional semantic description, because 'WLAN-OffloadInfo' can get assigned only one of these self-explanatory values.

```
WLAN-OffloadInfo ::= ENUMERATED {  
    none,  
5    policy-based-wlan-candidate,  
    policy-based-wlan-candidate-under-allowed-wlan-coverage,  
    offloading,  
    ...  
10 }
```

All UEs 8 served by the MeNB 2a transmit their own WLAN offload information to the serving eNB, and the MeNB 2a receives this information from the UEs, and updates its store of information about bearers currently identified by UEs as possible offload candidates. When the MeNB 2a next determines which bearers to select for DC
15 operation, the MeNB 2a extracts this information from the memory store, and uses the information to decide on a DC priority ranking for each bearer.

In this fourth example, the priority ranking list is determined by the MeNB 2a in the same way as the first example, but the MeNB 2a only receives information from the UE about which bearers are offload candidates when the UE 8 has detected that all conditions are
20 fulfilled for WLAN offload. Accordingly, a bearer that is identified as an offload candidate when the UE has not detected that all offload conditions are fulfilled will not be identified to the MeNB as an offload candidate, and will not therefore be subject by MeNB 2a to a decrease of its priority ranking for DC. As long as the UE 8 determines that not all offload conditions have been fulfilled, the one or more bearers for that UE will be treated
25 by the MeNB 2a as non-candidates and given a relatively high priority ranking for DC.

An example of a priority ranking list for this fourth example is shown below. Compared to Priority List B for Example 1, Bearer 1 for UE-ID 5566 has a higher priority ranking, because although it is identified as a possible offload candidate by the WLAN offload policy in the UE, the UE does not identify it as a possible offload candidate to the MeNB
30 2a because the UE 8 determines that all conditions for WLAN offloading are not fulfilled. Accordingly, MeNB 2a treats this bearer as a non-candidate for WLAN offload, as reflected in the priority ranking list below.

Priority	UE-ID	DRB-ID	Throughput	wlan-offload-candidate
1	3344	2	100000	False
2	5566	1	90000	False
3	5566	4	50000	False
4	7788	2	40000	False
5	1122	1	150000	True

Fifth Example

- 5 Figure 13 illustrates a fifth example of operations at a UE 8 and Figure 14 illustrates an example of related operations at the MeNB 2a. The same step numbers are used to identify steps common to the first and third examples.

This fifth example is the same as the third example, except that: the UE 8 also evaluates whether all conditions for WLAN offload have been fulfilled (STEP 605); the UE
 10 determines whether the MeNB 2a has up-to-date information about (i) which bearers are offload candidates; (ii) whether the UE 8 is within coverage of an allowed WLAN access point; and (iii) whether all other actual conditions for WLAN offloading are fulfilled (STEP 614); and the UE 8 transmits to the serving eNB all of: (i) an identification of any bearer that is an offload candidate; (ii) an indication of whether the UE 8 has detected an allowed
 15 WLAN access point; and (iii) an indication of whether all other actual conditions for offloading are fulfilled (STEP 616). Again, this evaluation and the subsequent identification of current offload candidates are carried out regularly because of possible changes to the WLAN coverage and/or offload policy and/or UE 8 position.

One example of a WLAN-OffloadInfo IE for this fifth example is shown below.

20

```

WLAN-OffloadInfo ::= SEQUENCE {
    policy-based-wlan-candidate    BOOLEAN,
    allowed-wlan-coverage          BOOLEAN,
    all-further-offload-conditions-fulfilled BOOLEAN,
    ...
  
```

25

}

The further actual offload conditions may, for example, be related to load and signal of the serving cell of the MeNB 2a and the one or more WLAN access points 6 available for offloading. One specific example of a further actual offload condition is: (a) the power (RSRP) at which the UE detects serving cell reference signals transmitted by the MeNB 2a is less than a predetermined RSRP threshold offload value, and (b) the basic service set (BSS) load for the WLAN is less than a predetermined BSS load threshold value.

All UEs 8 served by the MeNB 2a transmit their own WLAN offload information to the MeNB, and the MeNB 2a receives this information, and updates its store of information about bearers currently identified by UEs as possible offload candidates. When the MeNB 2a next determines which bearers to select for DC operation, the MeNB extracts this information from the memory store (STEP 810), and uses the information to decide on a DC priority ranking for each bearer (STEP 812).

According to one option for deciding a respective priority ranking for each bearer in this fifth example, the priority ranking is determined primarily on the basis of (i) whether the bearer has been identified by the respective UE as a offload candidate, (ii) whether the UE for the bearer is under allowed WLAN coverage, and (iii) whether all actual conditions for offloading have been met. The greater the number of positive indications for (i), (ii) and (iii), the higher the probability that the bearer may be offloaded by the UE 8, and the lower the priority ranking given to the bearer by the MeNB 2a. For bearers that have an equal number of positive indications, the priority ranking is secondarily based on the throughput size. For any bearers for which all three indications (i), (ii) and (iii) are positive, the MeNB may consider any such bearer as offloaded to WLAN, and the MeNB may be configured in such a situation to disable such bearers from DC operation, i.e. remove any such bearer from the DC candidate list or, if DC operation happens to already be configured for any such bearer, to de-configure any such bearer from the DC operation.

An example of priority ranking list for the fifth example is illustrated below for the same five bearers.

Priority	UE-ID	DRB-ID	Throughput	Policy based WLAN	WLAN coverage	All further offload condition

				candida te		s fulfilled
1	3344	2	100000	False	False	False
2	7788	2	40000	False	False	False
3	5566	4	50000	False	True	False
4	5566	1	90000	True	True	False
5	1122	1	150000	True	True	True

According to one variation of this 5th example, the process of determining the priority ranking order may involve giving higher weight to the throughput size, such that e.g. a bearer that has more positive indications than another bearer (provided that at least the “all further offload conditions fulfilled” indication is negative) may be assigned a priority ranking above the another bearer if the throughput for that bearer is greater than the throughput for the another bearer by more than a predetermined threshold amount.

The method of the 4th example has the advantage over the 5th example that less signalling is required, because the UE only sends the message if all conditions are fulfilled, i.e. if the UE can execute offloading the bearers to WLAN. The method of the 5th example has the advantage over the 4th example that the MeNB 2a can generate a more sophisticated priority list because it receives more detailed information from the UE 8, i.e. it knows if a bearer is a candidate for WLAN offloading due to the presence of corresponding off/onload policies and whether the UE 8 is under allowed WLAN coverage and whether all further actual offload conditions are fulfilled for offloading traffic to WLAN by the UE 8.

The fifth example is similar to the third example, except that the number of bearers effectively de-prioritized or disabled from DC usage (e.g. because of a low priority ranking) is further reduced because bearers that are identified as offload candidates without the conditions for WLAN offloading having actually been met are given higher priority for DC operation than offload candidate bearers for which the conditions for WLAN offloading have not been met.

In the first example, the MeNB 2a uses quite static offload information, whereas in the other examples, the MeNB 2a has to be updated more frequently by the UEs 8 it serves, because of relatively frequent changes in allowed WLAN coverage etc.. This frequent

updating may require a significant amount of signalling traffic between the UEs and MeNB. In order to avoid excessive RRC messages between the MeNB and the UEs it serves, the UEs may alternatively use MAC layer communication instead of RRC messages for communicating the information to the MeNB. MAC layer communication reduces the communication overhead, and may be a preferable alternative for the frequent exchange of small units of information, such as for example the above-described Boolean-type information.

The above description relates to the example where the MeNB does not have knowledge of the offload policy according to which bearers are identified as offload candidates.

However, at least Examples 2 to 5 are also of use when the MeNB does have knowledge of the offload policy. The offload information provided by the UEs to the MeNB about whether a UE is within allowed WLAN coverage and/or all the predetermined conditions for WLAN offloading have actually been met for a UE facilitates better DC priority ranking at the MeNB.

The above-described techniques may also be used to achieve better coordination of other resource assignment operations with the WLAN offloading. For example, the offload information provided by the UEs 8 to the serving eNB 2 may also be taken into account when deciding on intra-RAN handovers of UEs 8 for traffic steering purposes. If the information provided by the UEs 8 served by the serving eNB 2 indicates that one or more bearers are potential WLAN offloading candidates, then it may be effective to de-prioritize the respective UE(s) 8 from intra-RAN handovers in order to avoid that any UE 8 undergoes a handover operation for traffic steering purposes during or shortly before the same UE 8 offloads to a WLAN the very traffic that had made the UE a candidate for intra-RAN handover.

The above-described operations may require data processing in the various entities. The data processing may be provided by means of one or more data processors. Similarly various entities described in the above embodiments may be implemented within a single or a plurality of data processing entities and/or data processors. Appropriately adapted computer program code product may be used for implementing the embodiments, when loaded to a computer. The program code product for providing the operation may be stored on and provided by means of a carrier medium such as a carrier disc, card or tape. A possibility is to download the program code product via a data network. Implementation may be provided with appropriate software in a server.

For example the embodiments of the invention may be implemented as a chipset, in other words a series of integrated circuits communicating among each other. The chipset may comprise microprocessors arranged to run code, application specific integrated circuits (ASICs), or programmable digital signal processors for performing the operations
5 described above.

Embodiments of the invention may be practiced in various components such as integrated circuit modules. The design of integrated circuits is by and large a highly automated process. Complex and powerful software tools are available for converting a logic level design into a semiconductor circuit design ready to be etched and formed on a
10 semiconductor substrate.

Programs, such as those provided by Synopsys, Inc. of Mountain View, California and Cadence Design, of San Jose, California automatically route conductors and locate components on a semiconductor chip using well established rules of design as well as libraries of pre stored design modules. Once the design for a semiconductor circuit has
15 been completed, the resultant design, in a standardized electronic format (e.g., Opus, GDSII, or the like) may be transmitted to a semiconductor fabrication facility or "fab" for fabrication.

In addition to the modifications explicitly mentioned above, it will be evident to a person skilled in the art that various other modifications of the described embodiment may be
20 made within the scope of the invention.

CLAIMS

1. A method comprising: transmitting offload information from a communication
5 device to a node of a radio access network to which the communication device is attached
for the transfer of data between the communication device and a gateway via said radio
access network, wherein said offload information comprises information about a possibility
of a data transfer between said gateway and said communication device other than via
10 said radio access network whilst said communication device is attached to said radio
access network.
2. A method according to claim 1, wherein a plurality of bearers are established for
the transfer of data between said gateway and said communication device, and wherein
said offload information specifies one or more of said plurality of bearers as offload
15 candidates based on offload policy information.
3. A method according to claim 2, comprising receiving said offload policy information
at said communication device via said radio access network without being read by said
radio access network.
- 20
4. A method according to claim 2 or claim 3, comprising transmitting said offload
information specifying one or more bearers as offload candidates, only when the
communication device is within the coverage of a radio access point outside the radio
access network via which the communication device is allowed to transfer data to/from the
25 gateway.
5. A method according to claim 4, comprising transmitting said offload information
specifying one or more bearers as offload candidates, only when the communication
device is within the coverage of a radio access point outside the radio access network via
30 which the communication device is allowed to transfer data to/from the gateway, and

when all predetermined conditions are met for the transfer of data between said communication device and said gateway via said radio access point outside the radio access network.

- 5 6. A method according to any of claims 1 to 3, wherein said offload information includes an indication about whether the communication device is within the coverage of an access node outside the radio access network via which the communication device is allowed to transfer data to /from the gateway.
- 10 7. A method according to any of claims 1 to 3 and 6, wherein said offload information includes an indication of whether all necessary conditions for the transfer of data between said communication device and said gateway other than via the radio access network are fulfilled.
- 15 8. A method comprising: receiving offload information from one or more communication devices at a node of a radio access network to which the one or more communication devices are attached for the transfer of data between the one or more communication devices and a gateway via said radio access network; wherein said offload information comprises information about a possibility of a data transfer between
20 said gateway and said one or more communication devices other than via said radio access network whilst said one or more communication devices are attached to said radio access network; and making one or more decisions about the assignment of radio resources within said radio access network based at least partly on said offload information.
- 25
9. A method according to claim 8, wherein a respective one or more bearers are established for the transfer of data between said gateway and each of said one or more communication devices; and the method comprises deciding at said radio access network node for one or more bearers a respective level of priority for effecting an increase of data
30 throughput between said communication device and said gateway via said radio access network based at least partly on said offload information.

10. A method according to claim 9, wherein the offload information identifies one or more bearers as offload candidates.

5 11. A method according to claim 9 or claim 10, comprising: receiving at said radio access network node offload policy information according to which said one or more communication devices identify one or more bearers as offload candidates; and forwarding said offload policy information from said radio access network node to said one or more communication devices via said radio access network without reading said offload
10 policy information at said radio access network node.

12. A method according to claim 9 or claim 10, wherein the radio access network node also has access to offload policy information according to which said one or more communication devices identify one or more bearers as offload candidates; and said
15 offload information received from the one or more communication devices at least includes additional information about a possibility of a data transfer between said gateway and the communication devices other than via said radio access network for the one or more bearers identified as offload candidates by the offload policy information.

20 13. A method according to any of claims 8 to 12, wherein said offload information includes an indication about whether the communication device is within the coverage of an access node outside the radio access network via which the communication device is allowed to transfer data to/from the gateway.

25 14. A method according to any of claims 8 to 13, wherein said offload information includes an indication of whether all necessary conditions for the transfer of data between said communication device and said gateway other than via the radio access network are fulfilled.

15. A method according to claim 14, comprising: deciding against assigning extra radio resources to a communication device for which the offload information indicates that all necessary conditions for the transfer of data between said communication device and said gateway other than via the radio access network are fulfilled, and/or deciding to assign
5 extra radio resources to a communication device for which the offload information indicates that all necessary conditions for the transfer of data between said communication device and said gateway other than via the radio access network are not fulfilled.

10 16. A method according to claim 8, comprising: making one or more decisions about communication device handovers within said radio access network based at least partly on said offload information.

15 17. A method according to claim 16, comprising deciding at said radio access network node a respective level of handover priority for one or more communication devices based on the offload information.

20 18. An apparatus comprising: a processor and memory including computer program code, wherein the memory and computer program code are configured to, with the processor, cause the apparatus to:

transmit offload information from a communication device to a node of a radio access network to which the communication device is attached for the transfer of data between the communication device and a gateway via said radio access network, wherein said offload information comprises information about a possibility of a data transfer between
25 said gateway and said communication device other than via said radio access network whilst said communication device is attached to said radio access network.

30 19. An apparatus according to claim 18, wherein a plurality of bearers are established for the transfer of data between said gateway and said communication device, and wherein said offload information specifies one or more of said plurality of bearers as offload candidates based on offload policy information.

20. An apparatus according to claim 19, wherein the memory and computer program code are further configured to, with the processor, cause the apparatus to: receive said offload policy information at said communication device via said radio access network
5 without being read by said radio access network.

21. An apparatus according to claim 19 or claim 20, wherein the memory and computer program code are further configured to, with the processor, cause the apparatus to: transmit said offload information specifying one or more bearers as offload candidates,
10 only when the communication device is within the coverage of a radio access point outside the radio access network via which the communication device is allowed to transfer data to/from the gateway.

22. An apparatus according to claim 21, wherein the memory and computer program code are further configured to, with the processor, cause the apparatus to: transmit said offload information specifying one or more bearers as offload candidates, only when the communication device is within the coverage of a radio access point outside the radio access network via which the communication device is allowed to transfer data to/from the gateway, and when all predetermined conditions are met for the transfer of data between
20 said communication device and said gateway via said radio access point outside the radio access network.

23. An apparatus according to any of claims 18 to 20, wherein said offload information includes an indication about whether the communication device is within the coverage of
25 an access node outside the radio access network via which the communication device is allowed to transfer data to /from the gateway.

24. An apparatus according to any of claims 18 to 20 and 23, wherein said offload information includes an indication of whether all necessary conditions for the transfer of
30 data between said communication device and said gateway other than via the radio access network are fulfilled.

25. An apparatus comprising: a processor and memory including computer program code, wherein the memory and computer program code are configured to, with the processor, cause the apparatus to: receive offload information from one or more communication devices at a node of a radio access network to which the one or more communication devices are attached for the transfer of data between the one or more communication devices and a gateway via said radio access network; wherein said offload information comprises information about a possibility of a data transfer between said gateway and said one or more communication devices other than via said radio access network whilst said one or more communication devices are attached to said radio access network; and to make one or more decisions about the assignment of radio resources within said radio access network based at least partly on said offload information.

26. An apparatus according to claim 25, wherein a respective one or more bearers are established for the transfer of data between said gateway and each of said one or more communication devices; and the wherein the memory and computer program code are further configured to, with the processor, cause the apparatus to: decide at said radio access network node for one or more bearers a respective level of priority for effecting an increase of data throughput between said communication device and said gateway via said radio access network based at least partly on said offload information.

27. An apparatus according to claim 26, wherein the offload information identifies one or more bearers as offload candidates.

28. An apparatus according to claim 26 or claim 27, wherein the memory and computer program code are further configured to, with the processor, cause the apparatus to: receive at said radio access network node offload policy information according to which said one or more communication devices identify one or more bearers as offload candidates; and forward said offload policy information from said radio access network node to said one or more communication devices via said radio access network without reading said offload policy information at said radio access network node.

29. An apparatus according to claim 26 or claim 27, wherein the radio access network node also has access to offload policy information according to which said one or more communication devices identify one or more bearers as offload candidates; and said
5 offload information received from the one or more communication devices at least includes additional information about a possibility of a data transfer between said gateway and the communication devices other than via said radio access network for the one or more bearers identified as offload candidates by the offload policy information.

10 30. An apparatus according to any of claims 25 to 29, wherein said offload information includes an indication about whether the communication device is within the coverage of an access node outside the radio access network via which the communication device is allowed to transfer data to/from the gateway.

15 31. An apparatus according to any of claims 25 to 30, wherein said offload information includes an indication of whether all necessary conditions for the transfer of data between said communication device and said gateway other than via the radio access network are fulfilled.

20 32. An apparatus according to claim 31, wherein the memory and computer program code are further configured to, with the processor, cause the apparatus to: decide against assigning extra radio resources to a communication device for which the offload information indicates that all necessary conditions for the transfer of data between said communication device and said gateway other than via the radio access network are
25 fulfilled, and/or decide to assign extra radio resources to a communication device for which the offload information indicates that all necessary conditions for the transfer of data between said communication device and said gateway other than via the radio access network are not fulfilled.

30 33. An apparatus according to claim 25, wherein the memory and computer program code are further configured to, with the processor, cause the apparatus to: make one or

more decisions about communication device handovers within said radio access network based at least partly on said offload information.

34. An apparatus according to claim 33, wherein the memory and computer program code are further configured to, with the processor, cause the apparatus to: decide at said radio access network node a respective level of handover priority for one or more communication devices based on the offload information.

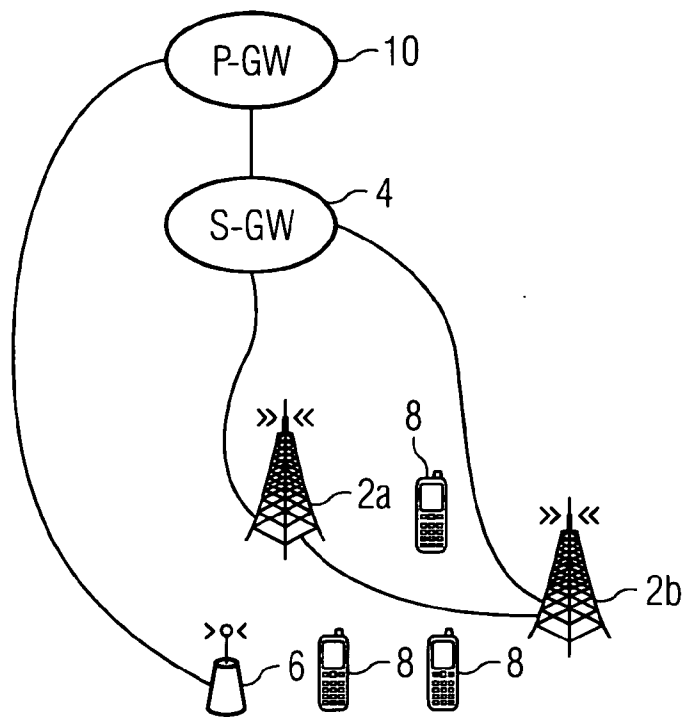
35. An apparatus configured to perform the method of any of claims 1 to 16.

36. A computer program product comprising program code means which when loaded into a computer controls the computer to: transmit offload information from a communication device to a node of a radio access network to which the communication device is attached for the transfer of data between the communication device and a gateway via said radio access network, wherein said offload information comprises information about a possibility of a data transfer between said gateway and said communication device other than via said radio access network whilst said communication device is attached to said radio access network.

37. A computer program product comprising program code means which when loaded into a computer controls the computer to: receive offload information from one or more communication devices at a node of a radio access network to which the one or more communication devices are attached for the transfer of data between the one or more communication devices and a gateway via said radio access network; wherein said offload information comprises information about a possibility of a data transfer between said gateway and said one or more communication devices other than via said radio access network whilst said one or more communication devices are attached to said radio access network; and to make one or more decisions about the assignment of radio resources within said radio access network based at least partly on said offload information.

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FIG 1



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FIG 2

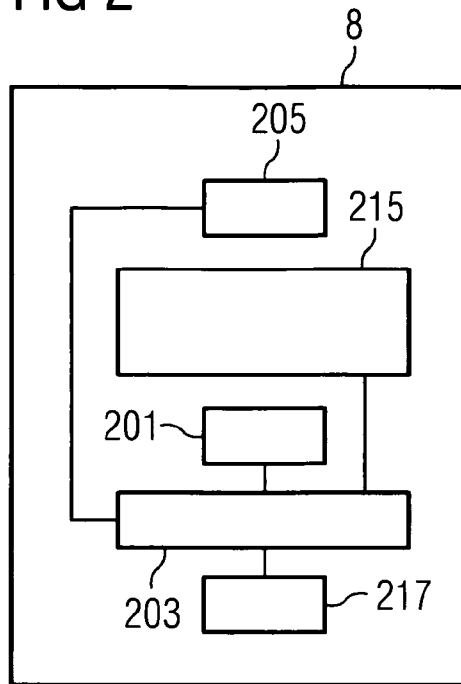
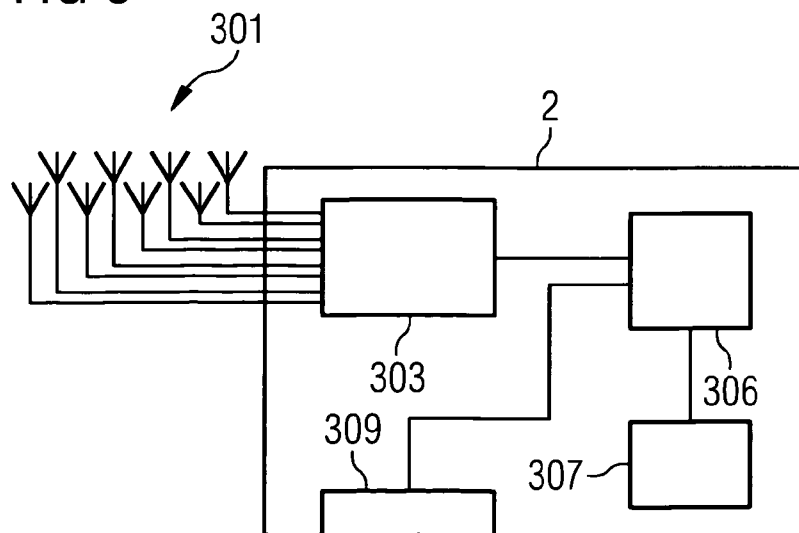


FIG 3



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FIG 4

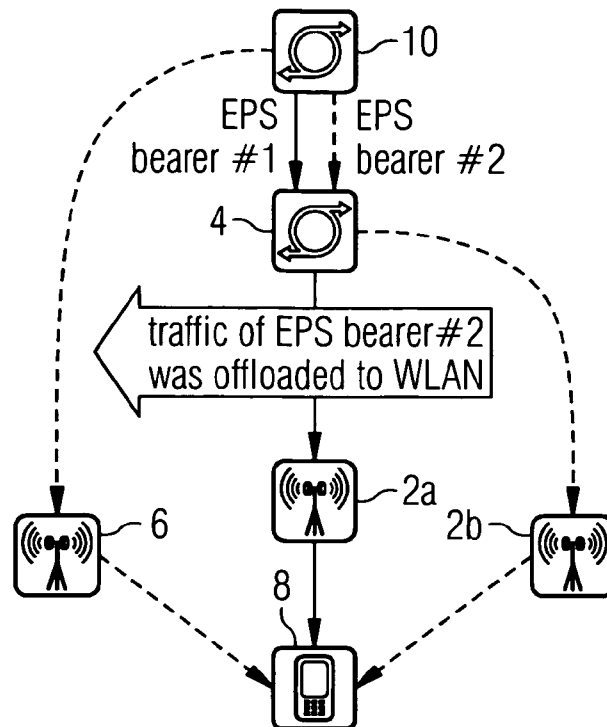
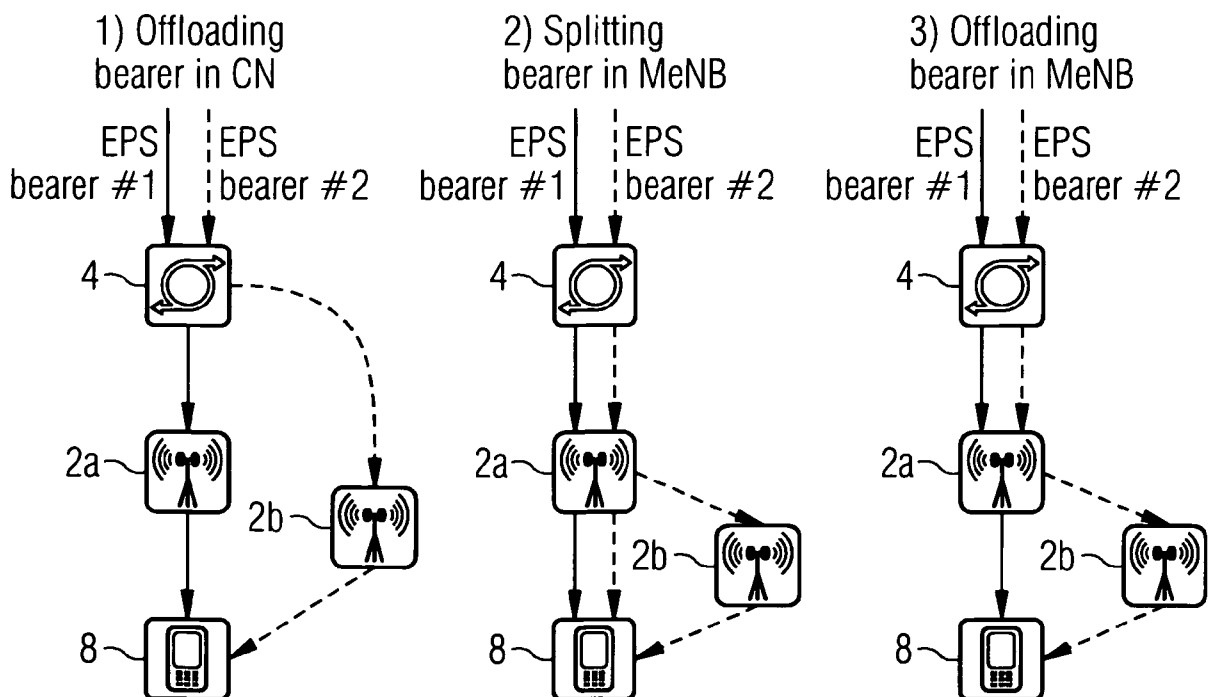


FIG 5



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FIG 6

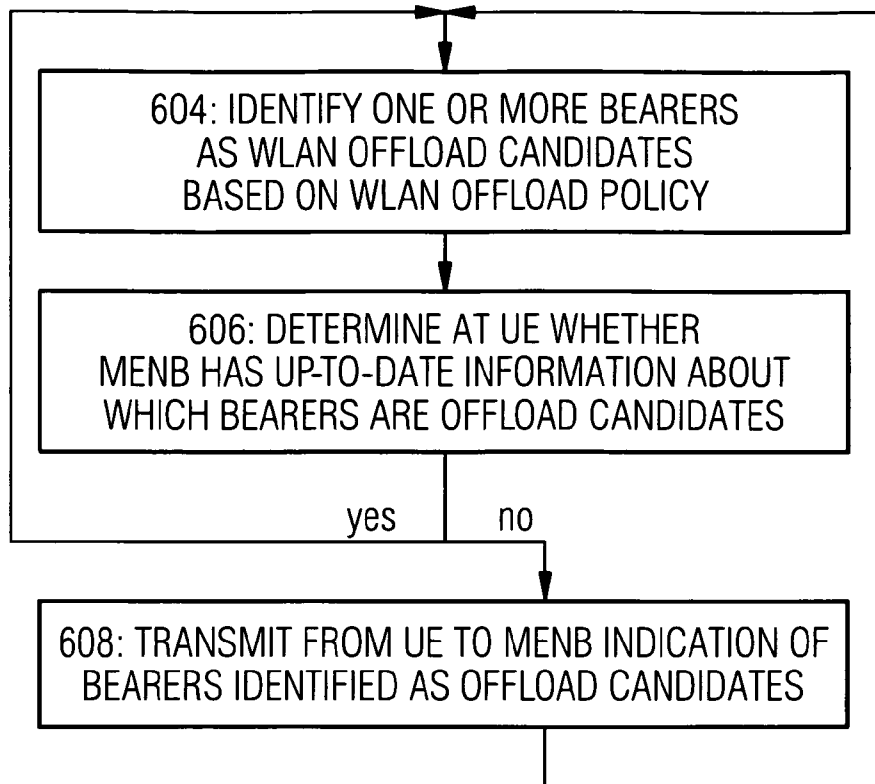
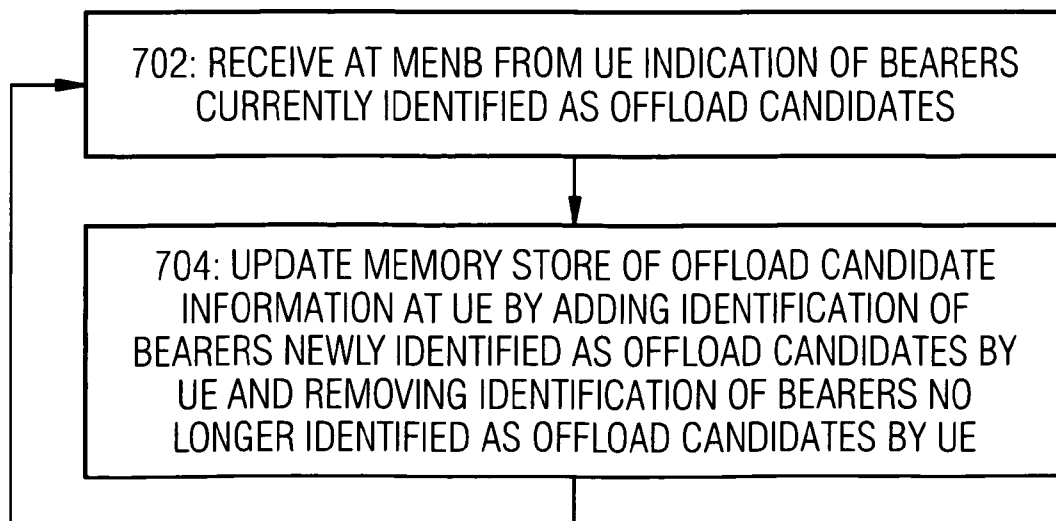


FIG 7



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FIG 8

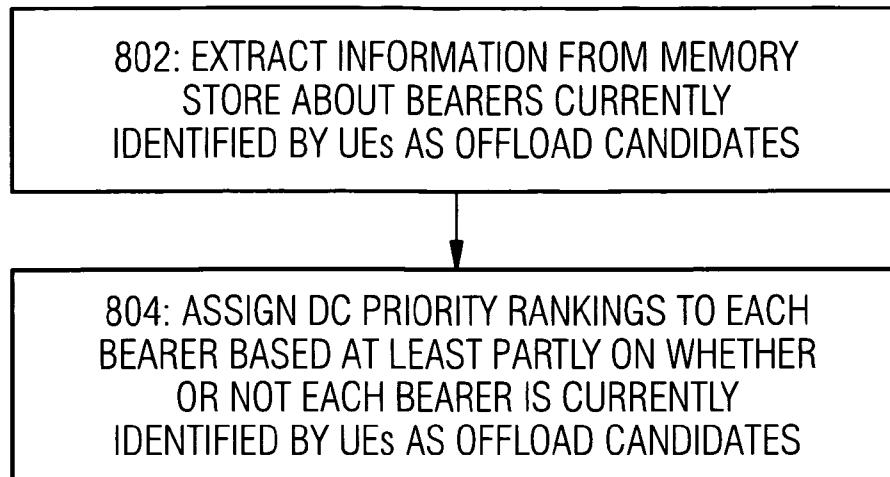
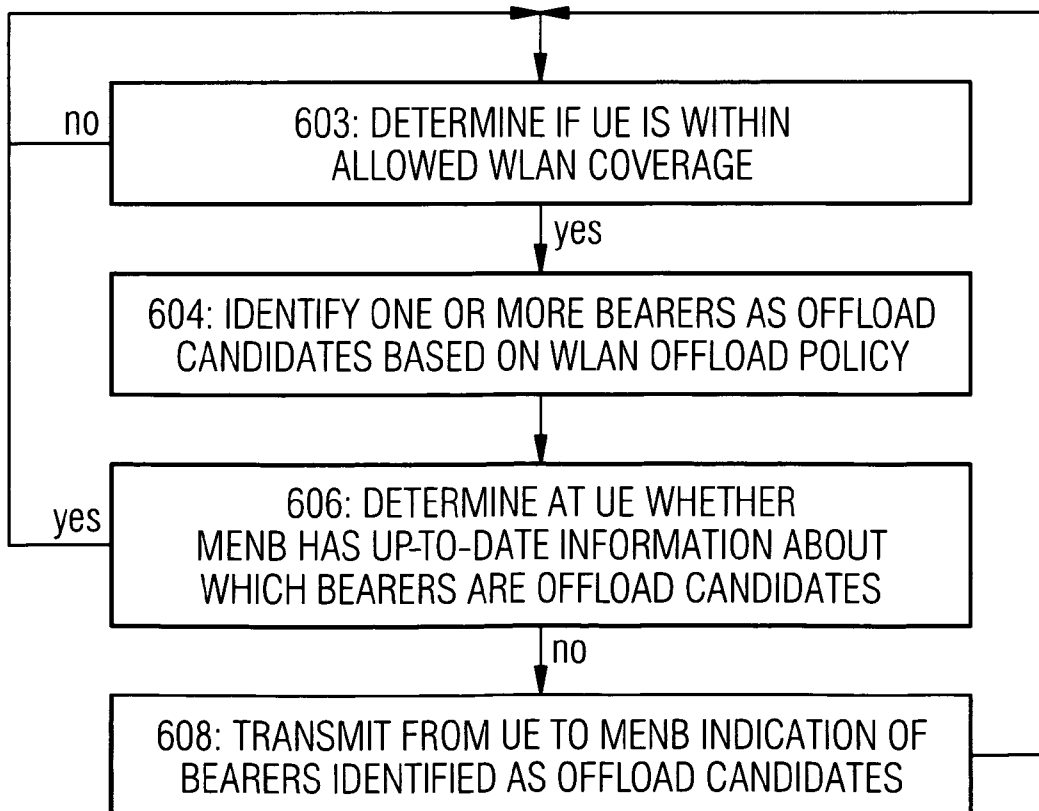
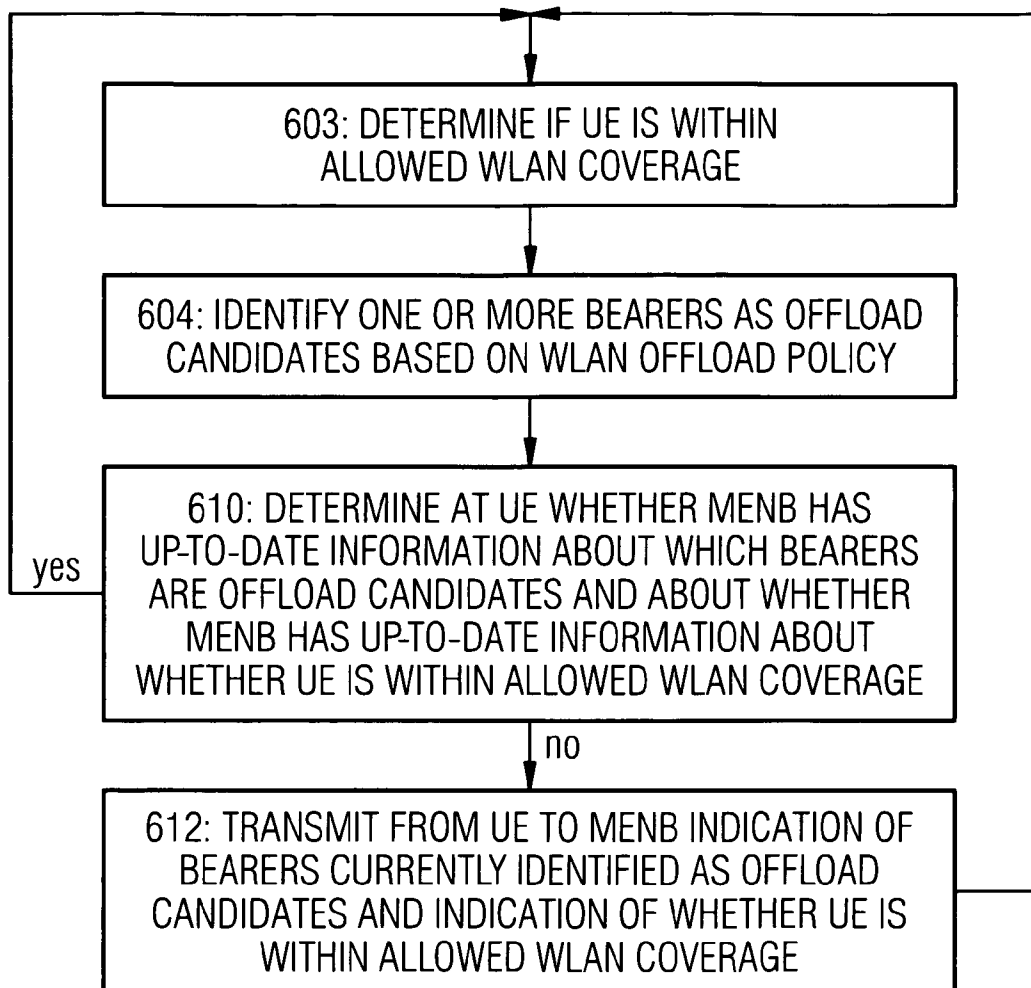


FIG 9



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FIG 10



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FIG 11

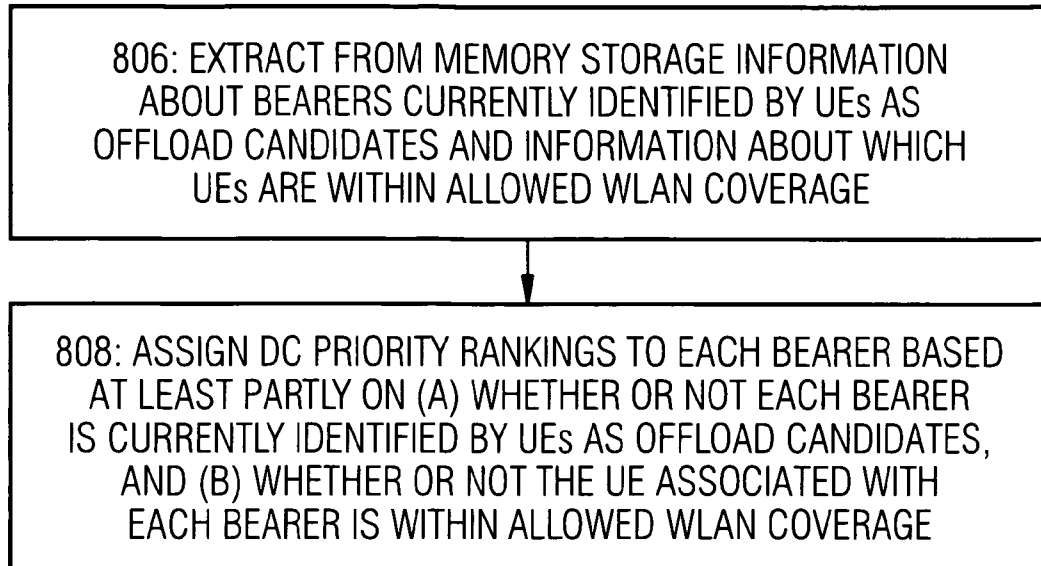
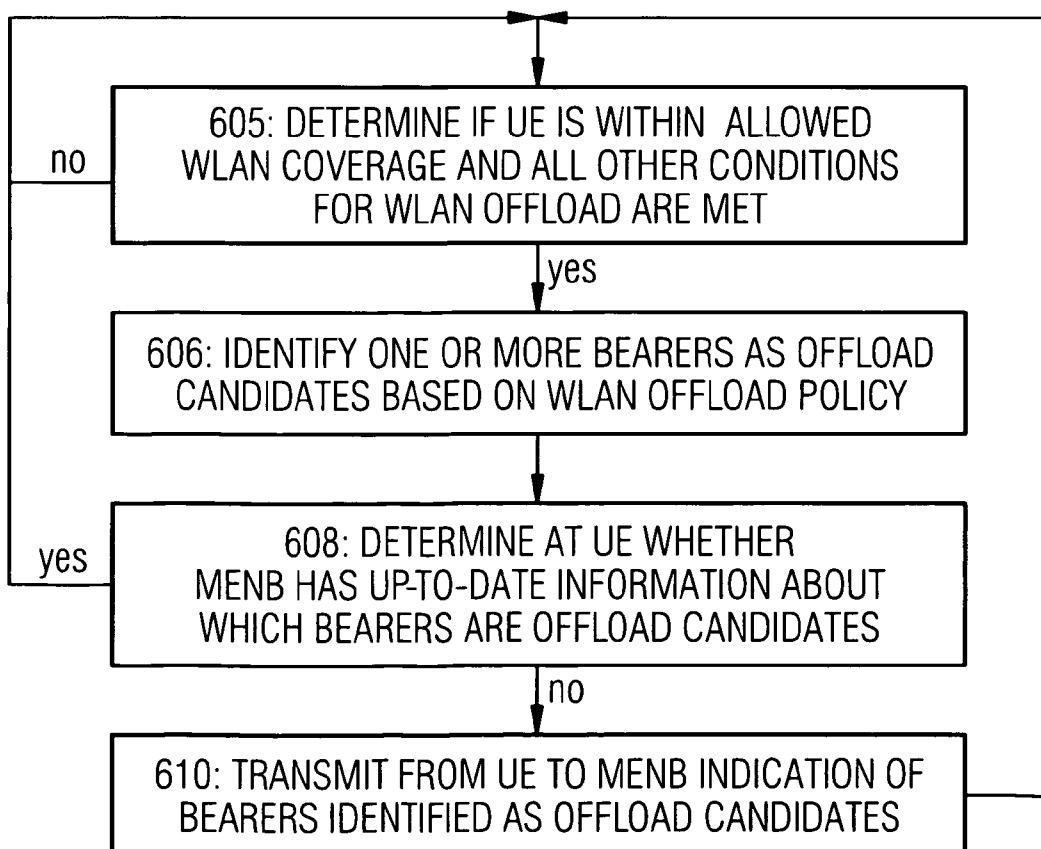
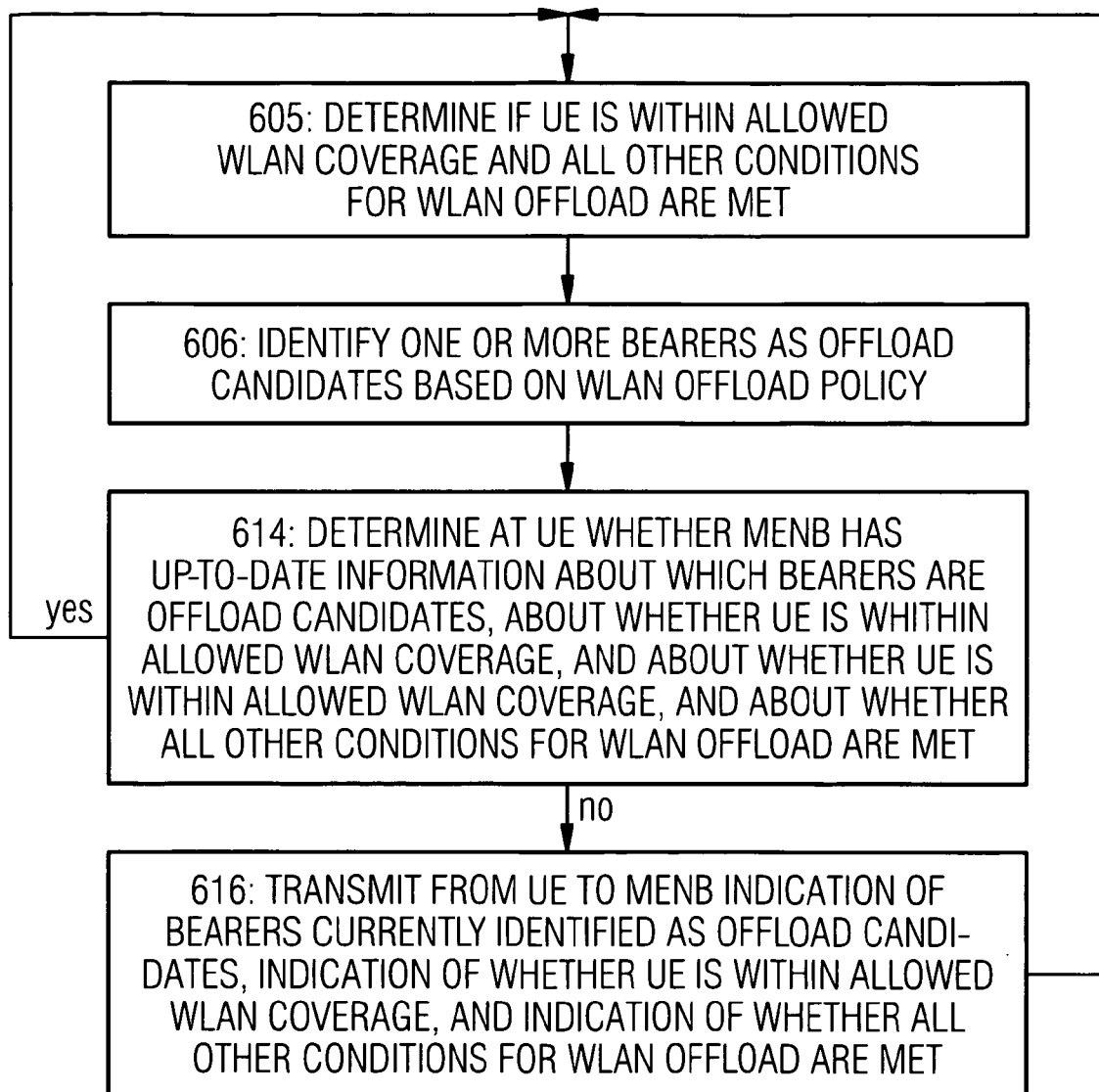


FIG 12



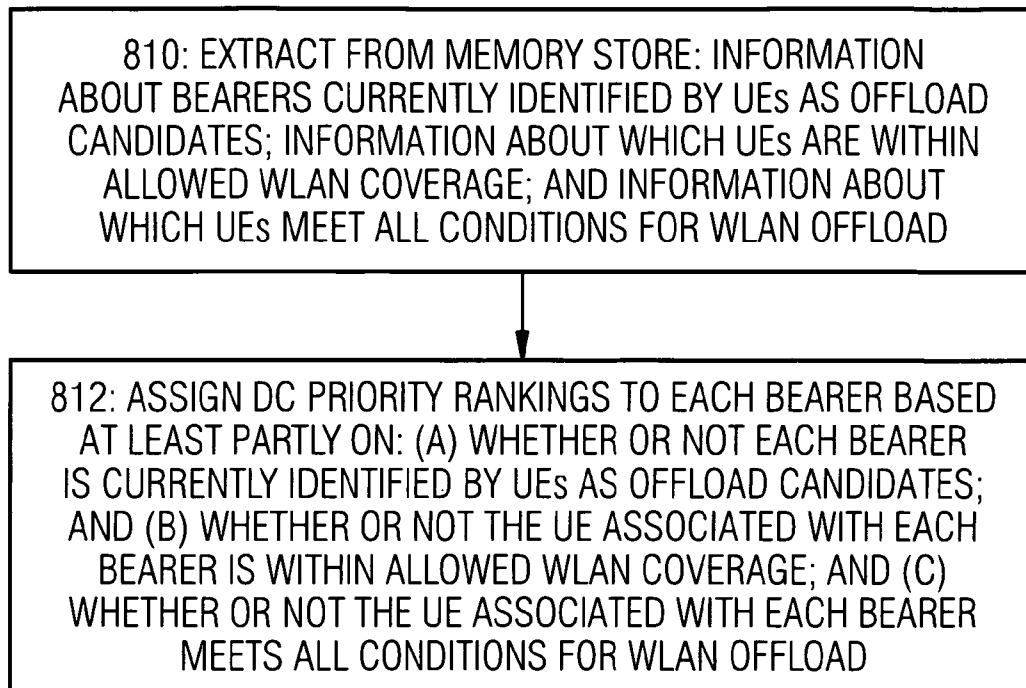
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FIG 13



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FIG 14



INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2014/066955

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04W28/08
ADD.

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

B. FIELDS SEARCHED

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

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

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

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2013/133871 A1 (NTT DOCOMO INC [JP]; ISHII HIROYUKI [US]) 12 September 2013 (2013-09-12) abstract page 13, paragraph 69-71 page 19, paragraphs 99-100,104 page 22, paragraph 116 page 26, paragraph 132-136 page 27, paragraphs 140,142 page 31, paragraph 156 page 35, paragraphs 181,182,185 page 41, paragraph 215 page 42, paragraph 220 page 44, paragraphs 232,235 page 45, paragraph 253 page 59, paragraphs 324,325 ----- -/-	1-37



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See patent family annex.

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Date of the actual completion of the international search

13 April 2015

Date of mailing of the international search report

17/04/2015

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INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2014/066955

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2013/265879 A1 (QIANG ZU [CA]) 10 October 2013 (2013-10-10) abstract page 1, paragraph 18-20 page 2, paragraphs 21,30,32,35-36 page 3, paragraph 37 -----	1-37
A	WO 2012/112571 A1 (ZTE USA INC [US]; WU YINGZHE [US]) 23 August 2012 (2012-08-23) abstract page 6, paragraph 28 - page 9, paragraph 29 page 11, paragraph 44-45 page 12, paragraphs 46,48 page 13, paragraph 49 -----	1-37

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2014/066955

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2013133871 A1	12-09-2013	CN 104285463 A	14-01-2015
		EP 2823661 A1	14-01-2015
		KR 20140138825 A	04-12-2014
		US 2015017993 A1	15-01-2015
		WO 2013133871 A1	12-09-2013

US 2013265879 A1	10-10-2013	US 2013265879 A1	10-10-2013
		WO 2013150500 A2	10-10-2013

WO 2012112571 A1	23-08-2012	NONE	
