



- (51) **International Patent Classification:**  
*H04W 36/22* (2009.01) *H04W 88/06* (2009.01)  
*H04W 28/08* (2009.01)
- (21) **International Application Number:**  
PCT/EP2014/067011
- (22) **International Filing Date:**  
7 August 2014 (07.08.2014)
- (25) **Filing Language:** English
- (26) **Publication Language:** English
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- (81) **Designated States** (*unless otherwise indicated, for every kind of national protection available*): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM,

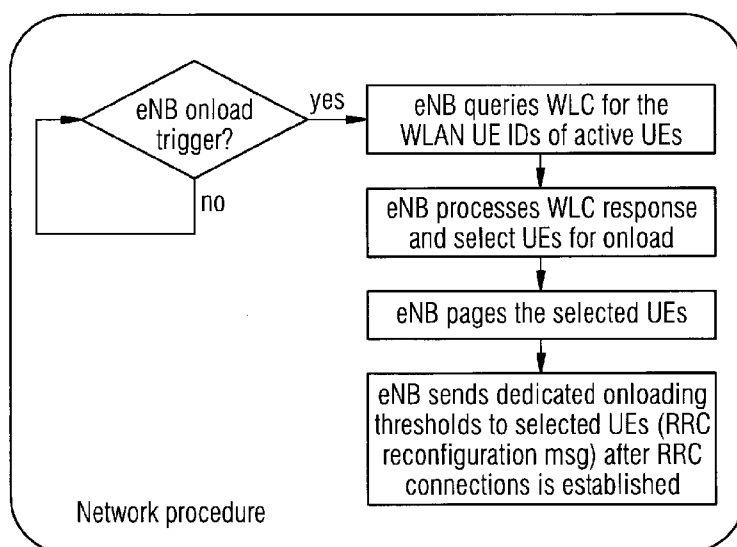
DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ,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

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

**Published:**  
— with international search report (Art. 21(3))

- (54) **Title:** METHOD, APPARATUS AND SYSTEM FOR PER-UE BASIS TRAFFIC STEERING IN WLAN-3GPP INTER-WORKING

FIG 4



- (57) **Abstract:** There is provided a method comprising receiving first identity information associated with a user equipment in a first network, at a node of a second network, associating the first identity information with second identity information, the second identity information associated with the user equipment in the second network, to control which of the first and second network a user equipment is associated with.

## DESCRIPTION

## TITLE

METHOD, APPARATUS AND SYSTEM FOR PER-UE BASIS TRAFFIC STEERING IN WLAN-3GPP  
INTERWORKING

5 The present application relates to a method, apparatus and system and in particular but not exclusively, coordinating traffic between two networks, such as a cellular communication network and a wireless local area network.

10 A communication system can be seen as a facility that enables communication sessions between two or more entities such as user terminals, base stations and/or other nodes by providing carriers between the various entities involved in the communications path. A communication system can be provided for example by means of a communication network and one or more compatible communication devices. The communications may comprise, for example, communication of data for carrying communications such as voice,  
15 electronic mail (email), text message, multimedia and/or content data and so on. Non-limiting examples of services provided include two-way or multi-way calls, data communication or multimedia services and access to a data network system, such as the Internet.

20 In a wireless communication system at least a part of communications between at least two stations occurs over a wireless link. Examples of wireless systems include public land mobile networks (PLMN), satellite based communication systems and different wireless local networks, for example wireless local area networks (WLAN). The wireless systems can typically be divided into cells, and are therefore often referred to as cellular systems.

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A user can access the communication system by means of an appropriate communication device or terminal. A communication device of a user is often referred to as user equipment (UE). A communication device is provided with an appropriate signal receiving and transmitting apparatus for enabling communications, for example enabling access to  
30 a communication network or communications directly with other users. The communication device may access a carrier provided by a station, for example a base station of a cell, and transmit and/or receive communications on the carrier.

The communication system and associated devices typically operate in accordance with a given standard or specification which sets out what the various entities associated with the system are permitted to do and how that should be achieved. Communication protocols and/or parameters which shall be used for the connection are also typically defined. An example of attempts to solve the problems associated with the increased demands for capacity is an architecture that is known as the long-term evolution (LTE) of the Universal Mobile Telecommunications System (UMTS) radio-access technology. The LTE is being standardized by the 3<sup>rd</sup> Generation Partnership Project (3GPP). The various development stages of the 3GPP LTE specifications are referred to as releases. The aim of the standardization is to achieve a communication system with, inter alia, reduced latency, higher user data rates, improved system capacity and coverage, and reduced cost for the operator.

In a first aspect there is provided a method comprising receiving first identity information associated with a user equipment in a first network, at a node of a second network, and associating the first identity information with second identity information, the second identity information associated with the user equipment in the second network, to control which of the first and second network a user equipment is associated with.

The method may comprise causing information comprising first identity information associated with at least one user equipment to be sent to a controller of the first network.

The method may comprise, in response to a request sent to the controller of the first network, determining if the at least one user equipment is routing traffic via the first network.

The method may comprise receiving a request from the controller of the first network to route traffic via the second network for the at least one user equipment.

The method may comprise, in response to a request sent to the controller of the first network, receiving first identity information associated with at least one user equipment routing traffic via the first network.

- 5 The method may comprise starting a connection procedure in the second network to the at least one user equipment.

The method may comprise determining threshold information to be sent to the at least one user equipment.

10

The method may comprise causing threshold information to be sent via radio resource signalling

- 15 Said threshold information may be used by said at least one user equipment with the second network in determining whether to associate with the second network.

The first network may be a wireless local area network and the second network may be a cellular communications network.

- 20 First identity information may comprise at least one of a media access control address, a network access identifier and user equipment generated identities.

- 25 Second identity information may comprise at least one of a cell-radio network temporary identifier, globally unique temporary user equipment identity and an international mobile subscriber identity.

The method may comprise receiving first identity information via radio resource control signalling.

- 5 The method may comprise storing the association between first identity information and second identity information for a user equipment at at least one of a mobility management entity and a node of the radio access network.

10 In a second aspect there is provided an apparatus, said apparatus comprising means for receiving first identity information associated with a user equipment in a first network, at a node of a second network and means for associating the first identity information with second identity information, the second identity information associated with the user equipment in the second network, to control which of the first and second network a user equipment is associated with.

- 15 The apparatus may comprise means for causing information comprising first identity information associated with at least one user equipment to be sent to a controller of the first network.

20 The apparatus may comprise, in response to a request sent to the controller of the first network, means for determining if the at least one user equipment is routing traffic via the first network.

25 The apparatus may comprise means for receiving a request from the controller of the first network to route traffic via the second network for the at least one user equipment.

The apparatus may comprise, in response to a request sent to the controller of the first network, means for receiving first identity information associated with at least one user equipment routing traffic via the first network.

The apparatus may comprise means for starting a connection procedure in the second network to the at least one user equipment.

5 The apparatus may comprise means for determining threshold information to be sent to the at least one user equipment.

The apparatus may comprise means for causing threshold information to be sent via radio resource signalling

10 Said threshold information may be used by said at least one user equipment with the second network in determining whether to associate with the second network.

The first network may be a wireless local area network and the second network may be a cellular communications network.

15

First identity information may comprise at least one of a media access control address, a network access identifier and user equipment generated identities.

20 Second identity information may comprise at least one of a cell-radio network temporary identifier, globally unique temporary user equipment identity and an international mobile subscriber identity.

The apparatus may comprise means for receiving first identity information via radio resource control signalling.

25

The apparatus may comprise means for storing the association between first identity information and second identity information for a user equipment at at least one of a mobility management entity and a node of the radio access network.

- 5 In a third aspect there is provided an apparatus comprising at least one processor, and at least one memory including computer program code, the at least one memory and the computer program code configured to, with the at least one processor, cause the apparatus at least to: receive first identity information associated with a user equipment in a first network, at a node of a second network; and associate the first identity information  
10 with second identity information, the second identity information associated with the user equipment in the second network, to control which of the first and second network a user equipment is associated with.

- The apparatus may be configured to cause information comprising first identity information  
15 associated with at least one user equipment to be sent to a controller of the first network.

- The apparatus may be configured to, in response to a request sent to the controller of the first network, determine if the at least one user equipment is routing traffic via the first network.  
20

The apparatus may be configured to receive a request from the controller of the first network to route traffic via the second network for the at least one user equipment.

- The apparatus may be configured to, in response to a request sent to the controller of the first network, receive first identity information associated with at least one user equipment  
25 routing traffic via the first network.

The apparatus may be configured to start a connection procedure in the second network to the at least one user equipment.

The apparatus may be configured to determine threshold information to be sent to the at least one user equipment.

- 5     The apparatus may be configured to cause threshold information to be sent via radio resource signalling

Said threshold information may be used by said at least one user equipment with the second network in determining whether to associate with the second network.

10

The first network may be a wireless local area network and the second network may be a cellular communications network.

- 15     First identity information may comprise at least one of a media access control address, a network access identifier and user equipment generated identities.

Second identity information may comprise at least one of a cell-radio network temporary identifier, globally unique temporary user equipment identity and an international mobile subscriber identity.

20

The apparatus may be configured to receive first identity information via radio resource control signalling.

- 25     The apparatus may be configured to store the association between first identity information and second identity information for a user equipment at at least one of a mobility management entity and a node of the radio access network.

In a thirteenth aspect there is provided a computer program comprising computer executable instructions which when run on one or more processors perform the method of the first aspect.

- 5 In the above, many different embodiments have been described. It should be appreciated that further embodiments may be provided by the combination of any two or more of the embodiments described above.

Embodiments will now be described, by way of example only, with reference to the  
10 accompanying Figures in which:

Figure 1 shows a schematic diagram of an example communication system comprising a base station and a plurality of communication devices;

- 15 Figure 2 shows a schematic diagram, of an example mobile communication device;

Figure 3 shows a flow chart of a method of allowing unique identification of a UE associated with a cellular network and a WLAN

- 20 Figure 4 shows a flowchart of an example method of identifying UEs for unloading

Figure 5 shows a flowchart of an example method of switching traffic from a first network to a second network in dependence on threshold information

- 25 Figure 6 shows a schematic diagram of an example control apparatus;

Before explaining in detail the examples, certain general principles of a wireless communication system and mobile communication devices are briefly explained with reference to Figures 1 to 2 to assist in understanding the technology underlying the described examples.

5

In a wireless communication system 100, such as that shown in figure 1, mobile communication devices or user equipment (UE) 102, 104, 105 are provided wireless access via at least one base station or similar wireless transmitting and/or receiving node or point. Base stations are typically controlled by at least one appropriate controller apparatus, so as to enable operation thereof and management of mobile communication devices in communication with the base stations. The controller apparatus may be located in a radio access network (e.g. wireless communication system 100) or in a core network (not shown) and may be implemented as one central apparatus or its functionality may be distributed over several apparatus. The controller apparatus may be part of the base station and/or provided by a separate entity such as a Radio Network Controller. In Figure 1 control apparatus 108 and 109 are shown to control the respective macro level base stations 106 and 107. The control apparatus of a base station can be interconnected with other control entities. The control apparatus is typically provided with memory capacity and at least one data processor. The control apparatus and functions may be distributed between a plurality of control units. In some systems, the control apparatus may additionally or alternatively be provided in a radio network controller. The control apparatus may be as the apparatus shown in figure 6, described below.

LTE systems may however be considered to have a so-called "flat" architecture, without the provision of RNCs; rather the (e)NB is in communication with a system architecture evolution gateway (SAE-GW) and a mobility management entity (MME), which entities may also be pooled meaning that a plurality of these nodes may serve a plurality (set) of (e)NBs. Each UE is served by only one MME and/or S-GW at a time and the (e)NB keeps track of current association. SAE-GW is a "high-level" user plane core network element in LTE, which may consist of the S-GW and the P-GW (serving gateway and packet data network gateway, respectively). The functionalities of the S-GW and P-GW are separated and they are not required to be co-located.

In Figure 1 base stations 106 and 107 are shown as connected to a wider communications network 113 via gateway 112. A further gateway function may be provided to connect to another network.

- 5 The smaller base stations 116, 118 and 120 may also be connected to the network 113, for example by a separate gateway function and/or via the controllers of the macro level stations. The base stations 116, 118 and 120 may be pico or femto level base stations or the like. In the example, stations 116 and 118 are connected via a gateway 111 whilst station 120 connects via the controller apparatus 108. In some embodiments, the smaller  
10 stations may not be provided.

A possible mobile communication device will now be described in more detail with reference to Figure 2 showing a schematic, partially sectioned view of a communication device 200. Such a communication device is often referred to as user equipment (UE) or  
15 terminal. An appropriate mobile communication device may be provided by any device capable of sending and receiving radio signals. Non-limiting examples include a mobile station (MS) or mobile device such as a mobile phone or what is known as a 'smart phone', a computer provided with a wireless interface card or other wireless interface facility (e.g., USB dongle), personal data assistant (PDA) or a tablet provided with wireless  
20 communication capabilities, or any combinations of these or the like. A mobile communication device may provide, for example, communication of data for carrying communications such as voice, electronic mail (email), text message, multimedia and so on. Users may thus be offered and provided numerous services via their communication devices. Non-limiting examples of these services include two-way or multi-way calls, data  
25 communication or multimedia services or simply an access to a data communications network system, such as the Internet. Users may also be provided broadcast or multicast data. Non-limiting examples of the content include downloads, television and radio programs, videos, advertisements, various alerts and other information.

- 30 The mobile device 200 may receive signals over an air or radio interface 207 via appropriate apparatus for receiving and may transmit signals via appropriate apparatus for transmitting radio signals. In Figure 2 transceiver apparatus is designated schematically by block 206. The transceiver apparatus 206 may be provided for example by means of a

radio part and associated antenna arrangement. The antenna arrangement may be arranged internally or externally to the mobile device.

5 A mobile device is typically provided with at least one data processing entity 201, at least one memory 202 and other possible components 203 for use in software and hardware aided execution of tasks it is designed to perform, including control of access to and communications with access systems and other communication devices. The data processing, storage and other relevant control apparatus can be provided on an appropriate circuit board and/or in chipsets. This feature is denoted by reference 204. The  
10 user may control the operation of the mobile device by means of a suitable user interface such as key pad 205, voice commands, touch sensitive screen or pad, combinations thereof or the like. A display 208, a speaker and a microphone can be also provided. Furthermore, a mobile communication device may comprise appropriate connectors (either wired or wireless) to other devices and/or for connecting external accessories, for  
15 example hands-free equipment, thereto.

The communication devices 102, 104, 105 may access the communication system based on various access techniques, such as code division multiple access (CDMA), or wideband CDMA (WCDMA). Other non-limiting examples comprise time division multiple  
20 access (TDMA), frequency division multiple access (FDMA) and various schemes thereof such as the interleaved frequency division multiple access (IFDMA), single carrier frequency division multiple access (SC-FDMA) and orthogonal frequency division multiple access (OFDMA), space division multiple access (SDMA) and so on.

25 An example of wireless communication systems are architectures standardized by the 3rd Generation Partnership Project (3GPP). A latest 3GPP based development is often referred to as the long term evolution (LTE) of the Universal Mobile Telecommunications System (UMTS) radio-access technology. The various development stages of the 3GPP specifications are referred to as releases. More recent developments of the LTE are often  
30 referred to as LTE Advanced (LTE-A). The LTE employs a mobile architecture known as the Evolved Universal Terrestrial Radio Access Network (E-UTRAN). Base stations of such systems are known as evolved or enhanced Node Bs (eNBs) and provide E-UTRAN features such as user plane Radio Link Control/Medium Access Control/Physical layer

protocol (RLC/MAC/PHY) and control plane Radio Resource Control (RRC) protocol terminations towards the communication devices. Other examples of radio access system include those provided by base stations of systems that are based on technologies such as wireless local area network (WLAN) and/or WiMax (Worldwide Interoperability for Microwave Access). A base station can provide coverage for an entire cell or similar radio service area.

The following relates to radio enhancements for multi-RAT (Radio Access Technologies) interworking, for example radio access network (RAN) interworking between a wireless local area network (WLAN) and a cellular communication network, such as a 3GPP network. Supporting improved connectivity over a network of a first RAT with the assistance of a network of a second RAT, such as operator assisted connectivity over WLAN, is considered.

The following may be relevant to multi-RAT coordination, for example with respect to discussions on a standardized interface between WLAN and a cellular communications network, for example a 3GPP RAN.

In RAN interworking, such as 3GPP and WLAN interworking, both network selection, at the start of a new connection, and traffic routing, during an existing connection, may be supported and governed by rules. These rules may be RAN defined rules and/or ANDSF (Access Network Discovery and Selection Function) rules. RAN interworking may rely on various thresholds, which may be part of RAN assistance information. The thresholds may be used by a UE when evaluating offloading/onloading conditions, using rules as discussed above. Offloading describes the attempt to move traffic from a first network, such as a cellular communication network, to a second network, e.g. WLAN, and onloading describes the attempt to move traffic from the second network to the first network. The above definitions for offload and onload are based on the understanding that normal radio services will be handled through a network that the mobile operator has full control over, for example, a radio access network (RAN). The definitions for onload and offload may differ depending on the networks involved.

The above-mentioned thresholds may relate to the RAN and WLAN signal strength / quality and load level. Any threshold can be signaled to UEs in both idle and connected mode by using broadcast messages (such as signal information blocks (SIB)) from the RAN. In addition, or alternatively, UEs in connected mode may receive any of the thresholds via dedicated signalling (for example, RRC signalling).

A UE offloading its traffic to WLAN may move to be in a RAN idle mode due to inactivity while being active over WLAN. If, at some point, the RAN desires to onload some of the UEs within its coverage area it may have only one method to onload the UEs. The RAN can update the RAN assistance parameters sent as broadcast information, such as a SIB, in this way targeting the whole population of UEs in idle mode for onloading. In scenarios where the UEs in IDLE mode are not active in WLAN this will not cause any problem due to the natural randomization of UEs in starting a new connection. However, if a substantial number of IDLE mode UEs are active in WLAN the broadcast information update may cause a mass toggling event when a large population of UEs attempt at the same time traffic routing from WLAN to the RAN resulting in sudden and undesired load peaks, which would most likely cause the RAN to start offloading users once more.

The following aims to address the issue above and may allow a RAN to target only selected UEs for onloading and thus have better network control of which users are onloading.

UE reporting of detected WLAN SSIDs (Service Set Identification) and other identifiers as well as the indication of successful offloading to WLAN has been proposed. However this may be limited to generating a WLAN coverage map at the RAN and to identify when a UE should offload to WLAN and route part of its traffic away from RAN.

In the following the interface is assumed to be standardized between a WLAN controller (which controls multiple WLAN access points) and the AP (access point) of a RAN, for example for 3GPP RAN an eNB or RNC. A standardized interface between WLAN and 3GPP RAN is being developed. All details of the interface are still open, e.g. which network elements the interface should connect, which elements should be part of the interface, according to which protocol/triggers/periodicity the transfer should occur. An aspect related to the mentioned standardized interface between WLAN and 3GPP RAN, involves transferring UE specific information to perform traffic steering on a per UE basis.

Currently, in order to do that the 3GPP UE identity should be uniquely coupled with the WLAN UE identity.

In the context of 3GPP core network based WLAN interworking features, the WLAN UE identity may be described by the Network Access Identifier (NAI) for the purpose of e.g. authentication. The NAI is structured according to 3GPP TS 23.003.

There is proposed a method to allow a RAN to onload UEs in idle mode back from WLAN to 3GPP RAN on a per UE basis. This offer larger flexibility avoiding mass toggling and allowing a RAN to react to poor WLAN performance and fine-tune a balanced performance between the WLAN and the RAN.

A method is shown in figure 3 of allowing unique identification of a UE associated with a cellular network and a WLAN. The method comprises, in a first step, receiving first identity information, the first identity information associated with a user equipment in a first network and, in a second step, associating first identity information with second identity information, the second identity information associated with the user equipment in a second network to control which of the first and second network a user equipment is associated with. The first network may be a WLAN network. The second network may be a cellular communication network, for example a 3GPP network.

A UE may report a WLAN UE identity to a RAN which uniquely identifies the UE in WLAN.

The first identity information, or UE identity, may have the form of e.g. the MAC address of the UE associated to WLAN, Network Access Identifier (NAI) or any other suitable form of identifier, for example a UE generated or "own-generated" identity.

First identity information may be reported by a UE when the UE is in connected mode. The first identity information may be reported via a RRC message/element. The report may occur only when a UE is associated with an operator controlled WLAN network. For example, the report may occur according to the SSIDs/WLAN IDs provided by an operator

RAN in the RAN assistance information and/or by ANDSF. The reporting of the first identity information, the WLAN UE identity report, may be combined with existing UE reporting, e.g. mobility reporting. Information, such as RSSI (Received Signal Strength Indication) to the WLAN AP and/or BSS (basic service set) load, may be reported along with the UE identity information.

Associating first identity information with second identity information may take place at the RAN. The RAN and/or MME may maintain the mapping of the first identity information, e.g. WLAN UE identity, to second identity information, e.g. 3GPP UE identity. The RAN and/or MME may, for example, store WLAN UE identities and maintain the mapping between the UE identity in 3GPP/RAN. UE identity in a cellular communication network may have the form of e.g. C-RNTI (Cell-Radio Network Temporary Identities) or IMSI (International Mobile Subscriber Identity), GUTI (Globally Unique Temporary UE Identity) or similar metric. In the case where the association is maintained at the MME, a dedicated element may be required over the S1 interface. In the case of multiple WLAN UE identity reports from the same UE the latest identity value may overwrite the previous one. The UE may create the identities in a randomized manner. In this way the UE may have the possibility to appear anonymous towards the RAN.

Maintaining the mapping of the WLAN UE identity to the cellular network UE identity allows a unique identification of a UE associated with the cellular network and WLAN.

Information comprising first identity information corresponding to at least one user equipment may be sent to a controller of the first network. In response to a request sent to the controller of the first network, the RAN may determine if the at least one user equipment is routing traffic via the first network. For example, a RAN/MME may identify IDLE mode UEs which are active in WLAN using a procedure query/response of the WLAN UE identities over the RAN/WLAN standardized and/or proprietary interface for the purpose of onloading and directed offloading.

The RAN may send a list of selected WLAN UE identities to the WLC (WLAN Controller). The RAN may query the WLC which of the UEs in the list are currently active in WLAN.

That is, the RAN may query the WLC as to which UEs in the list have ongoing traffic and thereby onloading potential. The WLC may respond accordingly.

Alternatively or in addition, the RAN may receive a request from the controller of the first network to route traffic via the second network for the at least one user equipment. The WLAN controller may send a request to the RAN to attempt to onload UEs in the provided list of WLAN UE identities.

The RAN, in response to a request sent to the controller of the first network, may receive first identity information corresponding to at least one user equipment routing traffic via the first network. The RAN may query the WLAN controller to provide the list of the WLAN UE identities of the UEs active in WLAN.

Figure 4 shows a flowchart of an example method of identifying UEs for unloading. In a first step, an eNB queries a WLAN controller (WLC) for the WLAN UE IDs of active UEs.

The second network, or RAN may start a connection procedure to the at least one UE identified in the query/response process. The connection procedure may make use of the second identity information, i.e. the identity in the cellular network. The WLAN controller (WLC) may prompt the RAN to start onloading at least some of the UEs within the WLAN UE list signalled over the RAN/WLAN interface when an ongoing overload situation and/or poor performance occurs. For example, in step 2 of figure 4, an eNB processes the WLC response and selects UE for onload. A set of different parameters may be combined to select the best (set of) UE(s) for onload. The parameters may include time advance value (indicating the physical distance from the eNB to the UE), RSSI/RSRP (received signal reference power)/RSRQ (reference signal received quality) indicating the potential link quality to expect for the given UE, expected throughput when onloaded to the RAN (whether the eNB have spare radio capacity to support the traffic increase), and /or quality of service expected from the UE. Cell load, subscriber level/priority, application types and their characteristics may be considered. UE service level/satisfaction in WLAN may be taken into account.

The RAN may start paging selected UEs when the RAN decides to perform onloading. In 3GPP networks, "paging frame" and "paging occasion" may be determined from the UE\_ID, which is derived from the IMSI. Some UEs may share the same PF and PO, and at a later instant a UE may be addressed directly. A RAN may start paging towards  
5 selected UEs among the ones identified by the WLC. Regular paging can be used for this purpose. As an example, in step 3 of figure 4, an eNB pages the selected UEs. A UE may respond to a paging message with the RACH (Random Access Channel) procedure and connect to the network.

10 Threshold information may be determined and may be sent to a UE selected for onloading. After a connection, such as an RRC connection, has been established, the RAN may send dedicated onloading thresholds over the connection, for example via RRC signalling, with "proper" setting to instruct the UE to onload. The thresholds may be set differently according to each UE's conditions and QoS profile, but may have substantially  
15 the same value. Thresholds of substantially the same value may simplify network operation. The RAN may use thresholds defined as part of RAN assistance information. Other parameters such as WLAN load in terms of queueing delay as broadcast from the AP in the beacon or 3GPP related parameters (for example, randomization parameter) may be used. Proper setting of threshold values may be defined as the setting which  
20 ensures that the onloading condition(s) related to the signaled threshold(s) will be fulfilled by the UE. The RAN may signal proper dedicated thresholds via RRC signalling in order to attempt to onload those selected UEs back to RAN. This can be seen, for example, in step 4 of figure 4. The thresholds may be adjusted to "force" the UEs to onload directly, or to increase the probability of the UE onloading to the RAN. If the probability is increased  
25 for a set of UEs, the average onloading may increase correspondingly (over a long term average). Alternatively, or in addition, RAN may send a dedicated onload instruction over RRC in the form of a direct onload indicator.

Figure 5 shows an example method of switching traffic from a first network to a second  
30 network in dependence on threshold information, such that the UE is associated with the second network. The method is shown from a UE once it has received dedicated thresholds. In step 1, the UE may re-evaluate unloading conditions. The onloading conditions may comprise ANDSF or RAN rules. If the onload conditions are met this is

reported to upper layers in step 2 and the UE may route ongoing traffic from a first network, e.g. WLAN, to a second network, such as 3GPP.

Larger flexibility may be offered to a RAN to onload on a per UE basis instead of targeting  
onload over the entire UE population. This may avoid mass toggling and/or allow a RAN to  
react to poor WLAN performance as well. The UE identity on a cellular communications  
network is coupled with the UE identity on WLAN which may be used to transfer UE  
specific information over the standardized interface between WLAN and 3GPP RAN to  
perform traffic steering on a per UE basis.

It should be understood that each block of the flowchart of Figures 3 to 5 and any  
combination thereof may be implemented by various means or their combinations, such  
as hardware, software, firmware, one or more processors and/or circuitry.

The method may be implemented on a control apparatus as shown in figure 6. Figure 6  
shows an example of a control apparatus for a communication system, for example to be  
coupled to and/or for controlling a station of an access system, such as a base station or  
(e) node B, or a node of a core network such as an MME, or a server or host. In some  
embodiments, base stations comprise a separate control apparatus unit or module. In  
other embodiments, the control apparatus can be another network element such as a  
radio network controller or a spectrum controller. The method may be implanted in a  
single control apparatus or across more than one control apparatus. The control  
apparatus may be integrated with or external to a node or module of a core network or  
RAN. In some embodiments, each base station may have such a control apparatus as  
well as a control apparatus being provided in a radio network controller. The control  
apparatus 109 can be arranged to provide control on communications in the service area  
of the system. The control apparatus 109 comprises at least one memory 301, at least  
one data processing unit 302, 303 and an input/output interface 304. Via the interface the  
control apparatus can be coupled to a receiver and a transmitter of the base station. The  
receiver and/or the transmitter may be implemented as a radio front end or a remote radio  
head. For example the control apparatus 109 can be configured to execute an appropriate  
software code to provide the control functions.

It should be understood that the apparatuses may include or be coupled to other units or modules etc., such as radio parts or radio heads, used in or for transmission and/or reception. Although the apparatuses have been described as one entity, different modules and memory may be implemented in one or more physical or logical entities.

5

It is noted that whilst embodiments have been described in relation to 3GPP and WLAN, similar principles can be applied in relation to other cellular networks and wireless local area networks and to any other communication system where support operative assisted connectivity over another network is used. Therefore, although certain embodiments were described above by way of example with reference to certain example architectures for wireless networks, technologies and standards, embodiments may be applied to any other suitable forms of communication systems than those illustrated and described herein.

It is also noted herein that while the above describes example embodiments, there are several variations and modifications which may be made to the disclosed solution without departing from the scope of the present invention.

In general, the various embodiments may be implemented in hardware or special purpose circuits, software, logic or any combination thereof. Some aspects of the invention may be implemented in hardware, while other aspects may be implemented in firmware or software which may be executed by a controller, microprocessor or other computing device, although the invention is not limited thereto. While various aspects of the invention may be illustrated and described as block diagrams, flow charts, or using some other pictorial representation, it is well understood that these blocks, apparatus, systems, techniques or methods described herein may be implemented in, as non-limiting examples, hardware, software, firmware, special purpose circuits or logic, general purpose hardware or controller or other computing devices, or some combination thereof.

The embodiments of this invention may be implemented by computer software executable by a data processor of the mobile device, such as in the processor entity, or by hardware, or by a combination of software and hardware. Computer software or program, also called program product, including software routines, applets and/or macros, may be stored in any apparatus-readable data storage medium and they include program instructions to perform particular tasks. A computer program product may comprise one or more computer-executable components which, when the program is run, are configured to carry

out embodiments. The one or more computer-executable components may be at least one software code or portions of it.

Further in this regard it should be noted that any blocks of the logic flow as in the Figures may represent program steps, or interconnected logic circuits, blocks and functions, or a combination of program steps and logic circuits, blocks and functions. The software may be stored on such physical media as memory chips, or memory blocks implemented within the processor, magnetic media such as hard disk or floppy disks, and optical media such as for example DVD and the data variants thereof, CD. The physical media is a non-transitory media.

The memory may be of any type suitable to the local technical environment and may be implemented using any suitable data storage technology, such as semiconductor-based memory devices, magnetic memory devices and systems, optical memory devices and systems, fixed memory and removable memory. The data processors may be of any type suitable to the local technical environment, and may include one or more of general purpose computers, special purpose computers, microprocessors, digital signal processors (DSPs), application specific integrated circuits (ASIC), FPGA, gate level circuits and processors based on multi-core processor architecture, as non-limiting examples.

Embodiments of the inventions 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 semiconductor substrate.

The foregoing description has provided by way of non-limiting examples a full and informative description of the exemplary embodiment of this invention. However, various modifications and adaptations may become apparent to those skilled in the relevant arts in view of the foregoing description, when read in conjunction with the accompanying drawings and the appended claims. However, all such and similar modifications of the teachings of this invention will still fall within the scope of this invention as defined in the appended claims. Indeed there is a further embodiment comprising a combination of one or more embodiments with any of the other embodiments previously discussed.

## CLAIMS

1. A method comprising:  
5 receiving first identity information associated with a user equipment in a first network, at a node of a second network; and  
associating the first identity information with second identity information, the second identity information associated with the user equipment in the second network, to control which of the first and second network a user equipment is  
10 associated with.
2. A method according to claim 1, comprising: causing information comprising first identity information associated with at least one user equipment to be sent to a controller of the first network.
- 15 3. A method according to claim 2 comprising, in response to a request sent to the controller of the first network, determining if the at least one user equipment is routing traffic via the first network.
- 20 4. A method according to claim 2, comprising receiving a request from the controller of the first network to route traffic via the second network for the at least one user equipment.
- 25 5. A method according to claim 1, in response to a request sent to the controller of the first network, receiving first identity information associated with at least one user equipment routing traffic via the first network.
6. A method according to claims 3 to 5 comprising starting a connection procedure in the second network to the at least one user equipment.
- 30 7. A method according to claims 3 to 6 comprising determining threshold information to be sent to the at least one user equipment.
8. A method according to claim 7 comprising causing threshold information to be sent  
35 via radio resource signalling

9. A method according to any one of claim 7 or claim 8, said threshold information to be used by said at least one user equipment with the second network in determining whether to associate with the second network.

5 10. A method according to any preceding claim, wherein the first network is a wireless local area network and the second network is a cellular communications network.

11. A method according to any preceding claim, wherein first identity information comprises at least one of a media access control address, a network access  
10 identifier and user equipment generated identities.

12. A method according to any preceding claim, wherein the second identity information comprises at least one of a cell-radio network temporary identifier, globally unique temporary user equipment identity and an international mobile  
15 subscriber identity.

13. A method according to any preceding claim, comprising storing the association between first identity information and second identity information for a user equipment at at least one of a mobility management entity and a node of the radio  
20 access network.

14. An apparatus comprising  
at least one processor;

and at least one memory including computer program code;

25 the at least one memory and the computer program code configured to, with the at least one processor, cause the apparatus at least to:

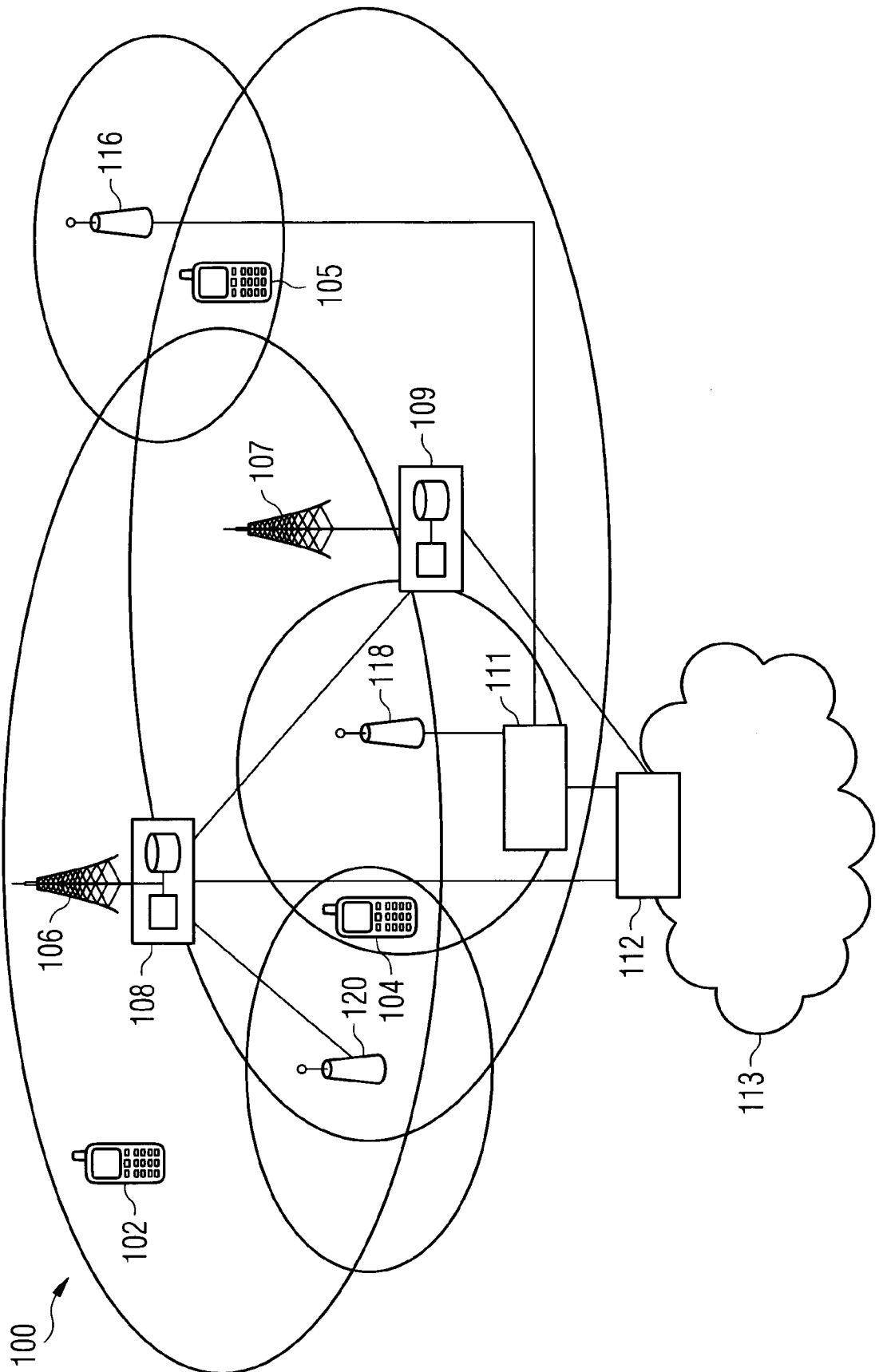
receive first identity information associated with a user equipment in a first network, at a node of a second network; and

30 associate the first identity information with second identity information, the second identity information associated with the user equipment in the second network, to control which of the first and second network a user equipment is associated with.

15. A computer program comprising computer executable instructions which when run on one or more processors perform the method of any of claims 1 to 13.

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FIG 1



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FIG 2

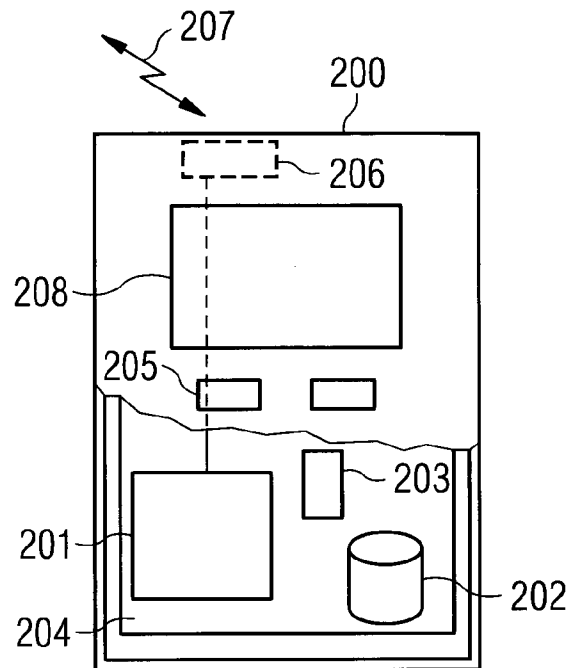


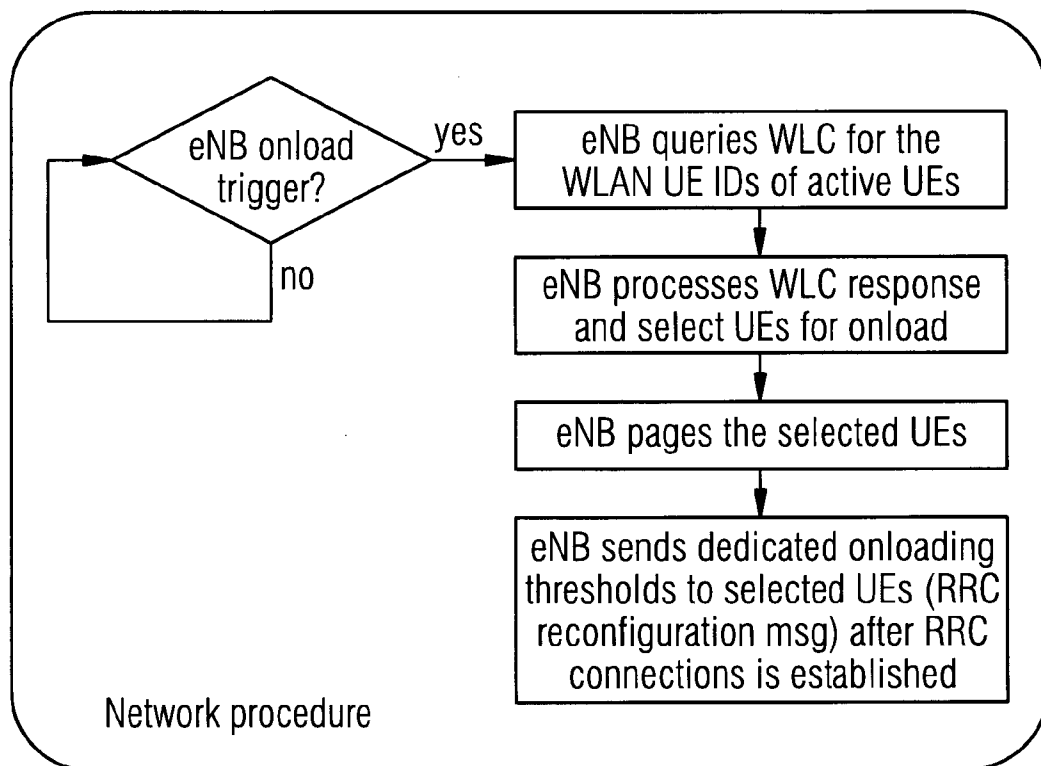
FIG 3

Receiving first identity information, the first identity information associated with a user equipment in a first network

Associating first identity information with second identity information, the second identity information associated with the user equipment in a second network to control which of the first and second network a user equipment is associated with

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FIG 4



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FIG 5

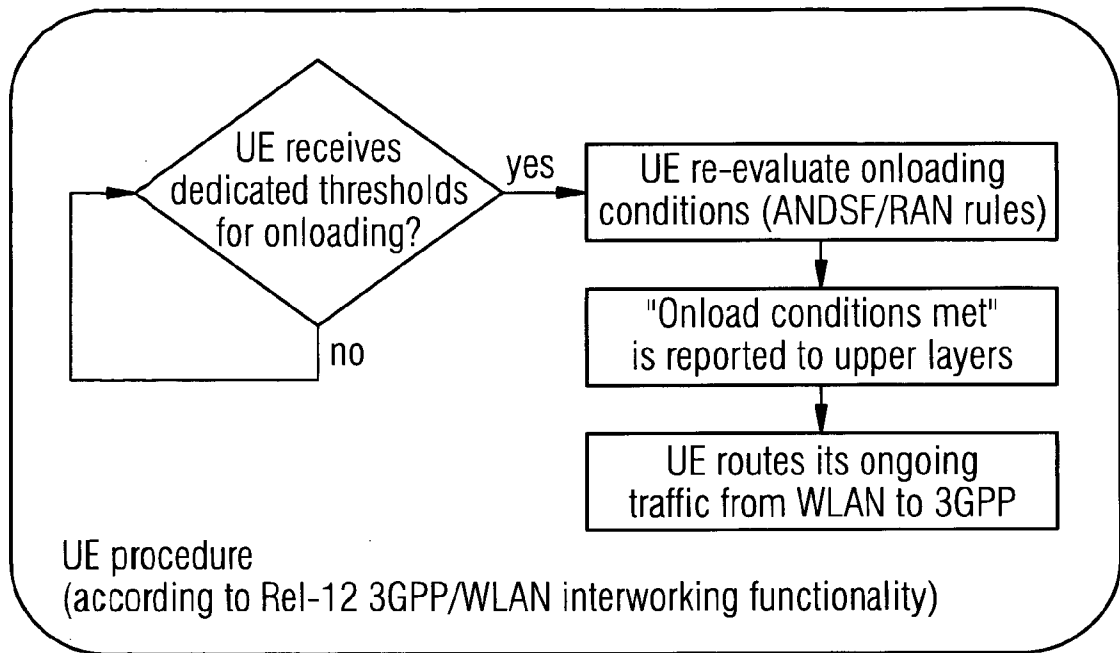
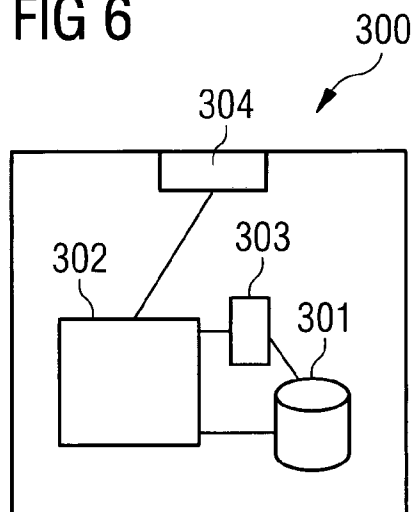


FIG 6



## INTERNATIONAL SEARCH REPORT

International application No  
PCT/EP2014/067011

A. CLASSIFICATION OF SUBJECT MATTER  
INV. H04W36/22 H04W28/08 H04W88/06  
ADD.

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

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)  
H04W H04L

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

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

EPO-Internal, WPI Data

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages                                                                                                                                                                      | Relevant to claim No.   |
|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| X<br>Y    | US 2014/204927 A1 (HORN GAVIN BERNARD [US]<br>ET AL) 24 July 2014 (2014-07-24)<br>abstract; figure 1<br>paragraphs [0052], [0053], [0057],<br>[0061] - [0065], [0067]<br>paragraphs [0072], [0075], [0081] -<br>[0083], [0089], [0093]<br>-----<br>-/-- | 1-3,5,<br>9-15<br>4,6-8 |



Further documents are listed in the continuation of Box C.



See patent family annex.

\* Special categories of cited documents :

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"&" document member of the same patent family

Date of the actual completion of the international search

22 April 2015

Date of mailing of the international search report

30/04/2015

Name and mailing address of the ISA/

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Authorized officer

Patras, Paula Larisa

## INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2014/067011

| C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                       |
|------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| Category*                                            | Citation of document, with indication, where appropriate, of the relevant passages                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Relevant to claim No. |
| Y                                                    | ERICSSON ET AL: "WLAN/3GPP Radio Interworking - More on IDLE and CONNECTED",<br>3GPP DRAFT; R2-131886 WLAN-3GPP RADIO INTERWORKING - MORE ON IDLE AND CONNECTED MODE SOLUTION, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 S<br><br>,<br>vol. RAN WG2, no. Fukuoka, Japan; 20130520 - 20130524<br>10 May 2013 (2013-05-10), XP050699917,<br>Retrieved from the Internet:<br>URL:http://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_82/Docs/<br>[retrieved on 2013-05-10]          | 4,6-8                 |
| A                                                    | chapter 2.1, chapter 3, chapter 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1-3,5,<br>9-15        |
| A                                                    | -----<br>NSN ET AL: "(Compromising) WLAN IW Solution for UEs with and without ANDSF",<br>3GPP DRAFT; R2-132327 (WLAN-3GPP SOLUTION), 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE<br><br>,<br>vol. RAN WG2, no. Barcelona, Spain; 20130819 - 20130823<br>9 August 2013 (2013-08-09), XP050718106,<br>Retrieved from the Internet:<br>URL:http://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_83/Docs/<br>[retrieved on 2013-08-09]<br>chapter 3.1.3 | 1-15                  |
| A                                                    | -----<br>US 2014/071925 A1 (LIU SHENG [CN])<br>13 March 2014 (2014-03-13)<br>abstract; figure 5<br>paragraphs [0081] - [0085], [0186] - [0194], [0228], [0229], [0292]<br>-----                                                                                                                                                                                                                                                                                                                                                          | 1-15                  |

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2014/067011

| Patent document<br>cited in search report | Publication<br>date | Patent family<br>member(s)                                              | Publication<br>date                                  |
|-------------------------------------------|---------------------|-------------------------------------------------------------------------|------------------------------------------------------|
| US 2014204927 A1                          | 24-07-2014          | TW 201431412 A<br>US 2014204927 A1<br>WO 2014116569 A1                  | 01-08-2014<br>24-07-2014<br>31-07-2014               |
| US 2014071925 A1                          | 13-03-2014          | CN 102918925 A<br>EP 2688363 A2<br>US 2014071925 A1<br>WO 2011157152 A2 | 06-02-2013<br>22-01-2014<br>13-03-2014<br>22-12-2011 |