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(71) Applicant (for all designated States except US): **NOKIA SIEMENS NETWORKS OY** [FI/FI]; Karaportti 3, FIN-02610 Espoo (FI).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **VIERING, Ingo** [DE/DE]; Werinherstrasse 95b, 81541 Munich (DE). **SARTORI, Cinzia** [IT/DE]; Donnerberger Str. 57, 80634 Munchen (DE). **WEGMANN, Bernhard** [DE/DE]; Am Oberfeld 2, 83607 Holzkirchen (DE). **REDANA, Simone** [IT/DE]; Schlierseestrasse 19, 81541 Munich (DE).

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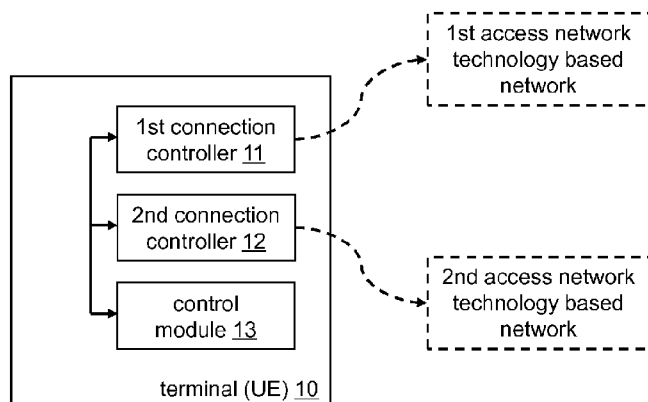


Figure 1

(57) Abstract: There are provided measures for mobile communication network assisted control of WLAN connectivity. Such measures exemplarily comprise receiving, using a first access 5 network technology, first control information, said first control information being indicative of a requested operating state of a second access network technology useable for communication, and controlling said operating state of said second access network technology based on said first control information.

DESCRIPTION

Title

5 Mobile communication network assisted control of WLAN connectivity

Field

10 The present invention relates to mobile communication network assisted control of WLAN connectivity. More specifically, the present invention exemplarily relates to measures (including methods, apparatuses and computer program products) for realizing mobile communication network assisted control of WLAN connectivity.

Background

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The present specification generally relates to automatically offloading traffic from a mobile communication network such as Long Term Evolution (LTE), Long Term Evolution Advanced (LTE-A), Universal Mobile Telecommunications System (UMTS) or Global System for Mobile Communications (GSM) toward e.g. a wireless local area network (WLAN) connection. In particular, energy saving strategies for involved terminals, i.e. mobile devices, in a scenario as outlined above are considered.

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Subscribers (users of the mobile device) of a mobile communication system (using network based technology as for example LTE, LTE-A, UMTS and GSM) are very often in the coverage area of WLAN access points (AP) which they are allowed to access, e.g. at home, in the company, or at places covered by APs belonging to the provider of mobile communication.

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In those cases, using WLAN instead of mobile communication for appropriate services would lead to several advantages. Namely, higher data rates can be achieved by the subscriber. Further, lower costs incur for the subscriber (unless the subscriber has a flat rate). In addition, less load in the mobile communication network occurs, which is in the interest of the operator of the mobile communication network. Those advantages are particularly pronounced since those areas in which WLAN is available and accessible in addition to the mobile communication network are quite often indoor.

However, using WLAN in such scenarios would require switching on a WLAN module of the mobile device, thus consuming more (battery) energy of the mobile device.

The most power drain in using the WLAN module is caused by searching and trying to acquire a WLAN AP. Consequently, it is better to have the WLAN module switched off when camping in inappropriate areas with respect to WLAN (in which no accessible WLAN is available). On the other hand, the user may not want to check if the mobile device is in the vicinity of an appropriate area and to take care of switching on/off manually.

An integration of WiFi and cellular systems (LTE, 3rd generation of mobile telecommunications technology (3G)) is specified in the 3rd Generation Partnership Project (3GPP) since Release 6 (I-WLAN, access network discovery and selection function (ANDSF) based). However, those methods aim at e.g. discover information (e.g. where to find a certain access network) and/or how to distribute traffic among available accesses if the UE is capable to do so.

Further, current mobile devices automatically use an existing WLAN connection instead of the mobile communication connection. Such technique relieves the user, which does not have to manually connect to a WLAN if available. However, the following disadvantages occur by such concept. Certainly, the mentioned concept requires an existing WLAN sensing, i.e. that the WLAN module of the mobile device is always switched on. Further, there is no control of the operator about which services are routed to WLAN. The device decides that autonomously, since it enters the WLAN connection once available. In addition,

inside a flat or a house with a single WLAN AP or in similar environment providing poor WLAN performance, the mobile device may run out of WLAN coverage. For some services, thus caused interruption of the communication may lead to deadlocks or discontinuous services.

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However, it is to be noted that subscribers with a flat rate may not necessarily be motivated to always switch WLAN on. It won't save them money, and the higher data rates may not always be needed. Further, subscribers often switch off WLAN to increase battery runtime. On the other hand, subscribers without a flat rate are typically motivated to switch on WLAN if WLAN is available, but they may forget it.

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In sum, for (battery) energy saving reasons, subscribers switch off the WLAN module of their terminals, i.e. mobile devices, when camping in inappropriate areas with respect to WLAN. On the other hand, users want to use WLAN when the mobile device is in the vicinity of an appropriate area with respect to WLAN (i.e. in the coverage area of a WLAN AP), but the users do not want to check by themselves if this is the case.

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Hence, the problem arises that that a corresponding automatism to switch on and off WLAN connectivity is missing. In particular, for the above mentioned scenarios, an optimal trade-off of between (battery) energy saving of the mobile device and using WLAN connection for appropriate services in the appropriate areas in an automated manner is to be found.

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Hence, there is a need to provide for mobile communication network assisted control of WLAN connectivity.

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Summary

Various exemplary embodiments of the present invention aim at addressing at least part of the above issues and/or problems and drawbacks.

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Various aspects of exemplary embodiments of the present invention are set out in the appended claims.

10 According to an exemplary aspect of the present invention, there is provided a method for communication in a mobile network, comprising receiving, using a first access network technology, first control information, said first control information being indicative of a requested operating state of a second access network technology useable for communication, and controlling said operating state of said second access network technology based on said first control information.

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According to an exemplary aspect of the present invention, there is provided a method for communication in a mobile network, comprising determining, whether a network for which access is allowed is spatially available to a recipient, based on a location of said recipient, and transmitting, using a first access network technology, first control information, said
20 first control information being indicative of a requested operating state of a second access network technology useable for communication, based on said determining, wherein said network is a second access network technology based network.

25 According to an exemplary aspect of the present invention, there is provided an apparatus for communication in a mobile network as or at a user equipment, comprising a first connection controller configured to receive, using a first access network technology, first control information, said first control information being indicative of a requested operating state of a second access network technology useable for communication, a second connection controller configured to communicate using said second access network technolo-

gy, and a control module configured to control said second connection controller based on said first control information.

5 According to an exemplary aspect of the present invention, there is provided an apparatus for communication in a mobile network as or at a network node, comprising a control module configured to determine, whether a network for which access is allowed is spatially available to a recipient, based on a location of said recipient, and a connection controller configured to transmit, using a first access network technology, first control information, said first control information being indicative of a requested operating state of a second
10 access network technology useable for communication, based on said determination, wherein said network is a second access network technology based network.

According to an exemplary aspect of the present invention, there is provided a computer program product comprising computer-executable computer program code which, when
15 the program is run on a computer (e.g. a computer of an apparatus according to any one of the aforementioned apparatus-related exemplary aspects of the present invention), is configured to cause the computer to carry out the method according to any one of the aforementioned method-related exemplary aspects of the present invention.

20 Such computer program product may comprise (or be embodied) a (tangible) computer-readable (storage) medium or the like on which the computer-executable computer program code is stored, and/or the program may be directly loadable into an internal memory of the computer or a processor thereof.

25 Any one of the above aspects enables an optimal trade-off between (battery) energy saving of the mobile device and using WLAN connection for appropriate services in the appropriate areas in an automated manner.

By way of exemplary embodiments of the present invention, there is provided mobile
30 communication network assisted control of WLAN connectivity. More specifically, by way

of exemplary embodiments of the present invention, there are provided measures and mechanisms for realizing mobile communication network assisted control of WLAN connectivity.

- 5 Thus, improvement is achieved by methods, apparatuses and computer program products enabling/realizing mobile communication network assisted control of WLAN connectivity.

Brief description of the drawings

- 10 In the following, the present invention will be described in greater detail by way of non-limiting examples with reference to the accompanying drawings, in which

Figure 1 is a block diagram illustrating an apparatus according to exemplary embodiments of the present invention,

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Figure 2 is a block diagram illustrating an apparatus according to exemplary embodiments of the present invention,

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Figure 3 is a schematic diagram of a procedure according to exemplary embodiments of the present invention,

Figure 4 is a schematic diagram of a procedure according to exemplary embodiments of the present invention, and

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Figure 5 is a block diagram alternatively illustrating apparatuses according to exemplary embodiments of the present invention.

Detailed description of drawings and embodiments of the present invention

5 The present invention is described herein with reference to particular non-limiting examples and to what are presently considered to be conceivable embodiments of the present invention. A person skilled in the art will appreciate that the invention is by no means limited to these examples, and may be more broadly applied.

10 It is to be noted that the following description of the present invention and its embodiments mainly refers to specifications being used as non-limiting examples for certain exemplary network configurations and deployments. Namely, the present invention and its embodiments are mainly described in relation to 3GPP and WLAN specifications being used as non-limiting examples for certain exemplary network configurations and deployments. In particular, LTE and WLAN communication is used as a non-limiting example for the applicability of thus described exemplary embodiments. As such, the description of exemplary
15 embodiments given herein specifically refers to terminology which is directly related thereto. Such terminology is only used in the context of the presented non-limiting examples, and does naturally not limit the invention in any way. Rather, any other communication or communication related system deployment, etc. may also be utilized as long as
20 compliant with the features described herein.

In particular, the present invention and its embodiments may be applicable in any combination or compound of mobile communication network (e.g. using network based technology) and AP or point-to-point based network in which offloading from the mobile communication network to the AP or point-to-point based network is implemented.
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Hereinafter, various embodiments and implementations of the present invention and its aspects or embodiments are described using several variants and/or alternatives. It is generally noted that, according to certain needs and constraints, all of the described variants and/or alternatives may be provided alone or in any conceivable combination (also
30 including combinations of individual features of the various variants and/or alternatives).

According to exemplary embodiments of the present invention, in general terms, there are provided measures and mechanisms for (enabling/realizing) mobile communication network assisted control of WLAN connectivity.

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According to exemplary embodiments of the present invention, the scope is to instruct the user equipment (UE), i.e. the mobile device, to activate WiFi (WLAN) in the UE in the proximity of WiFi APs (namely to activate the WLAN module of the UE) and switch them off when leaving the WiFi (WLAN) coverage (namely to deactivate the WLAN module of the UE). Accordingly, a communication between the UE and the mobile communication network to control in an automated and subscriber-specific manner the activation/deactivation of the WLAN module on the mobile device is introduced.

10

Such instruction is based on received information about the location of the UE (using the serving eNB). In sum, the network transmits an "On" or "Off" message to the UE indicating that the WLAN module can be either switched "On" or "Off". Consequently, according to exemplary embodiments of the present invention, power is not wasted by the UE in trying to find and access a WLAN AP (i.e. by keeping its WLAN module on continuously), thereby optimizing the consumption of battery energy of the UE.

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Although exemplary embodiments of the present invention are implementation specific described for an access node, the present invention can also be applied to LTE/GSM/UMTS and provides a way to save UE battery power.

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In other words, according to exemplary embodiments of the present invention, the mobile communication network sends a "WLANon" message to the UE, which instructs the UE to switch on its WLAN module. The "WLANon" message is sent, if the UE is in the vicinity of a WLAN AP.

Further, according to exemplary embodiments of the present invention, the mobile communication network sends a "WLANoff" message to the UE, which instructs the UE to switch off its WLAN module. The "WLANoff" message is sent, if the UE leaves the area in the vicinity of the WLAN AP, or if it is turned out that the WLAN connection cannot deliver the service properly (e.g. if the device regularly runs out of WLAN coverage and returns to LTE/UMTS).

Although there may be solutions discussed in different standardization bodies (3GPP and Institute of Electrical and Electronics Engineers (IEEE)) which improve interaction between e.g. LTE and WLAN, in particular in relation to load balancing/off-loading, those solutions may systemically require an update of the standardization. Existing terminals may not be upgraded with the functionality.

Since existing terminals already have intelligent mechanisms to select either WLAN or LTE (once WLAN and LTE modules are switched on), the exemplary embodiments of the present invention focus on switching WLAN on and off, which does not necessarily require standard changes, and in particular no new terminals. To the contrary, the respective functionality according to exemplary embodiments of the present invention can be added to a terminal by upgrading the operating system or the firmware of the terminal or installing additional software.

Figure 1 is a block diagram illustrating an apparatus according to exemplary embodiments of the present invention.

As shown in Figure 1, according to exemplary embodiments of the present invention, the apparatus is a terminal 10 comprising a first connection controller 11, a second connection controller 12 and a control module 13. The first connection controller 11 receives, using a first access network technology (i.e. the first connection controller connecting to the mobile communication network, e.g. LTE), first control information. The first control information is indicative of a requested operating state of a second access network technology useable for communication. Further, the second connection controller 12 communicates

using said second access network technology (i.e. the second connection controller connecting to the AP or point-to-point based network, e.g. WLAN). Further, the control module 13 controls said second connection controller 12 based on said first control information.

5 According to further exemplary embodiments of the present invention, the control module 13 further activates said second connection controller, if said first control information includes a request to activate said second access network technology. Further, the control module 13 deactivates said second connection controller, if said first control information includes a request to deactivate said second access network technology. In other words, if
10 the mobile operator (operator corresponding to the mobile communication network) sends a "WLANon" message to the UE which instructs the UE to switch on WLAN (UE in the vicinity of a WLAN AP), the WLAN module is switched on. On the other hand, if the mobile operator sends a "WLANoff" message to the UE which instructs the UE to switch off WLAN (UE leaves in the vicinity of a WLAN AP, or it is turned out that WLAN connection
15 cannot deliver the service properly), the WLAN module is switched off.

According to still further exemplary embodiments of the present invention, the control module further activates said second connection controller based on a user instruction. Subsequently the first connection controller 11 further transmits, using said first access
20 network technology, second control information, if a predetermined condition is satisfied. In doing so, the second control information is indicative of a spatial availability of a second access network technology based network for which access is allowed.

Namely, according to exemplary embodiments of the present invention, the "WLANon" and "WLANoff" messages are sent based on whether the UE is in the vicinity of a WLAN
25 AP. For that, e.g. a database is to be provided listing available and accessible WLAN APs linked with locations thereof. In order to fill such exemplary database, UEs have to report available and accessible WLAN APs which can then be stored in the exemplary database together with the location of the UE indicating the location of the AP.

In other words, once the subscriber switches WLAN on manually and a predetermined condition is satisfied, the UE informs the mobile operator via a "WLANavailable" message. The operator can store this information together with location information in the exemplary database.

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According to still further embodiments of the present invention, the predetermined condition is an exceeded predetermined value of data traffic communicated via said second access network technology based network.

10 For that, according to exemplary embodiments of the present invention, the second connection controller 12 further connects to said second access network technology based network, if access is allowed, and communicates via said second access network technology based network.

15 In other words, once the subscriber switches WLAN on manually, the device successfully connects to a WLAN access point, and exchanges significant traffic with the WLAN access point, the UE informs the mobile operator via the "WLANavailable" message.

Of course, such automatic database update requires at least one manual activation of the
20 WLAN module and a successful connection before the automatic activation for the certain AP can be carried out.

According to still further embodiments of the present invention, the predetermined condition is an exceeded predetermined value of a signal strength of said second access network technology based network, that is measured if access is allowed.
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In other words, on the control plane for example a new measurement report trigger (similar to A, B, 3A events) is defined. It is triggered, when a received signal from a WLAN AP is above a minimum level (a predetermined value) and the terminal (i.e. UE) is allowed to

access the WLAN AP. Such implementation also requires the WLAN module to be switched on manually (without data exchange being required). However, such proposed technique is able to accelerate filling the database with entries of available (and accessible) APs.

5

According to still further embodiments of the present invention, it is possible to wrap said first control information in a RRCConnectionReconfiguration message or any other message. In other words, as a control plane solution, the "WLANon" and "WLANoff" command can be send for example in the RRCConnectionReconfiguration message or in any other message.

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According to still further embodiments of the present invention, the first and/or second control information is transmitted on a user plane. Namely, the three messages defined above ("WLANon", "WLANoff" and "WLANavailable") might be implemented as user plane information. In this case, UEs can easily be upgraded by a firmware update, by an update of the operating system, or even by installing a client.

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As already stated above, it is to be noted that according to exemplary embodiments of the present invention, said first access network technology is a network based technology as for example LTE, LTE-A, UMTS and GSM technology. Further, the second access network technology is a (AP or) point-to-point connection based technology as for example WLAN and Bluetooth technology.

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It is further to be noted that according to exemplary embodiments of the present invention, the subscriber may explicitly allow such automatic activation and deactivation of WLAN (module). Currently, the subscriber has the option to switch WLAN on and off. With the invention implemented, the subscriber has a third option to allow automatic activation and deactivation. Consequently, the subscriber has still the possibility to switch WLAN on and off manually.

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The apparatus as shown in Figure 1 may be operable as or at a terminal, user equipment, mobile station or modem.

Figure 2 is a block diagram illustrating an apparatus according to exemplary embodiments
5 of the present invention.

As shown in Figure 2, according to exemplary embodiments of the present invention, the apparatus is a network node 20 comprising a control module 21 and a connection controller 22. The control module 21 determines, whether a network for which access is allowed
10 is spatially available to a recipient, based on a location of said recipient. The connection controller 22 transmits, using a first access network technology (i.e. the connection controller connecting to the mobile communication network, e.g. LTE), first control information. The first control information is indicative of a requested operating state of a second access network technology useable for communication (i.e. the AP or point-to-point
15 based network, e.g. WLAN), based on said determination. In doing so, the network is a second access network technology based network.

According to exemplary embodiments of the present invention, the first control information includes a request to activate said second access network technology, if said second access network technology based network is spatially available. Further, the first control information includes a request to deactivate said second access network technology, if said
20 second access network technology based network is not spatially available. In other words, the network node sends a "WLANon" message to the recipient (a UE) which instructs the UE to switch on WLAN, if the UE is in the vicinity of a WLAN AP. On the other hand, the network node sends a "WLANoff" message which instructs the recipient (UE) to
25 switch WLAN off, if the UE leaves vicinity of the WLAN AP, or if it turns out that WLAN cannot deliver the service properly.

According to further exemplary embodiments of the present invention, the control module
30 21 further matches the location of the recipient with a database. In doing so, the database comprises an entry linking said second access network technology based network with a

region. Further, the second access network technology based network is determined as being spatially available, if said location of said recipient matches said region (of coverage of the certain WLAN AP).

5 In other words, in order to do so control the UE to switch the WLAN module on or off, the mobile operator (i.e. the network node) needs to be aware of whether the UE is in the vicinity of an accessible WLAN AP. This information can be obtained by several methods. Preferably, a database linking the AP with the region of its coverage (any kind of location information) is used. By means of such database, the actual location of a UE can be
10 matched with the coverage (region) of the certain WLAN AP. More preferably, the WLAN APs contained in the database belong to the same mobile operator as the network node.

According to still further embodiments of the present invention, the connection controller 22 further receives, using said first access network technology, second control information. In doing so, the second control information is indicative of a spatial availability of
15 said second access network technology based network for which access is allowed. Further, the control module 21 stores said second access network technology based network linked with said location of said recipient in said database.

20 That is, if e.g. a UE recognizes a WLAN AP the UE is allowed to connect to, the UE sends information regarding the WLAN AP to the network node via e.g. a "WLANavailable" message. The operator, i.e. the network node, can store this information together with location information (indicative of the region of coverage of the WLAN AP) in a database (containing WLAN AP entries from the past). It is to be noted that the database mentioned above
25 (preferably containing the WLAN APs belonging to the same mobile operator as the network node) may be different from the database updated with the WLAN APs informed by the UE. Alternatively, both data bases could be the same.

The recognition of a WLAN AP the UE is allowed to connect to might be performed by,
30 switches on WLAN manually, connecting to the WLAN AP, and exchanging significant traffic (exceeding a predetermined value) with the WLAN AP. Alternatively, a newly de-

fined measurement report might be transmitted to the network node in case a signal strength of a WLAN AP the UE is allowed to connect to, measured by the UE is above a minimum level.

- 5 With respect to the database, it is to be noted that entries (of WLAN APs) therein may be removed if it is turned out that WLAN (provided by the WLAN APs) cannot deliver the service properly (e.g. if the UE regularly runs out of WLAN coverage and returns to LTE/UMTS).
- 10 According to still further embodiments of the present invention, the location and/or the region is defined by a cell identity of a cell used by said connection controller, an RF fingerprint, a global positioning system (GPS) position information, and/or a tracking area.

In other words, the location information could be one of the following:

- 15 - Cell ID: The ID of the cell currently used by the UE for communication in the first access network technology based network, i.e. the mobile communication network (e.g. LTE). This location information may be accurate enough, since a "false alarm" would only mean that WLAN is switched on unnecessarily.
- 20 - "RF fingerprint" methods: If more accuracy is needed, the cell ID can be combined with "RF fingerprint" methods, i.e. a combination of radio measurements (such as signal strength (reference signal received power (RSRP)), signal quality (reference signal received quality (RSRQ)) is added. "RF fingerprint" is a method for determining the position of a UE (e.g. in the absence of GPS). The RF fingerprint is the combination of measurements (signal strength and/or quality) from different cells,
- 25 measured at a certain location. From those combined measurements (the RF fingerprint) the certain location can be determined. For example, if a terminal measures (and reports) only a single cell with high signal strength, then it may be determined that the terminal is close to the single cell, and away from any other cell boundary. Further, if a terminal measures (and reports) two cells with a similar
- 30 strength, then it may be determined that the terminal is probably in the middle between those two cells. Furthermore, if a terminal measures (and reports) several cells with a certain relation, a location of the terminal may be determined by look-

ing into a RF fingerprint database and matching the combination of the measured signal strengths of the several cells with available entries in the RF fingerprint database. In the latter case, it would be advantageous if a GPS-capable terminal beforehand reported from a very similar location the same combination (= RF fingerprint) along with GPS coordinates.

- GPS information: global positioning system (GPS) position information (of the UE) may be used, although problems may arise since the above mentioned scenarios are likely indoor, where GPS is likely unavailable.
- Tracking area (including one or more cells): From this location information the advantage arises that even idle users can be reached. All methods based on the previous location information require that the UE is in connected mode (connected with the mobile communication network, which may or may not be early enough). To the contrary, when an idling UE enters a new tracking area, it becomes active for a short moment, and WLAN could be activated (i.e. the "WLANon" message could be transmitted), if a WLAN AP is associated with the tracking area. The disadvantage resulting from this implementation is that the location information is rather coarse, such that WLAN module might be activated unnecessarily more often.

In doing so, any combination of the previous mentioned location information may be used according to exemplary embodiments. Namely, for all UEs in connected mode (connected with the mobile communication network) cell ID/RF fingerprint/GPS may be used, whereas for UEs in idle mode (connection release), when UEs send a tracking area update, tracking area may be used as the location information.

The skilled person is aware that any further information suitable to render a location of the UE/WLAN AP may be used as the location information.

According to still further embodiments of the present invention, the first control information is wrapped in a RRCConnectionReconfiguration message (or any other message) as a control plane solution.

According to still further embodiments of the present invention, the first and/or second control information is transmitted on a user plane. Namely, the three messages “WLANon”, “WLANoff” and “WLANavailable” may be implemented as user plane information, such that UEs can easily be upgrade by a firmware update, by an update of the operating system or by installing a client.

As already stated above, it is to be noted that according to exemplary embodiments of the present invention, said first access network technology is a network based technology as for example LTE, LTE-A, UMTS and GSM technology. Further, the second access network technology is a (AP or) point-to-point connection based technology as for example WLAN and Bluetooth technology.

It is to be noted that the functionality as described above in connection with one network node may alternatively be implemented by more than one network nodes.

In particular, in case of LTE the whole functionality may be implemented in the evolved NodeB (eNB). However, involvement of the mobility management entity (MME) may be also needed for security reason. The functionality may then be split as outlined below.

The information about WLAN availability and location received from the terminal is provided/forwarded by the eNB to the MME (e.g. in the S1 interface message “UE CAPABILITY INFO INDICATION” or in any other existing or new S1 interface message). In such implementation the above mentioned database is available at the MME.

Further, when the UE returns into a cell with a WLAN AP it is allowed to connect, the MME receives e.g. the S1 interface message “INITIAL UE MESSAGE” (or any other existing or new S1 message), and if the MME recognizes that there is a WLAN AP the UE is allowed to connect in the coverage area of the eNB, the MME includes the “WLANon” command and the location information in the S1 interface message “INITIAL CONTEXT SETUP” towards the eNB.

In case of UMTS/GSM, the functionality may be split to and implemented in the radio network controller (RNC) and in the serving general packet radio service support node (SGSN).

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The apparatus as shown in Figure 2 may be operable as or at a base station, access node or network node of a cellular system.

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Figure 3 is a schematic diagram of a procedure according to exemplary embodiments of the present invention.

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As shown in Figure 3, a procedure according to exemplary embodiments of the present invention comprises an operation of receiving, using a first access network technology, first control information, said first control information being indicative of a requested operating state of a second access network technology useable for communication, and an operation of controlling said operating state of said second access network technology based on said first control information.

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According to a variation of the procedure shown in Figure 3, exemplary details of the controlling operation are given, which are inherently independent from each other as such.

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Such exemplary controlling operation according to exemplary embodiments of the present invention may comprise an operation of activating said second access network technology, if said first control information includes a request to activate said second access network technology, and an operation of deactivating said second access network technology, if said first control information includes a request to deactivate said second access network technology.

According to a variation of the procedure shown in Figure 3, exemplary additional operations are given, which are inherently independent from each other as such. According to such variation, an exemplary method according to exemplary embodiments of the present invention may comprise an operation of activating said second access network technology
5 based on a user instruction, and an operation of transmitting, using said first access network technology, second control information, if a predetermined condition is satisfied. In doing so, the second control information is indicative of a spatial availability of a second access network technology based network for which access is allowed.

10 According to further exemplary embodiments of the present invention, the predetermined condition is an exceeded predetermined value of data traffic communicated via said second access network technology based network.

According to a variation of the procedure shown in Figure 3, exemplary additional operations are given, which are inherently independent from each other as such. According to such variation, an exemplary method according to exemplary embodiments of the present invention may comprise an operation of connecting to said second access network technology based network, if access is allowed, and an operation of communicating via said
15 second access network technology based network.

20

According to further exemplary embodiments of the present invention, the predetermined condition is an exceeded predetermined value of a signal strength of said second access network technology based network measured if access is allowed.

25 According to further exemplary embodiments of the present invention, the first control information is wrapped in a RRCConnectionReconfiguration message.

According to further exemplary embodiments of the present invention, the first and/or second control information is transmitted on a user plane.

30

The procedure as shown in Figure 3 may be operable at or by a terminal, user equipment, mobile station or modem.

5 Figure 4 is a schematic diagram of a procedure according to exemplary embodiments of the present invention.

As shown in Figure 4, a procedure according to exemplary embodiments of the present invention comprises an operation of determining, whether a network for which access is allowed is spatially available to a recipient, based on a location of said recipient, and an
10 operation of transmitting, using a first access network technology, first control information, said first control information being indicative of a requested operating state of a second access network technology useable for communication, based on said determining. When doing so, the network is a second access network technology based network.

15 According to further exemplary embodiments of the present invention, the first control information includes a request to activate said second access network technology, if said second access network technology based network is spatially available, and the first control information includes a request to deactivate said second access network technology, if said second access network technology based network is not spatially available.

20

According to a variation of the procedure shown in Figure 4, exemplary details of the determining operation are given, which are inherently independent from each other as such.

Such exemplary determining operation according to exemplary embodiments of the present invention may comprise an operation of matching the location of said recipient with a
25 database. When doing so, the database comprises an entry linking said second access network technology based network with a region. Further, the second access network technology based network is determined as being spatially available, if said location of said recipient matches said region.

30

According to a variation of the procedure shown in Figure 4, exemplary additional operations are given, which are inherently independent from each other as such. According to such variation, an exemplary method according to exemplary embodiments of the present invention may comprise an operation of receiving, using said first access network technology, a second control information, said second control information being indicative of a spatial availability of said second access network technology based network for which access is allowed, and an operation of storing said second access network technology based network linked with said location of said recipient in said database.

According to further exemplary embodiments of the present invention, the location and/or the region is defined by a cell identity of a cell used for transmitting using said first access network technology, an RF fingerprint, a GPS position information, and/or a tracking area.

According to further exemplary embodiments of the present invention, the first control information is wrapped in a RRCConnectionReconfiguration message.

According to further exemplary embodiments of the present invention, the first and/or second control information is transmitted on a user plane.

The procedure as shown in Figure 4 may be operable at or by a base station, access node or network node of a cellular system.

The above-described procedures and functions may be implemented by respective functional elements, processors, or the like, as described below.

In the foregoing exemplary description of the network entity, only the units that are relevant for understanding the principles of the invention have been described using functional blocks. The network entity may comprise further units that are necessary for its respective operation. However, a description of these units is omitted in this specification. The ar-

rangement of the functional blocks of the devices is not construed to limit the invention, and the functions may be performed by one block or further split into sub-blocks.

5 When in the foregoing description it is stated that the apparatus, i.e. network entity (or some other means) is configured to perform some function, this is to be construed to be equivalent to a description stating that a (i.e. at least one) processor or corresponding circuitry, potentially in cooperation with computer program code stored in the memory of the respective apparatus, is configured to cause the apparatus to perform at least the thus mentioned function. Also, such function is to be construed to be equivalently implementa-
10 ble by specifically configured circuitry or means for performing the respective function (i.e. the expression "unit configured to" is construed to be equivalent to an expression such as "means for").

15 In Figure 5, an alternative illustration of apparatuses according to exemplary embodiments of the present invention is depicted. As indicated in Figure 5, according to exemplary embodiments of the present invention, the apparatus (terminal) 10' (corresponding to the terminal 10) comprises a processor 51, a memory 52 and an interface 53, which are connected by a bus 54 or the like. Further, according to exemplary embodiments of the present invention, the apparatus (network node) 20' (corresponding to the network node 20)
20 comprises a processor 55, a memory 56 and an interface 57, which are connected by a bus 58 or the like, and the apparatuses may be connected via link 59, respectively.

The processor 51/55 and/or the interface 53/57 may also include a modem or the like to facilitate communication over a (hardwire or wireless) link 59, respectively. The interface
25 53/57 may include a suitable transceiver coupled to one or more antennas or communication means for (hardwire or wireless) communications with the linked or connected device(s), respectively. The interface 53/57 is generally configured to communicate with at least one other apparatus, i.e. the interface thereof.

30 The memory 52/56 may store respective programs assumed to include program instructions or computer program code that, when executed by the respective processor, enables

the respective electronic device or apparatus to operate in accordance with the exemplary embodiments of the present invention.

5 In general terms, the respective devices/apparatuses (and/or parts thereof) may represent means for performing respective operations and/or exhibiting respective functionalities, and/or the respective devices (and/or parts thereof) may have functions for performing respective operations and/or exhibiting respective functionalities.

10 When in the subsequent description it is stated that the processor (or some other means) is configured to perform some function, this is to be construed to be equivalent to a description stating that at least one processor, potentially in cooperation with computer program code stored in the memory of the respective apparatus, is configured to cause the apparatus to perform at least the thus mentioned function. Also, such function is to be construed to be equivalently implementable by specifically configured means for performing the respective function (i.e. the expression "processor configured to [cause the apparatus to] perform xxx-ing" is construed to be equivalent to an expression such as "means for xxx-ing").

20 According to exemplary embodiments of the present invention, an apparatus representing the terminal 10 comprises at least one processor 51, at least one memory 52 including computer program code, and at least one interface 53 configured for communication with at least another apparatus. The processor (i.e. the at least one processor 51, with the at least one memory 52 and the computer program code) is configured to perform receiving, using a first access network technology, first control information, said first control information being indicative of a requested operating state of a second access network technology useable for communication (thus the apparatus comprising corresponding means for receiving), and to perform controlling said operating state of said second access network technology based on said first control information (thus the apparatus comprising corresponding means for controlling).

30

According to exemplary embodiments of the present invention, an apparatus representing the network node 20 comprises at least one processor 55, at least one memory 56 includ-

ing computer program code, and at least one interface 57 configured for communication with at least another apparatus. The processor (i.e. the at least one processor 55, with the at least one memory 56 and the computer program code) is configured to perform determining, whether a network for which access is allowed is spatially available to a recipient, based on a location of said recipient (thus the apparatus comprising corresponding means for determining), and to perform transmitting, using a first access network technology, first control information, said first control information being indicative of a requested operating state of a second access network technology useable for communication, based on said determining (thus the apparatus comprising corresponding means for transmitting). When doing so, the network is a second access network technology based network.

For further details regarding the operability/functionality of the individual apparatuses, reference is made to the above description in connection with any one of Figures 1 to 4, respectively.

15

For the purpose of the present invention as described herein above, it should be noted that

- method steps likely to be implemented as software code portions and being run using a processor at a network server or network entity (as examples of devices, apparatuses and/or modules thereof, or as examples of entities including apparatuses and/or modules therefore), are software code independent and can be specified using any known or future developed programming language as long as the functionality defined by the method steps is preserved;

- generally, any method step is suitable to be implemented as software or by hardware without changing the idea of the embodiments and its modification in terms of the functionality implemented;

- method steps and/or devices, units or means likely to be implemented as hardware components at the above-defined apparatuses, or any module(s) thereof, (e.g., devices carrying out the functions of the apparatuses according to the embodiments as described above) are hardware independent and can be implemented using any known or future developed hardware technology or any hybrids of these, such as MOS (Metal Oxide Semiconductor), CMOS (Complementary MOS), BiMOS (Bipolar MOS), BiCMOS (Bipolar

CMOS), ECL (Emitter Coupled Logic), TTL (Transistor-Transistor Logic), etc., using for example ASIC (Application Specific IC (Integrated Circuit)) components, FPGA (Field-programmable Gate Arrays) components, CPLD (Complex Programmable Logic Device) components or DSP (Digital Signal Processor) components;

- 5 - devices, units or means (e.g. the above-defined network entity or network register, or any one of their respective units/means) can be implemented as individual devices, units or means, but this does not exclude that they are implemented in a distributed fashion throughout the system, as long as the functionality of the device, unit or means is preserved;
- 10 - an apparatus like the user equipment and the network entity /network register may be represented by a semiconductor chip, a chipset, or a (hardware) module comprising such chip or chipset; this, however, does not exclude the possibility that a functionality of an apparatus or module, instead of being hardware implemented, be implemented as software in a (software) module such as a computer program or a computer program product
- 15 comprising executable software code portions for execution/being run on a processor;
- a device may be regarded as an apparatus or as an assembly of more than one apparatus, whether functionally in cooperation with each other or functionally independently of each other but in a same device housing, for example.
- 20 In general, it is to be noted that respective functional blocks or elements according to above-described aspects can be implemented by any known means, either in hardware and/or software, respectively, if it is only adapted to perform the described functions of the respective parts. The mentioned method steps can be realized in individual functional blocks or by individual devices, or one or more of the method steps can be realized in a
- 25 single functional block or by a single device.

Generally, any method step is suitable to be implemented as software or by hardware without changing the idea of the present invention. Devices and means can be implemented as individual devices, but this does not exclude that they are implemented in a

30 distributed fashion throughout the system, as long as the functionality of the device is preserved. Such and similar principles are to be considered as known to a skilled person.

Software in the sense of the present description comprises software code as such comprising code means or portions or a computer program or a computer program product for performing the respective functions, as well as software (or a computer program or a computer program product) embodied on a tangible medium such as a computer-readable (storage) medium having stored thereon a respective data structure or code means/portions or embodied in a signal or in a chip, potentially during processing thereof.

The present invention also covers any conceivable combination of method steps and operations described above, and any conceivable combination of nodes, apparatuses, modules or elements described above, as long as the above-described concepts of methodology and structural arrangement are applicable.

In view of the above, there are provided measures for mobile communication network assisted control of WLAN connectivity. Such measures exemplarily comprise receiving, using a first access network technology, first control information, said first control information being indicative of a requested operating state of a second access network technology useable for communication, and controlling said operating state of said second access network technology based on said first control information.

20

Even though the invention is described above with reference to the examples according to the accompanying drawings, it is to be understood that the invention is not restricted thereto. Rather, it is apparent to those skilled in the art that the present invention can be modified in many ways without departing from the scope of the inventive idea as disclosed herein.

25

List of acronyms and abbreviations

	3G	3 rd generation of mobile telecommunications technology
	3GPP	3 rd Generation Partnership Project
5	ANDSF	access network discovery and selection function
	AP	access point
	eNB	evolved NodeB
	GPS	global positioning system
	GSM	Global System for Mobile Communications
10	IEEE	Institute of Electrical and Electronics Engineers
	LTE	Long Term Evolution
	LTE-A	Long Term Evolution Advanced
	MME	mobility management entity
	RNC	radio network controller
15	RSRP	reference signal received power
	RSRQ	reference signal received quality
	SGSN	serving general packet radio service support node
	UE	user equipment
	UMTS	Universal Mobile Telecommunications System
20	WLAN	wireless local area network

Claims

1. A method for communication in a mobile network, comprising
- receiving, using a first access network technology, first control information, said
5 first control information being indicative of a requested operating state of a second access
network technology useable for communication; and
- controlling said operating state of said second access network technology based
on said first control information.
- 10 2. The method according to claim 1, wherein, in connection with said controlling said op-
erating state, the method further comprises
- activating said second access network technology, if said first control information
includes a request to activate said second access network technology; and
- deactivating said second access network technology, if said first control infor-
15 mation includes a request to deactivate said second access network technology.
3. The method according to claim 1 or 2, further comprising
- activating said second access network technology based on a user instruction; and
- transmitting, using said first access network technology, a second control infor-
20 mation, if a predetermined condition is satisfied;
- wherein
- said second control information is indicative of a spatial availability of a second
access network technology based network for which access is allowed.
- 25 4. The method according to claim 3, wherein

said predetermined condition is an exceeded predetermined value of data traffic communicated via said second access network technology based network.

5. The method according to claim 4, further comprising

5 connecting to said second access network technology based network, if access is allowed; and

communicating via said second access network technology based network.

6. The method according to claim 3, wherein

10 said predetermined condition is an exceeded predetermined value of a signal strength of said second access network technology based network measured if access is allowed.

7. The method according to any of claims 1 to 6, wherein

15 said first and/or second control information is transmitted on a user plane.

8. The method according to any of claims 1 to 7, wherein

 said first control information is wrapped in a RRCConnectionReconfiguration message.

20

9. The method according to any of claims 1 to 8, wherein

 said first access network technology is a network based technology as for example LTE, LTE-A, UMTS and GSM technology; and/or

25 said second access network technology is a point-to-point connection based technology as for example WLAN and Bluetooth technology.

10. A method for communication in a mobile network, comprising

determining, whether a network for which access is allowed is spatially available to a recipient, based on a location of said recipient; and

transmitting, using a first access network technology, first control information, said
5 first control information being indicative of a requested operating state of a second access network technology useable for communication, based on said determining;

wherein said network is a second access network technology based network.

11. The method according to claim 10, wherein

10 said first control information includes a request to activate said second access network technology, if said second access network technology based network is spatially available; and

said first control information includes a request to deactivate said second access network technology, if said second access network technology based network is not spa-
15 tially available.

12. The method according to claim 10 or 11, wherein, in connection with said determining, said method further comprises

matching the location of said recipient with a database;

20 wherein said database comprises an entry linking said second access network technology based network with a region;

wherein said second access network technology based network is spatially available, if said location of said recipient matches said region.

25 13. The method according to claim 12, further comprising

receiving, using said first access network technology, a second control information, said second control information being indicative of a spatial availability of said second access network technology based network for which access is allowed; and

5 storing said second access network technology based network linked with said location of said recipient in said database.

14. The method according to claim 12 or 13, wherein

said location and/or said region is defined by

10 a cell identity of a cell used for transmitting using said first access network technology; and/or

an RF fingerprint, and/or

a GPS position information; and/or

a tracking area.

15 15. The method according to any of claims 10 to 14, wherein

said first and/or second control information is transmitted on a user plane.

16. The method according to any of claims 10 to 15, wherein

20 said first control information is wrapped in a RRCConnectionReconfiguration message.

17. The method according to any of claims 10 to 16, wherein

said first access network technology is a network based technology as for example LTE, LTE-A, UMTS and GSM technology; and/or

25 said second access network technology is a point-to-point connection based technology as for example WLAN and Bluetooth technology.

18. An apparatus for communication in a mobile network as or at a user equipment, comprising

5 a first connection controller configured to receive, using a first access network technology, first control information, said first control information being indicative of a requested operating state of a second access network technology useable for communication;

a second connection controller configured to communicate using said second access network technology; and

10 a control module configured to control said second connection controller based on said first control information.

19. The apparatus according to claim 18, wherein

said control module is further configured to

15 activate said second connection controller, if said first control information includes a request to activate said second access network technology; and to

deactivate said second connection controller, if said first control information includes a request to deactivate said second access network technology.

20 20. The apparatus according to claim 18 or 19, wherein

said control module is further configured to activate said second connection controller based on a user instruction; and

25 said first connection controller is further configured to transmit, using said first access network technology, a second control information, if a predetermined condition is satisfied;

wherein

said second control information is indicative of a spatial availability of a second access network technology based network for which access is allowed.

21. The apparatus according to claim 20, wherein

5 said predetermined condition is an exceeded predetermined value of data traffic communicated via said second access network technology based network.

22. The apparatus according to claim 21, wherein

 said second connection controller is further configured to
10 connect to said second access network technology based network, if access is allowed; and to
 communicate via said second access network technology based network.

23. The apparatus according to claim 20, wherein

15 said predetermined condition is an exceeded predetermined value of a signal strength of said second access network technology based network measured if access is allowed.

24. The apparatus according to any of claims 18 to 23, wherein

20 said first and/or second control information is transmitted on a user plane.

25. The apparatus according to any of claims 18 to 24, wherein

 said first control information is wrapped in a RRCConnectionReconfiguration message.

25

26. The apparatus according to any of claims 18 to 25, wherein

said first access network technology is a network based technology as for example LTE, LTE-A, UMTS and GSM technology; and/or

5 said second access network technology is a point-to-point connection based technology as for example WLAN and Bluetooth technology.

27. An apparatus for communication in a mobile network as or at a network node, comprising

10 a control module configured to determine, whether a network for which access is allowed is spatially available to a recipient, based on a location of said recipient; and

 a connection controller configured to transmit, using a first access network technology, first control information, said first control information being indicative of a requested operating state of a second access network technology useable for communication, based on said determination;

15 wherein said network is a second access network technology based network.

28. The apparatus according to claim 27, wherein

20 said first control information includes a request to activate said second access network technology, if said second access network technology based network is spatially available; and

 said first control information includes a request to deactivate said second access network technology, if said second access network technology based network is not spatially available.

25 29. The apparatus according to claim 27 or 28, wherein

 said control module is further configured to match the location of said recipient with a database;

wherein said database comprises an entry linking said second access network technology based network with a region; and

wherein said second access network technology based network is spatially available, if said location of said recipient matches said region.

5

30. The apparatus according to claim 29, wherein

said connection controller is further configured to receive, using said first access network technology, a second control information, said second control information being indicative of a spatial availability of said second access network technology based network for which access is allowed; and

10

said control module is further configured to store said second access network technology based network linked with said location of said recipient in said database.

31. The apparatus according to claim 29 or 30, wherein

15

said location and/or said region is defined by

a cell identity of a cell used by said connection controller; and/or

an RF fingerprint; and/or

a GPS position information; and/or

a tracking area.

20

32. The apparatus according to any of claims 27 to 31, wherein

said first and/or second control information is transmitted on a user plane.

33. The apparatus according to any of claims 27 to 32, wherein

25

said first control information is wrapped in a RRCConnectionReconfiguration message.

34. The apparatus according to any of claims 27 to 33, wherein

said first access network technology is a network based technology as for example LTE, LTE-A, UMTS and GSM technology; and/or

5 said second access network technology is a point-to-point connection based technology as for example WLAN and Bluetooth technology.

35. A computer program product comprising computer-executable computer program code which, when the program is run on a computer, is configured to cause the computer
10 to carry out the method according to any one of claims 1 to 9 or 10 to 17.

36. The computer program product according to claim 35, wherein the computer program product comprises a computer-readable medium on which the computer-executable computer program code is stored, and/or wherein the program is directly loadable into an internal memory of the processor.
15

1/5

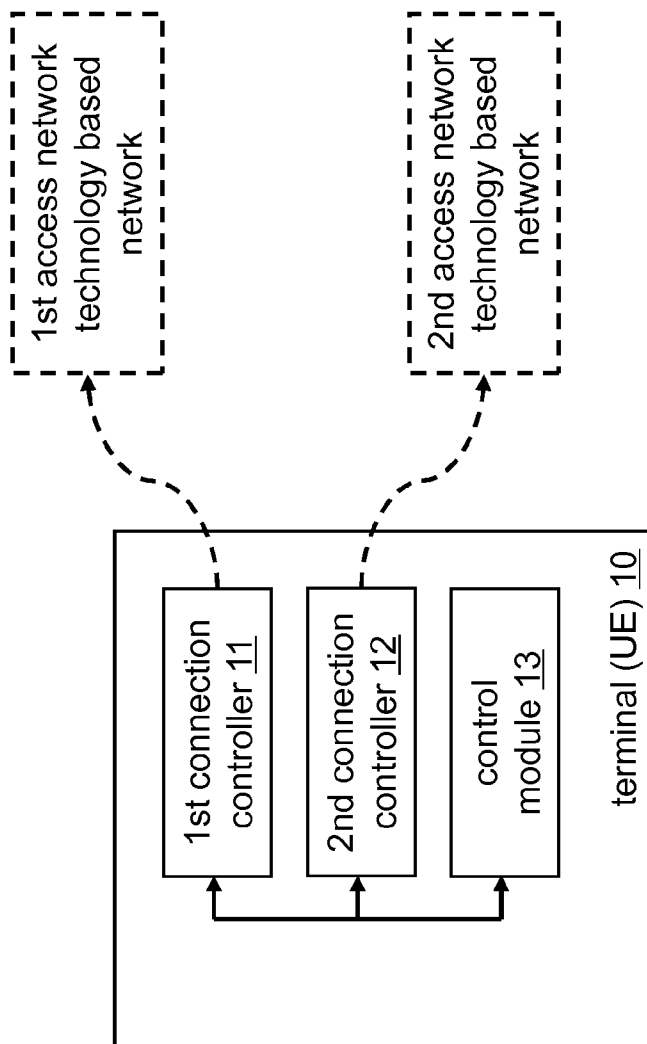


Figure 1

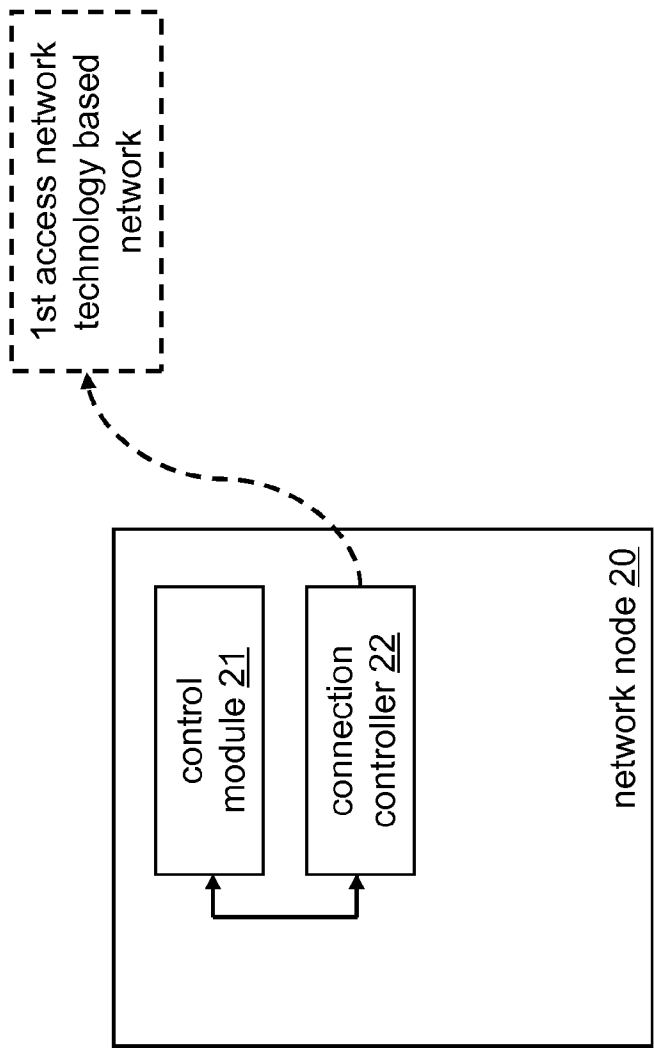


Figure 2

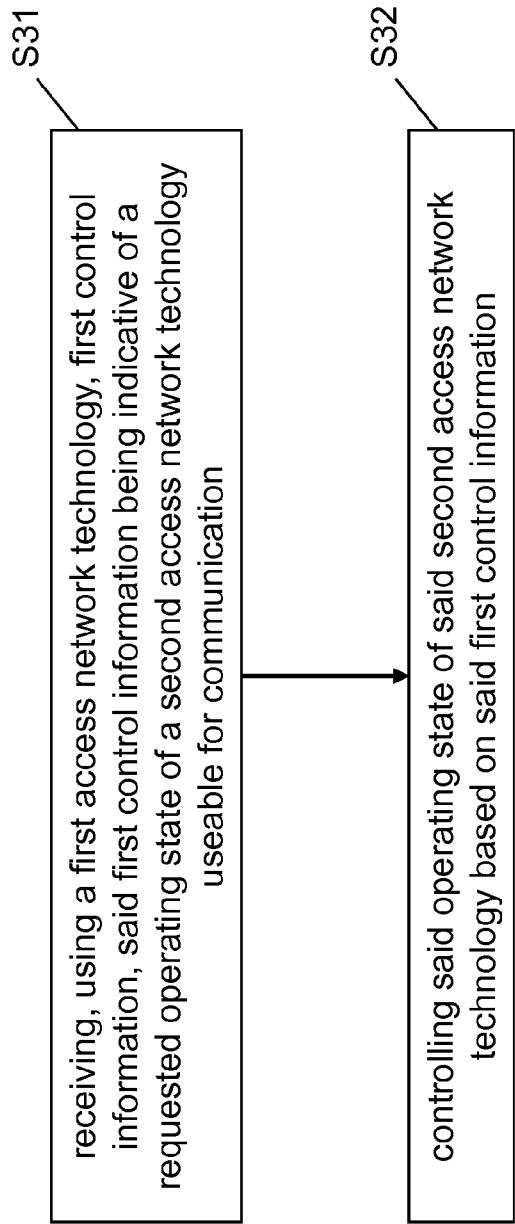


Figure 3

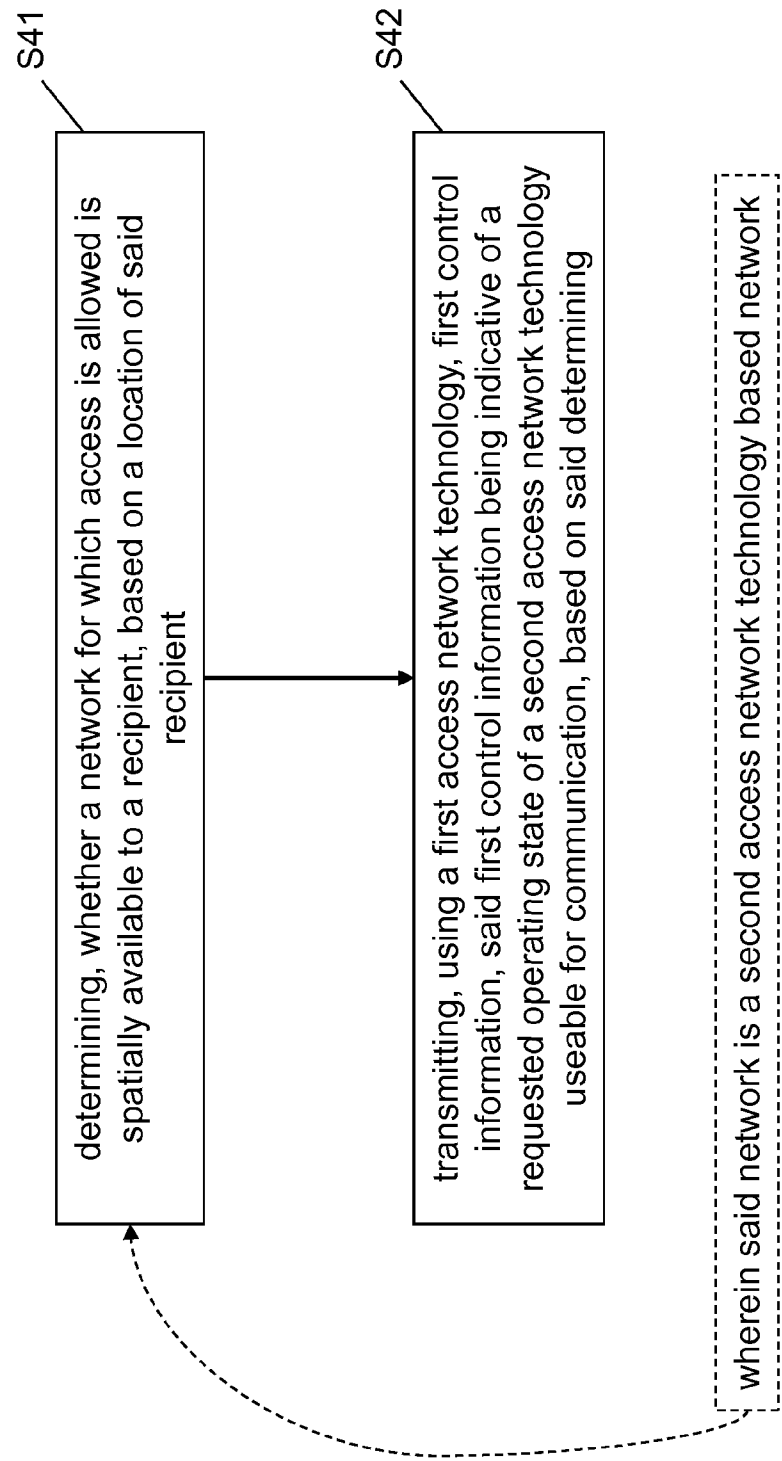


Figure 4

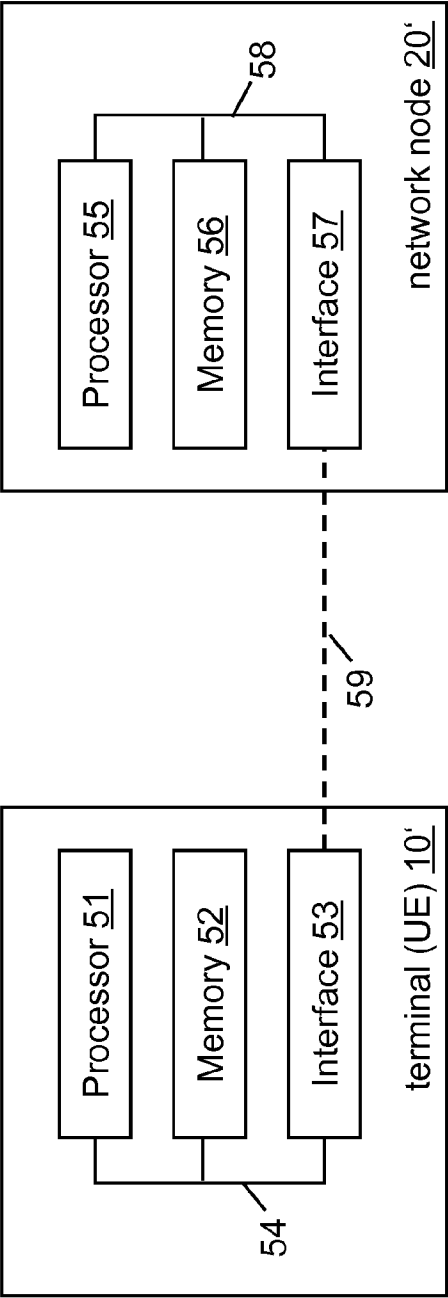


Figure 5

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2012/066859

A. CLASSIFICATION OF SUBJECT MATTER

INV. H04W52/02

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	US 2009/258649 A1 (SALOWEY JOSEPH [US]) 15 October 2009 (2009-10-15)	1,2,4,5, 7-36
Y	paragraph [0020] - paragraph [0023] paragraph [0004] paragraph [0030]	3,6,20, 23
Y	----- US 2004/033805 A1 (VERMA SHAILY [US] ET AL) 19 February 2004 (2004-02-19) paragraph [0020] -----	3,6,20, 23



Further documents are listed in the continuation of Box C.



See patent family annex.

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

11 June 2013

Date of mailing of the international search report

18/06/2013

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

Authorized officer

Emander, Andreas

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2012/066859

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