



(51) International Patent Classification:

H04W 8/18 (2009.01) H04W 88/06 (2009.01)
H04W 48/18 (2009.01)

(21) International Application Number:

PCT/EP2011/056341

(22) International Filing Date:

20 April 2011 (20.04.2011)

(25) Filing Language:

English

(26) Publication Language:

English

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

(72) Inventors; and

(75) Inventors/Applicants (for US only): **FORSSELL, Mika** [FI/FI]; Palokärjentie 11, FI-01150 Söderkulla (FI). **TEIT-TINEN, Veli-Matti** [FI/FI]; Tuijatie 2 J 57, FI-02880 Veikkola (FI).

(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, BR, BW, 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, IS, JP, KE, KG, KM, 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, PE, PG, PH, PL, PT, RO, RS, RU, 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, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, 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, ML, MR, NE, SN, TD, TG).

[Continued on next page]

(54) Title: AREA-SPECIFIC PLMN SELECTION IN MOBILE COMMUNICATIONS NETWORKS

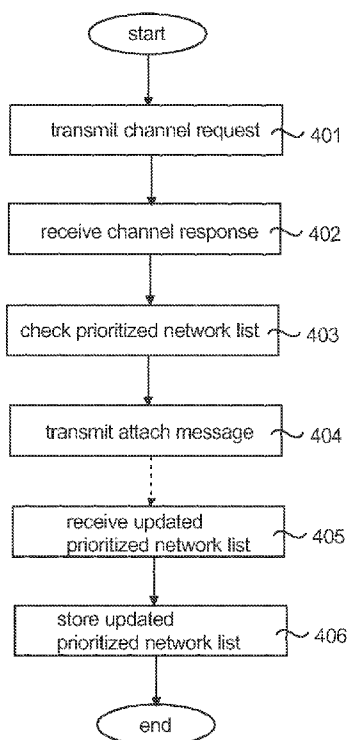


Fig. 4

(57) Abstract: PLMN selection in communications An aspect of the invention relates to a method comprising maintaining, for a user terminal, a prioritized visited network list, the list comprising information on a visited network operator, and radio access technology to be prioritized for the user terminal in a specific area; in response to recognising a predetermined event (402) related to the user terminal, checking (403), based on the prioritized visited network list maintained for the user terminal, whether a visited network operator and a radio access technology is to be prioritized for the user terminal in the area where the user terminal is currently located; wherein, if a visited network operator and a radio access technology is prioritized for the user terminal in the area where the user terminal is currently located, the method comprises causing the user terminal to select (404) the visited network operator and the radio access technology prioritized for the user terminal in said area.

WO 2012/143049 A1



Published:

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

DESCRIPTION

TITLE

5 **AREA- SPECIFIC PLMN SELECTION IN MOBILE COMMUNICATIONS NETWORKS**

FIELD OF THE INVENTION

10 The exemplary and non-limiting embodiments of this invention relate generally wireless communications networks, and more particularly to network selection.

BACKGROUND ART

15 The following description of background art may include insights, discoveries, understandings or disclosures, or associations together with disclosures not known to the relevant art prior to the present invention but provided by the invention. Some such contributions of the invention may be specifically pointed out below, whereas other such contributions of the invention will be apparent from their context.

20 Roaming refers to an ability of a subscriber's mobile device to access a network of another mobile operator. The subscriber's mobile device is able to make and receive calls outside its home network's coverage area, based on a roaming agreement between the operators. Higher charging rates may be
25 applied when the subscriber is roaming.

SUMMARY

30 The following presents a simplified summary of the invention in order to provide a basic understanding of some aspects of the invention. This summary is not an extensive overview of the invention. It is not intended to identify key/critical elements of the invention or to delineate the scope of the invention. Its sole purpose is to present some concepts of the invention in a simplified form as a prelude to the more detailed description that is presented later.

Various aspects of the invention comprise a method, apparatuses, and a computer-readable storage medium as defined in the independent claims. Further embodiments of the invention are disclosed in the dependent claims.

5 An aspect of the invention relates to a method comprising maintaining, for a user terminal, a prioritized visited network list, the list comprising information on a visited network operator, and radio access technology to be prioritized for the user terminal in a specific area; in response to recognising a predetermined event related to the user terminal,
10 checking, based on the prioritized visited network list maintained for the user terminal, whether a visited network operator and a radio access technology is to be prioritized for the user terminal in the area where the user terminal is currently located; wherein, if a visited network operator and a
15 radio access technology is prioritized for the user terminal in the area where the user terminal is currently located, the method comprises causing the user terminal to select the visited network operator and the radio access technology prioritized for the user terminal in said area.

A further aspect of the invention relates to a user terminal configured to maintain a prioritized visited network list, the list comprising information on a visited network operator, and radio access technology to be prioritized for the
25 user terminal in a specific area; in response to recognising a predetermined event, check, based on the prioritized visited network list, whether a visited network operator and a radio access technology is to be prioritized in the area where the user terminal is currently located; wherein, if a
30 visited network operator and a radio access technology is to be prioritized in the area where the user terminal is currently located, the user terminal is configured to select the visited network operator and the radio access technology prioritized in said area.

35 A still further aspect of the invention relates to an apparatus configured to provide, to a user terminal, a prioritized visited network list, the list comprising information on a visited network operator, and radio access technology priori-

tized for the user terminal in a specific area, so that, if a visited network operator and a radio access technology is prioritized for the user terminal in the area where the user terminal is currently located, the user terminal selects the visited network operator and the radio access technology prioritized for the user terminal in said area.

A still further aspect of the invention relates to a computer-readable storage medium embodying a program of instructions executable by a processor to perform actions directed toward maintaining, for a user terminal, a prioritized visited network list, the list comprising information on a visited network operator, and radio access technology to be prioritized for the user terminal in a specific area; in response to recognising a predetermined event related to the user terminal, checking, based on the prioritized visited network list maintained for the user terminal, whether a visited network operator and a radio access technology is to be prioritized for the user terminal in the area where the user terminal is currently located; wherein, if a visited network operator and a radio access technology is prioritized for the user terminal in the area where the user terminal is currently located, causing the user terminal to select the visited network operator and the radio access technology prioritized for the user terminal in said area.

BRIEF DESCRIPTION OF THE DRAWINGS

In the following the invention will be described in greater detail by means of exemplary embodiments with reference to the attached drawings, in which

Figure 1 shows a simplified block diagram illustrating exemplary system architecture;

Figure 2 shows a simplified block diagram illustrating exemplary apparatuses;

Figure 3 shows a messaging diagram illustrating an exemplary messaging event according to an exemplary embodiment;

Figure 4 shows a schematic diagram of a flow chart according to an exemplary embodiment.

DETAILED DESCRIPTION OF SOME EMBODIMENTS

Cellular (GSM/3G) devices have (U)SIM cards. Currently, a network operator is able to affect on roaming device VPLMN selection by using a SIM-based roaming management solution.

5 The network operator is able to use, for example, short messages to transfer VPLMN priority list to the roaming device. Upon receiving such a list, the SIM card stores the VPLMN priority list into the SIM card and, based on the list on the SIM card, the roaming device selects VPLMN networks being
10 available.

The VPLMN selection may be affected by the network operator by using a EFOPLMNwACT (operator controlled PLMN selector with access technology) file on the SIM card. 3GPP standards define the content of the EFOPLMNwACT file in the case of
15 USIM/SIM.

A remote file management (RFM) applet has been specified in the USIM application. There exists one RFM applet for a SIM file system, one for a UICC shared file system, and one for ADF (USIM) files. RFM allows an OTA server to send commands
20 to the USIM via short message service (SMS) and receive responses via SMS RP-ACK or RP-ERROR packet data units (PDU). RFM manages the content of the EFOPLMNwACT file.

Network operators may have special geographical areas where one partner network operator network (VPLMN) is to be used, and where, when outside of the area, another VPLMN is to be
25 selected. As an example, the home network operator may want that a roaming subscriber selects VPLMN1 when roaming at Heathrow airport, whereas the home network operator may want the subscriber to select VPLMN2 when roaming in other areas
30 of UK.

Currently SIM-based roaming management mechanisms provide means to affect on device VPLMN selection in general. The current mechanisms do not, however, provide a solution to address the above example, where the home network operator has
35 geographical-area-specific requirements for VPLMN selection. Thus roaming is not optimized, and it costs more for the operator and the subscriber than it needs to cost.

If a generic VPLMN selection list is provided for the user device, the network operator is not able to affect on the VPLMN selection on areas smaller than the area where VPLMN is visible. If the end user manually selects the VPLMN networks, the end user typically does not reselect VPLMN after having attached to a VPLMN network. What's more, the end user has no knowledge on operator-location-area-specific low cost deals. Current VPLMN priority lists merely include basic lists of VPLMN networks (MCC/MNC, mobile country code, mobile network code) in a prioritized order telling the device which VPLMN is to be selected.

In an exemplary embodiment, location-area-specific information is attached, for a roaming device, to a VPLMN priority list affecting on the device's VPLMN selection when the home operator has location area specific PLMN selection preferences. A SIM applet (or a device application in general) is provided, having the ability to monitor location areas the device is visiting and to modify VPLMN priority lists according to needs, in order to ensure that the device operating according to 3GPP standards uses the most preferred available VPLMN network. (A device operating according to current 3GPP standards is not able to consider location area as part of VPLMN selection priorities; the SIM applet/generic device application ensures support from all cellular devices).

In an exemplary embodiment, the basic priority list is enhanced with location-area-specific data to provide a location-area-specific VPLMN priority list. A location area defines an area where a specific VPLMN is to be selected and used, and where, when outside of the area, different VPLMN selection priorities may apply. A location area identifier may, for example, include: a location area code (LAC) in a GSM network (LAC identifies a group of GSM cells in certain area), a routing area code (RAC) in a GPRS network (RAC identifies a group of GPRS cells in a certain area), and/or an identity similar to LAC/RAC in a 3G, HSPA, LTE, WiMAX, etc. network. In a GPS-enabled device, the location area may also be defined by using GPS coordinates and, for example, by us-

ing a radius where VPLMN priorities are valid. An exemplary location-area-specific VPLMN priority list may be as follows:

1: MCC=a, MNC=b, RAT=GSM, LAC=x
2: MCC=a, MNC=d, RAT=GSM, LAC='empty'

5 3: ...

The above exemplary list causes the device to select an MCC=a/MNC=b operator when the device is located within a GSM location area=x (LAC is broadcasted via system information messages of a cell). Otherwise MCC=a/MNC=d is used. A mobile
10 virtual network operator (MVNO) may use location-area-specific VPLMN selection to provide lowest cost connectivity at home and, for example, in the office; otherwise PLMN of another operator may be used.

Current 3GPP standards do not support location-area-specific
15 VPLMN selection.

In an exemplary embodiment, a location area VPLMN selection SIM applet (or device application in general instead of specific applet), referred to as a VPLMN location manager, is used on the device side in order to perform required operations. The home network operator may install the applets to
20 the SIM card before selling the SIM card, or afterwards, for example, by using SMSs. In case of a generic VPLMN location manager application, the network operator may use device management to install the application. The VPLMN location manager is able to monitor MCC, MNC, and the location area where the device is located. The VPLMN location manager also has access to SIM information defining location area VPLMN selection priorities. When the VPLMN location manager notices a change in the location area and the location area requires
25 the selection of a VPLMN network different from the one being used, the VPLMN location manager may, for example, rewrite a VPLMN selection priority table used by the device, based on priorities available for the given location area, and/or send a "REFRESH" command (defined for SIM management in specifications) to the device to cause the device to re-read and cache
30 the VPLMN priority list and take necessary actions (like performing VPLMN reselection). In case support for location-area-specific (V)PLMN selection is standardized, e.g. within

3GPP, cellular protocols (like mobility management) handle the monitoring of location areas and are able to select appropriate PLMNs based on preconfigured PLMN priority information.

- 5 Table 1 describes the content of an EFOPLMNwACT file on the SIM card. Information on VPLMN networks is stored in a prioritized order, and the device uses the highest priority VPLMN being available.

10 Table1. EFOPLMNwACT file content

Bytes	Description	M/O	Length
1 to 3	1 st PLMN (highest priority)	M	3 bytes
4 to 5	1 st PLMN access technology identifier	M	2 bytes
:	:		
36 to 38	8 th PLMN	M	3 bytes
39 to 40	8 th PLMN access technology identifier	M	2 bytes
41 to 43	9 th PLMN	O	3 bytes
44 to 45	9 th PLMN access technology identifier	O	2 bytes
:	:		
(5n-4) to (5n-2)	N th PLMN (lowest priority)	O	3 bytes
(5n-1) to 5n	N th PLMN access technology identifier	O	2 bytes

Currently, the EFOPLMNwACT file has no space for location area specific identities.

- 15 In an exemplary embodiment, to introduce location area specific information into VPLMN selection, there are the following options for the transmission and storing the location area specific VPLMN list:

- Standardizing a modified file similar to the EFOPLMNwACT file, including location area specific information along with the VPLMN specific information.
- 20 - Installing a VPLMN location manager application (as described above) to the device and transmitting the location area specific VPLMN priority lists from the network to the VPLMN location manager application run in the device. The

VPLMN location manager then manages, for example, the content of the EFOPLMNwACT file based on the device location and received priorities and updates the file to ensure that other device functions execute and select the correct PLMNs. For example, the manager may update a top priority network in the EFOPLMNwACT file according to the device location.

- Changing management of the EFOPLMNwACT file as shown in Table 2. For example, if 10 VPLMN networks are transmitted to the device and stored into the EFOPLMNwACT file, the actual list being transmitted and stored contains 20 entries. First 10 entries define VPLMN data as defined in Table 1, and the next 10 entries contain location specific information for the actual VPLMN networks defined in the first 10 positions of the list - in a respective order. Available VPLMN selection mechanisms in the device are not able to find VPLMN networks matching entries 11-20, however, the VPLMN location manager is able to use the information in its operation (as described above for the VPLMN location manager).

Table 2. Modified EFOPLMNwACT file content

Bytes	Description	M/O	Length
1 to 3	1 st PLMN (highest priority)	M	3 bytes
4 to 5	1 st PLMN access technology identifier	M	2 bytes
:	:		
a to a+2	10 th PLMN	M	3 bytes
A+3 to a+4	10 th PLMN access technology identifier	M	2 bytes
41 to 43	1 st PLMN location area identifiers (if any)	O	3 bytes
44 to 45	1 st PLMN location area identifiers continued (if any)	O	2 bytes
:	:		

Exemplary embodiments of the present invention will now be described more fully hereinafter with reference to the accompanying drawings, in which some, but not all embodiments of the invention are shown. Indeed, the invention may be em-

bodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will satisfy applicable legal requirements. Although the specification may refer to "an", "one", or "some" embodiment(s) in several locations, this does not necessarily mean that each such reference is to the same embodiment(s), or that the feature only applies to a single embodiment. Single features of different embodiments may also be combined to provide other embodiments. Like reference numerals refer to like elements throughout.

The present invention is applicable to any user terminal, server, corresponding component, and/or to any communication system or any combination of different communication systems that support access network discovery and selection function. The communication system may be a fixed communication system or a wireless communication system or a communication system utilizing both fixed networks and wireless networks. The protocols used, the specifications of communication systems, servers and user terminals, especially in wireless communication, develop rapidly. Such development may require extra changes to an embodiment. Therefore, all words and expressions should be interpreted broadly and they are intended to illustrate, not to restrict, the embodiment.

In the following, different embodiments will be described using, as an example of a system architecture whereto the embodiments may be applied, without restricting the embodiment to such an architecture, however.

With reference to Figure 1, let us examine an example of a radio system to which embodiments of the invention can be applied. In this example, the radio system is based on LTE network elements. However, the invention described in these examples is not limited to the LTE radio systems but can also be implemented in other radio systems, such as UMTS (universal mobile telecommunications system), GSM, EDGE, WCDMA, bluetooth network, WLAN or other mobile or wireless network. In an embodiment, the presented solution may be applied be-

tween user equipment belonging to different but compatible systems such as LTE and UMTS.

A general architecture of a communication system is illustrated in Figure 1. Figure 1 is a simplified system architecture only showing some elements and functional entities, all being logical units whose implementation may differ from what is shown. The connections shown in Figure 1 are logical connections; the actual physical connections may be different. It is apparent to a person skilled in the art that the systems also comprise other functions and structures. It should be appreciated that the functions, structures, elements, and protocols used in or for wireless communication are irrelevant to the actual invention. Therefore, they need not be discussed in more detail here.

The exemplary radio system of Figure 1 comprises a public land mobile network 101 (HPLMN1) of a home network operator, the network 101 comprising a home network node 102 (NE1). The home network node 102 may include e.g. an MSC server (MSS), serving GPRS support node, gateway GPRS support node, mobility management entity (MME), home location register (HLR), home subscriber server (HSS), visitor location register (VLR), base station, enhanced node-B, radio network controller, or any other network element or a combination of network elements. The home network node 102 is capable connecting to one or more visited networks 103, 104 (VPLMN2, VPLMN3) utilizing an access technology (access type). The home network node 102 may be connected to the visited network 103, 104 e.g. via a respective visited network node 108, 109 or directly via a connection 105. In Figure 1, a situation is shown where the visited network 103 and the visited network 104 are operated by different roaming network operators. Figure 1 shows a user equipment 106 located in the service area of the visited network 103, 104. The user equipment refers to a portable computing device, and it may also be referred to as a user terminal. Such computing devices include wireless mobile communication devices operating with or without a subscriber identification module (SIM), including, but not limited to, the following types of devices: mobile phone, smart-

phone, personal digital assistant (PDA), handset, laptop computer. In the example situation of Figure 1, the user equipment 106 is capable of connecting to a visited network node 108, 109 via a connection 107. The home network node 102 and
5 the user equipment 106 are capable of connecting to each other via a visited network 103, 104 via connections 105, 107, correspondingly.

Figure 1 only illustrates a simplified example. In practice, the network may include more home network nodes and visited
10 network nodes, and more cells may be formed by the network nodes. The networks of two or more operators may overlap, the sizes and form of the cells may vary from what is depicted in Figure 1, etc. The communication system may also be able to communicate with other networks, such as a public switched
15 telephone network. The embodiments are not, however, restricted to the network given above as an example, but a person skilled in the art may apply the solution to other communication networks provided with the necessary properties. For example, the connections between different network elements
20 may be realized with internet protocol (IP) connections.

Figure 2 illustrates examples of apparatuses according to embodiments of the invention. Figure 2 shows a user equipment 106 located in the area of the visited network node 108, 109. The user equipment 106 is configured to be in connection with
25 the visited network node 108, 109. The user equipment or UE 106 comprises a controller 201 operationally connected to a memory 202 and a transceiver 203. The controller 201 controls the operation of the user equipment 106. The memory 202 is configured to store software and data. The transceiver 203 is
30 configured to set up and maintain a wireless connection to the visited network node 108, 109. The transceiver is operationally connected to a set of antenna ports 204 connected to an antenna arrangement 205. The antenna arrangement 205 may comprise a set of antennas. The number of antennas may be one
35 to four, for example. The number of antennas is not limited to any particular number. The user equipment 106 may also comprise various other components, such as a user interface, camera, and media player. They are not displayed in the fig-

ure due to simplicity. The visited network node (such as RNC/eNB) 108, 109 comprises a controller 206 operationally connected to an interface 207 and a transceiver 208. The controller 206 controls the operation of the visited network node 108, 109. The interface 207 is configured to setup and maintain the connection with a home network node 102. The transceiver 208 is configured to set up and maintain a wireless connection to the user equipment 106 within the service area of the visited network node 108, 109. The transceiver 208 is operationally connected to an antenna arrangement 209. The antenna arrangement may comprise a set of antennas. The number of antennas may be two to four, for example. The number of antennas is not limited to any particular number. The visited network node is operationally connected (directly or indirectly) to a network element 102 of the home network of the user equipment. The home network node 102 may be an MSC server (MSS), serving GPRS support node, mobility management entity (MME), home location register (HLR), home subscriber server (HSS), visitor location register (VLR), a radio network controller (RNC), a gateway, or a server, for example. The home network node 102 may comprise a controller 210 and a memory 211 configured to store software and data and an interface 212 configured to be in connection 105 with the visited network node.

The embodiments are not, however, restricted to the network given above as an example, but a person skilled in the art may apply the solution to other communication networks provided with the necessary properties. For example, the connections between different network elements may be realized with internet protocol (IP) connections.

The memory may include volatile and/or non-volatile memory and typically stores content, data, or the like. For example, the memory may store computer program code such as software applications (for example for the detector unit and/or for the adjuster unit) or operating systems, information, data, content, or the like for the processor to perform steps associated with operation of the apparatus in accordance with embodiments. The memory may be, for example, random access mem-

ory (RAM), a hard drive, or other fixed data memory or storage device. Further, the memory, or part of it, may be removable memory detachably connected to the apparatus.

The techniques described herein may be implemented by various means so that an apparatus implementing one or more functions of a corresponding mobile entity described with an embodiment comprises not only prior art means, but also means for implementing the one or more functions of a corresponding apparatus described with an embodiment and it may comprise separate means for each separate function, or means may be configured to perform two or more functions. For example, these techniques may be implemented in hardware (one or more apparatuses), firmware (one or more apparatuses), software (one or more modules), or combinations thereof. For a firm-ware or software, implementation can be through modules (e.g., procedures, functions, and so on) that perform the functions described herein. The software codes may be stored in any suitable, processor/computer-readable data storage medium(s) or memory unit(s) or article(s) of manufacture and executed by one or more processors/computers. The data storage medium or the memory unit may be implemented within the processor/computer or external to the processor/computer, in which case it can be communicatively coupled to the processor/computer via various means as is known in the art.

User equipment may refer to any user communication device. A term "user equipment" as used herein may refer to any device having a communication capability, such as a wireless mobile terminal, a PDA, a smart phone, a personal computer (PC), a laptop computer, a desktop computer, etc. For example, the wireless communication terminal may be an UMTS or GSM/EDGE smart mobile terminal. Thus, the application capabilities of the device according to various embodiments of the invention may include native applications available in the terminal, or subsequently installed applications. The messaging service center may be implemented in any network element, such as a server.

Figure 2 is a block diagram of an apparatus according to an embodiment of the invention. Although the apparatus has been

depicted as one entity, different modules and memory may be implemented in one or more physical or logical entities.

The functionality of the apparatus 106 is described in more detail below with Figures 3 and 4. It should be appreciated
5 that the apparatus 106 may comprise other units used in or for PLMN selection. However, they are irrelevant to the actual invention and, therefore, they need not to be discussed in more detail here.

The apparatus may also be a user terminal which is a piece of
10 equipment or a device that associates, or is arranged to associate, the user terminal and its user with a subscription and allows a user to interact with a communications system. The user terminal presents information to the user and allows the user to input information. In other words, the user ter-
15 minal may be any terminal capable of receiving information from and/or transmitting information to the network, connectable to the network wirelessly or via a fixed connection. Examples of the user terminal include a personal computer, a game console, a laptop (a notebook), a personal digital as-
20 sistant, a mobile station (mobile phone), and a line telephone.

The apparatus 106 may generally include a processor, controller, control unit or the like connected to a memory and to various interfaces of the apparatus. Generally the processor
25 is a central processing unit, but the processor may be an additional operation processor. The processor may comprise a computer processor, application-specific integrated circuit (ASIC), field-programmable gate array (FPGA), and/or other hardware components that have been programmed in such a way
30 to carry out one or more functions of an embodiment.

The techniques described herein may be implemented by various means so that an apparatus implementing one or more functions of a corresponding mobile entity described with an embodiment comprises not only prior art means, but also means for imple-
35 menting the one or more functions of a corresponding apparatus described with an embodiment and it may comprise separate means for each separate function, or means may be configured to perform two or more functions. For example, these tech-

niques may be implemented in hardware (one or more apparatuses), firmware (one or more apparatuses), software (one or more modules), or combinations thereof. For a firm-ware or software, implementation can be through modules (e.g., procedures, functions, and so on) that perform the functions described herein. The software codes may be stored in any suitable, processor/computer-readable data storage medium(s) or memory unit(s) or article(s) of manufacture and executed by one or more processors/computers. The data storage medium or the memory unit may be implemented within the processor/computer or external to the processor/computer, in which case it can be communicatively coupled to the processor/computer via various means as is known in the art.

The signaling chart of Figure 3 illustrates the required signaling. In the example of Figure 3, a user terminal (user equipment UE) may transmit a channel request message 301 to a network apparatus 108, 109. This may mean that a location area code, routing area code, and/or another network identity code identifying the area where the user terminal 106 is located changes. This may be related to the user terminal entering the area, a handover of the user terminal, and/or a location update of the user terminal. This may occur, e.g. when the user terminal is switched on or when the user terminal has moved to a different location. In response to the channel request message, the network apparatus 108, 109 which may comprise e.g. a radio network controller/enhanced node-B of a visited network, may transmit a channel response message 302 to the user terminal 106. In response to receiving the channel response message, the user terminal 106 is configured to check, in step 303, based on a prioritized visited network list maintained for the user terminal (e.g. stored in the user terminal/(U)SIM card), whether a visited network operator and a radio access technology is to be prioritized for the user terminal in the area where the user terminal is currently located. If a visited network operator and a radio access technology is prioritized for the user terminal in the area where the user terminal is currently located, the user terminal is configured to select the visited network operator

and the radio access technology prioritized for the user terminal in said area. (It should be noted that the user terminal may be configured to check the priority list based on some other event recognized in the user terminal (it is not required that a message is received from the visited network node). The user terminal may also be configured to check the priority list periodically, within predetermined time intervals, or e.g. every time the user terminal is switched on. If the network with the highest priority is not currently available, the user terminal may select a network determined to be a "second best" network for the user terminal in that area (herein area may refer to a location area, a routing area, and/or some other area comprising at least a part of a network coverage area)). In the situation shown in Figure 3, UE1 is located in the coverage area of NE2 and NE3. If, for the current UE1 location, NE2 is prioritized for UE1 (based on the prioritized visited network list maintained in UE1), UE1 is configured to select NE2, even if in another location and/or based on general agreements between operators NE3 were prioritized. In an attach message 304 the user terminal acknowledges the selected visited network node (e.g. NE2) on the attachment of the user terminal to the visited network (which, in the above exemplary situation, may be NE2/PLMN2). An IMSI attach of the user terminal is performed e.g. when the user terminal is powered on. Thus the user terminal scans networks nearby, and sends a channel request 301 to the visited network 103, 104. Based on a received channel response 302, the user terminal is able to perform IMSI verification, authentication, encryption, and location update related to the IMSI attach.

In a message 305, the home network node 102 may be configured to transmit an updated modified EFOPLMNwACT file to the user terminal 106, the updated modified EFOPLMNwACT file including area information, prioritized visited network operator information, and prioritized radio access technology information related to the user terminal. In step 306, the user terminal 106 receives the message 305, wherein the user terminal is configured to update 306 the prioritized visited network list

stored in the user terminal based on the received information. After that the user terminal may start to apply the updated list for VPLMN selection based on area as described above.

5 Figure 4 is a flow chart illustrating an exemplary embodiment. In the example of Figure 4, an apparatus 106, which may comprise e.g. a user terminal roaming in a visited network, transmits 401 a channel request message to a visited network node. This may mean that a location area code, routing area
10 code, and/or another network identity code identifying the area where the user terminal 106 is located, changes. This may be related to the user terminal entering the area, a handover of the user terminal, and/or a location update of the user terminal. This may occur, e.g. when the user terminal
15 is switched on or when the user terminal has moved to a different location. The user terminal may then receive 402 a channel response message from the visited network node. In response to receiving the channel response message, the user terminal 106 is configured to check, in step 403, based on a
20 prioritized visited network list maintained for the user terminal (e.g. stored in the user terminal/(U)SIM card), whether a visited network operator and a radio access technology is to be prioritized for the user terminal in the area where the user terminal is currently located. If a visited network operator and a radio access technology is prioritized for the
25 user terminal in the area where the user terminal is currently located, the user terminal is configured to select the visited network operator and the radio access technology prioritized for the user terminal in said area. (It should be
30 noted that the user terminal may be configured to check the priority list based on some other event recognized in the user terminal (it is not required that a message is received from the visited network node). The user terminal may also be configured to check the priority list periodically, within
35 predetermined time intervals, or e.g. every time the user terminal is switched on. If the network with the highest priority is not currently available, the user terminal may select a network determined to be a "second best" network for

the user terminal in that area (herein area may refer to a location area, a routing area, and/or some other area comprising at least a part of a network coverage area)). In the situation shown in Figure 4, UE1 is located in the coverage area of NE2/PLMN2 and NE3/PLMN3. If, for the current UE1 location, NE2/PLMN2 is prioritized for UE1 (based on the prioritized visited network list maintained in UE1), UE1 is configured to select NE2/PLMN2, even if in another location and/or based on general agreements between operators

NE3/PLMN3 were prioritized. In an attach message the user terminal acknowledges 404 the selected visited network node on the attachment of the user terminal to the visited network (which, in the above exemplary situation, may be NE2/PLMN2). In a step 405, the user terminal 106 may receive an updated modified EFOPLMNwACT file from a home network node 102, the updated modified EFOPLMNwACT file including area information, prioritized visited network operator information, and prioritized radio access technology information. In step 406, the user terminal is configured to update the prioritized visited network list stored in the user terminal. After that the user terminal may start to apply the updated list for VPLMN selection based on area as described above.

Thus, according to an exemplary embodiment, there is provided a method comprising performing the method steps of maintaining, for a user terminal, a prioritized visited network list, the list comprising information on a visited network operator, and radio access technology to be prioritized for the user terminal in a specific area; in response to recognising a predetermined event related to the user terminal, checking, based on the prioritized visited network list maintained for the user terminal, whether a visited network operator and a radio access technology is to be prioritized for the user terminal in the area where the user terminal is currently located; wherein, if a visited network operator and a radio access technology is prioritized for the user terminal in the area where the user terminal is currently located, the method comprises causing the user terminal to select the visited

network operator and the radio access technology prioritized for the user terminal in said area.

According to another exemplary embodiment, there is provided a user terminal configured to maintain a prioritized visited

5 network list, the list comprising information on a visited network operator, and radio access technology to be prioritized for the user terminal in a specific area; in response to recognising a predetermined event, check, based on the prioritized visited network list, whether a visited network
10 operator and a radio access technology is to be prioritized in the area where the user terminal is currently located; wherein, if a visited network operator and a radio access technology is to be prioritized in the area where the user terminal is currently located, the user terminal is config-
15 ured to select the visited network operator and the radio access technology prioritized in said area.

According to a yet another exemplary embodiment, there is provided an apparatus configured to provide, to a user terminal, a prioritized visited network list, the list comprising
20 information on a visited network operator, and radio access technology prioritized for the user terminal in a specific area, so that, if a visited network operator and a radio access technology is prioritized for the user terminal in the area where the user terminal is currently located, the user
25 terminal selects the visited network operator and the radio access technology prioritized for the user terminal in said area.

According to a yet another exemplary embodiment, there is provided a computer-readable storage medium embodying a pro-
30 gram of instructions executable by a processor to perform actions directed toward maintaining, for a user terminal, a prioritized visited network list, the list comprising information on a visited network operator, and radio access technology to be prioritized for the user terminal in a specific
35 area; in response to recognising a predetermined event related to the user terminal, checking, based on the prioritized visited network list maintained for the user terminal, whether a visited network operator and a radio access tech-

nology is to be prioritized for the user terminal in the area where the user terminal is currently located; wherein, if a visited network operator and a radio access technology is prioritized for the user terminal in the area where the user terminal is currently located, causing the user terminal to select the visited network operator and the radio access technology prioritized for the user terminal in said area. According to a yet another exemplary embodiment, said area comprises a location area, a routing area, and/or another area comprising at least a part of a network.

According to a yet another exemplary embodiment, the prioritized visited network list comprises information on a location area code, routing area code, and/or another network identity code identifying said area.

According to a yet another exemplary embodiment, the predetermined event related to the user terminal comprises the user terminal entering the area, a handover of the user terminal, and/or a location update of the user terminal.

According to a yet another exemplary embodiment, there is provided a user terminal configured to store the prioritized visited network list on a subscriber identity module.

According to a yet another exemplary embodiment, the prioritized visited network list involves a modified EFOPLMNwACT file.

According to a yet another exemplary embodiment, there the prioritized visited network list involves a modified EFOPLMNwACT file, the modified EFOPLMNwACT file including area information, prioritized visited network operator information, and prioritized radio access technology information.

According to a yet another exemplary embodiment, the prioritized visited network list involves a modified EFOPLMNwACT file, the modified EFOPLMNwACT file including area information, prioritized visited network operator information, and prioritized radio access technology information, wherein the user terminal is configured to modify the EFOPLMNwACT file based on information received from a network apparatus.

According to a yet another exemplary embodiment, there is provided an apparatus configured to transfer a modified

EFOPLMNwACT file to the user terminal, the modified EFOPLMNwACT file including area information, prioritized visited network operator information, and prioritized radio access technology information.

5 The steps/points, signalling messages and related functions de-scribed above in Figures 1 to 4 are in no absolute chronological order, and some of the steps/points may be performed simultaneously or in an order differing from the given one. Other functions can also be executed between the steps/points
10 or within the steps/points and other signalling messages sent between the illustrated messages. Some of the steps/points or part of the steps/points can also be left out or replaced by a corresponding step/point or part of the step/point. The apparatus operations illustrate a procedure that may be imple-
15 mented in one or more physical or logical entities. The signalling messages are only exemplary and may even comprise several separate messages for transmitting the same information. In addition, the messages may also contain other information.

20 Although the various aspects, embodiments and features of the invention are recited independently, it should be appreciated that all combinations of the various aspects, embodiments and features of the invention are possible and within the scope of the present invention as claimed.

25 It will be obvious to a person skilled in the art that, as the technology advances, the inventive concept can be implemented in various ways. The invention and its embodiments are not limited to the examples described above but may vary within the scope of the claims.

30

List of abbreviations

	GSM	global system for mobile communications
	3G	third generation
	USIM	UMTS subscriber identity module
5	UMTS	universal mobile telecommunications system
	SIM	subscriber identity module
	VPLMN	visited public land mobile network
	HPLMN	home public land mobile network
	NE	network element
10	UE	user equipment
	SMS	short message service
	EFOPLMNwACT	operator-controlled PLMN selector with access technology file
	3GPP	third generation partnership project
15	RFM	remote file management
	UICC	UMTS IC card; universal IC card
	IC	integrated circuit
	ADF	application dedicated file
	OTA	over-the-air technology
20	UK	United Kingdom
	MCC	mobile country code
	MNC	mobile network code
	LAC	location area code
	RAC	routing area code
25	HSPA	high speed packet access
	LTE	long term evolution
	WiMAX	worldwide interoperability for microwave access
	GPRS	general packet radio service
30	PLMN	public land mobile network

CLAIMS

1. A method for network selection in a communications system, **characterized** by

5 maintaining, for a user terminal (106), a prioritized visited network list, the list comprising information on a visited network operator, and radio access technology to be prioritized for the user terminal (106) in a specific area; in response to recognising (402) a predetermined event re-
10 lated to the user terminal, checking (403), based on the prioritized visited network list maintained for the user terminal (106), whether a visited network operator and a radio access technology is to be prioritized for the user terminal (106) in the area where the user terminal (106) is currently
15 located;
wherein, if a visited network operator and a radio access technology is prioritized for the user terminal (106) in the area where the user terminal (106) is currently located, the method comprises
20 causing the user terminal (106) to select (404) the visited network operator and the radio access technology prioritized for the user terminal (106) in said area.

2. A method according to claim 1, **characterized** in that
25 said area comprises a location area, a routing area, and/or another area comprising at least a part of a network.

3. A method according to claim 1 or 2, **characterized** in that the prioritized visited network list comprises information on a location area code, routing area code, and/or another network identity code identifying said area.
30

4. A method according to claim 1, 2 or 3, **characterized** in that the predetermined event related to the user terminal
35 (106) comprises the user terminal entering the area, a hand-over of the user terminal (106), and/or a location update of the user terminal (106).

5. A method according to any of claims 1 to 4, **characterized** in that the prioritized visited network list is stored on a subscriber identity module.

5 6. A method according to any of claims 1 to 5, **characterized** in that the prioritized visited network list involves a modified EFOPLMNwACT file.

10 7. A method according to any of claims 1 to 6, **characterized** in that the prioritized visited network list involves a modified EFOPLMNwACT file, wherein the EFOPLMNwACT file is modified (306, 406) based on information received (305, 405) from a network apparatus (102).

15 8. A user terminal for communications, **characterized** in that it is configured to maintain a prioritized visited network list, the list comprising information on a visited network operator, and radio access technology to be prioritized for the user terminal
20 (106) in a specific area;
in response to recognising a predetermined event, check, based on the prioritized visited network list, whether a visited network operator and a radio access technology is to be prioritized in the area where the user terminal (106) is currently located;
25 wherein, if a visited network operator and a radio access technology is to be prioritized in the area where the user terminal (106) is currently located, the user terminal is configured to
30 select the visited network operator and the radio access technology prioritized in said area.

9. A user terminal according to claim 8, **characterized** in that said area comprises a location area, a routing area,
35 and/or another area comprising at least a part of a network.

10. A user terminal according to claim 8 or 9, **characterized** in that the prioritized visited network list com-

prises information on a location area code, routing area code, and/or another network identity code identifying said area.

- 5 11. A user terminal according to claim 8, 9 or 10, **characterized** in that the predetermined event related to the user terminal (106) comprises the user terminal (106) entering the area, a handover of the user terminal (106), and/or a location update of the user terminal (106).
- 10 12. A user terminal according to any of claims 8 to 11, **characterized** in that it is configured to store the prioritized visited network list on a subscriber identity module.
- 15 13. A user terminal according to any of claims 8 to 12, **characterized** in that the prioritized visited network list involves a modified EFOPLMNwACT file, the modified EFOPLMNwACT file including area information, prioritized visited network operator information, and prioritized radio access technology information.
- 20 14. A user terminal according to any of claims 8 to 13, **characterized** in that the prioritized visited network list involves a modified EFOPLMNwACT file, the modified EFOPLMNwACT file including area information, prioritized visited network operator information, and prioritized radio access technology information, wherein the user terminal (106) is configured to modify the EFOPLMNwACT file based on information received from a network apparatus (102).
- 30 15. An apparatus for communications, **characterized** in that it is configured to provide, to a user terminal (106), a prioritized visited network list, the list comprising information on a visited network operator, and radio access technology prioritized for the user terminal in a specific area, so that, if a visited network operator and a radio access technology is prioritized for the user terminal in the area
- 35

where the user terminal (106) is currently located, the user terminal (106) selects the visited network operator and the radio access technology prioritized for the user terminal (106) in said area.

5

16. An apparatus according to claim 15, **characterized** in that it is configured to transfer a modified EFOPLMNwACT file to the user terminal, the modified EFOPLMNwACT file including area information, prioritized visited network operator information, and prioritized radio access technology information.

10

17. A computer-readable storage medium embodying a program of instructions executable by a processor to perform actions directed toward

maintaining, for a user terminal (106), a prioritized visited network list, the list comprising information on a visited network operator, and radio access technology to be prioritized for the user terminal (106) in a specific area;

in response to recognising a predetermined event related to the user terminal, checking, based on the prioritized visited network list maintained for the user terminal, whether a visited network operator and a radio access technology is to be prioritized for the user terminal (106) in the area where the user terminal (106) is currently located;

wherein, if a visited network operator and a radio access technology is prioritized for the user terminal (106) in the area where the user terminal (106) is currently located, causing the user terminal (106) to select the visited network operator and the radio access technology prioritized for the user terminal (106) in said area.

15

20

25

30

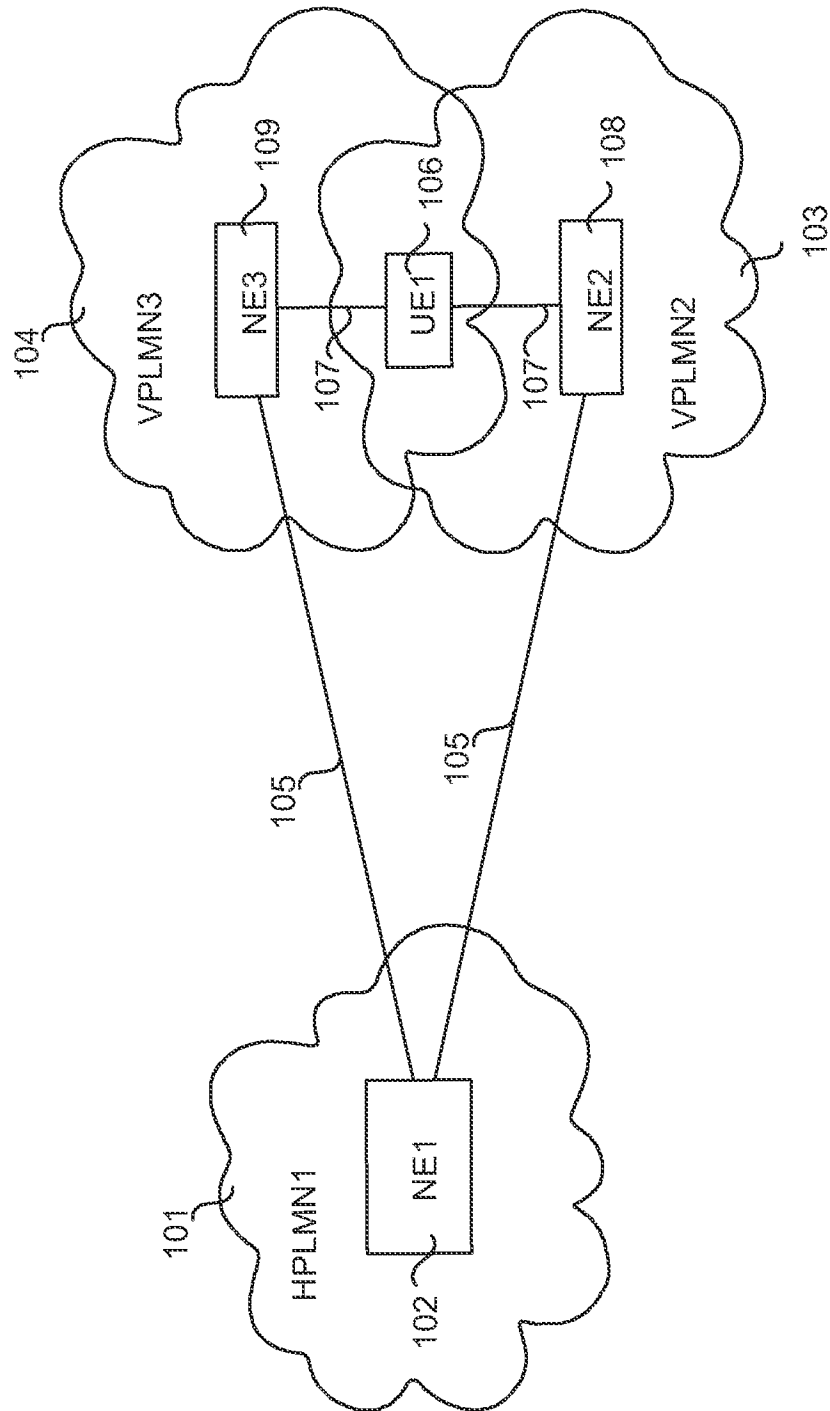


Fig. 1

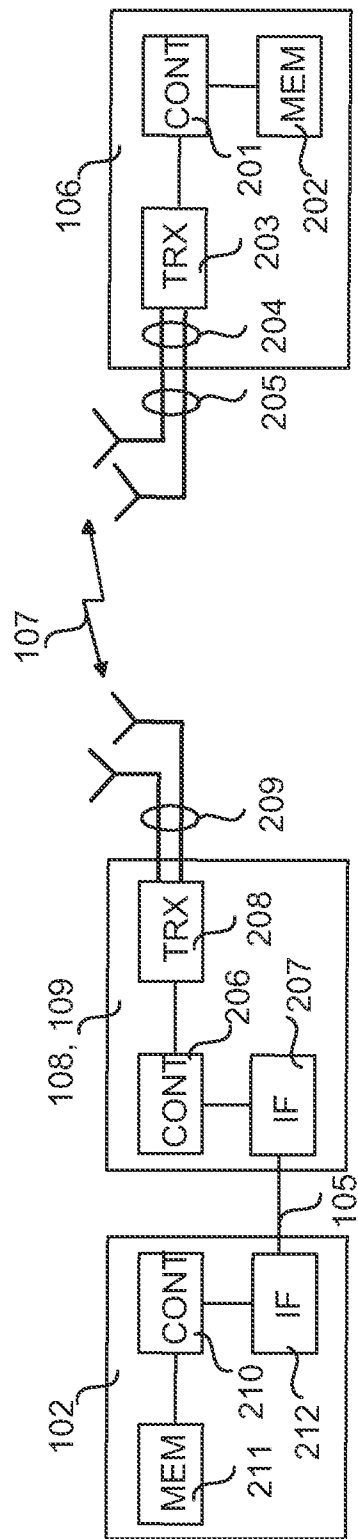


Fig. 2

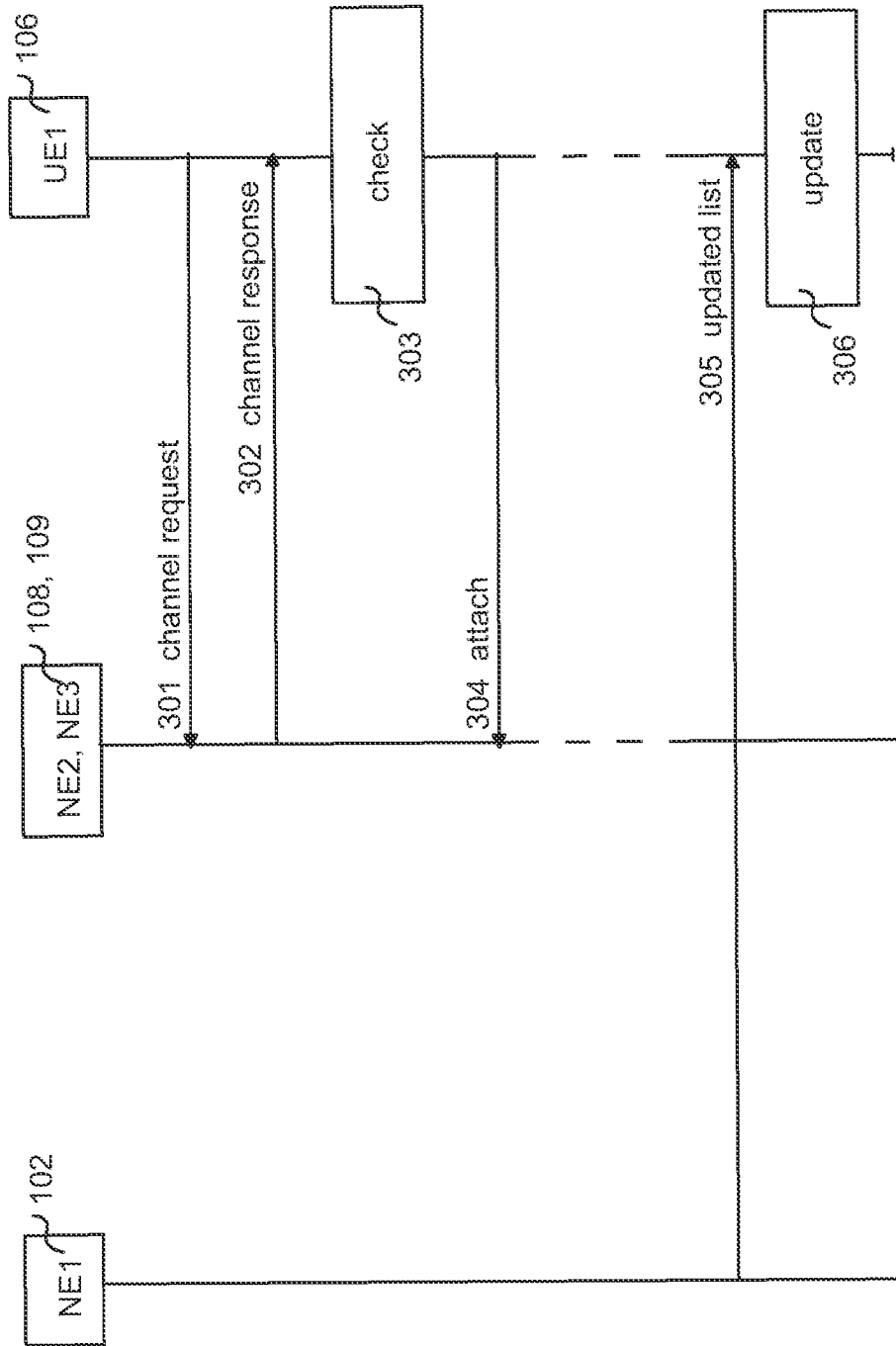


Fig. 3

4/4

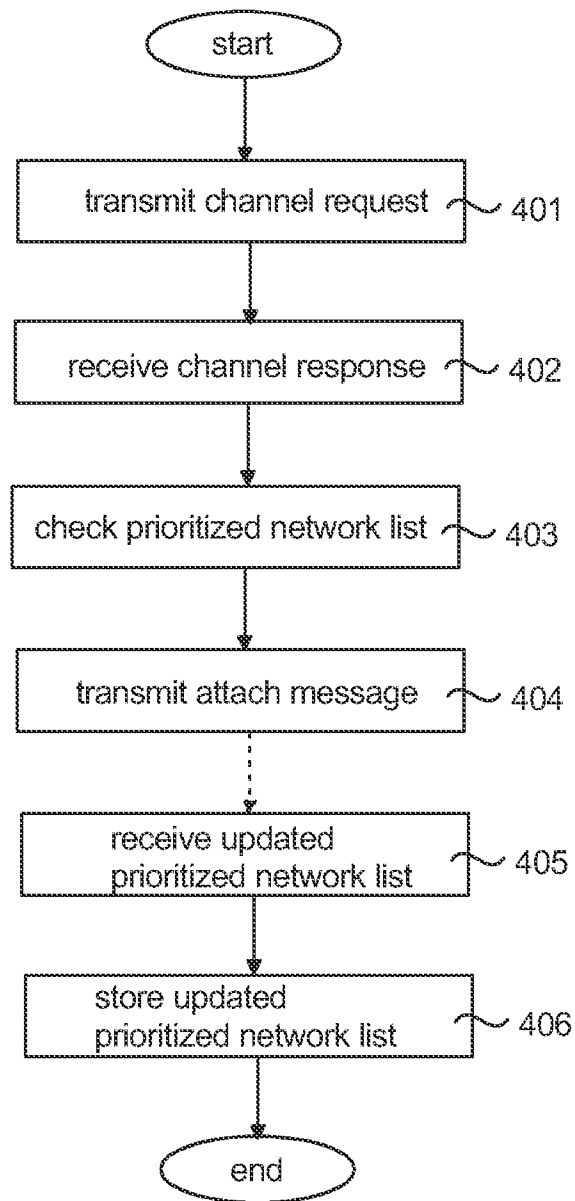


Fig. 4

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2011/056341

A. CLASSIFICATION OF SUBJECT MATTER

INV. H04W8/18 H04W48/18
 ADD. H04W88/06

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 practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	3GPP TS 23.122 V10.3.0 (2011-03): "3rd Generation Partnership Project; Technical Specification Group Core Network and Terminals; Non-Access-Stratum (NAS) functions related to Mobile Station (MS) in idle mode (Release 10)", 3GPP STANDARD; 3GPP TS 23.122, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE, no. V10.3.0, 1 April 2011 (2011-04-01), pages 1-43, XP050476762, [retrieved on 2011-04-01] page 16, par. 4.4.3; page 17, par. 4.4.3.1.1; page 22, par. 4.4.3.3.1; page 23, par. 4.4.6 ----- -/-	1-17



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance
 "E" earlier document but published on or after the international filing date
 "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
 "O" document referring to an oral disclosure, use, exhibition or other means
 "P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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

"&" document member of the same patent family

Date of the actual completion of the international search

24 January 2012

Date of mailing of the international search report

02/02/2012

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

Möll, Hans-Peter

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2011/056341

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	EP 2 048 910 A1 (FRANCE TELECOM [FR]) 15 April 2009 (2009-04-15) paragraph [0017] - paragraph [0020] -----	1-17
X	WO 2006/133720 A1 (ERICSSON TELEFON AB L M [SE]; MARIBLANCA-NIEVES DAVID [ES]; SANCHEZ HE) 21 December 2006 (2006-12-21)	1,8,15, 17
A	abstract figures 5,6 paragraph [0046] paragraph [0049] - paragraph [0051] paragraph [0053] - paragraph [0056] -----	2-7, 9-14,16
X	US 2006/126532 A1 (BINDING CARL [CH] ET AL) 15 June 2006 (2006-06-15)	1,8,15, 17
A	abstract figures 3,4 paragraph [0066] - paragraph [0077] -----	2-7, 9-14,16
X	WO 2006/111176 A1 (TELECOM ITALIA SPA [IT]; CATALANO GIUSEPPE [IT]; MAMINO DAVIDE [IT]; M) 26 October 2006 (2006-10-26)	1,8,15, 17
A	abstract figure 2 page 12, line 26 - page 13, line 32 -----	2-7, 9-14,16

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2011/056341

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 2048910	A1	15-04-2009	EP 2048910 A1 15-04-2009
			EP 2213136 A1 04-08-2010
			US 2010255836 A1 07-10-2010
			WO 2009047308 A1 16-04-2009

WO 2006133720	A1	21-12-2006	AT 463135 T 15-04-2010
			CN 101223804 A 16-07-2008
			EP 1891822 A1 27-02-2008
			JP 4718603 B2 06-07-2011
			JP 2008544596 A 04-12-2008
			US 2009196265 A1 06-08-2009
			WO 2006133720 A1 21-12-2006

US 2006126532	A1	15-06-2006	AU 2003274516 A1 15-06-2004
			CN 1711796 A 21-12-2005
			EP 1563702 A1 17-08-2005
			JP 2006506880 A 23-02-2006
			TW I246344 B 21-12-2005
			US 2006126532 A1 15-06-2006
			US 2008242300 A1 02-10-2008
			WO 2004047476 A1 03-06-2004

WO 2006111176	A1	26-10-2006	AT 497684 T 15-02-2011
			EP 1872611 A1 02-01-2008
			ES 2360675 T3 08-06-2011
			US 2009215447 A1 27-08-2009
			WO 2006111176 A1 26-10-2006
