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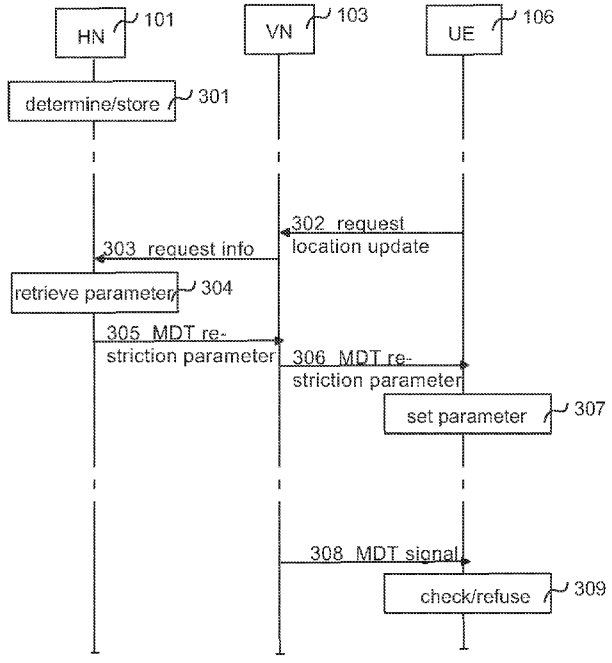

Fig. 3

(57) Abstract: The present solution involves determining (301), in a home network element (HN), an MDT parameter value for a user terminal (UE), the parameter value indicating whether or not collection of minimization of drive-tests data is allowed in a roaming network regarding the user terminal. Information on the parameter value is provided (305, 306) from a network apparatus (HN, VN) to the user terminal (UE) in order to restrict collection of minimization of drive-tests data in the roaming network regarding the user terminal (UE). The provision of the parameter to the user terminal (UE) is performed e.g. in connection with a location update procedure of the user terminal (UE) in the roaming network.

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METHOD AND APPARATUS FOR RESTRICTING COLLECTION OF MINIMIZATION OF DRIVE-TESTS DATA IN A ROAMING NETWORK

Field of the invention

The exemplary and non-limiting embodiments of this invention relate generally to wireless communications networks, and more particularly to minimization of drive-tests.

Background

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.

Minimization of drive-tests (MDT) refers to a functionality in which a wireless network operator has a possibility to collect MDT data via user terminals located in the operator's network. MDT data provides the network operator with valuable information on the network performance, thus reducing the need for separate drive-tests terminals.

Brief description of the invention

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 methods, apparatuses, computer program product, and a computer-readable storage medium as defined in the independent claims. Further embodiments of the invention are disclosed in the dependent claims.

According to an aspect of the present invention, there is provided a method for determining, in a network apparatus, a minimization of drive-tests parameter value for a user terminal, said parameter value indicating that collection of minimization of drive-tests data is not allowed in a roaming network regarding the user terminal, and for providing information on the parameter value from the network apparatus to the user terminal in order to restrict collection of minimization of drive-tests data in the roaming network regarding the user terminal.

According to another aspect of the present invention, there is provided a method for receiving, in the user terminal, information on the minimization of drive-tests parameter value regarding a user terminal, the parameter value indicating that collection of minimization of drive-tests data is not allowed in a roaming network regarding the user terminal, and for setting, in the user terminal, the received parameter value in order to restrict collection of minimization of drive-tests data in the roaming network regarding the user terminal.

According to yet another aspect of the present invention, there is provided a method for receiving, in a network apparatus, information on a minimization of drive-tests parameter value for a user terminal, said parameter value indicating that collection of minimization of drive-tests data is not allowed in a roaming network regarding the user terminal, and for restricting the collection of minimization

of drive-tests data in the roaming network regarding the user terminal based on the received minimization of drive-tests parameter value.

According to yet another aspect of the present invention, there is provided an apparatus configured to determine a minimization of drive-tests parameter value for a user terminal, said parameter value indicating that collection of minimization of drive-tests data is not allowed in a roaming network regarding the user terminal, and to provide information on the parameter value to the user terminal in order to restrict collection of minimization of drive-tests data in the roaming network regarding the user terminal.

According to yet another aspect of the present invention, there is provided an apparatus configured to receive, from a network apparatus, information on the minimization of drive-tests parameter value regarding a user terminal, the parameter value indicating that collection of minimization of drive-tests data is not allowed in a roaming network regarding the user terminal, and to set, in the user terminal, the received parameter value in order to restrict collection of minimization of drive-tests data in the roaming network regarding the user terminal.

According to yet another aspect of the present invention, there is provided an apparatus configured to receive, from a network apparatus, information on a minimization of drive-tests parameter value for a user terminal, said parameter value indicating that collection of minimization of drive-tests data is not allowed in a roaming network regarding the user terminal, and to restrict the collection of minimization of drive-tests data in the roaming network regarding the user terminal based on the received minimization of drive-tests parameter value.

According to yet another aspect of the present invention, there is provided a computer readable memory embodying a

program of instructions executable by a processor to perform actions of determining a minimization of drive-tests parameter value for a user terminal, said parameter value indicating that collection of minimization of drive-tests data is not allowed in a roaming network regarding the user terminal, and providing information on the parameter value to the user terminal in order to restrict collection of minimization of drive-tests data in the roaming network regarding the user terminal.

According to yet another aspect of the present invention, there is provided a computer readable memory embodying a program of instructions executable by a processor to perform actions of receiving information on the minimization of drive-tests parameter value regarding a user terminal, the parameter value indicating that collection of minimization of drive-tests data is not allowed in a roaming network regarding the user terminal, and setting the received parameter value in the user terminal in order to restrict collection of minimization of drive-tests data in the roaming network regarding the user terminal.

According to yet another aspect of the present invention, there is provided a computer readable memory embodying a program of instructions executable by a processor to perform actions of receiving, from a network apparatus, information on a minimization of drive-tests parameter value for a user terminal, said parameter value indicating that collection of minimization of drive-tests data is not allowed in a roaming network regarding the user terminal, and restricting the collection of minimization of drive-tests data in the roaming network regarding the user terminal based on the received minimization of drive-tests parameter value.

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.

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 an 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;

Figure 5 shows a schematic diagram of a flow chart according to another exemplary embodiment;

Figure 6 shows a schematic diagram of a flow chart according to another exemplary embodiment.

Detailed description of some embodiments

Exemplary embodiments of the present invention will now be de-scribed 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 embodied 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 a minimization of drive-tests (MDT) functionality. 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.

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 between 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 100 of a home network operator, the network 100 comprising a core network node 101. The core network node 101 may include e.g. a home location register (HLR), home subscriber server (HSS), or any other core network element or a combination of core network elements. The core network node 101 is connected to a public land mobile network 102 of a visited network operator, the network 102 comprising a core network node 103. The core network node 103 may include e.g. a visitor location register (VLR), MSC server (MSS), a serving GPRS support node, a mobility management entity (MME) or any other core network element or a combination of core network elements. The core network node 101 and the core network node 103 are connected to each other via a connection 104 or via one or more further network elements. In Figure 1, a base station 105 that may also be called eNB (enhanced node B) of the radio system hosts the functions for radio resource management in the visited public land mobile network 102. Figure 1 shows a user equipment 106 located in the service area of the base station 105. 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 the base station 105 via a connection 107. The core network node 103 may be connected to the base station

e.g. via a radio network controller or directly via a connection 108.

Figure 1 only illustrates a simplified example. In practice, the net-work may include more base stations and radio network controllers, and more cells may be formed by the base stations. 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 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 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 base station or eNB 105. The user equipment is configured to be in connection with the base station 105. The user equipment or UE 106 comprises a controller 202 operationally connected to a memory 203 and a transceiver 204. The controller 202 controls the operation of the user equipment 200. The memory 203 is configured to store software and data. The transceiver 204 is configured to set up and maintain a wireless connection to the base station 201. The transceiver is operationally connected to a set of antenna ports 205 connected to an antenna arrangement 206. The antenna arrangement 206 may comprise a set of antennas. The number of antennas may be one 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 figure due to simplicity. The base station or eNB 105 comprises a controller 207 operationally connected to a memory 208 and a

transceiver 209. The controller 207 controls the operation of the base station 105. The memory 208 is configured to store software and data. The transceiver 209 is configured to set up and maintain a wireless connection to the user equipment 106 within the service area of the base station 105. The transceiver 209 is operationally connected to an antenna arrangement 210. 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 base station may be operationally connected (directly or indirectly) to another network element 103 of the communication system. The network element 103 may be a visitor location register (VLR), MSC server (MSS), serving GPRS support node, MME (mobility management entity), a radio network controller (RNC), a gateway, or a server, for example. The base station may be connected to more than one network element. The base station 105 may comprise an interface 212 configured to set up and maintain connections with the network elements. The network element or VN 103 may comprise a controller 213 and a memory 214 configured to store software and data and an interface 215 configured to be in connection with the base station. The network element 103 may be operationally connected (directly or indirectly) to another network element 101 of the communication system. The network element 101 may be a home location register (HLR), home subscriber server (HSS), a database, a gateway, or a server, for example. The network element or HN 101 may comprise a controller 217 and a memory 218 configured to store software and data and an interface 219 configured to be in connection with the network element 103.

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 memory (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 firmware 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 having S60 operating system from Nokia Corporation. Thus, the application capabilities of the device according to various embodiments of the invention may include native S60 applications avail-able in the terminal, or subsequently installed applications. The messaging service center may be implemented in any network element, such as a server.

According to the minimization of drive-tests (MDT) functionality, MDT data collection may be carried out on a user terminal having a certain IMSI or IMEI number, for a specific area, or for a combination of these. In the case of area-based MDT data collection, the selection of the user terminal is carried out, for example, on the basis of certain user terminal capabilities (e.g. memory capacity, battery capacity, GPS module availability, logging support, and/or general MDT specific signaling support).

In an exemplary embodiment, a solution for MDT capability restriction is provided. In the exemplary embodiment, a home network operator has the possibility to restrict the participation of their own subscribers' user terminals in MDT data collection of while the user terminals are roaming in a visited network.

Currently, in a roaming scenario, there is no solution for the home network operator to restrict user terminal access with regard to support of MDT data collection in a visited network. This is because if the user terminal is roaming, HPLMN of the user terminal is not specifically involved in the MDT transaction, since MDT activation aims to carry out measurements for discovering coverage issues in a PLMN where the MDT activation has taken place (i.e. in the visited network). When the user terminal is roaming in a VPLMN the user terminal has a connection to the VPLMN operator's network, and when MDT data collection is activated, the HPLMN

operator has no possibility to act at that time in order to refuse any MDT data collection on the user terminal that is used by a HPLMN operator's subscriber.

However, the HPLMN operator may wish to refuse the participation of a certain subscriber's user terminal in the MDT data collection, while the user terminal is roaming. This is for a reason that MDT data collection may, for example, affect to the battery life/battery consumption of the user terminal. HPLMN operator may not want to have a negative effect in service usage during roaming, and thus HPLMN operator may wish to limit the number of events experienced by the user terminal in the visited network.

Therefore, in an exemplary embodiment, a new MDT UE capability parameter is created and maintained for identifying whether MDT data collection is supported or not. The parameter may be mapped to a subscription parameter that resides in a home location register. MDT UE capability parameter is configurable by the HPLMN operator, and it indicates whether MDT data collection is allowed or not regarding the user terminal in question in roaming scenarios. The configuration may be carried out via the network, i.e. the operator should be able to configure it from its network management system or from its provisioning system.

In an exemplary embodiment, MDT UE capability parameter is added to a subscription management (SuM) information model. The parameter may be on a user level. MDT UE capability parameter may be provisioned to a HLR/UDR database via a SuM interface. MDT UE capability parameter is stored in the HLR/UDR database. Once the subscriber (for which the parameter is to be set for MDT data collection restriction while roaming) makes a location update to the network or makes a mobile-terminated (MT) transaction (i.e. HLR is contacted for the subscriber), the value of the stored MDT UE capability parameter is signaled to the respective user terminal by kind of piggy backing it on the location update procedure or on any procedure that is between a home core

network node (e.g. HLR/HSS) and a visited core network node (e.g. VLR/MSC server/SGSN/MME). The visited core network node forwards the value of the MDT UE capability parameter to the user terminal via non-access stratum (NAS) signaling. When the user terminal receives the MDT UE capability parameter the user terminal is arranged to set the related MDT UE capability parameter according to the received value (e.g. the MDT UE capability parameter may be set to "MDT data collection NOT allowed in the visited network regarding the user terminal").

In a further exemplary embodiment, an indication may be forwarded from HPLMN to VPLMN by using a subscription parameter (e.g. access restriction) added in a user profile data, indicating to the visited network operator that MDT data collection is not allowed to be used for the user terminal in the visited network.

The signaling chart of Figure 3 illustrates the required signaling. In the example of Figure 3, a first network apparatus HN, which may comprise e.g. home location register (HLR), determines, in step 301, a minimization of drive-tests parameter value for a user terminal UE. The parameter value may indicate that collection of MDT data is not allowed in a roaming network VPLMN regarding the user terminal. The determined MDT capability parameter value regarding the user terminal UE may be stored to a subscription database in step 301. The user terminal UE may transmit a location update request message 302 to a second network apparatus VN. In response to receiving the location update request message, the second network apparatus VN transmits a location update info request message 303 to the first network apparatus HN. In response to receiving, in step 304, the location update info request message, the first network apparatus HN retrieves 304 and transmits 305, 306 the stored MDT capability parameter value regarding the user terminal UE to the user terminal e.g. via the second network apparatus VN. In step 307, the user terminal receives the parameter and

sets it accordingly (e.g. to the MDT UE capability parameter may be set to "MDT data collection NOT allowed in the visited network regarding the user terminal UE") in order to restrict collection of minimization of drive-tests data in a roaming network regarding the user terminal. Instead of a location update procedure, the MDT data collection restriction may be triggered in response to receiving, in HN, any other message related to a mobile-terminated procedure regarding the user terminal. In a message 308, VN (or some other roaming network node) may transmit an MDT signal, the signal indicating that the user terminal is requested to provide minimization of drive-tests data to the roaming network. In response to receiving the MDT signal in the user terminal UE, the user terminal is configured to check 309 the minimization of drive-tests parameter value regarding the user terminal, wherein if the minimization of drive-tests parameter value regarding the user terminal indicates that collection of minimization of drive-tests data is not allowed in the roaming network regarding the user terminal, the user terminal UE refuses to provide MDT data regarding the user terminal UE to the visited network VPLMN. Then the user terminal may or may not send an indication to the roaming network that collection of MDT data is not allowed in the roaming network regarding the user terminal.

In an embodiment, HN transmits to the roaming network VPLMN an indication that collection of minimization of drive-tests data is not allowed in the roaming network regarding the user terminal, wherein the VPLMN is configured to restrict MDT data collection for the user terminal UE (wherein the steps 306, 307, 308, 309 are not necessary). The indication may be forwarded from HPLMN to VPLMN by using a subscription parameter (e.g. access restriction) added in a user profile data, indicating to the visited network operator that MDT data collection is not allowed to be used for the user terminal in the visited network.

Figure 4 is a flow chart illustrating a non-limiting embodiment of the invention. In step 401, the network element determines the user equipment specific value of the MDT capability restriction parameter. In step 402, the network element stores the value e.g. to the HLR/UDR database. In step 403, the network element receives a location update info request from a visited network element regarding the user terminal. In step 404, the network element transmits the parameter value to UE and/or to VN.

Figure 5 is a flow chart illustrating a non-limiting embodiment of the invention. In step 501, the network element receives a location update request message (or some other UE-related message) from the user terminal. In step 502, the network element transmits a location update info request message to a home network element. In step 503, the network element receives the user equipment specific value of the MDT capability restriction parameter from HN. In step 504, the network element may transmit the value e.g. to the user terminal. In step 505, the network element may transmit an MDT signal to the user terminal (or the network element may restrict the MDT data collection based on step 503, wherein steps 504, 505 are not necessary).

Figure 6 is a flow chart illustrating a non-limiting embodiment of the invention from the user equipment's point of view. In step 601, the user equipment transmits a location update request message to a visited network element. In step 602, the user equipment receives the user equipment specific value of the MDT capability restriction parameter from VN. In step 603, the user equipment sets the value of parameter. In step 604, the user equipment may receive an MDT signal from VN. In step 604, the user equipment checks the parameter value and if the parameter value is set to indicate that MDT data collection NOT allowed in the visited network regarding the user equipment, the user equipment refuses to provide MDT data to the visited network.

Thus, an exemplary embodiment enables determining 301, in a home network element HN, an MDT parameter value for a user terminal UE, the parameter value indicating whether or not collection of minimization of drive-tests data is allowed in a roaming network regarding the user terminal. Information on the parameter value is provided 305, 306 from a network apparatus HN, VN to the user terminal UE in order to restrict collection of minimization of drive-tests data in the roaming network regarding the user terminal UE. The provision of the parameter to the user terminal UE is performed e.g. in connection with a location update procedure of the user terminal UE in the roaming network.

The steps, signaling messages and related functions described in Figures 1 to 6 are in no absolute chronological order, and some of the steps may be performed simultaneously or in an order differing from the given one. Other functions can also be executed between the steps or within the steps and other signaling messages sent between the illustrated messages. Some of the steps can also be left out or replaced with a corresponding step. The signaling 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.

An apparatus able to perform the above-described steps may be implemented as an electronic digital computer, which may comprise a working memory (RAM), a central processing unit (CPU), and a system clock. The CPU may comprise a set of registers, an arithmetic logic unit, and a control unit. The control unit is controlled by a sequence of program instructions transferred to the CPU from the RAM. The control unit may contain a number of microinstructions for basic operations. The implementation of microinstructions may vary depending on the CPU design. The program instructions may be coded by a programming language, which may be a high-level programming language, such as C, Java, etc., or a low-level programming language, such as a machine language, or an

assembler. The electronic digital computer may also have an operating system, which may provide system services to a computer program written with the program instructions.

An embodiment provides a computer program embodied on a distribution medium, comprising program instructions which, when loaded into an electronic apparatus, are configured to control the MDT data collection restriction of a user equipment as described above.

The computer program may be in source code form, object code form, or in some intermediate form, and it may be stored in some sort of carrier, which may be any entity or device capable of carrying the program. Such carriers include a record medium, computer memory, read-only memory, an electrical carrier signal, a telecommunications signal, and a software distribution package, for example. Depending on the processing power needed, the computer program may be executed in a single electronic digital computer or it may be distributed amongst a number of computers.

The apparatus may also be implemented as one or more integrated circuits, such as application-specific integrated circuits ASIC. Other hardware embodiments are also feasible, such as a circuit built of separate logic components. A hybrid of these different implementations is also feasible. When selecting the method of implementation, a person skilled in the art will consider the requirements set for the size and power consumption of the apparatus, the necessary processing capacity, production costs, and production volumes, for example.

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.

List of abbreviations

MDT minimization of drive-tests,
HLR home location register,
VLR visitor location register,
UDR user data repository,
RNC radio network controller,
UE user equipment,
SuM subscription management,
NRM network resource model,
NAS non-access stratum,
RRC radio resource control,
IMSI international mobile subscriber identity,
IMEI international mobile equipment identity,
HPLMN home public land mobile network,
VPLMN visited public land mobile network,
HSS home subscriber server,
MSC mobile switching center,
MSS MSC server,
SGSN serving GPRS support node,
GPRS general packet radio service,
MME mobility management entity,
GSM global system for mobile communications,
EDGE enhanced data rates for GSM evolution,
WCDMA wideband code division multiple access,
LTE long-term evolution,
GPS global positioning system.

Claims

1. A method comprising
determining, in a network apparatus, a minimization of drive-tests parameter value for a user terminal, said parameter value indicating that collection of minimization of drive-tests data is not allowed in a roaming network regarding the user terminal; and
providing information on the parameter value from the network apparatus to the user terminal in order to restrict collection of minimization of drive-tests data in the roaming network regarding the user terminal.

2. A method according to claim 2, wherein the method comprises storing the minimization of drive-tests parameter value regarding the user terminal to a subscription database.

3. A method according to claim 1 or 2, wherein
in response to receiving, in the network apparatus, a message related to a mobile-terminated procedure regarding the user terminal roaming in a roaming network, the method comprises retrieving the stored minimization of drive-tests parameter value regarding the user terminal; and
providing information on the parameter value to the user terminal

4. A method according to claim 2 or 3, wherein
in response to receiving, in a network apparatus, a message related to a location update procedure regarding the user terminal roaming in a roaming network, the method comprises retrieving the stored minimization of drive-tests parameter value regarding the user terminal; and
providing information on the retrieved parameter value to the user terminal.

5. A method according to any of claims 1 to 4, wherein the method comprises transmitting, from the network apparatus to the roaming network, an indication that collection of

minimization of drive-tests data is not allowed in the roaming network regarding the user terminal.

6. A method comprising
receiving, in a user terminal, information on the minimization of drive-tests parameter value regarding the user terminal, the parameter value indicating that collection of minimization of drive-tests data is not allowed in a roaming network regarding the user terminal; and
setting, in the user terminal, the received parameter value in order to restrict collection of minimization of drive-tests data in the roaming network regarding the user terminal.

7. A method according to claim 6, wherein
in response to receiving, in the user terminal, a collection of minimization of drive-tests data signal from the roaming network, the signal indicating that the user terminal is requested to provide minimization of drive-tests data to the roaming network, the method comprises
checking, in the user terminal, the minimization of drive-tests parameter value regarding the user terminal, wherein if the minimization of drive-tests parameter value regarding the user terminal indicates that collection of minimization of drive-tests data is not allowed in the roaming network regarding the user terminal, the method comprises
refusing, in the user terminal, to provide minimization of drive-tests data regarding the user terminal to the visited network.

8. A method according to claim 6 or 7, wherein the method comprises transmitting, from the user terminal, an indication to the roaming network that collection of minimization of drive-tests data is not allowed in the roaming network regarding the user terminal.

9. A method comprising

receiving, in a network apparatus, information on a minimization of drive-tests parameter value for a user terminal, said parameter value indicating that collection of minimization of drive-tests data is not allowed in a roaming network regarding the user terminal; and
restricting the collection of minimization of drive-tests data in the roaming network regarding the user terminal based on the received minimization of drive-tests parameter value.

10. A method according to claim 9, wherein the method comprises storing, in the roaming network, the minimization of drive-tests parameter value regarding the user terminal.

11. An apparatus configured to
determine, a minimization of drive-tests parameter value for a user terminal, said parameter value indicating that collection of minimization of drive-tests data is not allowed in a roaming network regarding the user terminal; and
provide information on the parameter value to the user terminal in order to restrict collection of minimization of drive-tests data in the roaming network regarding the user terminal.

12. An apparatus according to claim 11, wherein the apparatus is configured to store the minimization of drive-tests parameter value regarding the user terminal to a subscription database.

13. An apparatus according to claim 12, wherein the apparatus is configured to
in response to receiving a message related to a mobile-terminated procedure regarding the user terminal roaming in a roaming network,
retrieve the stored minimization of drive-tests parameter value regarding the user terminal; and
provide information on the retrieved parameter value to the user terminal.

14. An apparatus according to claim 12 or 13, wherein the apparatus is configured to
in response to receiving a message related to a location update procedure regarding the user terminal roaming in a roaming network,
retrieve the stored minimization of drive-tests parameter value regarding the user terminal; and
provide information on the retrieved parameter value to the user terminal.

15. An apparatus configured to
receive, from a network apparatus, information on the minimization of drive-tests parameter value regarding a user terminal, the parameter value indicating that collection of minimization of drive-tests data is not allowed in a roaming network regarding the user terminal; and
set, in the user terminal, the received parameter value in order to restrict collection of minimization of drive-tests data in the roaming network regarding the user terminal.

16. An apparatus according to claim 15, wherein the apparatus is configured to
in response to receiving a collection of minimization of drive-tests data signal from the roaming network, the signal indicating that the user terminal is requested to provide minimization of drive-tests data to the visited network,
check the minimization of drive-tests parameter value regarding the user terminal, wherein
if the minimization of drive-tests parameter value regarding the user terminal indicates that collection of minimization of drive-tests data is not allowed in the roaming network regarding the user terminal, the apparatus is configured to refuse to provide minimization of drive-tests data regarding the user terminal to the visited network.

17. An apparatus configured to
receive, from a network apparatus, information on a minimization of drive-tests parameter value for a user

terminal, said parameter value indicating that collection of minimization of drive-tests data is not allowed in a roaming network regarding the user terminal; and
restrict the collection of minimization of drive-tests data in the roaming network regarding the user terminal based on the received minimization of drive-tests parameter value.

18. An apparatus according to claim 17, wherein the apparatus is configured to store, in the roaming network, the minimization of drive-tests parameter value regarding the user terminal.

19. A computer readable memory embodying a program of instructions executable by a processor to perform actions of determining a minimization of drive-tests parameter value for a user terminal, said parameter value indicating that collection of minimization of drive-tests data is not allowed in a roaming network regarding the user terminal; and
providing information on the parameter value to the user terminal in order to restrict collection of minimization of drive-tests data in the roaming network regarding the user terminal.

20. A computer readable memory embodying a program of instructions executable by a processor to perform actions directed toward
receiving information on the minimization of drive-tests parameter value regarding a user terminal, the parameter value indicating that collection of minimization of drive-tests data is not allowed in a roaming network regarding the user terminal; and
setting the received parameter value in the user terminal in order to restrict collection of minimization of drive-tests data in the roaming network regarding the user terminal.

21. A computer readable memory embodying a program of instructions executable by a processor to perform actions of

receiving, from a network apparatus, information on a minimization of drive-tests parameter value for a user terminal, said parameter value indicating that collection of minimization of drive-tests data is not allowed in a roaming network regarding the user terminal; and

restricting the collection of minimization of drive-tests data in the roaming network regarding the user terminal based on the received minimization of drive-tests parameter value.

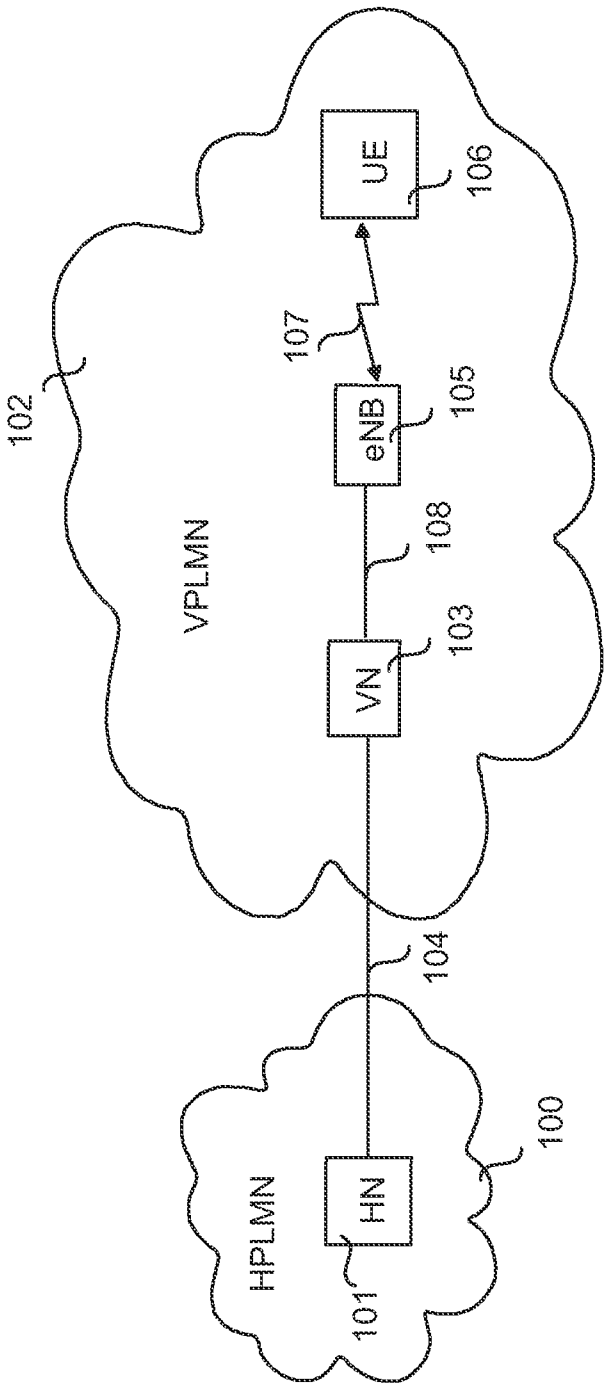

Fig. 1

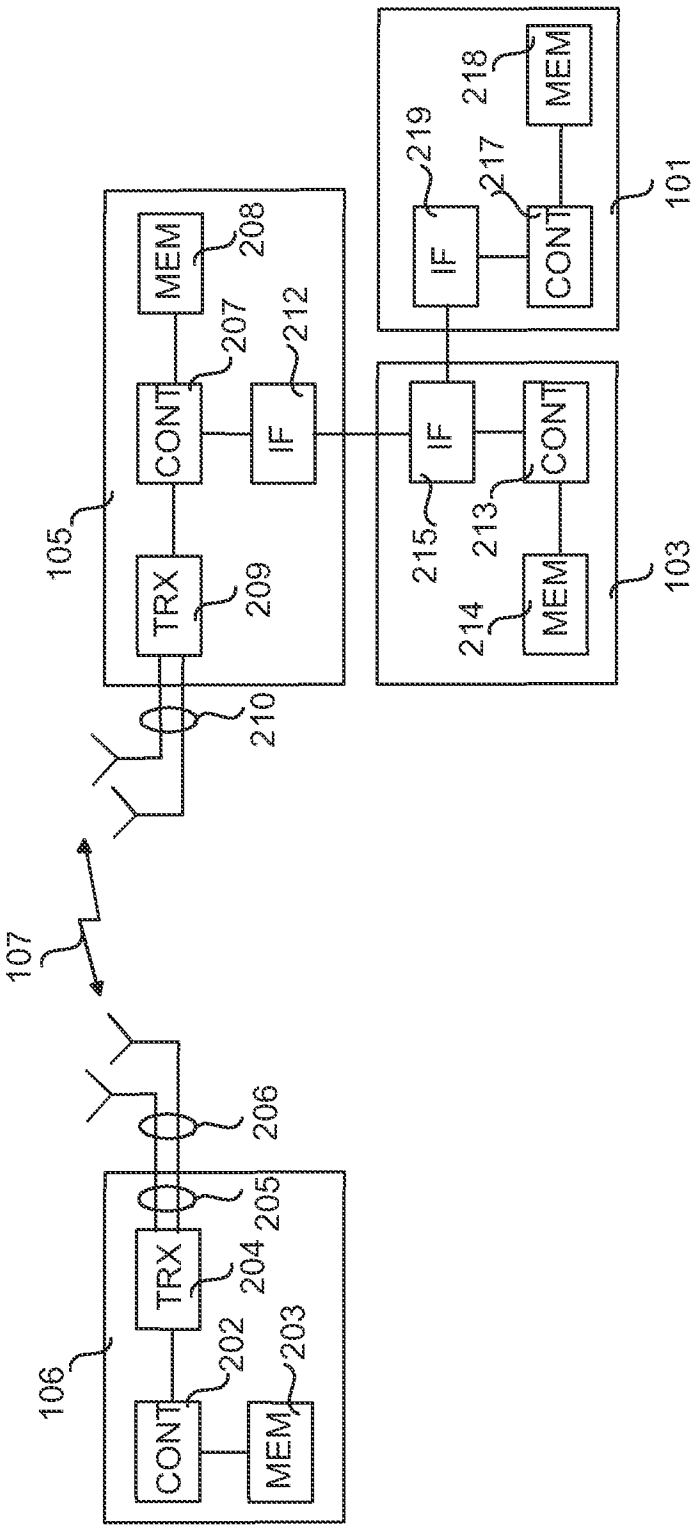
106
CONT
MEM
TRX
202
203
204
205
206
107
105
CONT
MEM
TRX
IF
207
208
209
210
212
103
IF
CONT
MEM
213
214
215
101
IF
CONT
MEM
217
218
219

Fig. 2

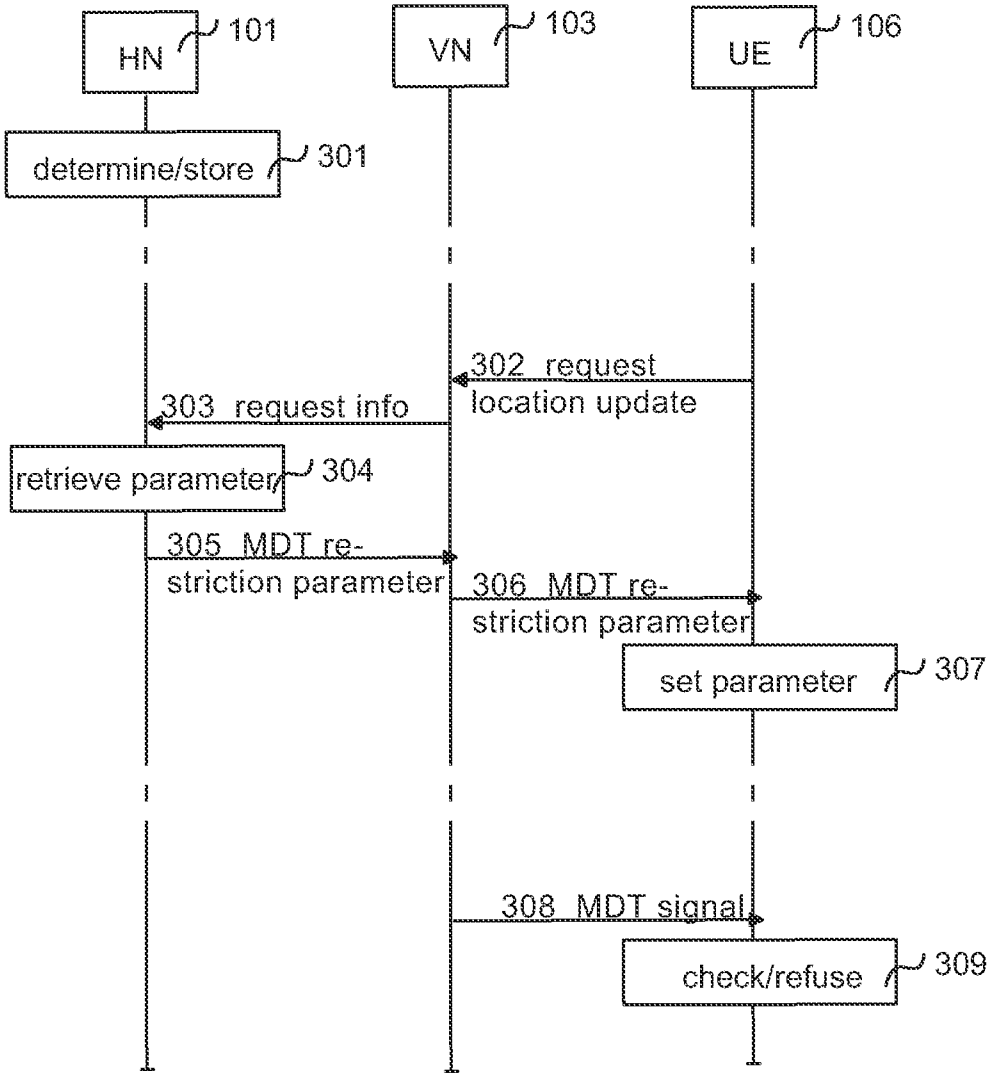
HN
101
VN
103
UE
106
determine/store
301
302 request location update
303 request info
retrieve parameter
304
305 MDT re-striction parameter
306 MDT re-striction parameter
set parameter
307
308 MDT signal
check/refuse
309

Fig. 3

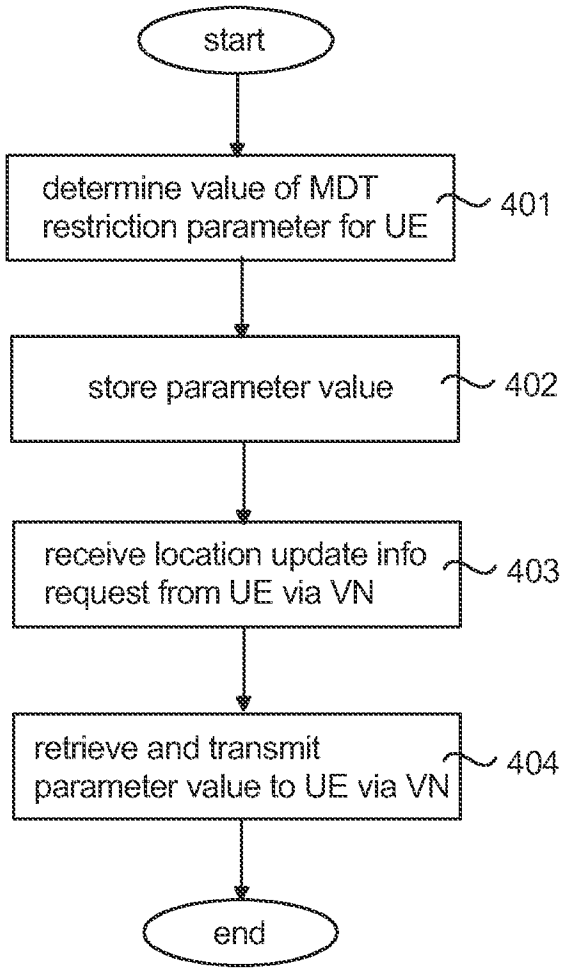
start
determine value of MDT restriction parameter for UE
401
store parameter value
402
receive location update info request from UE via VN
403
retrieve and transmit parameter value to UE via VN
404
end

Fig. 4

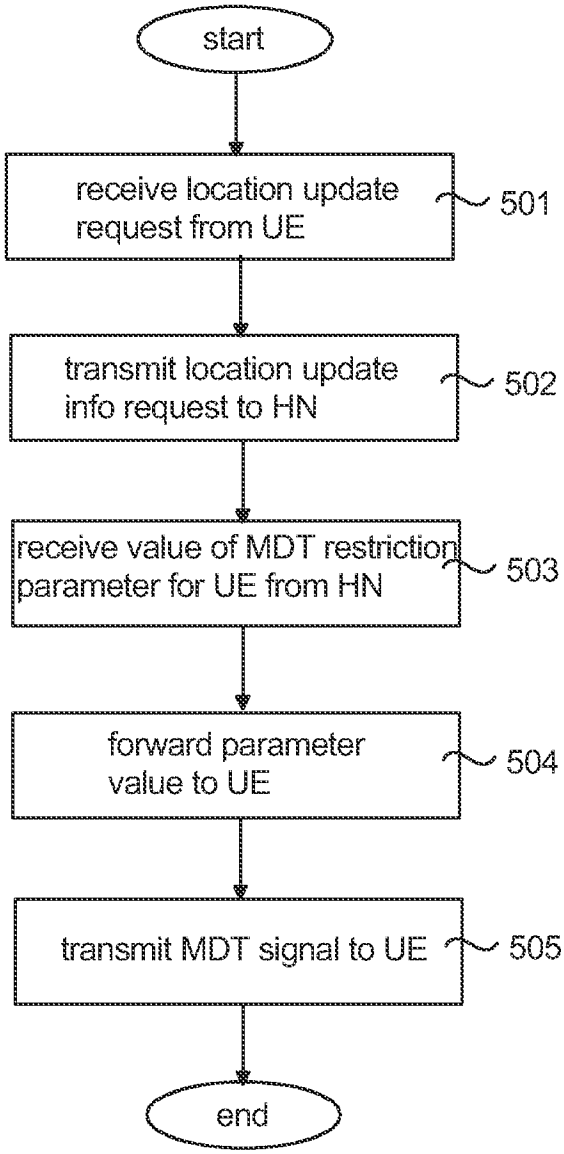
start
receive location update request from UE
501
transmit location update info request to HN
502
receive value of MDT restriction parameter for UE from HN
503
forward parameter value to UE
504
transmit MDT signal to UE
505
end

Fig. 5

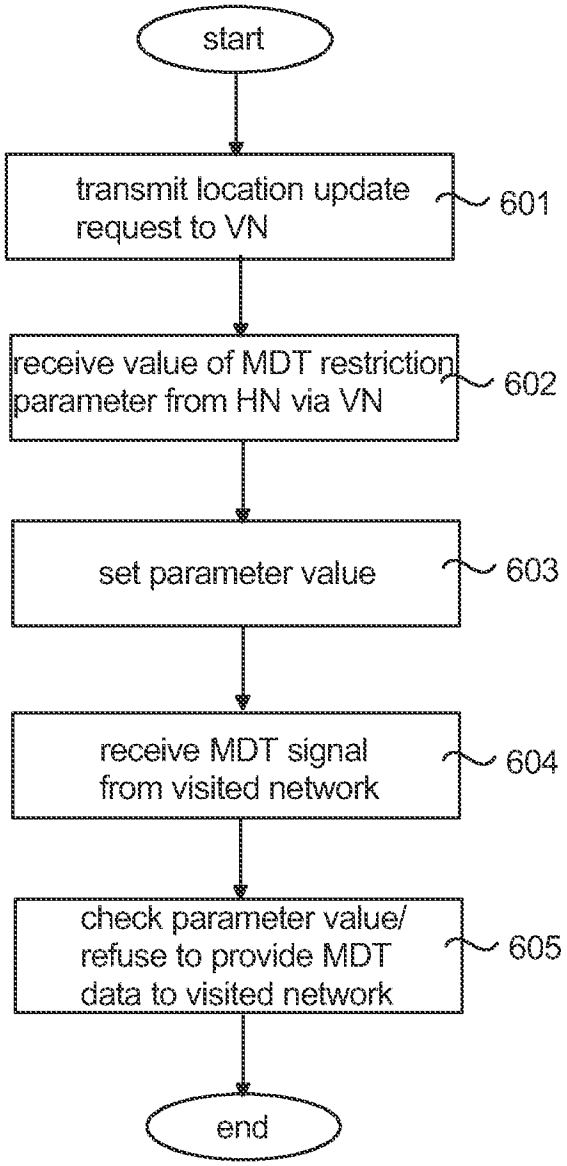
start
transmit location update request to VN
601
receive value of MDT restriction parameter from HN via VN
602
set parameter value
603
receive MDT signal from visited network
604
check parameter value/ refuse to provide MDT data to visited network
605
end

Fig. 6

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2010/061837

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04W24/00
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 practical, search terms used)

EPO-Internal, INSPEC, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	NTT DOCOMO ET AL: "MDT support for roaming and network sharing scenarios", 3GPP DRAFT; R2-103873_MDTSUPPORTFORROAMINGNWSHARING, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE, vol. RAN WG2, no. Stockholm, Sweden; 20100628, 22 June 2010 (2010-06-22), XP050451273, [retrieved on 2010-06-22] the whole document ----- -/--	1-21

[X] Further documents are listed in the continuation of Box C.

[X] 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	Date of mailing of the international search report
14 April 2011	28/04/2011

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Heinrich, Dietmar

1

Form PCT/ISA/210 (second sheet) (April 2005)

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2010/190488 A1 (JUNG SUNG-HOON [KR] ET AL) 29 July 2010 (2010-07-29) paragraph [0002] paragraph [0024] paragraph [0086] - paragraph [0105] -----	1-21
A	"3rd Generation Partnership Project;Technical Specification Group TSG RANUniversal Terrestrial Radio Access (UTRA) and Evolved Universal Terrestrial Radio Access (E-UTRA);Radio measurement collection for Minimization of Drive Tests (MDT);Overall description; Stage 2(Release 10)", 3GPP DRAFT; 37320-070, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE, vol. RAN WG2, no. Stockholm, Sweden; 20100628, 2 July 2010 (2010-07-02), XP050451420, [retrieved on 2010-07-02] the whole document -----	1-21

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2010/061837

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2010190488 A1	29-07-2010	WO 2010087625 A2	05-08-2010