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(54) **Title**: MINIMIZATION OF DRIVE TESTS IN A MOBILE COMMUNICATIONS NETWORK

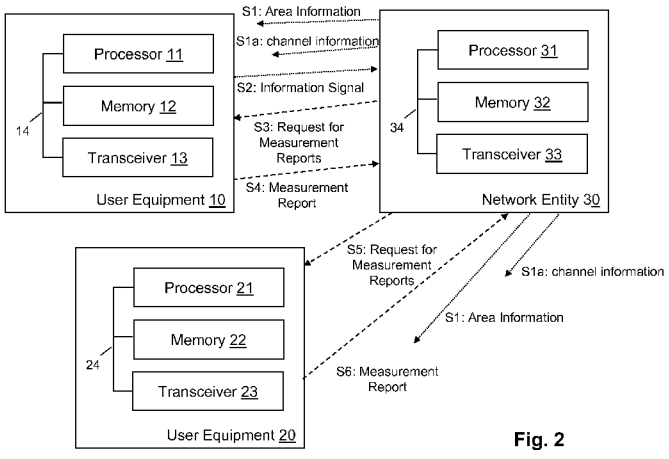


Fig. 2

(57) **Abstract**: A network entity (30) provides area information indicating areas of a mobile communications network, which are at least partially located in a coverage area of the network entity (30) and in which measurements regarding minimization of drive tests are to be performed, and broadcasts the area information (S1). A user equipment (10) receives the area information and determines, based on the area information, that it is in such measurement area, and transmits an information signal which indicates that it is located in the measurement area (S2). In case the user equipment (10) is in an idle mode, the information signal may be transmitted on a specific random access channel during a location update procedure. The specific random access channel may be selected from specific random access channel sequences predefined for the mobile communications network or different between network entities. The network entity (30) may reserve the specific random access channel sequences and indicate them to user equipments via a broadcast control channel and an extended random access channel configuration message (S1a).

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Description

Title

Minimization of Drive Tests in a Mobile Communications Network

The present invention relates to minimization of drive tests in a mobile communications network.

A typical task of operators is to optimize their networks with regard to coverage and capacity and, traditionally, problems like cell edge performance issues or coverage holes are identified by manual operator drive test runs which are a costly exercise for them.

Therefore, 3GPP (third generation partnership project) is investigating for Release 9/10 use cases for aiming at discovering the coverage and capacity problems automatically by support of UE (user equipment) based measurement reporting and avoiding manual testing. Mainly the measurement collection is seen as essential information basis to improve continuous coverage, reduce interference and provide increased capacity of the system and is input to OAM (operation and maintenance) related optimization algorithms.

Nowadays 3GPP standardization for LTE (long term evolution) is discussing in detail the following network optimization features which benefit from those automated measurement collections: Optimization of cell reselection and handover parameters for mobility robustness and load balancing, improvement of cell coverage and capacity, optimization of common channel configuration and minimization of drive tests (MDT).

In principle the approach for drive test minimization is to define on one hand the needed measurements for the use cases

like coverage and mobility optimization, radio access failure, RRC (radio resource control) message delivery failure, BCH (broadcast channel) failure, etc., and on the other hand find reasonable triggers to reduce amount of logging and reporting. Essential measurement data to be logged are location information, radio link failure events, throughputs, RSRP (reference signal received power) and RSRQ (reference signal received quality).

As mentioned above, part of drive test optimization discussion in standardization are solutions regarding needed measurement triggers and measurements like location information which is available from RAN (radio access network) perspective for UEs in connected mode at eNB (evolved node B) with cell level resolution.

Fig. 1 shows a basic system architecture and procedure for minimization of drive tests (MDT) studied in 3GPP. A UE informs a network entity of its logging/reporting capability. Based on the UE capability, an OAM policy & requirement enforcement function of the network entity provides logging and reporting configurations to the UE which are processed by a reporting configuration function and a measurement reporting function of the UE. The reporting configuration function and the measurement reporting function prepare and transmit a measurement log report to the network entity which is stored in a log storage of the network entity.

Currently, the following reporting triggers are under discussion: Absolute time based, on demand, periodical time based, UE memory usage based, when UE leaves measurement campaign (e.g. due to battery status), and absolute location based.

For the absolute location based trigger, the lowest granulation currently discussed is a cell area or registration area (groups of cells) which is implicitly known by the network

for each UE in idle or connected mode for communication and paging issue.

Operators are doing drive tests usually in small areas and then area by area. This is especially the case since for those kind of troubleshooting measurements, only very limited spots of a cell are relevant (e.g. some small part of the cell edge region or a critical handover area of a suburban motorway passage). Further service dependent optimization is often important especially in urban cells with hot spots and highly unequal requirements. Therefore, in those realistic problem cases collecting measurements from a large network area (multi cell area) or even from a whole, but specifically selected cell, would waste data base storage capacity, network capacity and UE battery consumption due to collection of mostly irrelevant data.

Therefore, a major problem currently is that from network architecture and UE perspective there is no MDT enhanced and efficient absolute location based selection possibility for UEs to do MDT measurements for limited spot troubleshooting.

Further, to utilize UE memory needed for recording and averaging of measurement data efficiently and to minimize needed network capacity for transmission of measurement data, controlling means are missing from network side.

The present invention aims at solving the above problems.

This is achieved by the apparatuses and methods as defined in the appended claims. The invention may also be implemented by a computer program product.

In the following, embodiments of the invention will be described with reference to the accompanying drawings, in which:

Fig. 1 shows a schematic diagram illustrating a procedure for minimization of drive test measurement reporting according to the prior art;

Fig. 2 shows a schematic block diagram illustrating structures of user equipments and a network entity and communication between them according to an embodiment of the invention;

Fig. 3 shows a diagram illustrating a principle of MDT measurement areas and UE specific procedures according to an embodiment of the invention; and

Fig. 4 shows a diagram illustrating a situation in which a non-GPS but MDT capable UE is triggered for MDT reporting by a GPS UE according to an embodiment of the invention.

Regarding an information flow mechanism of measurements for MDT between a UE and an OAM (operation and maintenance instance), two basic cases for minimization of drive tests can be distinguished:

UE to OAM direct interface architecture: Here an eNB is transparent. In principle an OAM drive test server initiates a connection to a UE for requesting measurements, and the UE reports measurement results to the OAM drive test server. All communication between server and UE is based on user-plane bearers. In principle this solution is similar to already available proprietary solutions for "Test UEs" reporting through user-plane.

However, a problem of the "UE to OAM direct interface architecture" is that it is initially not aware of a location of each UE and there may be a need to query location information of many UEs until some UEs are found to be located in the

small spot of interest. Further, UEs which are in principle at right position (cell spot under interest) but are in idle mode cannot be reached efficiently for requesting measurements.

eNB involved control plane architecture: An eNB can request UEs to make measurements. The UE then performs measurements and reports the results to the eNB. The communication between UE and eNB is assumed to be point to point control plane communication based on RRC signaling. The eNB can then be managed by an OAM drive test server that requests needed measurements from the eNB and that receives the results from UEs.

As explained above, for typical operator drive tests usually specific small areas are important and then optimization of a network is done area by area. According to an embodiment of the invention, even finer granularity than cell level resolution is available by taking into account neighbor cell and timing advance measurements. Further in addition to the 3GPP system provided means for localization, there is also GPS (global positioning system) location modules included in numerous UEs and smart phones for street map and navigation type applications which are utilized according to an embodiment of the invention.

Fig. 2 shows a schematic block diagram illustrating structures of user equipments and a network entity and communication between them according to an embodiment of the invention.

A user equipment (UE) 10 which according to an embodiment may be a GPS and MDT capable UE, comprises a processor 11, a memory 12 and a transceiver 13 which are connected by a bus 14.

A user equipment (UE) 20 which according to an embodiment may be a non-GPS, MDT capable UE, comprises a processor 21, a

memory 22 and a transceiver 23 which are connected by a bus 24.

A network entity 30 which may be a base station or eNB comprises a processor 31, a memory 32 and a transceiver 33 which are connected by a bus 34.

The memories 12, 22, 32 may store programs, and the transceivers 13, 23, 33 may be suitable radio frequency (RF) transceivers coupled to one or more antennas (not shown) for bidirectional wireless communications over one or more wireless links 20 between the user equipments 10, 20 and the network entity 30.

The terms "connected," "coupled," or any variant thereof, mean any connection or coupling, either direct or indirect, between two or more elements, and may encompass the presence of one or more intermediate elements between two elements that are "connected" or "coupled" together. The coupling or connection between the elements can be physical, logical, or a combination thereof. As employed herein two elements may be considered to be "connected" or "coupled" together by the use of one or more wires, cables and printed electrical connections, as well as by the use of electromagnetic energy, such as electromagnetic energy having wavelengths in the radio frequency region, the microwave region and the optical (both visible and invisible) region, as non-limiting examples.

At least one of the programs stored in the memories 12, 22, 32 is assumed to include program instructions that, when executed by the associated processor 11, 21, 31, enable the electronic device to operate in accordance with the exemplary embodiments of this invention, as detailed below. Inherent in the processors 11, 21, 31 is a clock to enable synchronism among the various apparatus for transmissions and receptions within the appropriate time intervals and slots required, as

the scheduling grants and the granted resources/subframes are time dependent. The transceivers 13, 23, 33 include both transmitter and receiver, and inherent in each is a modulator/demodulator commonly known as a modem.

In general, the exemplary embodiments of this invention may be implemented by computer software stored in the memories 12, 22, 32 and executable by the processors 11, 21, 31, or by hardware, or by a combination of software and/or firmware and hardware in any or all of the devices shown.

In general, the various embodiments of the user equipment 10, 20 can include, but are not limited to, mobile stations, cellular telephones, personal digital assistants (PDAs) having wireless communication capabilities, portable computers having wireless communication capabilities, image capture devices such as digital cameras having wireless communication capabilities, gaming devices having wireless communication capabilities, music storage and playback appliances having wireless communication capabilities, Internet appliances permitting wireless Internet access and browsing, as well as portable units or terminals that incorporate combinations of such functions.

The memories 12, 22, 32 may be of any type suitable to the local technical environment and may be implemented using any suitable data storage technology, such as semiconductor-based memory devices, magnetic memory devices and systems, optical memory devices and systems, fixed memory and removable memory. The processors 11, 21, 31 may be of any type suitable to the local technical environment, and may include one or more of general purpose computers, special purpose computers, microprocessors, digital signal processors (DSPs) and processors based on a multi-core processor architecture, as non-limiting examples.

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

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

According to an embodiment of the invention, in order to optimize a network such as a mobile communications network area by area, according to an embodiment of the invention, the following MDT procedures are designed for minimal UE complexity and minimum network capacity needs.

The network, e.g. the network entity 30, indicates an area where MDT measurements are needed. For this purpose, higher layer signaling on BCCH may be used by the network entity 30 to signal MDT measurement areas. The MDT measurement areas may be signaled by various means, e.g.:

- as a list of GPS location points and a radius around the GPS location points where measurements shall be reported by UEs;
- as a timing advance value TA_{value}, wherein a measurement area is reached when a value $TA_{UE,eNB}$ of timing advance between a UE and an eNB exceeds the timing advance value TA_{value};
- as a list of PCIs of neighboring cells; and

- any combination of the above mentioned means.

In other words, the network entity 30, e.g. its processor 31, provides area information indicating areas of a mobile communications network, in which measurements regarding minimization of drive tests are to be performed. The area information is broadcast (step S1), e.g. by the transceiver 33, for example in a higher layer signaling on a broadcast control channel. The area information describes an area usually smaller than a coverage area of the transceiver 33 or network entity 30. In other words, the MDT measurement areas are at least partially located in the coverage area. The MDT measurement areas are not identical with a cell or coverage area served by the transceiver 33 or network entity 30, and usually are smaller than the cell or coverage area. Thus, the area information describing the MDT measurement areas is different from conventional cell specific information provided by the network entity 30.
The user equipment 10, 20, e.g. its transceiver 13, 23, receives the area information. In case it is determined, e.g. by the processor 11, 21, based on the area information, that the user equipment 10, 20 is in an area of those areas (drive test area), an information signal is transmitted, e.g. by the transceiver 13, 23, which indicates that the user equipment 10, 20 is located in the area. Fig. 2 shows transmittal of the information signal from user equipment 10 to the network entity 30 in step S2.

In case the user equipment 10 is in an active/connected mode and enters the area where MDT measurements are requested by the network (e.g. GPS capable UE), it indicates to the network entity 30 by higher layer signaling that it is in the drive test area.

In case the user equipment 10 is in idle mode and enters the area where MDT measurements are requested (e.g. GPS capable

UE, or MDT able UE which identified it by other means) or is located at the area where MDT measurements are requested may be using during periodic location update procedure a specific RACH signal to indicate to the network entity 30 that it is located where MDT measurements are needed.

Therefore, the network entity 30 may reserve specific RACH sequences for this purpose. The reserved specific sequences can be indicated to the user equipments 10, 20 via BCCH, and an extended RACH configuration message can be used (step S1a).

The sequences used by the user equipments 10, 20 to indicate that the user equipment 10, 20 is located where MDT measurements are needed can be predefined for the whole network or can be different from network entity to network entity, e.g. from eNB to eNB.

The network entity 30 may activate idle mode UEs for measurements via paging procedure. After the user equipment 10 has sent a RACH signal (information signal on specific random access channel) the network entity 30 sets up a data channel and requests measurement reports (step S3).

In active/connected mode the network entity 30 may request measurement reports from the user equipment 10 via control plane signaling (step S3).

Upon receiving the request, the user equipment 10 prepares a measurement report including minimization of drive tests parameters and transmits the measurement report to the network entity 30 (step S4).

According to an embodiment of the invention, the user equipment 10 may prepare and transmit the measurement report when

it enters the area where MDT measurements are requested, without waiting for a request for measurement reports.

To save UE battery consumption after indication of appropriate MDT location a timer may be started in the user equipment 10. When the timer is expired, the user equipment 10 is checking its position again. If the position of the user equipment 10 is not any more in the area where MDT measurements are requested, the user equipment signals via location update procedure and specific RACH signaling that it has left the drive test area.

In other words, after the information signal has been sent in step S2, the user equipment 10. e.g. its processor 11, checks whether the user equipment 10 is still in the area, and if the user equipment 10 is not in the area anymore, an indication is transmitted, e.g. by the transceiver 13, that the user equipment 10 has left the area on a specific random access channel during a location update procedure.

Operators may provoke specific region reporting, especially for non-GPS UEs, by temporary placing a femto cell to this region (e.g. partial co-channel deployment, or for LTE-A (long term evolution advanced) utilizing a specific component carrier only), where the femto cell has a CSG identification. CSG stands for closed subscriber group, and user equipments not being subscribed to this group, will not enter and camp on this femto cell. For this particular application, the CSG is empty, thus none of the user equipments in vicinity will enter this femto cell, but all will read its femto PCI (physical cell identification). By this means, the operator can provoke reporting from a certain region, in transmitting the timing advance value and this specific PCI as reporting trigger.

In other words, according to an embodiment of the invention the area information comprises a list of physical layer cell identifications of neighboring cells and a timing advance value, and the user equipment 10, e.g. its processor 11, determines that it is in the drive test area, when a physical layer cell identification is received e.g. by the transceiver 13, which is present in the list and a measured timing advance value measured by the user equipment 10 exceeds the timing advance value.

Instead of temporarily placing a femto cell in a specific region, femto stations used as HNB (home node B) may be used as trigger elements. The operator has a database on the HNB locations. Using an OAM center, a transmit power of a specific HNB gets increased to its maximum, to improve outdoor visibility to all UEs. Usually an unwanted effect, does this temporary measure enable an MDT measurement trigger for non-GPS UEs.

In other words, the user equipment 10 may determine that it is in the drive test area, when it receives a signal from a specific base station.

According to a further embodiment of the invention, a GPS and MDT capable UE is used as a scouting UE, e.g. the user equipment 10. If such scouting UE is in a drive test area, it starts to report different values including a timing advance value and a PCI neighbor list, and how strong neighbor cells are read (RSSI). Non-GPS but MDT enabled UEs (e.g. user equipment 20) which are delivering within a range the same PCI list and measurements can be assumed to be also in the drive test area. The network entity 30 activates now the user equipment 20 to report also the additional MDT parameters (steps S5 and S6).

In other words, the network entity 30, e.g. its processor 31, compares measurement values received from the user equipment 10 within the drive test area, which has indicated to be in the area, with measurement values received from the user equipment 20 which has not indicated to be in the area, and in case the measurement values are similar, activates the user equipment 20 to transmit reports on measurements regarding minimization of drive tests (step S5).

When the user equipment 20, e.g. its transceiver 23, receives the request for measurement reports, a measurement report is prepared e.g. by the processor 21, which includes minimization of drive tests parameters, and is transmitted to the network entity 30 (step S6).

Fig. 3 shows an example where a measurement area (drive test area) is defined as a region where a timing advance value $TA_{UE,eNB}$ of a UE is higher than a threshold TA_{value}. MDT measurement area information is broadcast via a base station (e.g. NB or eNB) broadcast control channel (BCCH). Only a UE 10a in the measurement area can provide needed measurements for eNB or OAM (operation and management) and therefore a UE 10b not located in the measurement area is using conventional RACH and location update procedure. The UE 10a - if in idle mode - in the measurement area however indicates to the network entity 30, that it has entered or is located in an MDT measurement area. As described above this is done without the need for additional signaling. The UE 10a is utilizing a specific location update procedure e.g. by using specific predefined RACH sequences.

A UE timer ensures that a UE in the measurement area periodically checks if it is still located in the network or base station configured MDT measurement area. If a UE in idle mode detects during these periodic measurements that it is not any more located in the measurement area it will utilize immedi-

ately or during the next location update procedure a specific RACH sequence to indicate to the network that it is not any more in an MDT measurement area.

Fig. 4 shows an example how a non-GPS but MDT capable UE 20 gets triggered for MDT reporting by a GPS UE 10. A measurement area (drive test area) is defined by GPS coordinates and radius. MDT measurement area information is broadcast via a base station (e.g. NB or eNB) broadcast control channel (BCCH). The UE 10 which has indicated to a network 30 to be in the drive test area also reports RSSI and PCI data. The UE 20 reports similar RSSI and PCI data to the network 30 since it is in the same region as the UE 10. However, since the UE 20 is a non-GPS UE, it is not aware of the drive test area. The network 30 compares the report data and activates non-GPS MDT reporting from the UE 20, as described above with reference to steps S5 and S6 of Fig. 2.

According to an embodiment of the invention, an apparatus such as the network entity 30 comprises providing means for providing area information indicating areas of a mobile communications network, which are at least partially located in a coverage area of transmitting means and in which measurements regarding minimization of drive tests are to be performed, and the transmitting means for broadcasting the area information. The providing means may comprise the processor 31 and the transmitting means may comprise the transceiver 33.

The transmitting means may broadcast the area information in a higher layer signaling on a broadcast control channel.

The providing means may provide the area information as at least one of a list of location points of a global positioning system and a radius around the location points, a timing

advance value, and a list of physical layer cell identifications of neighboring cells.

The apparatus may comprise reserving means for reserving specific random access channel sequences on which user equipments are supposed to indicate that they are located in an area of said areas, and the transmitting means may broadcast information about the reserved specific random access channel sequences. The reserving means may comprise the processor 31.

The apparatus may comprise indicating means for indicating the information in an extended random access channel configuration message and the transmitting means may broadcast the extended random access channel configuration message on a broadcast control channel. The indicating means may comprise the processor 31.

The apparatus may comprise receiving means for receiving an information signal on a specific random access channel, which indicates that a user equipment is located in an area of said areas, whereupon setting up means of the apparatus may set up a data channel and requesting means of the apparatus may request reports on measurements regarding minimization of drive tests from the user equipment. The receiving means may comprise the transceiver 33, and the setting up means and the requesting means may comprise the processor 31 and/or the transceiver 33.

The receiving means may receive an information signal on a higher layer, which indicates that a user equipment is located in an area of said areas, whereupon the requesting means may request reports on measurements regarding minimization of drive tests from the user equipment via control plane signaling.

The apparatus may comprise comparing means for comparing measurement values received from a first user equipment within an area of said areas, which has indicated to be in the area, with measurement values received from a second user equipment which has not indicated to be in the area, and in case the measurement values are similar, activating means of the apparatus may activate the second user equipment to transmit reports on measurements regarding minimization of drive tests. The comparing means may comprise the processor 31 and the activating means may comprise the processor 31 and/or the transceiver 33.

According to an embodiment of the invention, an apparatus such as the user equipment 10, 20 comprises receiving means for receiving area information indicating areas of a mobile communications network, which are at least partially located in a coverage area of a network entity and in which measurements regarding minimization of drive tests are to be performed, determining means for determining, based on the area information, whether the apparatus is in an area of said areas, and transmitting means for transmitting an information signal which indicates that the apparatus is located in the area in case the determining means determines that the apparatus is in the area.

The receiving means and the transmitting means may comprise the transceiver 13, 23, and the determining means may comprise the processor 11, 21.

When the apparatus is in an idle mode, the transmitting means may transmit the information signal on a specific random access channel during a location update procedure, and when the apparatus is in an active mode, the transmitting means may transmit the information signal on a higher layer.

The apparatus may comprise preparing means for preparing a measurement report including minimization of drive tests parameters in case the determining means determines that the apparatus is in the area, and the transmitting means may transmit the measurement report via a data channel. The preparing means may comprise the processor 11, 21.

When the receiving means receive a request for measurement reports, the preparing means may prepare a measurement report including minimization of drive tests parameters and the transmitting means may transmit the measurement report.

The preparing means may prepare the measurement report including the minimization of drive tests parameters, when the receiving means receive the request for measurement reports after the transmitting means have transmitted the information signal.

After the information signal has been transmitted by the transmitting means, checking means of the apparatus may check whether the apparatus is still in the area, and if the apparatus is not in the area anymore, the transmitting means may transmit an indication that the apparatus has left the area on a specific random access channel during a location update procedure. The checking means may comprise the processor 11, 21.

The area information may comprise a list of physical layer cell identifications of neighboring cells and a timing advance value, and the determining means may determine that the apparatus is in the area, when the receiving means receive a physical layer cell identification which is present in the list and a measured timing advance value measured by measuring means of the apparatus exceeds the timing advance value. The measuring means may comprise the processor 11, 21.

The determining means may determine that the apparatus is in the area, when the receiving means receive a signal from a specific base station.

According to an embodiment of the invention, a network entity 30 provides area information indicating areas of a mobile communications network, which are at least partially located in a coverage area of the network entity (30) and in which measurements regarding minimization of drive tests are to be performed, and broadcasts the area information (S1). A user equipment 10 receives the area information and determines, based on the area information, that it is in such measurement area, and transmits an information signal which indicates that it is located in the measurement area (S2). In case the user equipment 10 is in an idle mode, the information signal may be transmitted on a specific random access channel during a location update procedure. The specific random access channel may be selected from specific random access channel sequences predefined for the mobile communications network or different between network entities. The network entity 30 may reserve the specific random access channel sequences and indicate them to user equipments via a broadcast control channel and an extended random access channel configuration message (S1a).

It is to be understood that the above description is illustrative of the invention and is not to be construed as limiting the invention. Various modifications and applications may occur to those skilled in the art without departing from the true spirit and scope of the invention as defined by the appended claims.

CLAIMS:

1. An apparatus comprising:
a transceiver; and
a processor configured to provide area information indicating areas of a mobile communications network, which are at least partially located in a coverage area of the transceiver and in which measurements regarding minimization of drive tests are to be performed, and to cause the transceiver to broadcast the area information.

2. The apparatus of claim 1, wherein the processer is configured to cause the transceiver to broadcast the area information in a higher layer signaling on a broadcast control channel.

3. The apparatus of claim 1 or 2, wherein the processor is configured to provide the area information as at least one of a list of location points of a global positioning system and a radius around the location points, a timing advance value, and a list of physical layer cell identifications of neighboring cells.

4. The apparatus of any one of claims 1 to 3, wherein the processor is configured to reserve specific random access channel sequences on which user equipments are supposed to indicate that they are located in an area of said areas, and cause the transceiver to broadcast information about the reserved specific random access channel sequences.

5. The apparatus of claim 4, wherein the processor is configured to indicate the information in an extended random access channel configuration message and cause the transceiver to broadcast the extended random access channel configuration message on a broadcast control channel.

6. The apparatus of any one of claims 1 to 5, wherein, when the transceiver receives an information signal on a specific random access channel, which indicates that a user equipment is located in an area of said areas, the processor is configured to set up a data channel and request reports on measurements regarding minimization of drive tests from the user equipment.

7. The apparatus of any one of claims 1 to 5, wherein, when the transceiver receives an information signal on a higher layer, which indicates that a user equipment is located in an area of said areas, the processor is configured to request reports on measurements regarding minimization of drive tests from the user equipment via control plane signaling.

8. The apparatus of any one of claims 1 to 7, wherein the processor is configured to compare measurement values received from a first user equipment within an area of said areas, which has indicated to be in the area, with measurement values received from a second user equipment which has not indicated to be in the area, and in case the measurement values are similar, activate the second user equipment to transmit reports on measurements regarding minimization of drive tests.

9. An apparatus comprising:

a transceiver configured to receive area information indicating areas of a mobile communications network, which are at least partially located in a coverage area of a network entity and in which measurements regarding minimization of drive tests are to be performed; and

a processor configured to determine, based on the area information, whether the apparatus is in an area of said areas, and to cause the transceiver to transmit an information signal which indicates that the apparatus is located in the

area in case the processor determines that the apparatus is in the area.

10. The apparatus of claim 9, wherein, when the apparatus is in an idle mode, the processor is configured to cause the transceiver to transmit the information signal on a specific random access channel during a location update procedure, and when the apparatus is in an active mode, the processor is configured to cause the transceiver to transmit the information signal on a higher layer.

11. The apparatus of claim 9 or 10, wherein the processor is configured to prepare a measurement report including minimization of drive tests parameters in case the processor determines that the apparatus is in the area, and cause the transceiver to transmit the measurement report via a data channel.

12. The apparatus of claim 9 or 10, wherein, when the transceiver receives a request for measurement reports, the processor is configured to prepare a measurement report including minimization of drive tests parameters and cause the transceiver to transmit the measurement report.

13. The apparatus of claim 12, wherein the processor is configured to prepare the measurement report including the minimization of drive tests parameters, when the transceiver receives the request for measurement reports after having sent the information signal.

14. The apparatus of any one of claims 9 to 11 and 13, wherein, after the information signal has been sent, the processor is configured to check whether the apparatus is still in the area, and if the apparatus is not in the area anymore, cause the transceiver to transmit an indication that the apparatus has left the area on a specific random access channel during a location update procedure.

15. The apparatus of any one of claims 9 to 11, 13 and 14, wherein the area information comprises a list of physical layer cell identifications of neighboring cells and a timing advance value, and the processor is configured to determine that the apparatus is in the area, when the transceiver receives a physical layer cell identification which is present in the list and a measured timing advance value measured by the processor exceeds the timing advance value.

16. The apparatus of any one of claims 9 to 11, 13 and 14, wherein the processor is configured to determine that the apparatus is in the area, when the transceiver receives a signal from a specific base station.

17. A method for an apparatus, the method comprising:

providing area information indicating areas of a mobile communications network, which are at least partially located in a coverage area of the apparatus and in which measurements regarding minimization of drive tests are to be performed; and

broadcasting the area information.

18. The method of claim 17, wherein the broadcasting comprises broadcasting the area information in a higher layer signaling on a broadcast control channel.

19. The method of claim 17 or 18, wherein the area information is provided as at least one of a list of location points of a global positioning system and a radius around the location points, a timing advance value, and a list of physical layer cell identifications of neighboring cells.

20. The method of any one of claims 17 to 19, comprising:

reserving specific random access channel sequences on which user equipments are supposed to indicate that they are located in an area of said areas; and

broadcasting information about the reserved specific random access channel sequences.

21. The method of claim 20, comprising:

indicating the information in an extended random access channel configuration message; and

broadcasting the extended random access channel configuration message on a broadcast control channel.

22. The method of any one of claims 17 to 21, comprising:

when an information signal on a specific random access channel is received, which indicates that a user equipment is located in an area of said areas, setting up a data channel and requesting reports on measurements regarding minimization of drive tests from the user equipment.

23. The method of any one of claims 17 to 21, comprising:

when an information signal on a higher layer is received, which indicates that a user equipment is located in an area of said areas, requesting reports on measurements regarding minimization of drive tests from the user equipment via control plane signaling.

24. The method of any one of claims 17 to 23, comprising:

comparing measurement values received from a first user equipment within an area of said areas, which has indicated to be in the area, with measurement values received from a second user equipment which has not indicated to be in the area, and in case the measurement values are similar, activating the second user equipment to transmit reports on measurements regarding minimization of drive tests.

25. A method for an apparatus, the method comprising:

receiving area information indicating areas of a mobile communications network, which are at least partially located in a coverage area of a network entity and in which measurements regarding minimization of drive tests are to be performed; and

determining, based on the area information, whether the apparatus is in an area of said areas, and transmitting an information signal which indicates that the apparatus is located in the area in case it is determined that the apparatus is in the area.

26. The method of claim 25, comprising:

when the apparatus is in an idle mode, transmitting the information signal on a specific random access channel during a location update procedure, and when the apparatus is in an active mode, transmitting the information signal on a higher layer.

27. The method of claim 25 or 26, comprising:

preparing a measurement report including minimization of drive tests parameters in case it is determined that the apparatus is in the area, and transmitting the measurement report via a data channel.

28. The method of claim 25 or 26, comprising:

when a request for measurement reports is received, preparing a measurement report including minimization of drive tests parameters and transmitting the measurement report.

29. The method of claim 28, comprising:

preparing the measurement report including the minimization of drive tests parameters, when the request for measurement reports is received after transmitting the information signal.

30. The method of any one of claims 25 to 27 and 29, comprising:

after transmitting the information signal, checking whether the apparatus is still in the area, and if the apparatus is not in the area anymore, transmitting an indication that the apparatus has left the area on a specific random access channel during a location update procedure.

31. The method of any one of claims 25 to 27, 29 and 30, wherein the area information comprises a list of physical layer cell identifications of neighboring cells and a timing advance value, and the method comprises:

determining that the apparatus is in the area, when a physical layer cell identification is received which is present in the list and a measured timing advance value exceeds the timing advance value.

32. The method of any one of claims 25 to 27, 29 and 30, comprising:

determining that the apparatus is in the area, when a signal from a specific base station is received.

33. A computer program product including a program for a processing device, comprising software code portions for performing the steps of any one of claims 17 to 32 when the program is run on the processing device.

34. The computer program product according to claim 33, wherein the computer program product comprises a computer-readable medium on which the software code portions are stored.

35. The computer program product according to claim 33, wherein the program is directly loadable into an internal memory of the processing device.

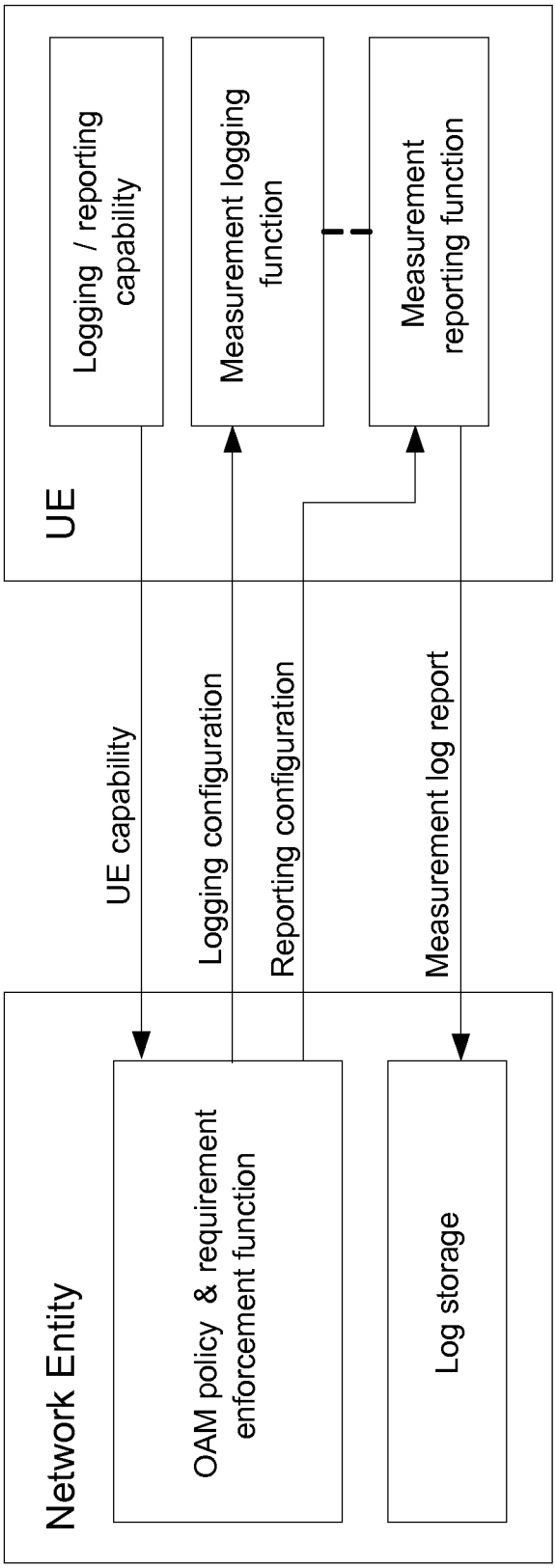

UE
Logging / reporting capability
Measurement logging function
Measurement reporting function
UE capability
Logging configuration
Reporting configuration
Measurement log report
Network Entity
OAM policy & requirement enforcement function
Log storage

Fig. 1

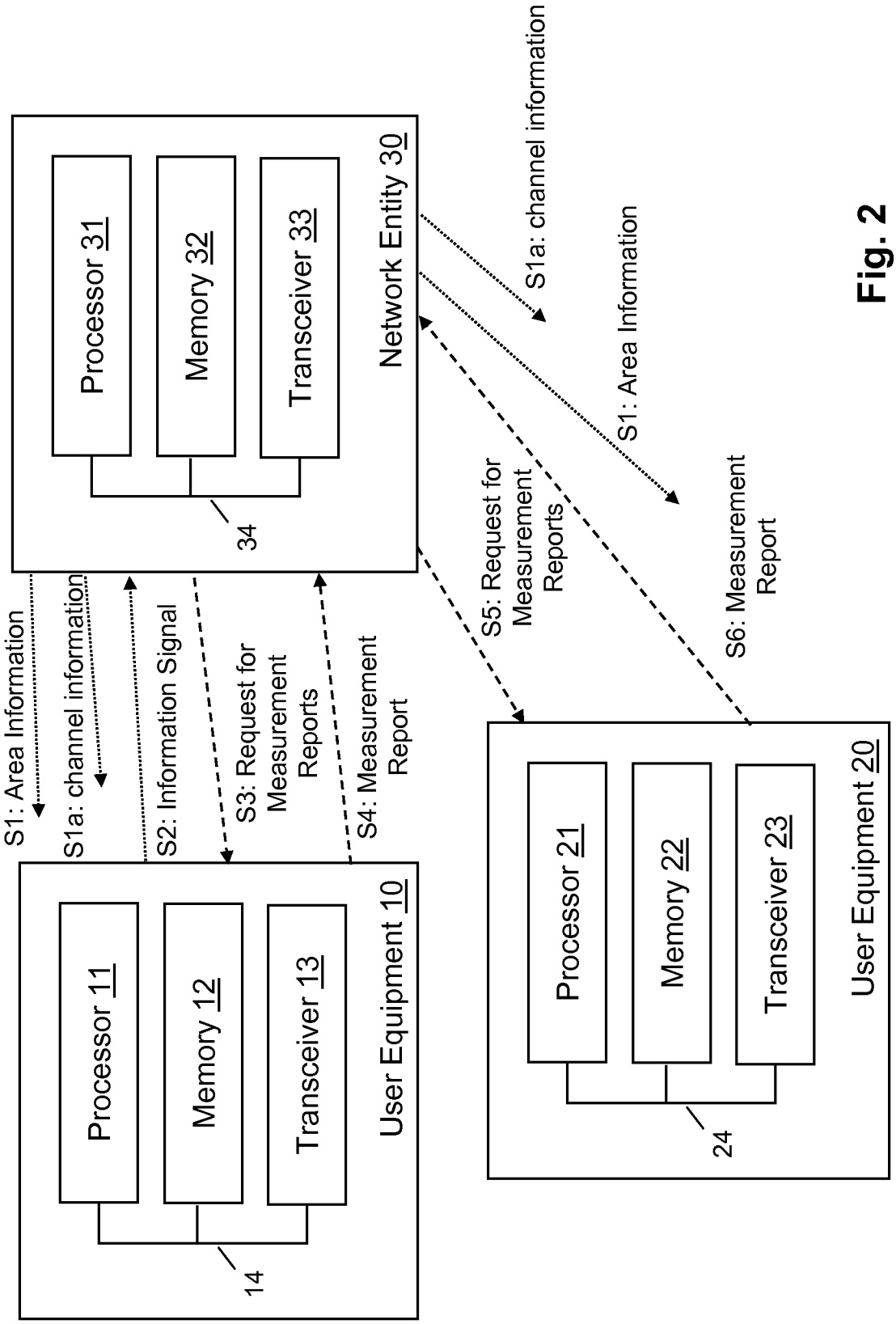

Network Entity 30
Processor 31
Memory 32
Transceiver 33
34
User Equipment 10
Processor 11
Memory 12
Transceiver 13
14
User Equipment 20
Processor 21
Memory 22
Transceiver 23
24
S1: Area Information
S1a: channel information
S2: Information Signal
S3: Request for Measurement Reports
S4: Measurement Report
S5: Request for Measurement Reports
S6: Measurement Report
S1a: channel information
S1: Area Information

Fig. 2

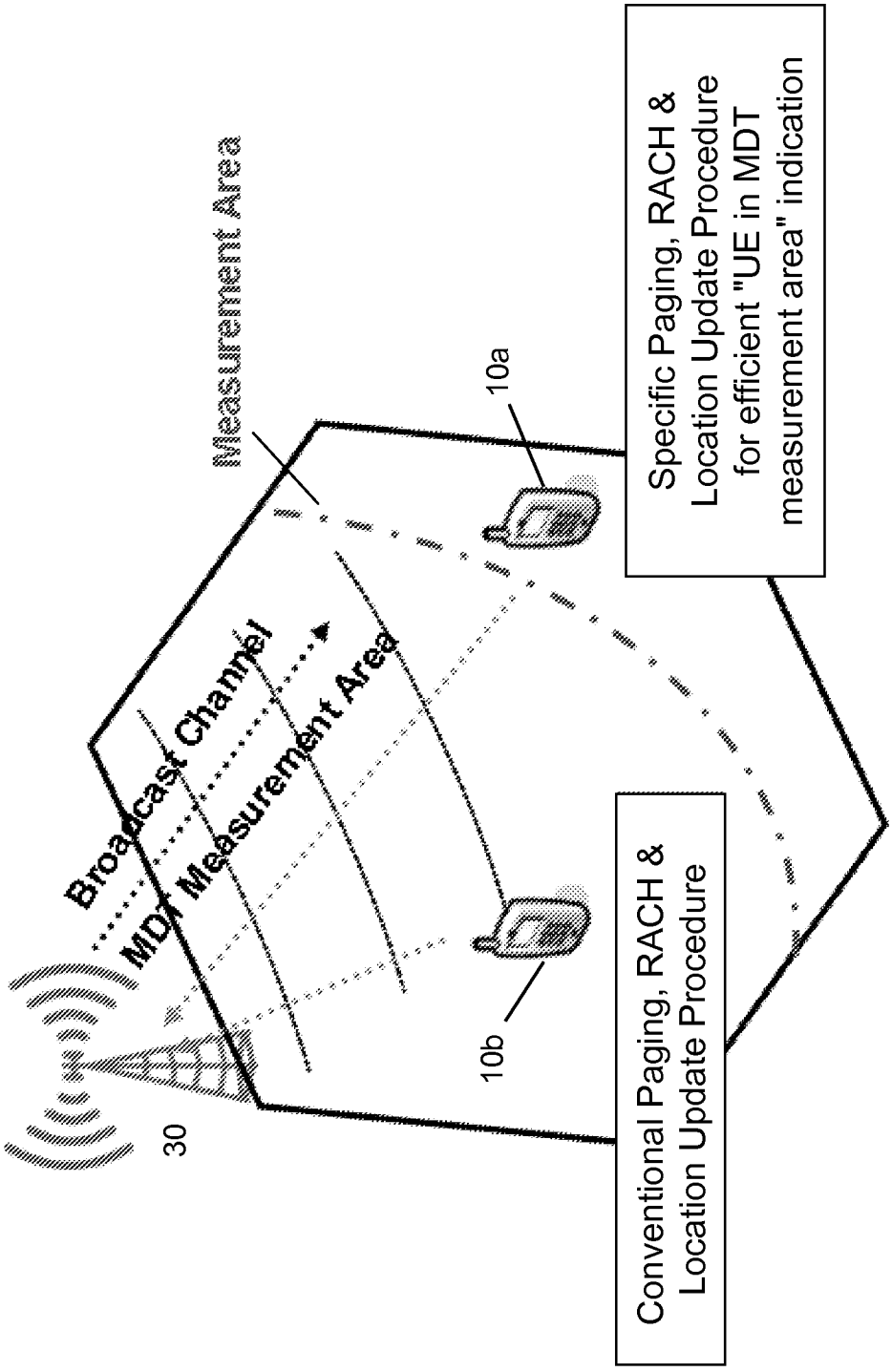

Measurement Area
Broadcast Channel
MDT Measurement Area
10a
10b
30
Specific Paging, RACH & Location Update Procedure for efficient "UE in MDT measurement area" indication
Conventional Paging, RACH & Location Update Procedure

Fig. 3

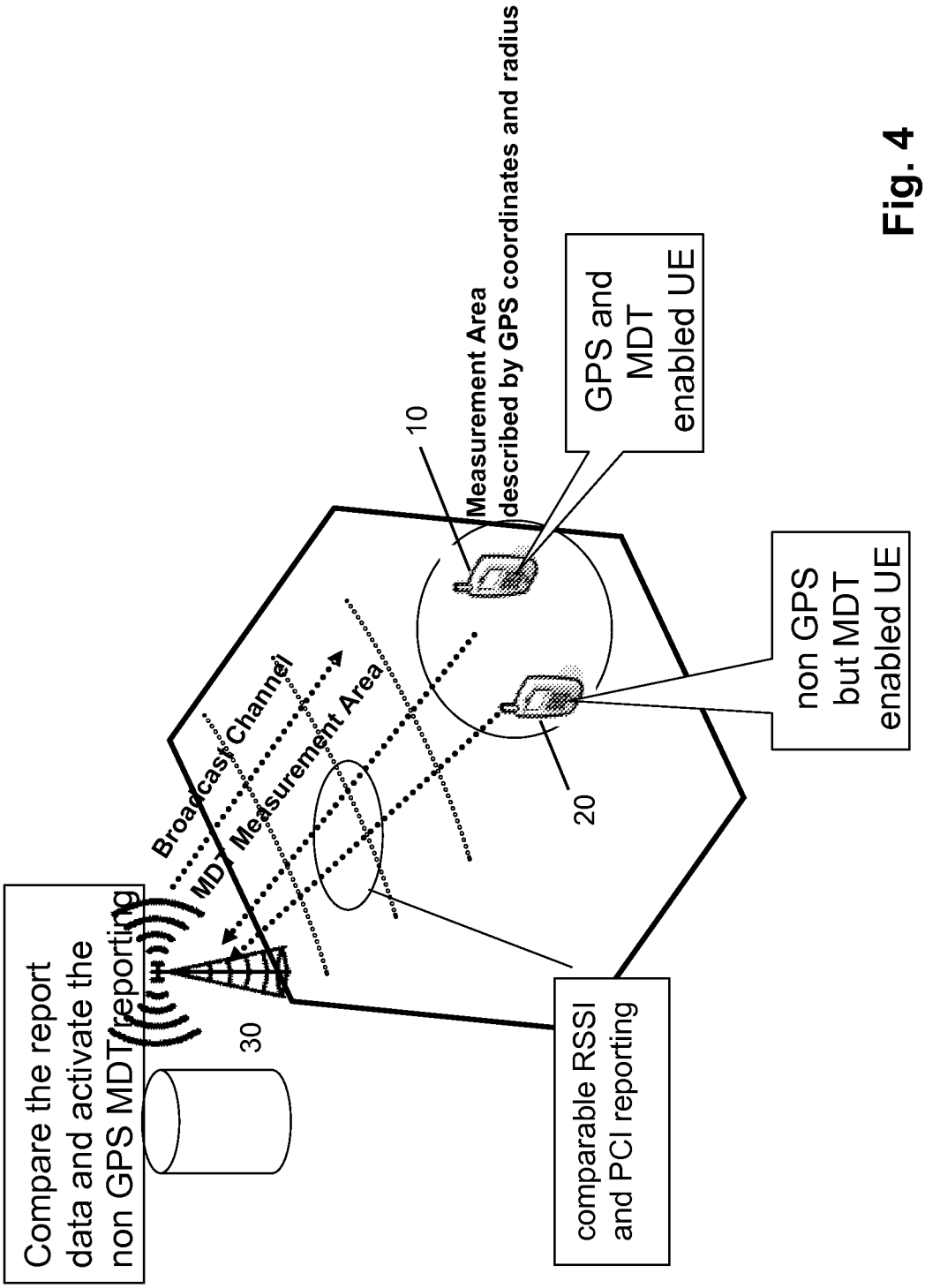

Compare the report data and activate the non GPS MDT reporting
30
Broadcast Channel
MDT Measurement Area
10
Measurement Area described by GPS coordinates and radius
GPS and MDT enabled UE
20
non GPS but MDT enabled UE
comparable RSSI and PCI reporting

Fig. 4

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2010/051975

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04W24/10
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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	ORANGE ET AL: "MDT Measurement Model", 3GPP DRAFT; R2-100239, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE, vol. RAN WG2, no. Valencia, Spain; 20100118, 12 January 2010 (2010-01-12), XP050420989, [retrieved on 2010-01-12] the whole document ----- -/--	1-3,7,9, 11-13, 15-19, 23, 25-29, 31-35

[X] 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	Date of mailing of the international search report
17 December 2010	23/12/2010

Name and mailing address of the ISA/	Authorized officer
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INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2010/051975

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	ZTE: "Hybrid architecture for MDT", 3GPP DRAFT; R2-096772 HYBRID ARCHITECTURE FOR MDT, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE, no. Jeju; 20091109, 9 November 2009 (2009-11-09), XP050391238, [retrieved on 2009-11-03] the whole document	1-35
A	"3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Study on Minimization of drive-tests in Next Generation Networks; (Release 9)", 3GPP STANDARD; 3GPP TR 36.805, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE, no. V9.0.0, 21 December 2009 (2009-12-21), pages 1-24, XP050401520, [retrieved on 2009-12-21] the whole document	1-35