(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
11 October 2012 (11.10.2012)

WIPO | PCT

(10) International Publication Number
WO 2012/138083 A2

(51) International Patent Classification:
H04B 7/26 (2006.01) *H04W 24/10* (2009.01)

(21) International Application Number:
PCT/KR2012/002439

(22) International Filing Date:
2 April 2012 (02.04.2012)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
10-2011-0030441 2 April 2011 (02.04.2011) KR

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

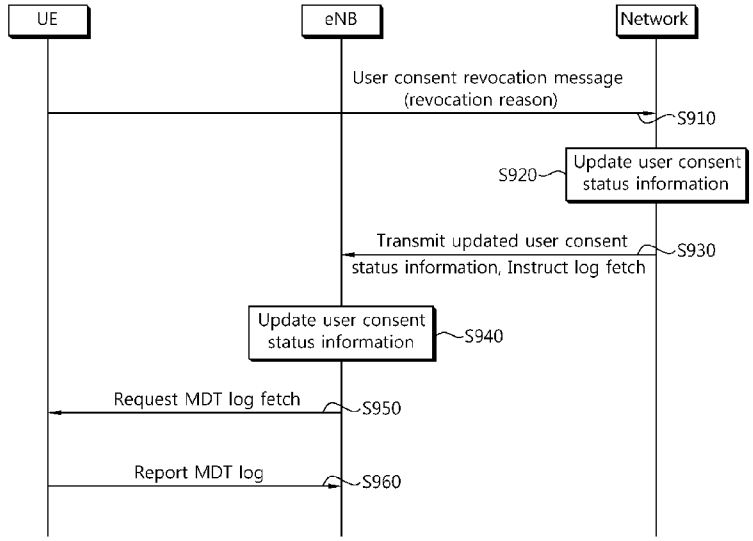
(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR,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

Published:

— *without international search report and to be republished upon receipt of that report (Rule 48.2(g))*

(54) Title: APPARATUS AND METHOD FOR PERFORMING MINIMIZATION DRIVING TEST USER CONSENT REVOCATION IN WIRELESS COMMUNICATION

[Fig. 9]



(57) Abstract: The present invention relates to a method of revoking user consent to a Minimization Driving Test (MDT) and an apparatus using the same. The method includes, if user consent to an MDT is determined to be revoked, transmitting a user consent revocation message and information about a reason of the user consent revocation to a network and stopping performing the MDT; and receiving an MDT log fetch request message or an MDT log clear instruction message from an evolved NodeB (eNB). Furthermore, when the MDT log fetch request message is received, User Equipment (UE) transmits an MDT log, stored in memory, to the eNB and clears the stored MDT log, and when the MDT log clear instruction message is received, the UE clears the stored MDT log.

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Description

Title of Invention: APPARATUS AND METHOD FOR PERFORMING MINIMIZATION DRIVING TEST USER CONSENT REVOCATION IN WIRELESS COMMUNICATION

Technical Field

[0001] The present invention relates to wireless communication technology and, more particularly, to a method and apparatus for performing user consent revocation for a Minimization Driving Test (hereinafter referred to as an 'MDT').

Background Art

[0002] In order to improve the capability of a wireless communication system, a wireless communication network must always take the improvements of throughput, frequency efficiency, mobility, coverage, and Multimedia Broadcast/Multimedia Service (MBMS) into consideration. With the development of wireless communication technology, factors affecting a wireless communication network have also been greatly changed.

[0003] For example, a wireless communication system typically uses one bandwidth in order to transmit data. A different bandwidth is used in each of mobile communication generations. The 2nd generation wireless communication system uses a bandwidth of 200 KHz to 1.25 MHz, and the 3rd generation wireless communication system uses a bandwidth of 5 MHz to 10 MHz. In order to support an increased transmission capacity, the bandwidth of the recent Long Term Evolution (LTE) or IEEE 802.16m of the 3rd Generation Partnership Project (3GPP) is extending up to 20 MHz or higher.

[0004] In order to increase the transmission capacity as described above, to increase the bandwidth may be indispensable. It is, however, not easy to allocate a frequency of a great bandwidth owing to the shortage of frequency resources other than some regions all over the world.

[0005] In order to effectively operate a mobile communication system, a service provider must take several conditions into consideration according to environments. More particularly, a service provider must take how insufficient frequency resources will be used as described above, how degree a base station will have a cell radius when the base station is configured, and to what extent will the frequency requirements of a cell be set into consideration.

[0006] In order to effectively operate a system while maintaining high Quality of Service (QoS), a service provider needs to check a network coverage environment (e.g., a traffic quality state and a signal transmission/reception state within a cell) of a network locally.

Summary of Invention

Technical Problem

[0007] An object of the present invention is to provide an apparatus and method for performing user consent revocation for an MDT in wireless communication technology.

[0008] Another object of the present invention is to provide an apparatus and method, wherein User Equipment (UE) that has consent an MDT revokes the consent to the MDT and stops performing the MDT or does not start the execution of the MDT in a situation where it is difficult for the UE to perform the MDT or when the UE does not want to perform the MDT.

[0009] Yet another object of the present invention is to provide an apparatus and method, wherein UE can stop performing an MDT and effectively manage resources necessary for the operation of the UE in a situation where it is difficult for the UE to perform the MDT or when the UE does not want to perform the MDT.

[0010] Further yet another object of the present invention is to provide an apparatus and method, wherein UE can take necessary measures in an evolved-NodeB (eNB) or a network by taking a reason of consent revocation into consideration when the UE revokes consent to an MDT.

[0011] Still yet another object of the present invention is to provide an apparatus and method for transmitting and receiving a user consent revocation reason for an MDT in wireless communication technology.

[0012] Further yet another object of the present invention is to provide transmission/ reception apparatuses and transmission/reception methods for guaranteeing efficiency of a log report for an MDT in wireless communication technology.

Solution to Problem

[0013] In accordance with an aspect of the present invention, there is provided a method of User Equipment (UE) revoking user consent to a Minimization Driving Test (MDT), comprising, if the user consent to the MDT is determined to be revoked, transmitting a user consent revocation message and information about a reason of the user consent revocation to a network and stopping performing the MDT; and receiving an MDT log fetch request message or an MDT log clear instruction message from an evolved NodeB (eNB). When the MDT log fetch request message is received, the UE may transmit an MDT log stored in memory to the eNB and clear the stored MDT log, and when the MDT log clear instruction message is received, the UE may clears the stored MDT log.

[0014] The UE may determine to revoke the user consent to the MDT when available memory is smaller than predetermined reference memory. The user consent revocation

message may comprise a cause value of available memory shortage as the reason of the user consent revocation.

[0015] Furthermore, the UE may determine to revoke the user consent to the MDT when a remaining battery amount is smaller than a predetermined reference battery amount. The user consent revocation message may comprise a cause value of battery shortage as the reason of the user consent revocation.

[0016] The method may further comprise determining whether log disposal processing is necessary, wherein if the log disposal processing is determined to be necessary, the UE may clear the stored MDT log although the MDT log fetch request message or the MDT log clear instruction message is not received from the eNB. Here, if the log disposal processing is determined not to be necessary, the UE may transmit the stored MDT log to the eNB and clear the stored MDT log when the MDT log fetch request message is received from the eNB, and the UE may clear the stored MDT log when the MDT log clear instruction message is received.

[0017] In accordance with another aspect of the present invention, there is provided a method of an eNB processing revocation of user consent to an MDT, comprising receiving user consent status information about UE from a network and changing a user consent status of the UE based on the user consent status information, wherein if an instruction for the UE is included in the user consent status information, the eNB may transmit a request message or an instruction message according to the instruction to the UE.

[0018] If the instruction for the UE is an MDT log fetch instruction, the eNB may transmit an MDT log fetch request message to the UE. If the user consent status information of the UE instructs the revocation of the user consent to the MDT and information on a reason of the user consent revocation of the UE is included in the user consent status information, the eNB may transmit an instruction, corresponding to the reason, to the UE. If the reason of the user consent revocation of the UE is memory shortage, the eNB may transmit an MDT log clear instruction, together with a log fetch request message, to the UE.

[0019] If the user consent status information of the UE instructs the revocation of the user consent to the MDT, the eNB may transmit an MDT log fetch request message to the UE.

[0020] When the UE performs handover and establishes a connection with the eNB, the eNB may change the user consent status of the UE based on the user consent status information of the UE and may receive an MDT log from the UE, and when the UE performs handover and releases a connection with the eNB, the eNB may change the user consent status of the UE based on the user consent status information of the UE.

[0021] In accordance with yet another aspect of the present invention, there is provided UE

supporting an MDT, comprising a controller for controlling the execution of the MDT and generating an MDT log, a transceiver for transmitting or receiving pieces of information about the execution of the MDT including the MDT log, and memory for storing some or all of the pieces of information about the execution of the MDT including the MDT log. If the UE determines to revoke user consent to the MDT, the controller may transmit a user consent revocation message and information about a reason of the user consent revocation to a network and stop performing the MDT, when an MDT log fetch request message is received from an eNB, the controller may transmit the MDT log stored in the memory to the eNB through the transceiver and clear the MDT log stored in the memory, and when an MDT log clear instruction message is received from the eNB, the controller may clear the MDT log stored in the memory.

[0022] In accordance with further yet another aspect of the present invention, there is provided an eNB supporting an MDT, comprising a controller for controlling the execution of an MDT, a transceiver for transmitting and receiving pieces of information about the execution of the MDT, and memory for storing some or all of the pieces of information about the execution of the MDT. When user consent status information about UE is received from a network, the controller may change a user consent status of the UE based on the user consent status information, and when an instruction for the UE is included in the user consent status information, the controller may transmit a request message or an instruction message according to the instruction to the UE through the transceiver.

[0023] In accordance with still yet another aspect of the present invention, there is provided a method of a network side processing user consent revocation for an MDT, comprising receiving a user consent revocation message including a reason of the user consent revocation from UE, changing user consent status information of the UE based on the user consent revocation message, and transmitting a user consent status information message, including the changed user consent status information, to the serving cell eNB of the UE. The user consent status information message may include an instruction for enabling the UE to handle the reason of the user consent revocation or a cause value corresponding to the reason of the user consent revocation.

[0024] In accordance with further yet another aspect of the present invention, there is provided a network node supporting an MDT, comprising a transceiver for receiving information about a user consent revocation procedure for the execution of the MDT of UE, memory for storing information about the UE and an eNB accessing the network node, and a controller for changing a user consent status regarding the execution of the MDT of the UE based on the information about the user consent revocation procedure regarding the execution of the MDT, received from the UE. When the user consent

status regarding the execution of the MDT of the UE is changed, the controller may transmit a user consent status information message, including the changed user consent status information, to the serving cell eNB of the UE.

[0025] The user consent status information message may include an instruction for enabling the UE to handle a reason of user consent revocation or a cause value corresponding to the reason of the user consent revocation.

Advantageous Effects of Invention

[0026] In accordance with the present invention, if it is difficult for UE that has consent to the execution of an MDT to perform the MDT or the UE no longer wants to perform the MDT, the UE may revoke the consent to the execution of the MDT and may stop performing the MDT or may not start performing the MDT. Accordingly, there is an advantage in that resources necessary for the operation of UE can be effectively managed.

[0027] Furthermore, in accordance with the present invention, if UE revokes consent to the execution of an MDT, an eNB or network can rapidly take necessary measures by taking a reason of the consent revocation into consideration. Furthermore, in accordance with the present invention, UE or an eNB or both or a network may take necessary measures by taking an MDT user consent revocation reason of the UE into consideration. Accordingly, a result according to the execution of an MDT may be utilized or resources necessary for the operation of UE can be effectively managed.

Brief Description of Drawings

[0028] The accompany drawings, which are included to provide a further understanding of this document and are incorporated on and constitute a part of this specification illustrate embodiments of this document and together with the description serve to explain the principles of this document.

[0029] FIG. 1 is a conceptual diagram schematically showing a concept of a driving test for measuring wireless traffic quality or coverage or both by using a vehicle in a system to which the present invention is applied;

[0030] FIG. 2 is a conceptual diagram schematically showing an example in which a network communication environment (i.e., wireless traffic quality or coverage or both) is measured using an MDT in a system to which the present invention is applied;

[0031] FIG. 3 is a flowchart schematically illustrating an example of an MDT configuration method in a system to which the present invention is applied;

[0032] FIG. 4 is a conceptual diagram schematically showing an example in which a log is configured in a periodic MDT in a system to which the present invention is applied;

[0033] FIG. 5 is a flowchart schematically illustrating a method of configuring an event-triggered MDT in a system to which the present invention is applied;

[0034] FIG. 6 is a conceptual diagram schematically showing an example in which a log is written in a mixed method of a periodic method and an event-triggered method in a system to which the present invention is applied;

[0035] FIG. 7 is a flowchart schematically illustrating an example in which the consent information of UE about the execution of an MDT is transmitted between an eNB and an MME;

[0036] FIG. 8 is a flowchart schematically illustrating the revocation of the user consent of UE to the execution of an MDT in a system to which the present invention is applied;

[0037] FIG. 9 is a flowchart schematically illustrating an embodiment in which a user consent revocation procedure is performed by taking a user consent revocation reason for the execution of an MDT into consideration in a system to which the present invention is applied;

[0038] FIG. 10 is a flowchart schematically illustrating another embodiment in which a user consent revocation procedure is performed by taking a user consent revocation reason for the execution of an MDT into consideration in a system to which the present invention is applied;

[0039] FIG. 11 is a flowchart schematically illustrating yet another embodiment in which a user consent revocation procedure is performed by taking a user consent revocation reason for the execution of an MDT into consideration when UE performs handover in a system to which the present invention is applied;

[0040] FIG. 12 is a flowchart schematically illustrating a user consent revocation procedure performed by UE in a system to which the present invention is applied;

[0041] FIG. 13 is a flowchart schematically illustrating a user consent revocation procedure performed by a network in a system to which the present invention is applied;

[0042] FIG. 14 is a flowchart schematically illustrating a user consent revocation procedure performed by an eNB in a system to which the present invention is applied; and

[0043] FIG. 15 is a block diagram schematically illustrating the construction each of the subjects of operations in a system to which the present invention is applied.

Mode for the Invention

[0044] Hereinafter, in this specification, the contents related to the present invention will be described in detail in connection with exemplary embodiments with reference to the accompanying drawings. It is to be noted that in assigning reference numerals to respective elements in the drawings, the same reference numerals designate the same elements throughout the drawings although the elements are shown in different drawings. Furthermore, in describing the embodiments of the present invention, a detailed description of the known functions and constructions will be omitted if it is deemed to make the gist of the present invention unnecessarily vague.

[0045] Furthermore, in this specification, the focus of the description is a wireless communication network. Tasks performed in the wireless communication network may be performed in a process in which a system (e.g., a base station) managing the wireless communication network controls the wireless communication network and sending data or may be performed in UE combined with the wireless communication network.

[0046] The wireless communication system to which the present invention is applied may have a 3GPP LTE/LTE-A network structure. An Evolved-UMTS Terrestrial Radio Access Network (E-UTRAN) includes a Base Station (BS) that provides a control plane and a user plane to the UE.

[0047] The UE may be fixed or mobile and may also be called another terminology, such as a Mobile Station (MS), a User Terminal (UT), a Subscriber Station at step SS), a Mobile Terminal (MT), or a Wireless Device. The BS refers to a fixed station which communicates with the UE, and it may also be called another terminology, such as an eNB, a Base Transceiver System (BTS), an access point. The BS is hereinafter called an 'eNB'.

[0048] An interface for transmitting user traffic or control traffic may be used between eNBs. For example, eNBs may be interconnected through an X2 interface. Furthermore, an eNB may be connected to an Evolved Packet Core (EPC) through an S1 interface (more specifically, a Mobility Management Entity (MME) through an S1-MME and a Serving GateWay at step S-GW) through an S1-U). The S1 interface supports a many-to-many-relation between the eNB and the MME/SAE gateway.

[0049] In general, when constructing a wireless communication network, a network service provider optimizes an eNB or a network, such as or a cell environment, by checking the wireless traffic quality of UE or whether UE is out of coverage related to a cell radius or checking a coverage hold. To this end, the network service provider may measure data for a network communication environment by utilizing the UE. For example, in order to check the intensity of a signal, the network service provider may effectively handle situations by checking a position where the UE can perform communication or checking a position where the UE is unable to perform communication owing to the attenuation of a signal. Alternatively, in order to lay out a scheme by checking a shadow area where the UE is unable to perform communication, the network service provider may use a measurement value related to traffic quality, including the signal intensity of an eNB.

[0050] FIG. 1 is a conceptual diagram schematically showing a concept of a driving test for measuring wireless traffic quality or coverage or both by using a vehicle in a system to which the present invention is applied. A network service provider, etc. moves within the constructed traffic region of an eNB 100 (i.e., a cell) using a vehicle 710.

[0051] As can be seen from the moving path 120 of the vehicle 110, the vehicle 110 collects

the traffic quality of the constructed traffic region by using UE, etc. mounted on the vehicle while moving all possible places within the cell. The traffic quality within the cell is changed by various factors, such as the positions of buildings 130 or a geographical high and low within the cell. For example, there may be areas 140 and 150 where traffic is possible, and there may be a traffic shadow area 160. Furthermore, from among the areas where traffic is possible, there may be the area 140 where the traffic quality is good and the area 150 where the traffic quality is bad.

[0052] In general, the traffic quality may be different depending on the distance from the eNB 100. For example, it may be expected that the area 140 where the traffic quality is good has a better traffic quality in terms of transmission power because it is closer to the eNB 100 than the area 150 where the traffic quality is bad. As described above, however, the traffic quality or a call status is influenced by various factors. When a geographical influence, such as the buildings 130, is taken into consideration, an actual traffic quality for each area may be different from an expected traffic quality. For example, an area may be the traffic shadow area 160 although the area is placed between the buildings and not far from the eNB 100.

[0053] Accordingly, in order to optimize a network, detailed information about a communication environment within the network is necessary. If a driving test is performed for all necessary places within a cell, a lot of time and human power are necessary.

[0054] In order to solve this problem, a method of measuring traffic quality for a communication environment within a network (i.e., a method of measuring the traffic quality within the network while minimizing a driving test (i.e., an MDT)) without measuring the traffic quality while directly moving all possible areas within a cell by using a vehicle, etc. may be taken into consideration.

[0055] The MDT may be divided into a periodic MDT and an event-triggered MDT depending on a method of performing measurement.

[0056] In the periodic MDT, UE measures network communication quality and writes, stores, and manages a log in a predetermined period during a predetermined duration.

[0057] Information that the UE has measured a wireless environment for the MDT is called a log. The log may be called information related to communication environments, such as the signal intensity of a serving cell or a neighbor cell, a position where the signal is measured, and the time when the signal is measured which are measured by UE and accumulated in memory. The UE may continue to accumulate a log whenever the UE measures the state of a wireless communication environment as a new log form.

[0058] UE may report, to a network or an eNB, that the UE now has a log accumulated through the execution of an MDT. If UE is requested to report information about a log from a network or an eNB, the UE may transmit the log information to the network or the eNB.

[0059] In the event-triggered MDT, UE performs MDT measurement when a triggering event is generated. When a triggering event is generated, UE may perform MDT measurement and write a log according to a predetermined rule or instruction. Alternatively, UE may perform MDT measurement and write a log only when there is an explicit request from a network although the triggering event is generated.

[0060] The MDT may be divided into an Immediate MDT (IMDT) and a Logged MDT (LMDT) depending on a mode in which measurement is performed. In both the IMDT and the LMDT, UE receives an MDT configuration in an RRC_CONNECTED mode.

[0061] In the IMDT, UE in the RRC_CONNECTED mode may perform measurement based on an MDT configuration in a predetermined period. Furthermore, UE in the RRC_CONNECTED mode may perform measurement when a triggering event is generated according to an instruction of an eNB or a predetermined rule.

[0062] The UE may log the result of the measurement. For example, UE may log the result of measurement when a Radio Link Failure (RLF) occurs. The UE may inform an eNB that the UE can report the log. The eNB may check that the UE can report an MDT based on the received log.

[0063] The eNB may request the MDT report from the UE. For example, an eNB may transmit an information request message (e.g., channel information) regarding measurement typically performed by UE, including a message requesting an MDT report. When the MDT report request message is received, the UE may report MDT log information to the eNB.

[0064] In the LMDT, UE in an RRC_IDLE mode may perform measurement at specific periods based on an MDT configuration. For example, UE may perform measurement based on an MDT configuration in a period set by a multiple of the 'On Duration' period of DRX. Furthermore, UE may perform measurement when a triggering event is generated according to an instruction of an eNB or a predetermined rule.

[0065] UE that has performed measurement based on an MDT configuration logs the result of the measurement. UE in the RRC_IDLE mode may access a cell through, for example, a selection/reselection process. At this time, the UE may inform an eNB that the UE can report a log in the process of accessing the cell. The eNB may check that the UE can perform an MDT report based on the received log.

[0066] The eNB may request the MDT report from the UE. For example, an eNB may transmit an information request message, including a message requesting an MDT report. When the MDT report request message is received, UE may report MDT log information to the eNB.

[0067] The MDT may also be divided into a signaling-based MDTn and a management-based MDT depending on a method of selecting UE that will perform an MDT.

[0068] In the signaling-based MDT, a network side selects UE that will perform an MDT by

performing signaling to each UE and performs an MDT configuration so that the UE can perform the MDT. The term 'network side' includes network elements necessary for the selection of MDT UE and an MDT configuration, such as an Operation, Administration, and Maintenance (OAM) server, a Mobility Management Entity (MME), and a Home Subscriber Server (HSS).

[0069] Whether consent to the execution of an MDT has been given might have been configured in UEs that can perform the MDT. In a process of selecting UE that will perform an MDT, the network side may check whether UE is UE that has consented to the execution of an MDT based on user consent status information about the UE and select UE that will perform an MDT, from among UEs that have consented to the execution of an MDT. Furthermore, in a process of selecting UE that will perform the execution of an MDT, the capability, etc. of the UE may be taken into consideration. The user consent status information is reserved by an OAM server, an MME, or an HSS and may be checked from information.

[0070] In the management-based MDT, when a network side selects UE that will perform an MDT, the network side selects the UE that will perform an MDT, from among UEs within a specific area or a specific cell, and performs an MDT configuration so that the selected UE can perform the MDT. Unlike in the signaling-based MDT in which a network side selects UE that will perform an MDT by performing signaling to each UE and performs an MDT configuration, an MDT is performed within a specific area or a specific cell selected by the network side. Here, the network side transfers information about a user consent status to an eNB, and the eNB checks whether UE can perform an MDT so that the UE can perform the MDT.

[0071] FIG. 2 is a conceptual diagram schematically showing an example in which a network communication environment (i.e., wireless traffic quality or coverage or both) is measured using an MDT in a system to which the present invention is applied.

[0072] A wireless communication environment and a coverage situation can be checked while minimizing the measurement of traffic quality performed within a cell through direct movement within the cell, based on information about communication quality in several positions within the cell where each UE performs measurement and reports the result of the measurement. As in an actual driving test, an area where UE can perform communication, an area where it is difficult for UE to perform communication owing to the attenuation of a signal, an area where UE is unable to perform communication, and so on within a cell can be checked by utilizing values measured by UEs scattered in several areas.

[0073] Referring to FIG. 2, in order to measure wireless traffic quality, a vehicle 110 for measurement has only to move along a minimum path 160 by utilizing a number of UEs 200 scattered within a cell.

[0074] In addition to the measurement performed by the vehicle 110 that moves, measurement for a wireless environment is performed by a number of UEs at several places within the cell. Each of the UEs may measure a wireless environment at a current position according to an MDT configuration.

[0075] The UE may continue to accumulate a log whenever the status of a wireless communication environment is measured and store the log as a new log form. The UE may report, to an eNB, that the UE now has a log accumulated through the execution of an MDT. When information about the log is requested by the eNB, the UE may transmit the log information to the eNB.

[0076] FIG. 3 is a flowchart schematically illustrating an example of an MDT configuration method in a system to which the present invention is applied.

[0077] Referring to FIG. 3, an eNB configures an MDT configuration parameter at step S310.

[0078] In case of the periodic MDT, the MDT configuration parameter may include the object of MDT measurement, the duration of MDT measurement, the period of MDT measurement, a method of reporting a log, a period during which a log is reported, the time of an eNB, and so on. In case of the event-triggered MDT, the MDT configuration parameter may further include a parameter related to a type of a triggering event.

[0079] In order to obtain information about a network communication status or traffic quality, an eNB may configure the object to be measured by UE through a parameter related to the object of MDT measurement. The object of MDT measurement may be limited to the signal quality of a serving cell or may be configured to include even the intensity of a signal that is transmitted from an eNB within a neighbor cell according to circumstances.

[0080] An eNB may set a duration in which MDT measurement is performed and the period of MDT measurement performed during the duration through a parameter related to the duration and period of MDT measurement. In relation to the setting, the MDT measurement may be set to be periodically performed during a specific duration at specific intervals or the MDT measurement may be set so that it is performed during a specific duration after a triggering event is generated and then finished.

[0081] An eNB may configure a method of transferring the result of MDT measurement from UE to a network through a parameter related to a method of reporting a log. When an eNB requests UE to report log information, the UE may report the log information to the eNB. Furthermore, if there is no explicit request from an eNB, the eNB may configure that how UE will process log information. For example, UE may be configured to report log information to an eNB or to periodically report log information to an eNB at specific intervals although there is no explicit request from the eNB after a lapse of specific period since MDT measurement is started.

[0082] An eNB may configure a period during which log information is reported through a parameter related to the report period of a log. In this case, the eNB may perform an MDT for each of the objects of MDT measurement and differently configure the period during which log information is reported for every object. Furthermore, an eNB may set the period during which log information is reported so that a log regarding some of the objects of MDT measurement is periodically reported and a log regarding some of the objects is reported only when there is an explicit request from the eNB.

[0083] An eNB may configure a reference time regarding an MDT measurement value through a parameter related to the time of the eNB.

[0084] Although some parameters regarding the MDT configuration have been described above, the parameters regarding the MDT configuration may be configured in various ways depending on the optimization of a network in addition to the above parameters. Furthermore, the existing MDT configuration parameters may be modified or cleared or new MDT configuration parameters may be added to the existing MDT configuration parameters.

[0085] An eNB transmits an MDT log configuration request message to UE at step S320. The MDT log configuration request message may include information about an MDT configuration value that is stored in the UE. The MDT log configuration request message may further include information necessary to perform MDT measurement. The MDT log configuration request message may include an indicator to initiate MDT measurement. In some embodiments, the MDT log configuration message may be an indicator to initiate MDT measurement. The MDT log configuration message may be configured based on an MDT configuration parameter.

[0086] The UE receives the MDT log configuration request message from the eNB and starts an MDT at step S330. A configuration necessary to perform the MDT may be performed based on MDT configuration information included in the MDT log configuration request message.

[0087] If an MDT log is necessary, the eNB requests an MDT log fetch from the UE at step S340. In the periodic MDT, the eNB may request the MDT log fetch from the UE in a predetermined period or may request the MDT log fetch from the UE in each period different from the MDT period of the UE. If an MDT log is aperiodically necessary, the eNB may request the MDT log fetch from the UE.

[0088] The UE that has received the MDT log fetch request from the eNB reports a written MDT log to the eNB at step S350.

[0089] An example in which the UE transfers the MDT log to the eNB only when the eNB requests an MDT log information report has been described, but the present invention is not limited to the example. For example, the UE may report the MDT log to the eNB although the eNB does not make an explicit MDT log fetch request depending on a

predetermined condition.

[0090] An example in which an eNB configures an MDT configuration parameter has been described with reference to FIG. 3. In some embodiments, however, an entity placed over an eNB may configure an MDT configuration parameter, and the eNB may transmit an MDT log configuration request to UE based on the MDT configuration parameter.

[0091] FIG. 4 is a conceptual diagram schematically showing an example in which a log is configured in the periodic MDT in a system to which the present invention is applied.

[0092] Referring to FIG. 4, UE measures a network communication environment at each of measurement time points T_1 to T_5 in an MDT measurement period T_M during an MDT measurement duration T_{on}. The MDT measurement duration or the MDT measurement period or both are the configuration parameters of the periodic MDT and may be configured by an eNB or a network.

[0093] In the example of FIG. 4, the MDT measurement period T_M is set to be a multiple of a paging Discontinuous Reception (DRX) cycle T_d. In order to reduce power consumption in a UE reception circuit, DRX is supported in LTE. The DRX function corresponds to a Continuous Packet Connectivity (CPC) function supported in HSPA, etc. When the DRX cycle is designated, UE monitors downlink control signaling in one subframe in each DRX cycle, but maintains a sleep mode in other subframes. In the periodic MDT, the DRX cycle may be utilized as one reference for configuring an MDT measurement period.

[0094] The UE measures a network communication environment based on the MDT configuration and writes a log based on measured information. A log continues to be accumulated for every measurement and stored in the UE as a new log form. As can be seen from an example of the log shown in FIG. 4, a log number Log #1 according to a measurement time point may be indicated in the log in order to distinguish logs from each other, and the log may include a value for the measured wireless communication environment, a timestamp for the time when the wireless communication environment was measured, information about a position where the wireless communication environment was measured, and so on. Although a log is illustrated to include a measurement value, a timestamp, and position information for a wireless communication environment, the log may include various pieces of information according to circumstances.

[0095] As another method of the execution of an MDT, the event-triggered MDT may be used.

[0096] FIG. 5 is a flowchart schematically illustrating a method of configuring the event-triggered MDT in a system to which the present invention is applied.

[0097] Referring to FIG. 5, an eNB configures a method of the event-triggered MDT

method at step S510. An example in which the eNB performs an MDT configuration is illustrated. However, as in the periodic MDT described with reference to FIG. 3, an entity placed over an eNB may perform the MDT configuration, and the eNB may transfer an MDT log configuration request to UE based on the MDT configuration. Parameters set to configure the event-triggered MDT may include a parameter related to a type of a triggering event, in addition to parameters regarding the writing of a log or a log information report or both.

[0098] Triggering events for MDT measurement may be various. An eNB may select a necessary triggering event from the triggering events. The update of position information by UE, a change in the status of a network measured by UE, a failure in a UE operation or an eNB operation, and so on may be taken into consideration as an event that may be used in the event-triggered MDT.

[0099] The eNB transmits an MDT log configuration request message to UE at step S520. The MDT log configuration request message may include an event-triggered MDT configuration message. The MDT log configuration request message may further include information necessary to perform MDT measurement. The MDT log configuration request message may further include an indicator that enables event-triggered MDT measurement to be started. The MDT log configuration request message may be an indicator that enables event-triggered MDT measurement to be started.

[0100] An example in which the event-triggered MDT configuration parameter is included in the MDT log configuration request message and then transmitted has been described above. However, the event-triggered MDT configuration parameter may be included in a message different from the MDT log configuration message and be then transmitted to UE, or a message including only the event-triggered MDT configuration parameter may be configured and then transmitted to the UE. When transmitting the event-triggered MDT configuration parameter to the UE, an eNB may separately inform the UE of information about the transmission according to circumstances.

[0101] The UE receives the MDT log configuration request message from the eNB and starts an MDT at step S530. The MDT log configuration request message includes a parameter related to the event-triggered MDT configuration, and the UE may configure an MDT log environment based on the parameter related to the event-triggered MDT configuration.

[0102] If MDT log information is necessary, the eNB may request an MDT log fetch from the UE at step S540. The UE that has received the MDT log fetch request from the eNB reports a written MDT log to the eNB at step S550.

[0103] An example in which UE transfers an MDT log to an eNB when the eNB makes an MDT log fetch request has been described. However, the present invention is not

limited to the example. UE may report an MDT log to an eNB after a lapse of some time since the UE performs MDT measurement although the eNB does not make an explicit MDT log fetch request depending on a predetermined condition.

[0104] FIG. 6 is a conceptual diagram schematically showing an example in which a log is written in a mixed method of the periodic method and the event-triggered method in a system to which the present invention is applied.

[0105] Referring to FIG. 6, UE may measure a network communication environment based on a periodic MDT configuration at each of measurement time points T_1 to T_5 in an MDT measurement period T_M during an MDT measurement duration T_{on}. A duration in which MDT measurement is periodically performed or a period during which the MDT measurement is performed may be configured in the form of a periodic MDT configuration parameter. The duration in which MDT measurement is periodically performed or the period during which the MDT measurement is performed may be configured in various ways according to circumstances. In the example of FIG. 6, the measurement period T_M of the periodic MDT is set to a multiple of the paging DRX cycle T_d.

[0106] UE may measure a network communication environment, etc. based on a periodic MDT configuration and may write a log (i.e., measurement information). A log continues to be accumulated whenever measurement is performed and then stored in the UE as a new log form. As can be seen from an example of the log shown in FIG. 6, the log may include a value for the measured wireless communication environment, a timestamp for the time when the wireless communication environment was measured, information about a position where the wireless communication environment was measured, etc. along with a log number Log #1 for distinguishing logs when measurement was performed from each other.

[0107] An example in which a log is illustrated to include a measurement value, a timestamp, and position information for a wireless communication environment has been described, but the present invention is not limited to the example. For example, the log may include various pieces of information according to circumstances.

[0108] When an event is triggered, UE may measure a network communication environment based on an event-triggered MDT configuration and may write a log for the measured network communication environment. The log may be differently configured according to types of triggering events.

[0109] For example, if a triggering event is a change of position information about UE, a log for an event-triggered MDT may include the position information about the UE and a timestamp when a network communication environment was measured, as shown in FIG. 6.

[0110] UE may write, store, manage, and report the log for the periodic MDT and the log for

the event-triggered MDT based on different configurations. Furthermore, UE may write, store, manage, and report the log for the periodic MDT and the log for the event-triggered MDT based on some or all of configurations according to circumstances.

[0111] For example, in the periodic MDT, if there is an explicit report request from a network, UE may report log information to the network. In the event-triggered MDT, if a specific condition is satisfied although there is no explicit report request from a network, UE may report log information to the network. Furthermore, in the event-triggered MDT, if there is an explicit report request from a network, UE may report log information to the network. In the periodic MDT, if a specific condition is satisfied although there is no explicit report request from a network, UE may report log information to the network.

[0112] Unlike in a network system, such as an eNB, UE is operated with limited resources (e.g., limited battery and memory). If power available for UE is insufficient, the execution of an MDT may cause a problem in the operation of UE. In particular, in the LMDT, battery consumption must be minimized in order for UE in the RRC_IDLE mode to be operated for a necessary wait time. Furthermore, in a situation where the memory of UE is insufficient, it may be necessary to minimize the usage of memory so that memory shortage is not caused owing to logs accumulated in an MDT execution process.

[0113] Accordingly, UE that has consented to the execution of an MDT may revoke consent the execution of an MDT.

[0114] For this, a method of processing the user consent of specific UE to the execution of an MDT is first described. In order to perform the MDT, the specific UE has to previously inform a network side, selecting UE that will perform the MDT, that the specific UE can perform the MDT through a process of consenting to the execution of the MDT. For example, UE may perform a higher procedure, such as subscription, and a network side may obtain information about whether the UE is UE that may participate in an MDT based on the subscription. The information about subscription may be managed by the network side (e.g., a Home Subscriber Server (HSS) or other core network nodes).

[0115] The network side transfers information about whether specific UE has consent to the execution of the MDT from the network node, such as an OAM server, an MME, or an HSS, to an eNB.

[0116] The user consent information about the execution of the MDT by the UE may be transferred in various ways from the network side to the eNB. For example, the information about consent to the execution of the MDT by the UE may be transferred from the network side to the eNB based on a Subscriber Profile ID (hereinafter referred to as an 'SPID') for Radio Access Technology (RAT)/Frequency Selection Priority

(FSP). The SPID Information Element (IE) for RAT/FSP is used to define a camp characteristic in the IDLE mode and to control inter-RAT/inter-frequency handover in an active mode. The SPID IE may be included in an initial context setup request message and transferred from a network side to an eNB.

[0117] 'User consent to the execution of an MDT' is hereinafter simply referred to as 'user consent', for convenience of description.

[0118] FIG. 7 is a flowchart schematically illustrating an example in which user consent information by UE is transmitted between an eNB and an MME. FIG. 7 shows an example of a method in which information about the user consent of UE is transferred from the MME to the eNB. In this example, the information about the user consent of the UE may be included in an initial context setup request message and transferred from the MME to the eNB.

[0119] In order to perform initial context setup between the MME and the eNB, the MME transmits the initial context setup message to the eNB at step S710. The initial context setup message may include a trace activation IE, a handover restriction list IE which may include information about roaming, an area, or access restriction, a UE radio capability IE, an SPID IE, a CS fallback indicator IE, and so on.

[0120] The information about the user consent of the UE is included in the SPID IE and transmitted. As described above, the SPID ID is information or IE that may be transmitted from a network side, an MME, an HSS, or an OAM server to an eNB. The transmitted SPID may be configured as in Table 1.

[0121] [Table 1]

IE/Group Name	Presence	IE Type and Reference
Subscriber Profile ID for RAT/Frequency Priority	M	INTEGER(1..256)

[0122] Referring to Table 1, the SPID is mandatory (M) information, and it indicates a profile corresponding to a written integer.

[0123] The SPID may index user information through handover or Initial Direct Transfer (IDT) when UE newly accesses a core network. For example, the SPID may index information, such as a mobility profile or a service usage profile. For example, referring to Table 1, the SPID may index a profile, including relevant information, through an indicated value (i.e., integer).

[0124] An eNB may obtain necessary information by checking a profile indexed by the received SPID. Accordingly, an MME may transfer information about the user consent of UE to the eNB so that the SPID can index a profile including information about the user consent of the UE. The eNB may check that the UE performs an MDT by checking that a user consent status is 'consent' in the profile of MDT-related in-

formation indexed by the SPID.

[0125] Referring back to FIG. 7, in response to the initial context setup request message received from the MME, the eNB transmits an initial context setup response to the MME at step S720. The eNB may perform initial context setup based on configuration information included in the initial context setup request message.

[0126] An example in which the information about the user consent of UE is transferred from the MME to the eNB through the SPID has been described. However, a network side may transfer the information about user consent, obtained from the UE, to the eNB through a message in which UE-specific information is transmitted within a scope of the technical spirit of the present invention.

[0127] The user consent revocation of UE is described below.

[0128] As described above, UE may no longer perform an MDT or may not initiate the execution of the MDT, although the UE has consent to the execution of the MDT. For example, the remaining battery power of UE is insufficient to perform an MDT, or the available memory of UE is insufficient owing to an MDT log written according to the execution of the MDT.

[0129] In this case, the UE performs a user consent revocation procedure. The user consent revocation procedure includes a series of operations in which UE revokes consent to the execution of an MDT and stops performing the MDT or does not start performing the MDT.

[0130] A case in which UE revokes user consent may be divided into a case in which the UE is now performing an MDT and a case before the UE performs the MDT according to the state in which the MDT is performed.

[0131] First, a cause that the UE revokes user consent and stops performing the MDT when the UE now performs the MDT may be various. A representative case may include a case in which the available memory of the UE is a specific level or less and a case in which the remaining battery amount of the UE is a specific level or less.

[0132] In case of available memory, in order for UE to be normally operated, the UE must have available memory of a specific level or higher. If available memory is reduced to a specific level or less owing to an MDT log written by the execution of an MDT, it is necessary to stop performing the MDT or to transmit or clear MDT logs, making the available memory insufficient, with consideration taken of memory having the least level necessary to perform a normal operation.

[0133] Furthermore, in case of the remaining battery, UE needs to maintain the remaining battery power of a specific level for a normal operation. In particular, if the UE is in the IDLE mode, the battery must be maintained for a long time. Accordingly, if it is difficult for UE to maintain the remaining battery power of a level necessary for a normal operation, the UE has to stop performing an MDT and reduce power con-

sumption.

[0134] Meanwhile, even when UE that has consented to the execution of an MDT has not yet started the execution of the MDT, it may necessary for the UE to revoke the user consent and not to start the execution of the MDT. For example, if UE is already performing an MDT, as described above, the UE may check available memory and the remaining battery amount and then determine that it will be better not to perform the MDT in order for the UE to be normally operation. In this case, the UE may need to reduce power consumption and revoke the user consent in order to maintain available memory.

[0135] In order to determine whether to revoke the user consent, the UE may compare current available memory with a predetermined reference value $M_{threshold}$. If the available memory is smaller than the predetermined reference value, the UE may determine to revoke the user consent. In this case, the UE may perform a user consent revocation procedure in order to stop performing the MDT or may not start performing the MDT.

[0136] In order to determine whether to revoke consent to the execution of the MDT, the UE may compare the remaining battery amount with a predetermined reference value $B_{threshold}$. If the remaining battery amount is smaller than the predetermined reference value, the UE may determine to revoke the user consent. In this case, the UE may perform a user consent revocation procedure in order to stop performing the MDT or may not start performing the MDT

[0137] The user consent revocation procedure includes that a higher protocol or application, such as a Non Access Stratum (NAS) layer), revokes UE consent to the execution of an MDT. More specifically, a higher protocol or application, such as an NAS layer, may instruct that an MDT-related procedure, regarding UE that has revoked user consent, through an Access Stratum (AS) layer protocol.

[0138] To this end, the user consent revocation procedure includes an operation of UE transferring a message, indicating that user consent to the execution of an MDT is revoked, to a network side (e.g., an MME, an HSS, an OAM server, an eNB, or a network node such as an NB). In response to the message, the network side may update user consent status information about the UE from 'user consent' to 'user non-consent'.

[0139] FIG. 8 is a flowchart schematically illustrating a user consent revocation procedure by UE in a system to which the present invention is applied.

[0140] Referring to FIG. 8, the UE transmits a user consent revocation message to a network at step S810. The network may be an MME, an OAM server, or an HSS.

[0141] The user consent revocation message is the message of an NAS layer or an application layer. Accordingly, an eNB capable of checking only an Access Stratum (AS)

message simply transfers the user consent revocation message to the network side. That is, the user consent revocation procedure is performed in the NAS protocol or application of UE, and it does not influence the operation of an AS in such as way as to directly change a configuration for the execution of an MDT by the UE between the UE and the eNB.

[0142] The user consent revocation message transmitted by the UE may include the UE ID, the MDT consent revocation indicator, etc. of the UE.

[0143] In response to the user consent revocation message received from the UE, the network updates user consent status information about the MDT of the UE at step S820. The network may update the user consent status information about the UE that has transmitted the user consent revocation message from a 'user consent' state to a 'user non-consent' state.

[0144] The network transmits the changed user consent status information to the eNB as will be described later. For example, as described above, if the user consent status information is transmitted to the eNB through an SPID, the network may configure the SPID so that an index of the SPID is mapped to a profile regarding user consent status information 'user non-consent'.

[0145] For example, it is assumed that a profile regarding user consent status information 'user consent' is mapped when an index value indicated by the SPID is 1 and a profile regarding user consent status information 'user non-consent' is mapped when an index value indicated by the SPID is 2. When the network checks that the UE wants to revoke the user consent through the user consent revocation message, the network may change the index value of the SPID regarding the user consent status information of the UE from 1 to 2. Accordingly, the eNB that has received the SPID checks necessary information in the profile regarding user consent status information 'user non-consent' mapped in the index value 2, as will be described later.

[0146] Here, the network may configure the profile regarding user consent status information 'user non-consent' so that the profile includes information necessary for the eNB to revoke the MDT procedure regarding the UE, such as the UE ID, the MDT consent revocation indicator, etc. of the UE that has transmitted the user consent revocation message.

[0147] The network transmits the updated user consent status information about the UE that has transmitted the user consent revocation message to the eNB at step S830. The updated user consent status information may be included in the user consent status information message and then transmitted. The user consent status information message transmitted from the network to the eNB may be an initial context setup request message, as described above.

[0148] The user consent status information message may be a message through which an

updated user consent status is transferred to the eNB or may be a message through which only information indicating that a user consent status has changed is transferred to the eNB.

[0149] If the updated user consent status information is transferred through the SPID, the network may configure a profile mapped to the changed user consent status and transmit the configured profile along with the SPID. For example, it is assumed that a profile regarding user consent status information 'user consent' is mapped when an index value indicated by the SPID is 1 and a profile regarding user consent status information 'user non-consent' is mapped when an index value indicated by the SPID is 2. In response to the user consent revocation message, the network may transmit the SPID in which the index value of the user consent status information about the UE is 2 and the profile regarding user consent status information 'user non-consent' at the same time.

[0150] The profile regarding user consent status information includes information necessary for the eNB to perform a procedure related to an MDT based on the user consent status of UE (i.e., user consent or user non-consent).

[0151] In response to the user consent status information message, the eNB updates the user consent status information about the UE at step S840. The eNB that has received the user consent status information message from the network changes the existing user consent status information based on the user consent status information of the UE included in the user consent status information message.

[0152] If only information indicating that the user consent status has changed is received from the network, the eNB changes a current user consent status into the other user consent status. For example, regarding UE that has transmitted a user consent revocation message to a network, the user consent status of the UE, now owned by an eNB, will be 'user consent'. Accordingly, the eNB changes the user consent status of the UE into 'user non-consent'.

[0153] Furthermore, if the network transmits user consent status information about the execution of an MDT to the eNB using an SPID, the eNB may check a profile matched with an index regarding the user consent status information of the SPID and update the user consent status information based on the checked profile information. For example, it is assumed that a profile regarding user consent status information 'user consent' is mapped when an index value indicated by the SPID is 1 and a profile regarding user consent status information 'user non-consent' is mapped when an index value indicated by the SPID is 2. If the index value of the SPID transmitted by the network is 2, the eNB may obtain the user consent status information 'user non-consent' about UE by checking the mapped profiled. The eNB may change the user consent status of the UE into 'user non-consent' based on the obtained user consent status information.

[0154] An example in which a user consent status is changed by checking a profiled mapped to the index of an SPID regarding user consent status information or changed user consent status information is obtained has been described. However, the present invention is not limited to the example. For example, an eNB may determine whether to change a user consent status based on only the index value of an SPID and change the user consent status of UE according to a predetermined rule.

[0155] Meanwhile, if user consent is revoked, a method of checking a reason of the revocation and utilizing the reason may be taken into consideration. For example, if UE transmits a user consent revocation message, together with a user consent revocation reason, to a network, the network may take additional measures based on the user consent revocation reason. For example, in the case in which a user consent revocation reason is memory shortage, when UE transmits a user consent revocation message together with the reason or transmits the user consent revocation message, including the reason, to a network, the network may check the user consent revocation reason (i.e., memory shortage) and take necessary measures against an MDT log that causes the memory shortage of the UE.

[0156] FIG. 9 is a flowchart schematically illustrating an embodiment in which a user consent revocation procedure is performed by taking a user consent revocation reason into consideration in a system to which the present invention is applied. An example in which the user consent revocation reason is memory shortage is described with reference to FIG. 9, for convenience of description.

[0157] It is to be noted that the same contents as those of FIG. 8 may be omitted in the description regarding FIG. 9, for convenience of description.

[0158] Unlike in FIG. 8, UE transmits a user consent revocation message and a user consent revocation reason to a network at the same time at step S910. The user consent revocation reason may be included in the user consent revocation message and transmitted or may be transmitted as an additional signaling or message. An MDT-related message (i.e., a user consent revocation message and a user consent revocation reason) transmitted from the UE to the network as described above is an NAS protocol or application message, and it does not influence the operation of an AS layer. An eNB simply transfers the MDT-related message to the network.

[0159] The user consent revocation procedure in the UE may be started in a higher layer (e.g., an NAS or application). The NAS or application does not influence an AS layer. In case of user consent revocation by UE, it is advantageous to rapidly stop an MDT-related operation in terms of the resource management efficiency of the UE. Accordingly, the NAS or application implemented in one UE may inform the AS layer of the MDT user consent revocation situation of a higher layer and request the AS layer to stop the MDT-related operation. For example, UE that has checked a problem in the

battery or memory may request an AS layer implemented therein to stop the MDT-related operation.

[0160] If the NAS or application implemented in the UE does not request the AS layer to stop the MDT-related operation, the UE may continue to perform the MDT-related operation during the time configured in relation to the MDT. In this case, a network may know that the UE has revoked user consent based on a user consent revocation message and that the UE continues to perform the MDT-related operation based on the MDT-related configuration set in the UE. In this state, the network may transmit a message, instructing that the MDT-related operation be stopped, to the UE. In response to the message, the UE stops the MDT-related operation now being performed.

[0161] Here, the network may be an MME, an OAM server, or an HSS.

[0162] The user consent revocation message may include the UE ID, the MDT consent revocation indicator, etc. of the UE. A reason of user consent revocation may include memory shortage, battery shortage, etc. A cause value corresponding to the user consent revocation reason may be previously determined between UE and a network and between the UE and an eNB. Accordingly, the UE may inform the network and the eNB that what is a reason of user consent revocation by transmitting a relevant cause value to the network.

[0163] Furthermore, the UE may transmit a user consent revocation message or a cause value for a reason of user consent revocation, including information indicating that there is an MDT log written by performing an MDT, to the network.

[0164] In response to the user consent revocation message received from the UE, the network updates user consent status information about the UE at step S920. Unlike in FIG. 8, the network also receives the user consent revocation reason (i.e., a cause value) from the UE.

[0165] If the received user consent revocation reason is memory shortage, the network may know that the available memory of the UE is insufficient. Furthermore, if the UE is now performing an MDT, the network may determine that the UE has stored a written MDT log in its memory. In some embodiments, the UE may transmit the user consent revocation message, including an indicator to indicate that the MDT log is stored in the memory, to the network. Accordingly, the UE may explicitly inform the network that the UE stores the MDT log in the memory through the indicator. This method may be used if it is difficult to determine whether UE stores an MDT log in memory based on only a user consent revocation reason. For example, the indicator informing that the UE stores the MDT log in the memory may be implemented by a 1-bit flag. When the bit value is 0, it may inform that the UE does not store the MDT log in the memory. When the bit value is 1, it may inform that the UE stores the MDT log in the memory.

[0166] If the UE is switched off or the UE detaches a written MDT log, the MDT log may

be removed from the memory. If not, it is necessary to take measures in order to remove the MDT log from the memory of the UE by transmitting or clearing the MDT log.

[0167] The network transmits an instruction for taking necessary measures based on the user consent revocation reason, together with updated user consent status information about the UE that has transmitted the user consent revocation message, to an eNB at step S930.

[0168] The updated user consent status information may be included in the user consent status information message and then transmitted. The user consent status information message transmitted from the network to the eNB, as described above, may be an initial context setup request message. Here, the network may transmit the user consent status information through an SPID.

[0169] If the user consent revocation reason of the UE checked by the network at step S920 is memory shortage, the network may transmit an MDT log fetch instruction to the eNB so that the eNB reports MDT log information to the UE as relevant measures. The MDT log fetch instruction may be included in the user consent status information message and then transmitted to the eNB.

[0170] In response to the user consent status information message, the eNB may change the user consent status of the UE at step S940.

[0171] In response to the user consent status information message received from the network, the eNB may change the existing user consent status information based on the user consent status information of the UE that is included in the user consent status information message.

[0172] If the eNB receives only information, indicating that the user consent status has changed, from the network, the eNB may change a current user consent status to the other user consent status. For example, regarding UE that has transmitted a user consent revocation message to a network, the user consent status of the UE, now owned by an eNB, will be 'user consent'. Accordingly, the eNB changes the user consent status of the UE into 'user non-consent'.

[0173] Furthermore, if the network transmits the user consent status information to the eNB using an SPID, the eNB may check a profile mapped to an index regarding the user consent status information of the SPID and update the user consent status information based on the checked profile information. For this, the eNB may determine whether the user consent status has changed based on only the index value of the SPID and may change the user consent status of the UE according to a predetermined rule.

[0174] Meanwhile, the eNB may know that an MDT log can be obtained from the UE based on the log fetch information received from the network.

[0175] The eNB may transmit an MDT log fetch request message to the UE that has

transmitted the user consent revocation message at step S950. The MDT log fetch request message transmitted by the eNB may be a message UEInformationRequest that requests information about the UE.

[0176] As described above, in a common MDT-related operation, the eNB is informed that the eNB does not need to report an MDT log for a predetermined MDT log duration and may use a log after the log duration is finished (i.e., log available indication). Next, when the eNB or the network requests the UE to report the MDT log, the UE reports the MDT log.

[0177] Unlike in the common MDT-related operation, in the user consent revocation procedure, the UE may transmit the user consent revocation message to the network, but may no longer perform the MDT-related operation. Accordingly, if necessary measures (e.g., the MDT log fetch request) do not exist, the UE may store the MDT log in the memory for a specific time (e.g., 48 hours) (unless the UE is switched off or the written MDT log). This is not a preferred one in the management of memory, in particular, the UE having insufficient available memory.

[0178] Accordingly, if the user consent status is changed from 'user consent' to 'user non-consent' and the user consent revocation reason is memory shortage, it may necessary to request the UE to perform MDT log fetch so that the UE can efficiently use memory.

[0179] In response to the MDT log fetch request message, the UE writes an MDT log, stores the MDT log in the memory, and reports the MDT log to the eNB using an MDT log report message at step S960. The MDT log report message transmitted from the UE to the eNB is a response message UEInformationResponse to the message UEInformationRequest. The UE may clear the MDT log from the memory because it has reported the stored MDT log to the eNB.

[0180] An example of measures in which UE is requested to perform MDT log fetch when a user consent revocation reason is memory shortage has been described with reference to FIG. 9. In some embodiments, however, a network and an eNB may request or instruct UE to clear an MDT log so that the UE can solve memory shortage without requesting the UE to perform MDT log fetch.

[0181] In other words, an example in which measures due to a user consent revocation reason may not be performed according to an instruction or request of a network and an eNB as in FIG. 9, but may be performed by UE by itself may be taken into consideration.

[0182] FIG. 10 is a flowchart schematically illustrating another embodiment in which a user consent revocation procedure is performed by taking a user consent revocation reason into consideration in a system to which the present invention is applied. An example in which a user consent revocation reason is memory shortage is described with reference

to FIG. 10, for convenience of description. Furthermore, in FIG. 10, the same contents as those of FIG. 9 will be simply described or a description thereof will be omitted, for convenience of description.

[0183] Referring to FIG. 10, UE transmits a user consent revocation message to a network at step S1010. Here, the UE transmits the user consent revocation message together with a user consent revocation reason. The user consent revocation message may include information about the user consent revocation reason.

[0184] After transmitting the user consent revocation message to the network, the UE by itself may take necessary measures according to the user consent revocation reason. If the user consent revocation reason is memory shortage, the UE may clear MDT log stored in its memory at step S1020. The UE can additionally secure available memory by clearing the MDT log without waiting for a detailed instruction or request from the network and an eNB.

[0185] The necessary measures taken by the UE may be previously determined between the UE and the network/eNB. If the necessary measures taken by the UE may be previously determined between the UE and the network/eNB, whether the UE will wait for an instruction or request from the network/eNB or whether the UE by itself will take necessary measures may be determined according to a user consent revocation reason.

[0186] In FIG. 10, an example in which the UE by itself takes necessary measures against user consent revocation having a reason of memory shortage is described, for convenience of description.

[0187] In response to the user consent revocation message received from the UE, the network updates user consent status information about the UE at step S1030. The network may determine that the UE by itself may take necessary measures based on the user consent revocation reason received from the UE at step S1010. For example, the network may determine that the user consent revocation reason received from the UE is memory shortage and that the UE may clear the stored MDT log in order to solve memory shortage.

[0188] The network transmits the updated user consent status information message for the UE that has transmitted the user consent revocation message to the eNB at step S1040. At this time, the network does not need to transmit necessary measures (e.g., an MDT log fetch instruction) to the eNB because the network determines that the UE by itself will take necessary measures.

[0189] In response to the user consent status information message, the eNB may change user consent status information about the UE at step S1050.

[0190] The examples in which a user consent revocation procedure regarding the execution of an MDT is performed within the same cell have been described so far. However, a

procedure in which UE that revokes user consent performs handover may be taken into consideration. A user consent revocation procedure related to handover is described below.

[0191] FIG. 11 is a flowchart schematically illustrating yet another embodiment in which a user consent revocation procedure is performed by taking a user consent revocation reason into consideration when UE performs handover in a system to which the present invention is applied. An example in which a user consent revocation reason is memory shortage is described with reference to FIG. 11, for convenience of description. Furthermore, in FIG. 11, the same contents as those of FIGS. 9 and 10 will be simply described or a description thereof will be omitted, for convenience of description.

[0192] Referring to FIG. 11, the UE transmits a user consent revocation message to a network at step S1110. At this time, the UE transmits the user consent revocation message together with a user consent revocation reason. The user consent revocation message may include information about the user consent revocation reason.

[0193] In response to the user consent revocation message received from the UE, the network updates user consent status information about the UE at step S1120. The network also receives the user consent revocation reason from the UE.

[0194] Meanwhile, the UE moves from a Source eNB (hereinafter referred to as an 'SeNB') to a Target eNB (hereinafter referred to as an 'TeNB') in the IDLE mode and then accesses the network in the CONNECTED mode. Here, the UE accesses the TeNB.

[0195] Accordingly, the network transmits the user consent status information about the UE to the TeNB at step S1130. At this time, in order to solve the memory shortage problem of the UE, the network transmits an MDT log fetch instruction to the TeNB. In response to the MDT log fetch instruction, the TeNB transmits an MDT log fetch request message to the UE, as will be described later.

[0196] The network may also transmit the user consent status information to the SeNB at step S1140. Although the UE has performed handover from the SeNB to the TeNB when the user consent status information is transmitted, the user consent status information about the UE is shared by the SeNB and the TeNB. Accordingly, the user consent status information may be subsequently used. Furthermore, the network may also transmit the MDT log fetch instruction to the SeNB. In response to the MDT log fetch instruction, the SeNB may determine that the UE writes an MDT log by performing an MDT within the cell of the SeNB and reports the MDT log to the TeNB and the TeNB will have the MDT log.

[0197] In response to the user consent status information message, the TeNB may change the user consent status information about the UE at step S1150.

[0198] Furthermore, in response to the user consent status information message, the SeNB may change the user consent status information about the UE at step S1160. Ac-

cordingly, the SeNB can update the user consent status information about the UE into the latest information and subsequently utilize the latest information.

[0199] The TeNB may transmit the MDT log fetch request message to the UE that has transmitted the user consent revocation message at step S1170. The MDT log fetch request message transmitted by the TeNB may be a message UEInformationRequest that requests information about the UE as described above.

[0200] In response to the MDT log fetch request message, the UE writes an MDT log within the cell of the SeNB, stores the MDT log in memory, and reports the MDT log to the TeNB at step S1180. The MDT log report message transmitted from the UE to the TeNB may be a message UEInformationResponse as described above. The UE may clear the MDT log from the memory by reporting the stored MDT log to the TeNB.

[0201] An example in which necessary measures due to a user consent revocation reason are taken in response to an instruction or request from a network/TeNB and at this time UE performs handover has been described with reference to FIG. 11. However, the present invention may also be applied to an example in which UE by itself takes necessary measures and at this time, the UE performs handover. In this case, unlike in the example of FIG. 11, the UE may transmit the user consent revocation message to the network and take necessary measures (e.g., clearing an MDT log stored in the memory), as described above with reference to FIG. 10, without the step S1170 of the TeNB sending the log fetch request message and the step S1180 of the UE reporting the MDT log. Accordingly, the network does not need to transmit the MDT log fetch instruction to each of the SeNB and the TeNB.

[0202] Meanwhile, regarding the step S1140 of sending the user consent status information, the user consent status information may be transmitted to the SeNB so that the SeNB can update the user consent status information. If the user consent status information does not need to be updated, the user consent status information may not be transmitted to the SeNB. If the user consent status information needs to be updated (e.g., the UE may return back to the SeNB or it is expected that the updated of the user consent status information about the UE is not easy from another network), the step S1140 of sending the user consent status information so that the user consent status information can be updated may be preferably performed.

[0203] The operation of each of the subjects in a consent revocation procedure in which a user consent revocation reason is taken into consideration is described below.

[0204] FIG. 12 is a flowchart schematically illustrating a user consent revocation procedure performed by UE in a system to which the present invention is applied.

[0205] The UE that has consented to the execution of an MDT determines whether to stop performing the MDT or not to start performing the MDT at step S1210. The UE determines whether a situation in which the MDT cannot be performed has occurred and

stops performing the MDT or does not start performing the MDT according to a result of the determination.

[0206] For example, if the UE cannot perform the MDT (e.g., available memory is insufficient or the remaining battery amount is insufficient), the UE may stop the MDT or may determine not to start the MDT (hereinafter referred to as an 'MDT stop decision'). In this case, the UE compares current available memory with predetermined reference memory $M_{threshold}$. If, as a result of the comparison, the current available memory is smaller than the predetermined reference memory, the UE may make an MDT stop decision. Furthermore, the UE may compare the remaining battery amount with a predetermined reference battery amount $B_{threshold}$. If, as a result of the comparison, the remaining battery amount is smaller than the reference battery amount, the UE may make an MDT stop decision.

[0207] If the MDT stop decision is made, the UE transmits a user consent revocation message to a network at step S1220. At this time, the UE transmits a user consent revocation reason together with the user consent revocation message. The user consent revocation reason may be included in the user consent revocation message and then transmitted. Here, the user consent revocation message is the NAS protocol or application message of the UE. An eNB simply transfers the user consent revocation message to a network side.

[0208] The network to which the user consent revocation message is transmitted may be an MME, an OAM server, or an HSS.

[0209] In order to take necessary measures against a situation that an MDT cannot be performed (e.g., memory shortage or battery shortage), the UE may determine whether it needs a processing instruction or request from the network/eNB at step S1230. Whether the processing instruction or request from the network/eNB is necessary might have been previously determined between the UE and the network/eNB or might have been previously determined according to a user consent revocation reason.

[0210] If, as a result of the determination, the processing instruction or request from the network/eNB is determined not to be necessary, the UE by itself may take necessary measures. For example, if available memory is insufficient, the UE may clear MDT logs stored in its memory at step S1240.

[0211] If, as a result of the determination, the processing instruction or request from the network/eNB is determined to be necessary, the UE receives an instruction or request for taking necessary measures from the eNB. For example, if the user consent revocation reason is available memory shortage, the UE may receive an MDT log fetch request message from the eNB at step S1250.

[0212] The UE takes measures based on the instruction or request received from the eNB. For example, in response to the MDT log fetch request message received from the

eNB, the UE may write an MDT log by performing an MDT, store the MDT log in the memory, and report the MDT log to the eNB at step S1260. The UE that has reported the MDT log may further secure available memory by deleting the MDT log from the memory.

[0213] FIG. 13 is a flowchart schematically illustrating a user consent revocation procedure performed by a network in a system to which the present invention is applied.

[0214] Referring to FIG. 13, the network receives a user consent revocation message from UE at step S1310. The network receives a user consent revocation reason together with the user consent revocation message. The user consent revocation reason may be included in the user consent revocation message.

[0215] In response to the user consent revocation message, the network updates user consent status information about the UE at step S1320. Accordingly, the user consent status information of the UE is changed from 'user consent' to 'user non-consent'.

[0216] The network may determine whether the UE by itself takes necessary measures related to the user consent revocation reason at step S1330. The necessary measures related to the user consent revocation reason are measures for solving the user consent revocation reason (i.e., a cause of a problem in the normal operation of the UE (i.e., a reason of MDT stop decision) to the utmost. For example, if the user consent revocation reason is memory shortage, the necessary measures may be an operation of deleting MDT logs stored in the memory of the UE.

[0217] Whether the UE by itself will take the necessary measures might have been previously determined between the UE and the network/eNB. Whether the UE by itself will take the necessary measures might have been collectively determined for all user consent revocation reasons. In some embodiments, whether the UE by itself will take the necessary measures might have been determined for every user consent revocation reason. In this case, the network may determine whether the UE by itself will take the necessary measures based on the user consent revocation reason.

[0218] If, as a result of the determination at step S1330, the network determines that the UE by itself will take the necessary measures, the network transmits the updated user consent status information about the UE to the eNB at step S1340. At this time, the network may transmit the user consent revocation reason of the UE, together with the updated user consent status information, to the eNB.

[0219] The updated user consent status information may be included in a user consent status information message and then transmitted. The user consent status information message transmitted from the network to the eNB, as described above, may be an initial context setup request message.

[0220] The user consent status information message may include the updated user consent status information by itself or may include only information indicating that the user

consent status has changed.

[0221] The updated user consent status information, as described above, may be transferred through an SPID. In this case, the network may configure a profile mapped to the changed user consent status and transmit the configured profile together with the SPID. The network may configure the SPID so that the index of the SPID is mapped to a profile regarding user consent status information 'user non-consent'. Furthermore, the network may configure the profile regarding user consent status information 'user non-consent' so that information necessary for the eNB to stop an MDT procedure, such as the UE ID, the MDT consent revocation indicator, etc. of the UE that has transmitted the user consent revocation message, is included in the profile regarding user consent status information 'user non-consent'.

[0222] If, as a result of the determination at step S1330, the network determines that the UE by itself will not take the necessary measures, the network may transmit an instruction/request regarding the necessary measures, in addition to the user consent status information message, to the eNB at step S1350. In this case, the network may also transmit the user consent revocation reason of the UE, together with the user consent status information message, to the eNB.

[0223] The necessary measures may be different according to a user consent revocation reason as described above. If the user consent revocation reason is memory shortage, the network may transmit an MDT log fetch instruction to the eNB as the necessary measures (e.g., so that an MDT log is reported). If the network determines that the MDT log has only to be cleared without the MDT log report as described above, the network may instruct or request the eNB so the UE immediately clears the MDT log.

[0224] FIG. 14 is a flowchart schematically illustrating a user consent revocation procedure performed by an eNB in a system to which the present invention is applied.

[0225] Referring to FIG. 14, the eNB receives a user consent status information message for UE from a network at step S1410. The network may be an MME, an OAM server, or an HSS may be.

[0226] The user consent status information message transmitted from the network to the eNB may be an initial context setup request message. The user consent status information message may include only updated user consent status information by itself and may include only information indicating that a user consent status has changed.

[0227] The updated user consent status information may be transferred through an SPID included in the context setup request message. In this case, the index of the SPID may be mapped to a profile regarding user consent status information 'user non-consent'. The profile to which the index of the SPID is mapped may include information that is necessary for the eNB to stop an MDT procedure regarding the UE, such as the UE ID, the MDT consent revocation indicator, etc. of the UE that has transmitted the user

consent revocation message.

[0228] The eNB updates user consent status information about the UE based on the received user consent status information at step S1420. Accordingly, the user consent status information of the UE that has transmitted the user consent revocation message may be changed from 'user consent' to 'user non-consent'.

[0229] Next, the eNB determines whether an MDT log fetch instruction is included in the received user consent status information message or the MDT log fetch instruction, together with the user consent status information message, has been received at step S1430. The MDT log fetch instruction instructs the UE to transmit an MDT log that is written and stored in the UE.

[0230] If, as a result of the determination, the MDT log fetch instruction is determined not to exist, the procedure in the eNB is finished at S1420 of updating the user consent status information of the UE.

[0231] If, as a result of the determination at step S1420, the MDT log fetch instruction is determined to exist, the eNB transmits an MDT log fetch request message to the UE that has transmitted a user consent revocation message at step S1440. The MDT log fetch request message transmitted by the eNB may be a message UEInformationRequest that requests information about the UE.

[0232] The eNB receives an MDT log report message including an MDT log report written by the UE and stored in the memory of the UE at step S1450. The MDT log report message transmitted from the UE to the eNB is a response UEInformationResponse to the message UEInformationRequest. The UE may clear the MDT log stored in the memory by reporting the stored MDT log to the eNB.

[0233] Meanwhile, an example in which MDT log fetch is requested as an example of necessary measures when a user consent revocation reason is memory shortage has been described with reference to FIG. 14. However, the UE may be instructed or requested to clear the MDT log instead of requesting the UE to perform MDT log fetch so that the UE solves memory shortage.

[0234] Furthermore, the examples in which, if measures against a user consent revocation reason need to be taken, an instruction corresponding to the measures is transmitted from a network side to an eNB and the eNB transmits an instruction or request regarding the measures to the UE that has transmitted a user consent revocation message have been described, but the present invention is not limited to the examples.

[0235] More particularly, instead of transmitting the instruction regarding the necessary measures, together with user consent status information about the UE that has transmitted the user consent revocation message, to the eNB, the network may transmit only the user consent revocation reason (i.e., a cause value), together with the user consent status information, to the eNB. In this case, the eNB may transmit the in-

struction or request necessary for the measures to the UE by checking the received user consent revocation reason (i.e., a cause value). For example, if the user consent revocation reason is memory shortage, the network may transmit information (i.e., a cause value), indicating that the user consent revocation reason is memory shortage, together with changed user consent status information about the UE, to the eNB. The eNB may change the user consent status information of the UE regarding the execution of an MDT based on the received user consent status information, check the user consent revocation reason (i.e., a cause value), and transmit the measures against memory shortage (i.e., an MDT log fetch request or an instruction to clear an MDT log) to the UE.

[0236] In this case, the measures taken by the UE by itself might have been previously determined between the UE and the eNB/the network. If the measures taken by the UE by itself might have been previously determined between the UE and the eNB/the network, the network does not need to transmit the user consent revocation reason (i.e., a cause value) to the eNB, and the eNB may change only the user consent status information of the UE without taking the necessary measures according to a predetermined rule or change only the user consent status information of the UE by checking that the user consent revocation reason (i.e., a cause value) has not received from the network.

[0237] If the measures taken by the UE by itself are determined for every user consent revocation reason, the network may check the user consent revocation reason (i.e., a cause value) transmitted by the UE and may transmit an instruction necessary for the eNB or the user consent revocation reason (i.e., a cause value) only when the UE by itself does not take the measures as a result of the check. The eNB may check whether the instruction or the user consent revocation reason (i.e., a cause value) has been received from the network and transmit an instruction/request, corresponding to the instruction, or an instruction/request, corresponding to the user consent revocation reason (i.e., a cause value), to the UE.

[0238] FIG. 15 is a block diagram schematically illustrating the construction of each of the subjects of operations in a system to which the present invention is applied.

[0239] UE 1500 includes a transceiver 1505, memory 1510, and a controller 1515. The UE 1500 transmits and receives necessary information through the transceiver 1505. The transceiver 1505 may transmit an MDT log, a user consent revocation message regarding the execution of an MDT, etc. to an eNB/network.

[0240] The memory 1510 may store configuration information necessary to perform an MDT, an MDT log written by performing the MDT, predetermined reference values $M_{threshold}$, $B_{threshold}$ necessary to make an MDT stop decision, and so on.

[0241] The controller 1515 is connected to the transceiver 1505 and the memory 1510 and is

configured to control the transceiver 1505 and the memory 1510. The controller 1515 of the UE 1510 controls the above procedures of the present invention so that the procedures are performed. For example, the controller 1515 may perform an MDT based on an MDT configuration, write an MDT log, and transmit the MDT log through the transceiver 1505. Furthermore, the controller 1515 may make an MDT stop decision. For example, the controller 1515 may determine whether to stop performing an MDT by comparing the available memory and the remaining battery amount of the UE with respective predetermined reference values. If the execution of the MDT is determined to be stopped, the controller 1515 may directly transmit a user consent revocation message regarding the execution of the MDT to a network through the transceiver 1505 or may transmit the user consent revocation message to the network through an eNB.

[0242] Furthermore, the controller 1515 may take necessary measures in order to solve a problem that has caused a user consent revocation reason (e.g., memory shortage or battery shortage) according to an instruction or request from a network 1560 or an eNB 1530 or both. Here, the controller 1515 may determine that the UE 1500 by itself will take necessary measures according to a predetermined rule. In this case, the controller 1515 may take the necessary measures without waiting for the instruction or request from the network 1560 or the eNB 1530 or both.

[0243] The eNB 1530 includes a transceiver 1535, memory 1540, and a controller 1545. The eNB 1530 may transmit and receive information to and from the UE 1500 or the network 1560 or both through the transceiver 1535. The transceiver 1535 transfers a user consent revocation message regarding the execution of an MDT, received from the UE 1500, to the network 1560.

[0244] The memory 1540 may store a configuration for the execution of an MDT, an MDT log received from UE, user consent status information about the execution of an MDT for each UE, and so on.

[0245] The controller 1545 is connected to the transceiver 1535 and the memory 1540 and is configured to control the transceiver 1535 and the memory 1540. The controller 1545 may change user consent status information about the UE 1500 based on user consent status information received from the network 1560. Furthermore, the controller 1545 may transfer an instruction or request necessary to perform a procedure, required by the UE 1500, to the UE 1500 through the transceiver 1535 according to circumstances or according to an instruction of the network 1560.

[0246] The network 1560 includes a transceiver 1565, memory 1570, and a controller 1575. The network 1560 may be an MME, an OAM server, or an HSS. Here, a 'network node' (i.e., an MME, an OAM server, or an HSS) is referred to as a 'network', for convenience of description. The network 1560 may transmit and receive necessary in-

formation through the transceiver 1565. For example, the transceiver 1565 may receive a user consent revocation message regarding the execution of an MDT by the UE 1500. Furthermore, the transceiver 1565 may transmit information messages necessary for a user consent revocation procedure regarding the execution of an MDT.

[0247] The memory 1570 may store pieces of information about eNBs and UEs connected to the network 1560. For example, the memory 1570 may store user consent status information regarding the execution of an MDT for every UE. The controller 1575 is connected to the transceiver 1565 and the memory 1570 and is configured to control the transceiver 1565 and the memory 1570. The controller 1575 may change user consent status information about the UE 1500 in response to a user consent revocation message regarding the execution of an MDT, received from the UE 1500. Furthermore, the controller 1575 may determine what necessary measures are necessary for the UE 1500 based on a user consent revocation reason received from the UE 1500.

[0248] Furthermore, the controller 1575 may configure a message in order to transfer information, changed according to the user consent revocation of the UE 1500, to the eNB 1530 and transmit the configured message to the eNB 1530 through the transceiver 1565. Furthermore, if the controller 1575 determines that necessary measures need to be taken by the UE 1500, the controller 1575 may configure an instruction to be transmitted to the eNB 1560 so that the UE 1500 may take the necessary measures and transmit the configured instruction to the eNB 1560 through the transceiver 1565.

[0249] The system to which the present invention is applied has been illustrated to be composed of one UE, one eNB, and one network node, but this is for convenience of description. A plurality of UEs and a plurality of eNBs may exist for one network node.

[0250] In the above-described exemplary systems, although the methods have been described on the basis of the flowcharts using a series of the steps or blocks, the present invention is not limited to the sequence of the steps, and some of the steps may be performed at different sequences from the remaining steps or may be performed simultaneously with the remaining steps. Furthermore, those skilled in the art will understand that the steps shown in the flowcharts are not exclusive and other steps may be included or one or more steps of the flowcharts may be deleted without affecting the scope of the present invention.

[0251] While the invention has been shown and described with respect to the preferred embodiments, it will be understood by those skilled in the art that various changes and modifications may be made without departing from the spirit and scope of the invention as defined in the following claims.

Claims

[Claim 1] A method of User Equipment (UE) revoking user consent to a Minimization Driving Test (MDT), the method comprising:
if the user consent to the MDT is determined to be revoked, transmitting a user consent revocation message and information about a reason of the user consent revocation to a network and stopping performing the MDT; and
receiving an MDT log fetch request message or an MDT log clear instruction message from an evolved NodeB (eNB),
wherein when the MDT log fetch request message is received, the UE transmits an MDT log stored in memory to the eNB and clears the stored MDT log, and when the MDT log clear instruction message is received, the UE clears the stored MDT log.

[Claim 2] The method as claimed in claim 1, wherein the UE determines to revoke the user consent to the MDT when available memory is smaller than predetermined reference memory.

[Claim 3] The method as claimed in claim 2, wherein the user consent revocation message comprises a cause value of available memory shortage as the reason of the user consent revocation.

[Claim 4] The method as claimed in claim 1, wherein the UE determines to revoke the user consent to the MDT when a remaining battery amount is smaller than a predetermined reference battery amount.

[Claim 5] The method as claimed in claim 4, wherein the user consent revocation message comprises a cause value of battery shortage as the reason of the user consent revocation.

[Claim 6] The method as claimed in claim 1, further comprising determining whether log disposal processing is necessary,
wherein if the log disposal processing is determined to be necessary, the UE clears the stored MDT log although the MDT log fetch request message or the MDT log clear instruction message is not received from the eNB.

[Claim 7] The method as claimed in claim 1, further comprising determining whether log disposal processing is necessary,
wherein if the log disposal processing is determined not to be necessary, the UE transmits the stored MDT log to the eNB and clears the stored MDT log when the MDT log fetch request message is received from the eNB, and the UE clears the stored MDT log when the

MDT log clear instruction message is received.

[Claim 8] A method of an evolved NodeB (eNB) processing revocation of user consent to a Minimization Driving Test (MDT), the method comprising:
receiving user consent status information about User Equipment (UE) from a network; and
changing a user consent status of the UE based on the user consent status information,
wherein if an instruction for the UE is included in the user consent status information, the eNB transmits a request message or an instruction message according to the instruction to the UE.

[Claim 9] The method as claimed in claim 8, wherein if the instruction for the UE is an MDT log fetch instruction, the eNB transmits an MDT log fetch request message to the UE.

[Claim 10] The method as claimed in claim 9, wherein if the user consent status information of the UE instructs the revocation of the user consent to the MDT and information on a reason of the user consent revocation of the UE is included in the user consent status information, the eNB transmits an instruction corresponding to the reason to the UE.

[Claim 11] The method as claimed in claim 10, wherein if the reason of the user consent revocation of the UE is memory shortage, the eNB transmits an MDT log clear instruction, together with a log fetch request message to the UE.

[Claim 12] The method as claimed in claim 8, wherein if the user consent status information of the UE instructs the revocation of the user consent to the MDT, the eNB transmits an MDT log fetch request message to the UE.

[Claim 13] The method as claimed in claim 8, wherein:
when the UE performs handover and establishes a connection with the eNB, the eNB changes the user consent status of the UE based on the user consent status information of the UE and receives an MDT log from the UE, and
when the UE performs handover and releases a connection with the eNB, the eNB changes the user consent status of the UE based on the user consent status information of the UE.

[Claim 14] User Equipment (UE) supporting a Minimization Driving Test (MDT), comprising:
a controller for controlling an execution of the MDT and generating an MDT log;

a transceiver for transmitting or receiving pieces of information about the execution of the MDT including the MDT log; and

memory for storing some or all of the pieces of information about the execution of the MDT including the MDT log,

wherein if the UE determines to revoke user consent to the MDT, the controller transmits a user consent revocation message and information about a reason of the user consent revocation to a network and stops the execution of the MDT, when an MDT log fetch request message is received from an evolved NodeB (eNB), the controller transmits the MDT log stored in the memory to the eNB through the transceiver and clears the MDT log stored in the memory, and when an MDT log clear instruction message is received from the eNB, the controller clears the MDT log stored in the memory.

[Claim 15] An evolved NodeB (eNB) supporting a Minimization Driving Test (MDT), comprising:

a controller for controlling an execution of an MDT;

a transceiver for transmitting and receiving pieces of information about the execution of the MDT; and

memory for storing some or all of the pieces of information about the execution of the MDT,

wherein when user consent status information about UE is received from a network, the controller changes a user consent status of the UE based on the user consent status information, and when an instruction for the UE is included in the user consent status information, the controller transmits a request message or an instruction message according to the instruction to the UE through the transceiver.

[Claim 16] A method of a network side processing user consent revocation for a Minimization Driving Test (MDT), the method comprising:

receiving a user consent revocation message including a reason of the user consent revocation from User Equipment (UE);

changing user consent status information of the UE based on the user consent revocation message; and

transmitting a user consent status information message, including the changed user consent status information, to a serving cell evolved NodeB (eNB) of the UE,

wherein the user consent status information message includes an instruction for enabling the UE to handle the reason of the user consent revocation or a cause value corresponding to the reason of the user

consent revocation.

[Claim 17] A network node supporting a Minimization Driving Test (MDT), comprising:

a transceiver for receiving information about a user consent revocation procedure for an execution of the MDT of User Equipment (UE);

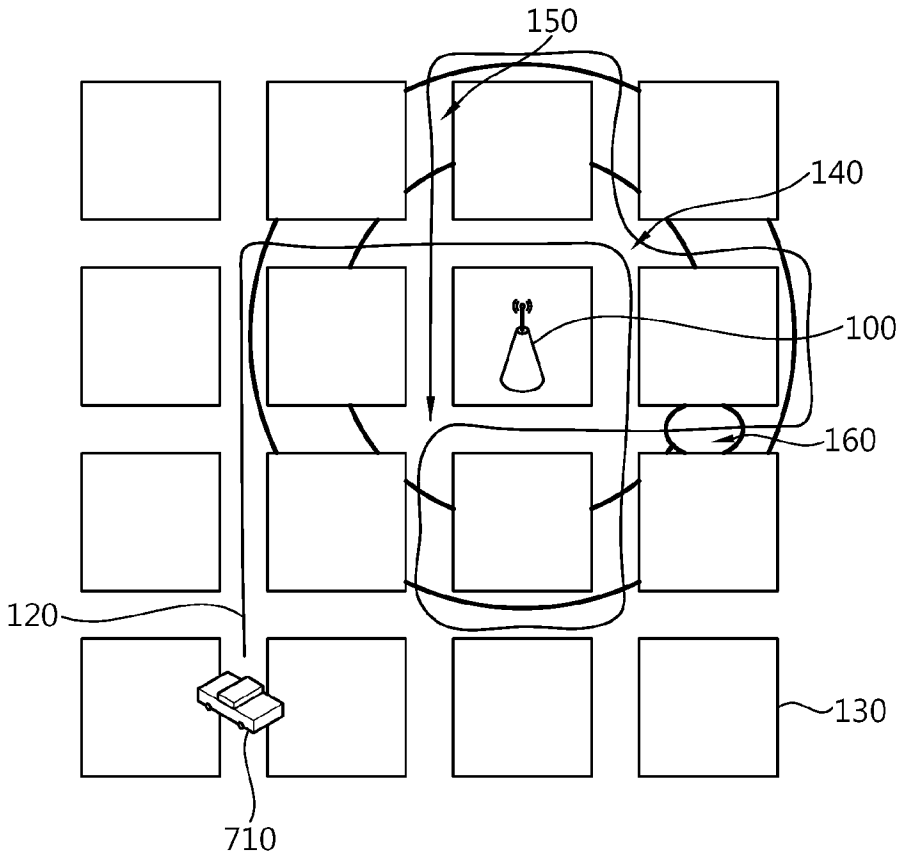
memory for storing information about the UE and an evolved NodeB (eNB) accessing the network node; and

a controller for changing a user consent status regarding the execution of the MDT of the UE based on the information about the user consent revocation procedure regarding the execution of the MDT, received from the UE,

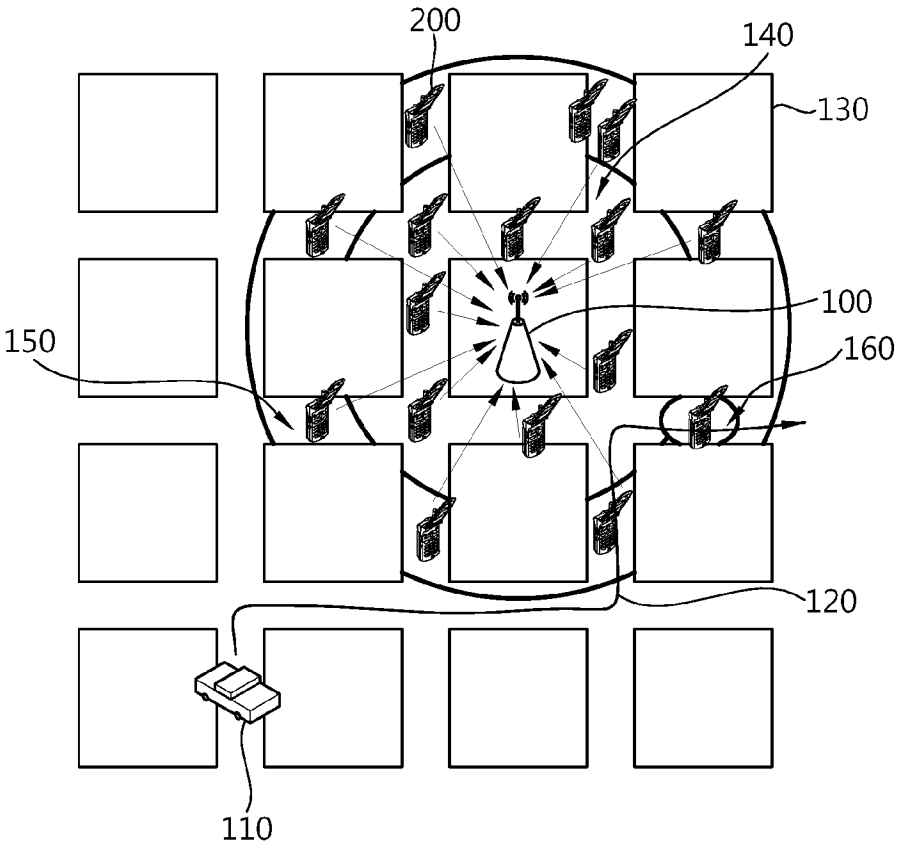
wherein when the user consent status regarding the execution of the MDT of the UE is changed, the controller transmits a user consent status information message, including the changed user consent status information, to a serving cell eNB of the UE.

[Claim 18] The network node as claimed in claim 17, wherein the user consent status information message includes an instruction for enabling the UE to handle a reason of user consent revocation or a cause value corresponding to the reason of the user consent revocation.

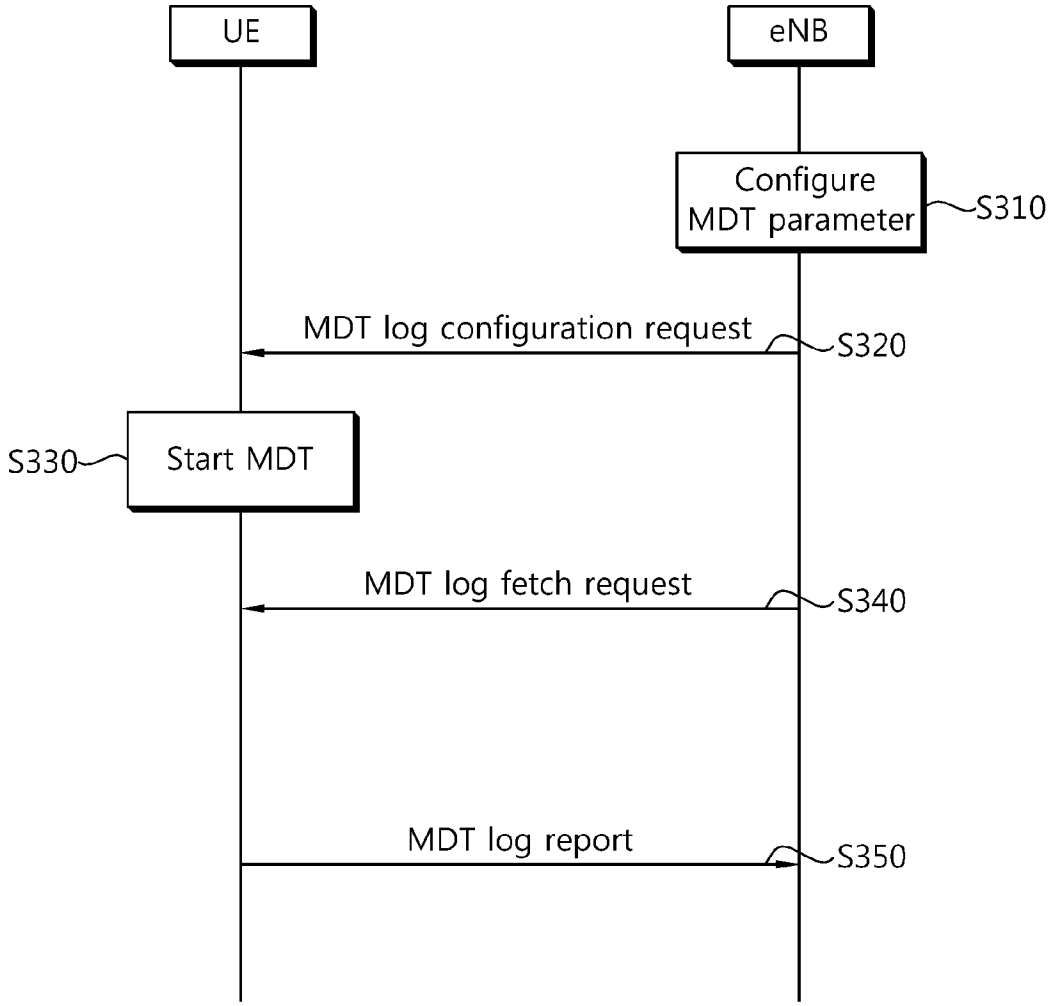
[Fig. 1]



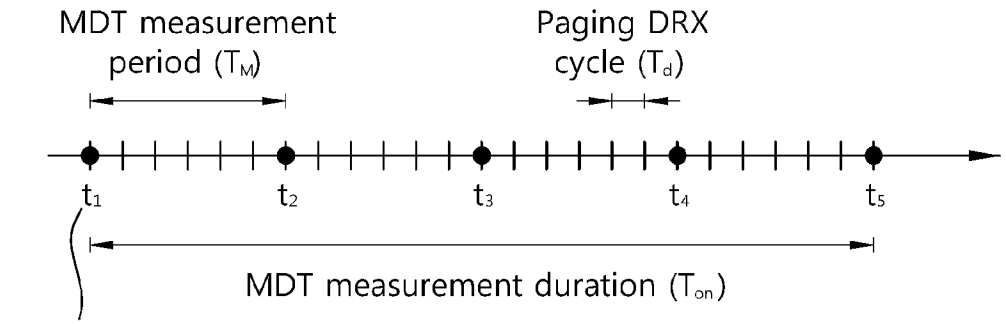
[Fig. 2]



[Fig. 3]

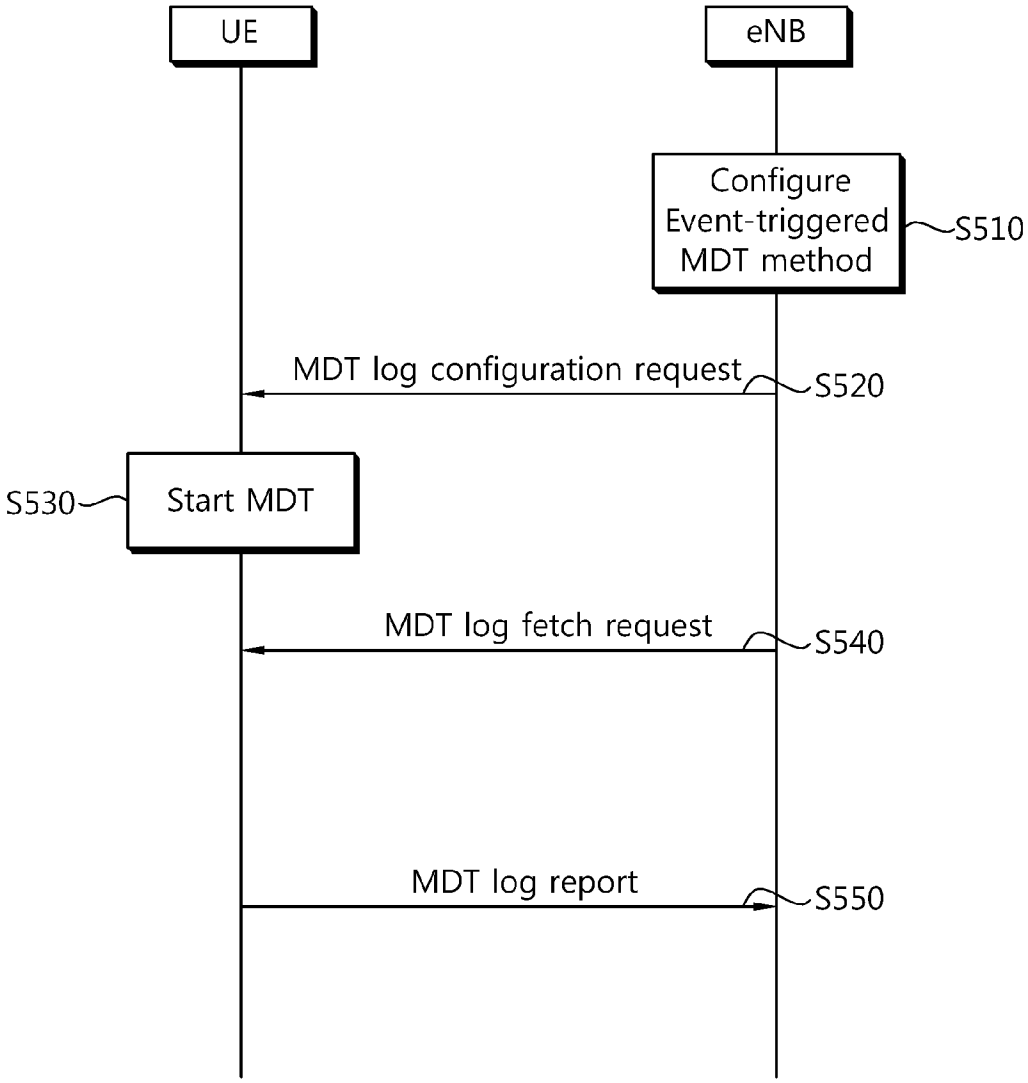


[Fig. 4]

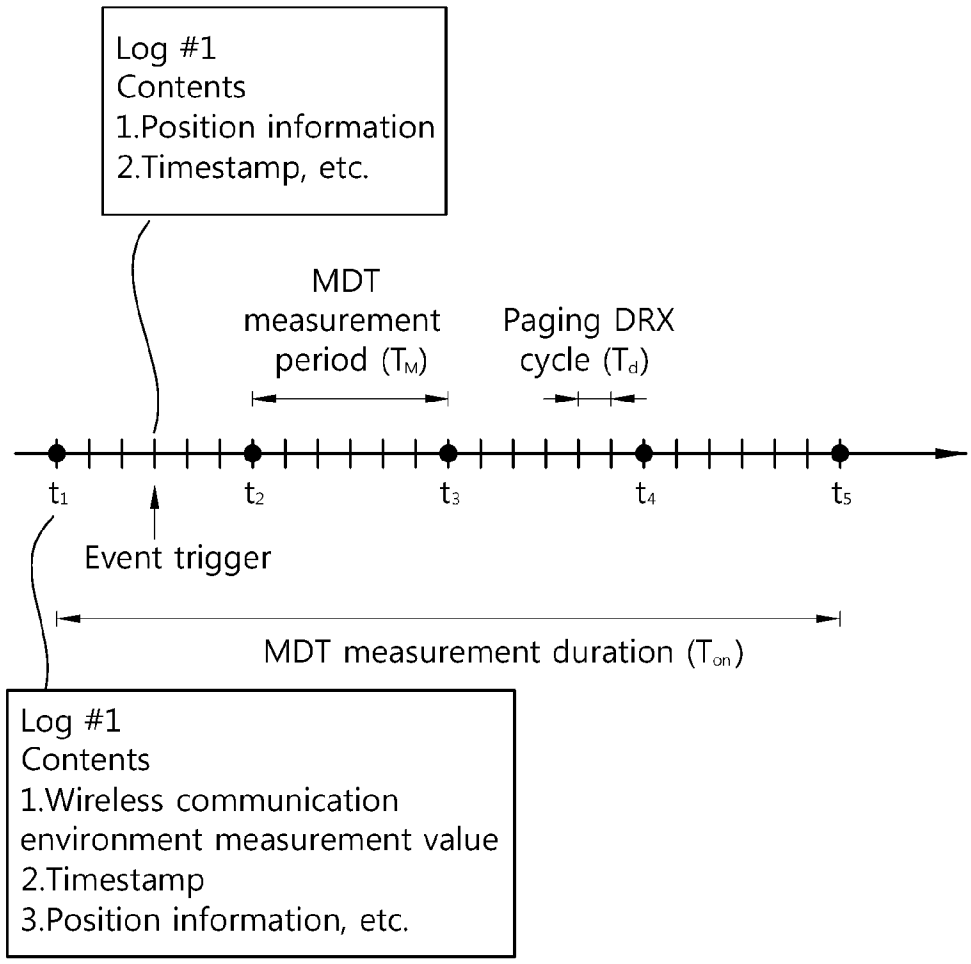


Log #1
Contents
1.Wireless communication environment measurement value
2.Timestamp
3.Position information, etc.

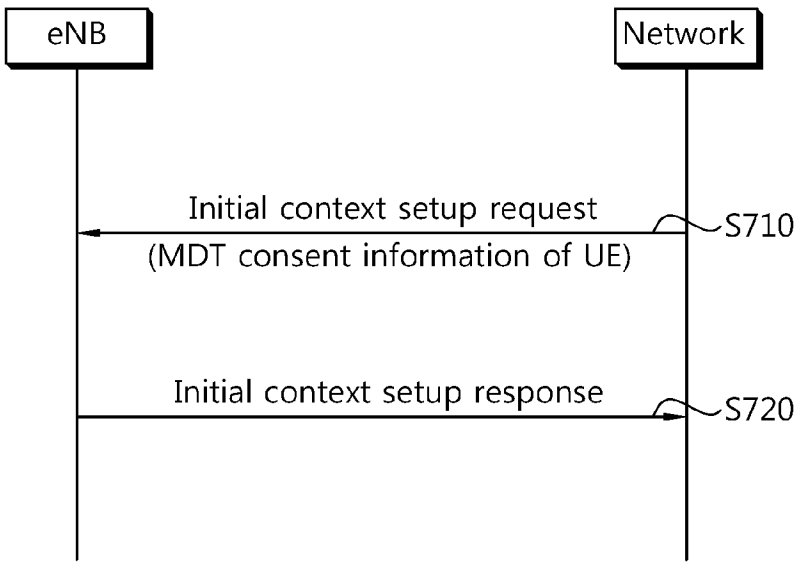
[Fig. 5]


UE
eNB
Configure Event-triggered MDT method
S510
MDT log configuration request
S520
S530
Start MDT
MDT log fetch request
S540
MDT log report
S550

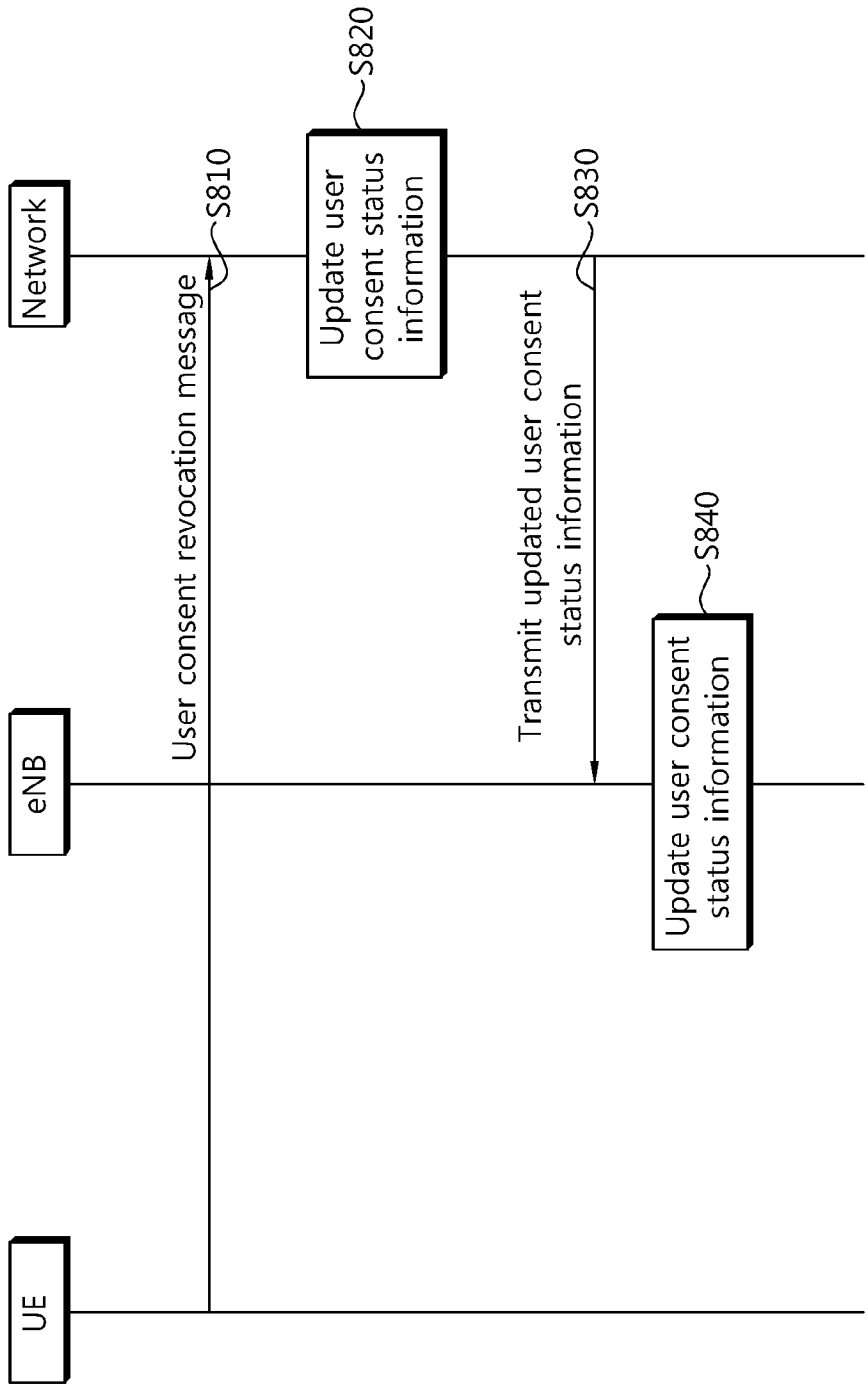
[Fig. 6]


Log #1
Contents
1.Position information
2.Timestamp, etc.
MDT
measurement
period (T_M)
Paging DRX
cycle (T_d)
t_1
t_2
t_3
t_4
t_5
Event trigger
MDT measurement duration (T_{on})
Log #1
Contents
1.Wireless communication
environment measurement value
2.Timestamp
3.Position information, etc.

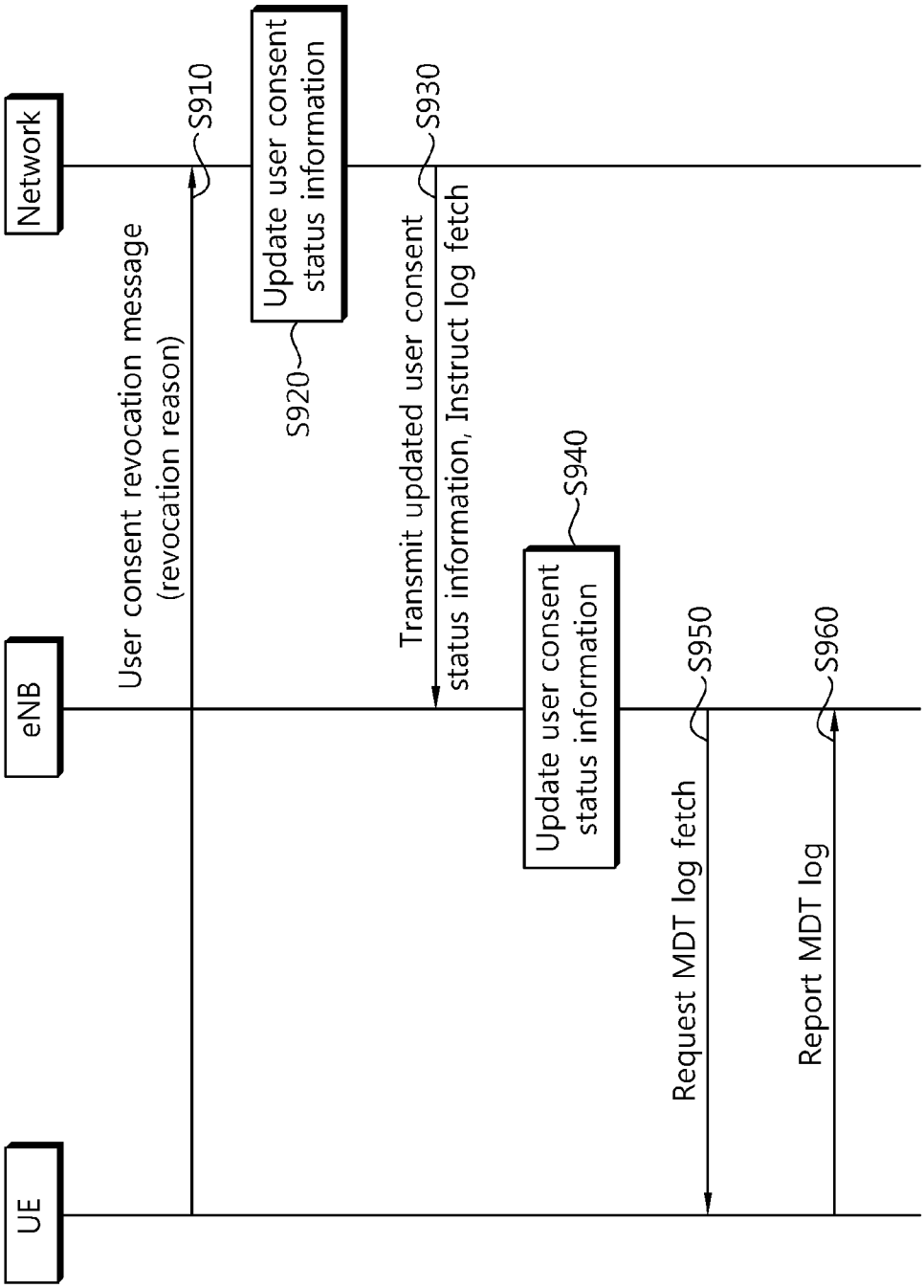
[Fig. 7]


eNB
Network
Initial context setup request
(MDT consent information of UE)
S710
Initial context setup response
S720

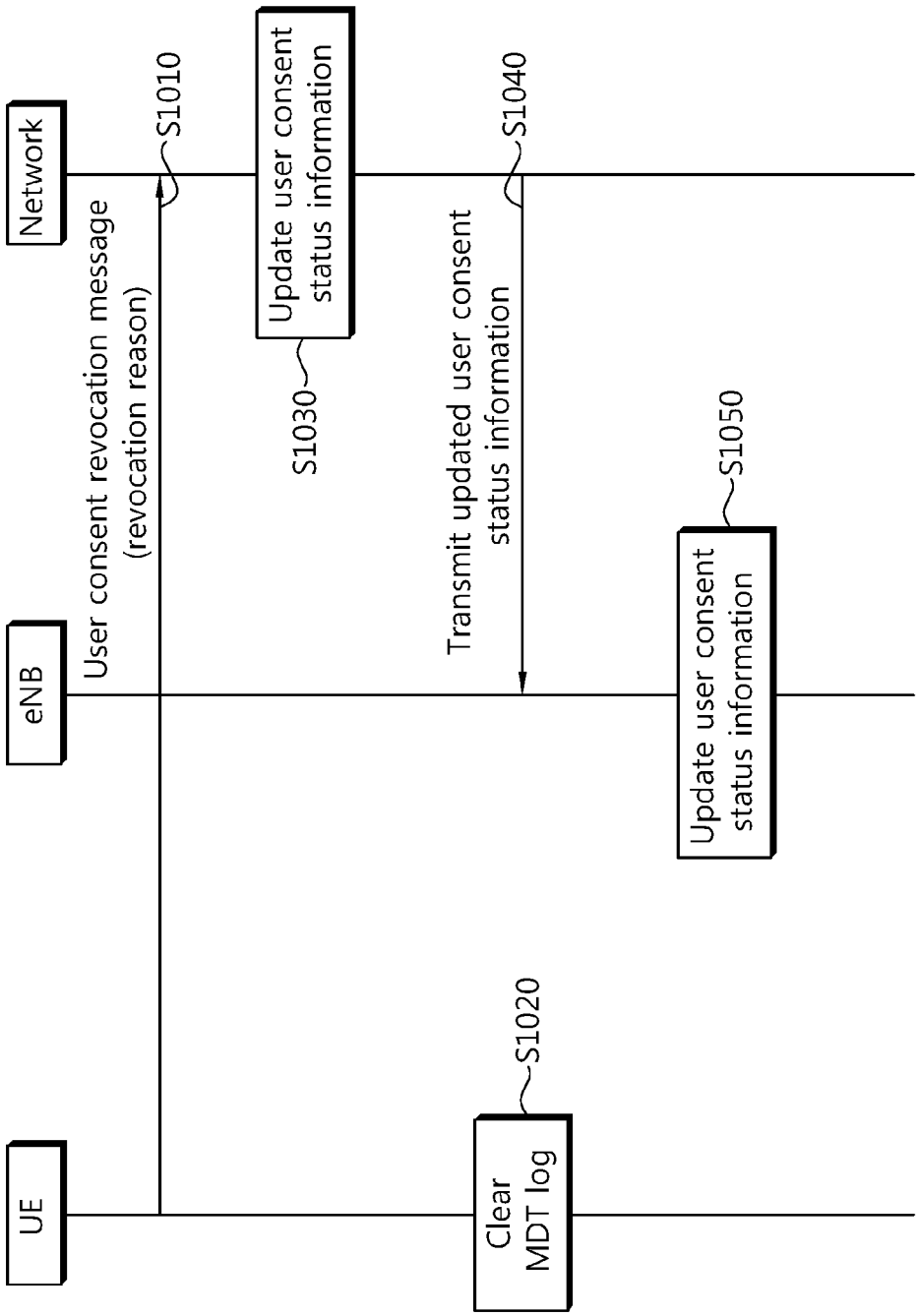
[Fig. 8]


Network
eNB
UE
S810
User consent revocation message
S820
Update user consent status information
S830
Transmit updated user consent status information
S840
Update user consent status information

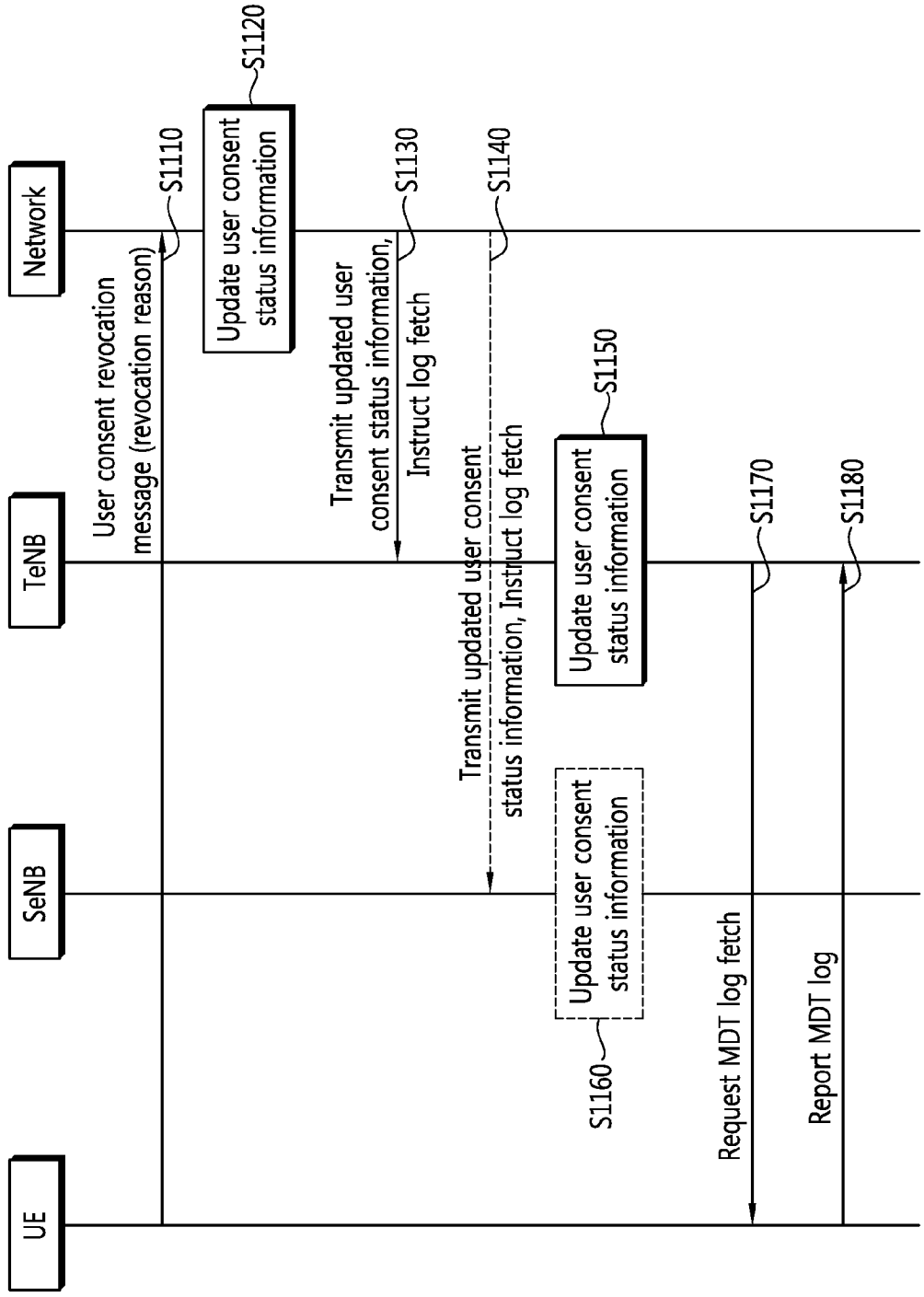
[Fig. 9]


Network
eNB
UE
S910
User consent revocation message
(revocation reason)
S920
Update user consent
status information
S930
Transmit updated user consent
status information, Instruct log fetch
S940
Update user consent
status information
S950
Request MDT log fetch
S960
Report MDT log

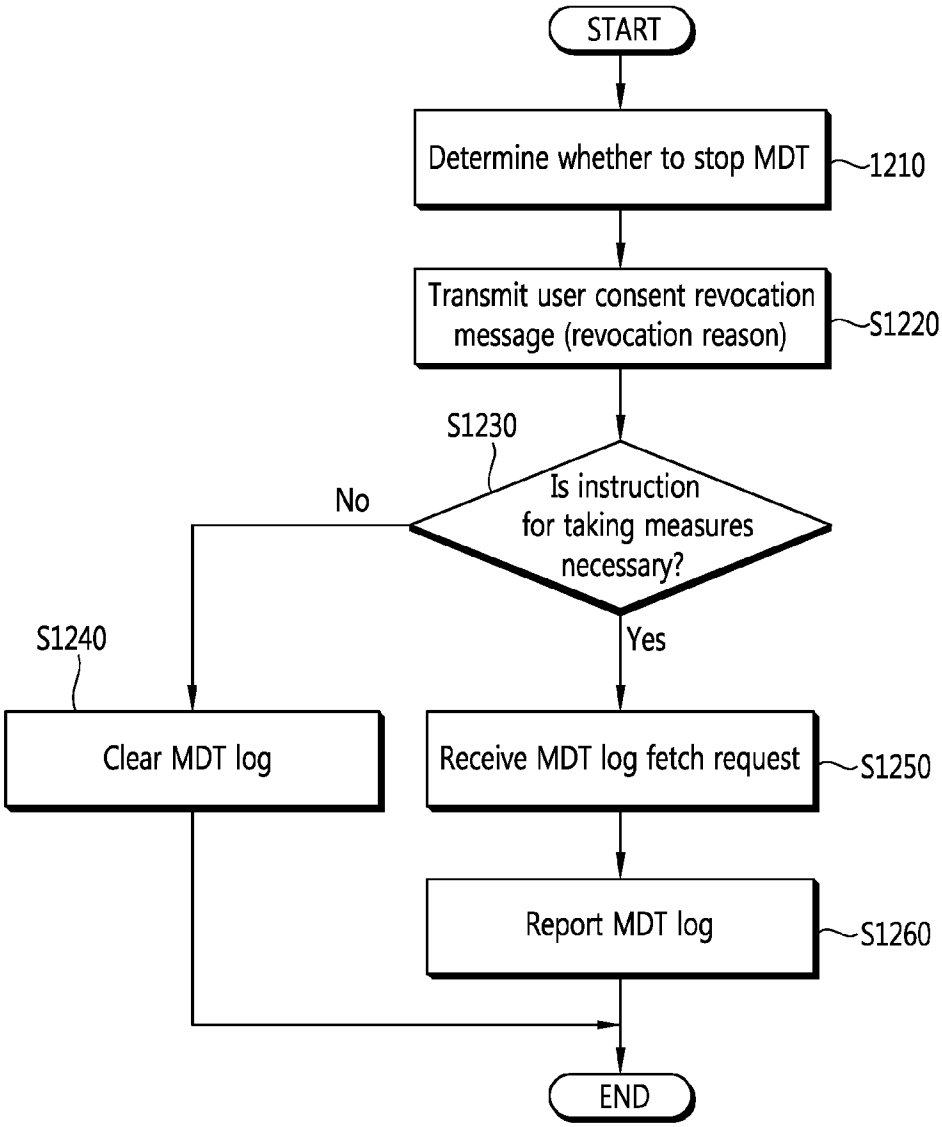
[Fig. 10]


Network
eNB
UE
S1010
User consent revocation message
(revocation reason)
Update user consent
status information
S1030
S1040
Transmit updated user consent
status information
S1050
Update user consent
status information
S1020
Clear
MDT log

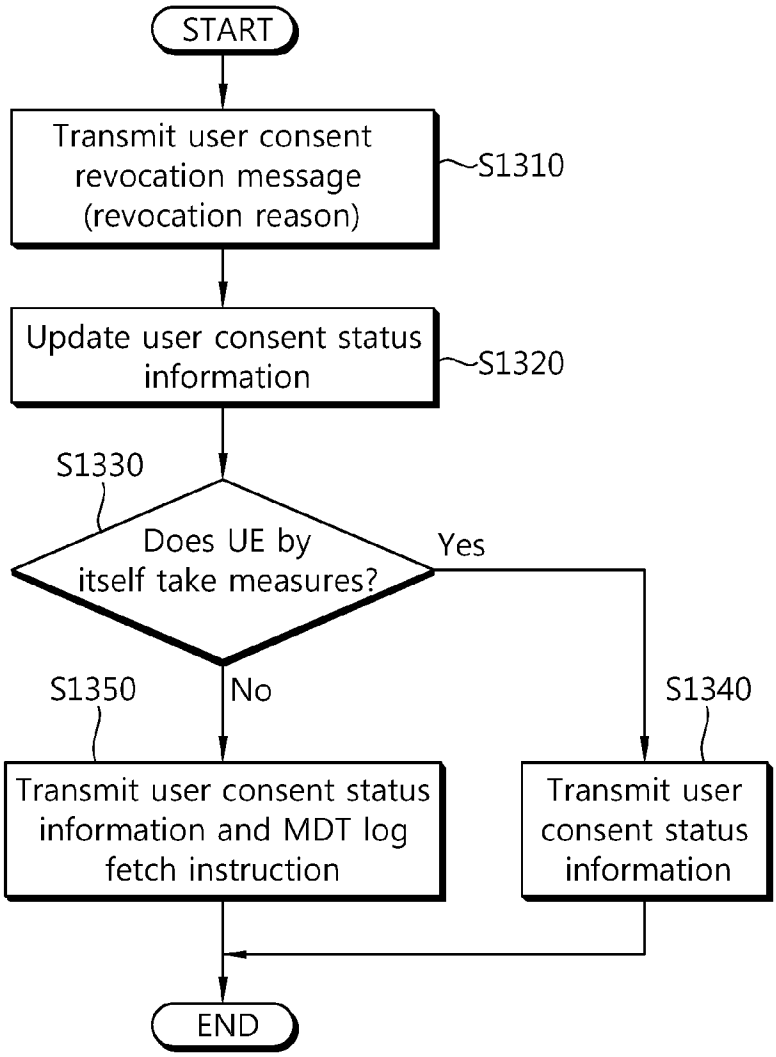
[Fig. 11]


Network
TeNB
SeNB
UE
S1110
User consent revocation message (revocation reason)
S1120
Update user consent status information
S1130
Transmit updated user consent status information, Instruct log fetch
S1140
Transmit updated user consent status information, Instruct log fetch
S1150
Update user consent status information
S1160
Update user consent status information
S1170
Request MDT log fetch
S1180
Report MDT log

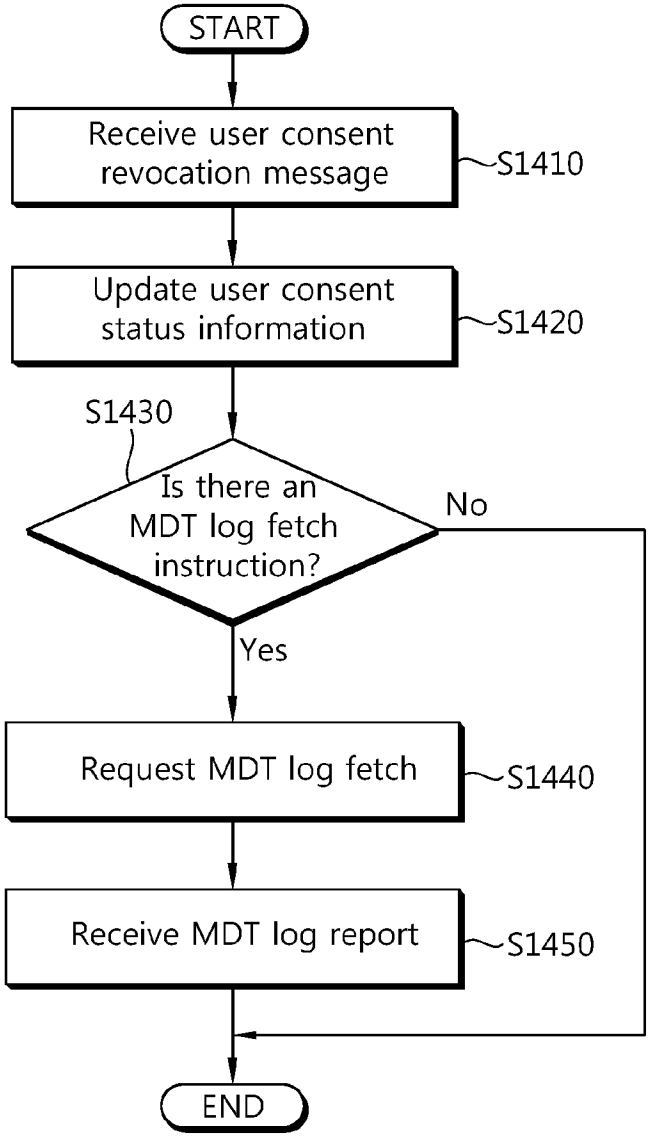
[Fig. 12]


START
Determine whether to stop MDT
1210
Transmit user consent revocation message (revocation reason)
S1220
S1230
Is instruction for taking measures necessary?
No
Yes
S1240
Clear MDT log
Receive MDT log fetch request
S1250
Report MDT log
S1260
END

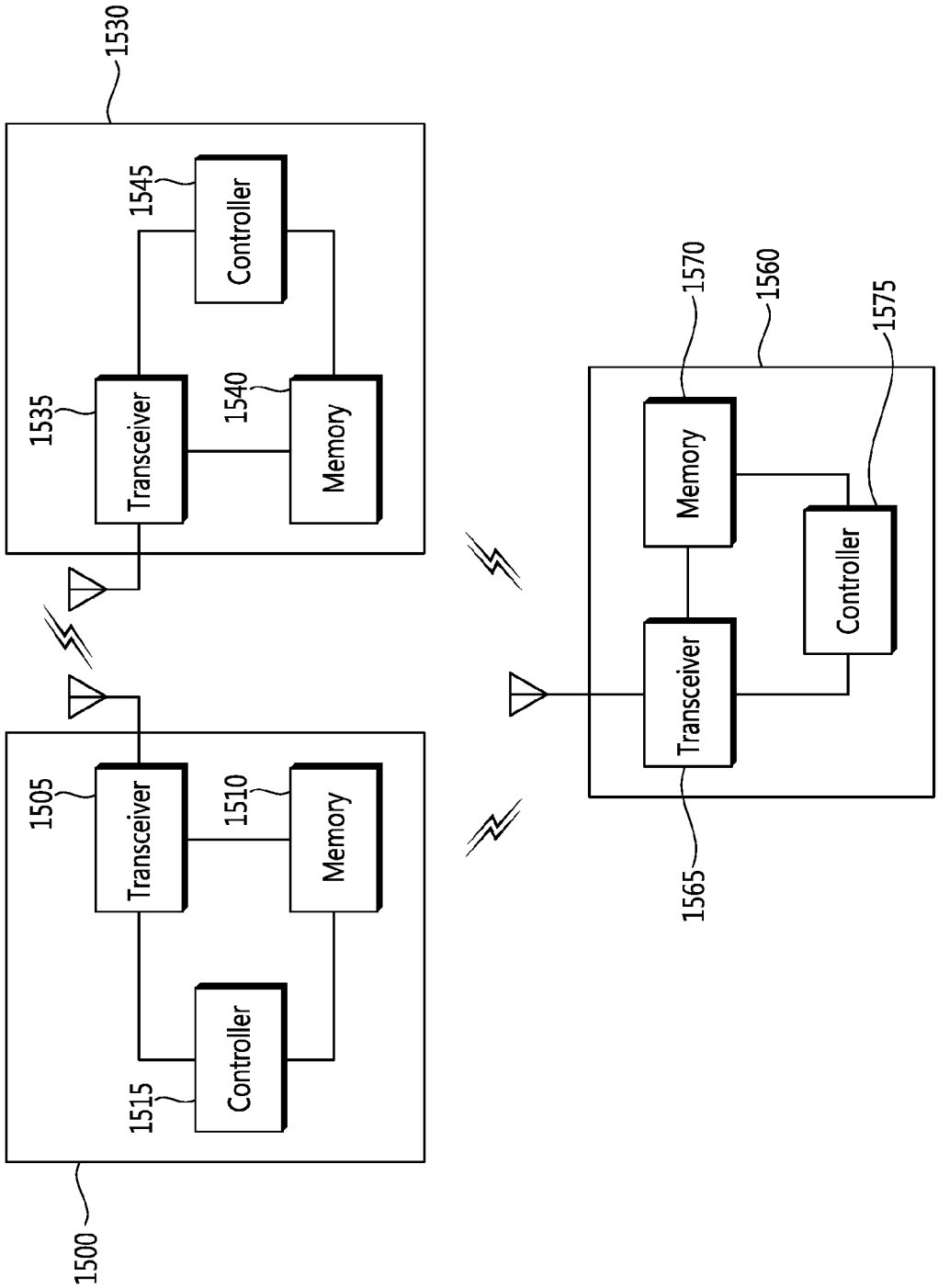
[Fig. 13]


START
Transmit user consent revocation message (revocation reason)
S1310
Update user consent status information
S1320
S1330
Does UE by itself take measures?
Yes
No
S1340
S1350
Transmit user consent status information and MDT log fetch instruction
Transmit user consent status information
END

[Fig. 14]


START
Receive user consent revocation message
S1410
Update user consent status information
S1420
S1430
Is there an MDT log fetch instruction?
No
Yes
Request MDT log fetch
S1440
Receive MDT log report
S1450
END

[Fig. 15]


1530
1545
Controller
1535
Transceiver
1540
Memory
1505
Transceiver
1510
Memory
1515
Controller
1500
1570
1560
1575
Memory
Transceiver
Controller
1565