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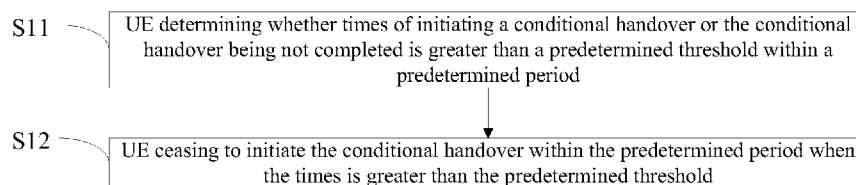


FIG. 1

(57) Abstract: The present disclosure discloses a communication handover method. The method comprises: determining whether times of initiating a conditional handover or the conditional handover being not completed is greater than a predetermined threshold within a predetermined period by a user equipment /base station; and ceasing to initiate the conditional handover /configure a new conditional handover within the predetermined period by the user equipment /base station when the times is greater than the predetermined threshold. The present disclosure also discloses a communication handover apparatus.



COMMUNICATION HANDOVER METHOD AND APPARATUS

TECHNICAL FIELD

[0001] Embodiments of the present disclosure generally relate to communication technology, and in particular relate to communication handover methods and apparatuses.

BACKGROUND

[0002] Handover is the most fundamental and important process in mobility management. In LTE / LTE-A, the handover of a user equipment is controlled by a base station. In NR, since the high frequency carrier and the beamforming techniques are utilized, the channel conditions change rapidly, which may lead to the failure of a handover command delivery from the source base station, i.e., the base station to which the user equipment is currently connected to the user equipment. Once the failure occurs, the control signaling between the user equipment and the base station is gone, and the user equipment will go radio link failure (RLF) and get a RRC reestablishment, which takes more delay.

[0003] In order to solve this problem, conditional handover (i.e., autonomous handover) procedure is proposed. Specifically, the user equipment measures the measurement objectives (generally comprises neighboring cell/beam of the currently connected cell/beam of the user equipment), and transmits a measurement report to the source base station (i.e., the base station of the currently connected cell/beam of the user equipment) to initiate the conditional handover when a trigger condition is satisfied. After selecting the candidate objectives which includes part or all of the measurement objectives according to the measurement report, the source base station negotiates with its base station, and transmits a conditional handover instruction

including information of the candidate objective(s) successfully negotiated and handover condition to the user equipment. The user equipment measures the candidate objectives, and may initiate an actual handover itself to attempt to hand over to a target objective selected from the candidate objectives when the handover condition is satisfied.

[0004] The conditional handover has a valid period. If the user equipment does not actually hand over to a target base station in the valid period, the conditional handover will be abandoned after the valid period. The trigger condition may be that the signal quality of the measurement objective is better than the signal quality of the currently connected cell and the difference between the two is greater than a first threshold, and the handover condition may be that the signal quality of the candidate objective is better than the signal quality of the currently connected cell and the difference between the two is greater than a second threshold, in which the first threshold is smaller than the second threshold, and the source base station can complete the preparation for handover when the channel quality is relatively better.

[0005] If the user equipment is in a wireless environment which satisfies the trigger condition but does not satisfies the handover condition, for example, when located near to the edge of the source cell, the following situation will occur, S1: a user equipment determines that a trigger condition is satisfied; S2: the user equipment transmits a measurement report to a source base station to initiate a conditional handover; S3: the user equipment determines that a handover condition is not satisfied and an actual handover is not initiated; S4: the conditional handover fails after a valid period. After step S4, since the user equipment is still in the same wireless environment, it will determine that the trigger condition is satisfied again, and the process proceeds to S1 to repeat the above-mentioned steps, which results in an infinite loop or a Ping-Pong problem, and introduces a large amount of the resource

and power consumption as well as the signaling overhead.

SUMMARY

[0006] In view of the above, embodiments of the present disclosure provide communication handover methods and apparatuses, aiming at addressing the issues of a large amount of the resource and power waste as well as the signaling overhead caused by the Ping-Pong problem when the user equipment is in a wireless environment which satisfies the trigger condition but does not satisfy the handover condition in the related art.

[0007] In order to solve the above-mentioned technical problem, a first aspect of the present disclosure provides a communication handover method. The method includes: determining, by a user equipment, whether times of initiating a conditional handover or the conditional handover being not completed is greater than a predetermined threshold within a predetermined period; and ceasing, by the user equipment, to initiate the conditional handover within the predetermined period when the times is greater than the predetermined threshold.

[0008] In order to solve the above-mentioned technical problem, a second aspect of the present disclosure provides a communication handover method. The method includes: determining, by a base station, whether times of initiating a conditional handover or the conditional handover being not completed is greater than a predetermined threshold within a predetermined period; and ceasing, by the base station, to configure a new conditional handover within the predetermined period when the times is greater than the predetermined threshold.

[0009] In order to solve the above-mentioned technical problem, a third aspect of the present disclosure provides a communication handover apparatus. The apparatus comprises a processor and a communication circuit connected to the processor.

The processor is configured to execute instructions to implement the methods provided by the first or second aspect of the present disclosure.

[0010] In order to solve the above-mentioned technical problem, a fourth aspect of the present disclosure provides a communication handover apparatus. The apparatus stores instructions, in which the instructions implement the methods provided by the first or second aspect of the present disclosure while executed.

[0011] The present disclosure may have the advantages that whether times of initiating a conditional handover or the conditional handover being not completed is greater than a predetermined threshold within a predetermined period can be determined by a user equipment / base station; and if the times is greater than the predetermined threshold, the user equipment / base station can cease to initiate the conditional handover / configure a new conditional handover within the predetermined period. Even if the user equipment stays in the wireless environment which satisfies the trigger condition but does not satisfy the handover condition, after the times of the conditional handover is greater than the predetermined threshold, the user equipment and / or base station can be configured such that new conditional handover will not be triggered within the predetermined period to avoid the Ping-Pong problem, thereby reducing the resource and power consumption as well as the signaling overhead.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] FIG. 1 is a flowchart illustrating a first embodiment of a communication handover method according to the disclosure.

[0013] FIG. 2 is a flowchart illustrating a second embodiment of a communication handover method according to the disclosure.

[0014] FIG. 3 is a flowchart illustrating a third embodiment of a communication

handover method according to the disclosure.

[0015] FIG. 4 is a flowchart illustrating a fourth embodiment of a communication handover method according to the disclosure.

[0016] FIG. 5 is a flowchart illustrating a fifth embodiment of a communication handover method according to the disclosure.

[0017] FIG. 6 is a flowchart illustrating a sixth embodiment of a communication handover method according to the disclosure.

[0018] FIG. 7 is a flowchart illustrating a seventh embodiment of a communication handover method according to the disclosure.

[0019] FIG. 8 is a flowchart illustrating an eighth embodiment of a communication handover method according to the disclosure.

[0020] FIG. 9 is a flowchart illustrating a ninth embodiment of a communication handover method according to the disclosure.

[0021] FIG. 10 is a flowchart illustrating a tenth embodiment of a communication handover method according to the disclosure.

[0022] FIG. 11 is a flowchart illustrating an eleventh embodiment of a communication handover method according to the disclosure.

[0023] FIG. 12 is a flowchart illustrating a twelfth embodiment of a communication handover method according to the disclosure.

[0024] FIG. 13 is a block diagram illustrating a first embodiment of a communication handover apparatus according to the disclosure.

[0025] FIG. 14 is a block diagram illustrating a second embodiment of a communication handover apparatus according to the disclosure.

[0026] FIG. 15 is a block diagram illustrating a third embodiment of a communication handover apparatus according to the disclosure.

[0027] FIG. 16 is a block diagram illustrating a fourth embodiment of a

communication handover apparatus according to the disclosure.

[0028] This disclosure includes references to “one embodiment,” “a particular embodiment,” “some embodiments,” “various embodiments,” or “an embodiment.” The appearances of the phrases “in one embodiment,” “in a particular embodiment,” “in some embodiments,” “in various embodiments,” or “in an embodiment,” do not necessarily refer to the same embodiment. Particular features, structures, or characteristics may be combined in any suitable manner consistent with this disclosure. Various modules, units, circuits, or other components may be described or claimed as “configured to” perform a task or tasks. In such contexts, “configured to” is used to connote structure by indicating that the modules/units/circuits/components include structure (e.g., circuitry) that performs those task or tasks during operation. As such, the modules/units/circuits/components can be said to be configured to perform the task even when the specified module/unit/circuit/component is not currently operational (e.g., is not on). The modules/units/circuits/components used with the “configured to” language include hardware—for example, circuits, memory storing program instructions executable to implement the operation, etc. Reciting that a module/unit/circuit/component is “configured to” perform one or more tasks is expressly intended not to invoke 35 U.S.C. §112(f), for that module/unit/circuit/component. Additionally, “configured to” can include a generic structure (e.g., generic circuitry) that is manipulated by software and/or firmware (e.g., an FPGA or a general-purpose processor executing software) to operate in a manner that is capable of performing the task(s) at issue. “Configured to” may also include adapting a manufacturing process (e.g., a semiconductor fabrication facility) to fabricate apparatuses (e.g., integrated circuits) that are adapted to implement or perform one or more tasks. As used herein, the term “based on” describes one or more factors that affect a determination. This term

does not foreclose additional factors that may affect the determination. That is, a determination may be solely based on those factors or based, at least in part, on those factors. Consider the phrase “determine A based on B.” While in this case, B is a factor affects the determination of A, such a phrase does not foreclose the determination of A from also being based on C. In other instances, A may be determined based solely on B.

DETAILED DESCRIPTION

[0029] The present disclosure will now be described in detail with reference to the accompanying drawings and embodiments. In the following embodiments, the non-conflicting ones may be combined with each other.

[0030] Referring to FIG. 1, a flowchart is depicted illustrating a first embodiment of a communication handover method according to the present disclosure. The present method can be implemented on a user equipment (UE). The user equipment can be stationary or mobile, including cellular phones, personal digital assistants (PDA), wireless modems, tablet computers, notebook computers, cordless phones, etc.. For purposes of illustration, the method is illustrated as being sequential. However, portions of the method may be performed in other orders or in parallel (e.g., simultaneously). The present method may include the following blocks.

[0031] At S11: the UE may determine whether times of initiating a conditional handover or the conditional handover being not completed is greater than a predetermined threshold within a predetermined period.

[0032] The initiating the conditional handover may include transmitting a measurement report to a source base station, i.e. a base station of a cell to which the UE is currently connected. The UE may transmit the measurement report to the

source base station to initiate a conditional handover after determining that a trigger condition is satisfied. Before this block, the UE may receive a measurement configuration message from the source base station, wherein the measurement configuration message may include the trigger condition, and the measurement configuration message may further include condition for initiating measurement and / or measurement objective(s).

[0033] The conditional handover being not completed includes a failure of an actual handover or the actual handover is not initiated within a valid period of the conditional handover. The UE can only count the times of one of initiating the conditional handover and the conditional handover being not completed, or can count the times of the two at the same time. The predetermined period may be greater than a product of the predetermined threshold and the valid period of the conditional handover.

[0034] The UE can use a timer to monitor the predetermined period, and / or use a counter to count the times of initiating the conditional handover or the conditional handover being not completed. The timer and the counter can be started at the same time, or can be started separately. If the predetermined threshold is 0, it means that there is only one time of initiating the conditional handover or the conditional handover being not completed in the predetermined period, in which case the counter can be omitted.

[0035] At S12: the UE may cease to initiate the conditional handover within the predetermined period when the times is greater than the predetermined threshold.

[0036] If the times is greater than the predetermined threshold, the user equipment is likely to stay in a wireless environment which satisfies the trigger condition but does not satisfy the handover condition. In order to avoid the Ping-Pong problem, the user equipment can cease to initiate the conditional handover within the

predetermined period, that is, even if the user equipment determines that the trigger condition is satisfied in the remaining time, a new measurement report will not be sent to the source base station to initiate the conditional handover, until the predetermined period expires. In this case, the user equipment can still perform a conventional handover process controlled by the base station so as to realize the mobility management.

[0037] If the times is less than or equal to the predetermined threshold, the user equipment can initiate the conditional handover normally.

[0038] After the predetermined period, if the user equipment determines that the trigger condition is satisfied, it can transmit the measurement report to the source base station normally so as to initiate the condition handover.

[0039] According to the present embodiment,, even if the user equipment stays in the wireless environment which satisfies the trigger condition but does not satisfy the handover condition, after the times of the conditional handover being greater than the predetermined threshold, the user equipment can be configured such that new conditional handover will not triggered within the predetermined period to avoid the Ping-Pong problem, thereby reducing the resource and power consumption as well as the signaling overhead.

[0040] Referring to FIG. 2, a flowchart is depicted illustrating a second embodiment of a communication handover method according to the present disclosure, which is based on the first embodiment of the communication handover method and in which a timer and a counter are utilized for determination. The present embodiment is a further extension of the first embodiment of the communication handover method, hence common contents as those of the first embodiment will not be detailed again. The method according to the present embodiment may include the following blocks.

[0041] At S111: the UE may start a timer and initialize a counter, wherein the timer may have a valid period of the predetermined period.

[0042] The initial value of the counter can be 0, the predetermined threshold, or other values. The sequence of starting the timer and initializing the counter is not limited.

[0043] At S112: the UE may increase / decrease a value of the counter by one if the conditional handover is initiated or not completed within the valid period of the timer.

[0044] At S113: the UE may determine whether a difference between a current value and an initial value of the counter is greater than the predetermined threshold.

[0045] If the difference is greater than the predetermined threshold, it means that the times of initiating the conditional handover or the conditional handover being not completed is greater than the predetermined threshold within the predetermined period, and the process proceeds to step S114.

[0046] If the initial value of the counter is 0 and counted in an increasing manner, that is, increased by one each time, the user equipment can directly determine whether the current value of the counter is greater than the predetermined threshold in this block. If the initial value of the counter is the predetermined threshold and counted in a decreasing manner, that is, decremented by one each time, the user equipment can directly determine whether the current value of the counter is smaller than 0 in this block. And so on, how to perform the determination according to the current value of the counter while the initial value of the counter is other value and / or other counting method is utilized can therefore be derived.

[0047] At S114: the UE may cease to initiate the conditional handover within the predetermined period.

[0048] Referring to FIG. 3, a flowchart is depicted illustrating a third embodiment of a communication handover method according to the present disclosure, which is

based on the first embodiment of the communication handover method, and in which merely the timer is utilized for determination, and the timer is started before monitoring whether the conditional handover is initiated or not completed. The present embodiment is a further extension of the first embodiment of the communication handover method, hence common contents as those of the first embodiment will not be detailed again. The method according to the present embodiment may include the following blocks.

[0049] At S121: the UE may start a timer, wherein the timer may have a valid period of the predetermined period.

[0050] At S122: the UE may cease to initiate the conditional handover if the conditional handover is initiated or not completed within the valid period of the timer.

[0051] In the present embodiment, the predetermined threshold is 0, which means that the user equipment should cease to initiate the conditional handover once the conditional handover is initiated or not completed, hence the counter can be omitted.

[0052] Referring to FIG. 4, a flowchart is depicted illustrating a fourth embodiment of a communication handover method according to the present disclosure, which is based on the first embodiment of the communication handover method, and in which merely the timer is utilized for determination, and the timer is started after monitoring whether the conditional handover is initiated or not completed. The present embodiment is a further extension of the first embodiment of the communication handover method, hence common contents as those of the first embodiment will not be detailed again. The method according to the present embodiment may include the following blocks.

[0053] At S131: the UE may initiate the conditional handover or the conditional handover can be not completed.

[0054] At S132: the UE may start a timer, wherein the timer may have a valid

period of the predetermined period.

[0055] At S133: the UE may cease to initiate the conditional handover within the valid period of the timer.

[0056] Similar to the previous embodiment, the predetermined threshold is 0 in the present embodiment, which means that the user equipment should cease to initiate the conditional handover once the conditional handover is initiated or not completed, hence the counter can be omitted.

[0057] Referring to FIG. 5, a flowchart is depicted illustrating a fifth embodiment of a communication handover method according to the present disclosure, which is based on the first embodiment of the communication handover method and in which the predetermined period includes a connection period of the user equipment and a currently connected cell. The present embodiment is a further extension of the first embodiment of the communication handover method, hence common contents as those of the first embodiment will not be detailed again. The method according to the present embodiment may include the following blocks.

[0058] At S141: the UE may initialize a counter.

[0059] The initial value of the counter can be 0, the predetermined threshold, or other values.

[0060] Since the predetermined period includes the connection period of the user equipment and the currently connected cell, that is, once the times of the user equipment to initiate the conditional handover or the conditional handover being not completed is greater than the predetermined threshold, then within the connection period with the current cell, that is, before the user equipment hands over to another base station, the user equipment will not initiate the conditional handover, hence the timer can be omitted in the present embodiment.

[0061] S142: the UE may increase / decrease a value of the counter by one if the

conditional handover is initiated or not completed.

[0062] S143: the UE may determine whether a difference between a current value and an initial value of the counter is greater than the predetermined threshold.

[0063] If the difference is greater than the predetermined threshold, it means that the times of initiating the conditional handover or the conditional handover being not completed is greater than the predetermined threshold, and the process proceeds to step S144.

[0064] If the initial value of the counter is 0 and counted in an increasing manner, that is, increased by one each time, the user equipment can directly determine whether the current value of the counter is greater than the predetermined threshold in this block. If the initial value of the counter is the predetermined threshold and counted in a decreasing manner, that is, decremented by one each time, the user equipment can directly determine whether the current value of the counter is smaller than 0 in this block. And so on, how to perform the determination according to the current value of the counter while the initial value of the counter is other value and / or other counting method is utilized can therefore be derived.

[0065] S144: the UE may cease to initiate the conditional handover.

[0066] Referring to FIG. 6, a flowchart is depicted illustrating a sixth embodiment of a communication handover method according to the present disclosure, which is based on the first embodiment of the communication handover method and further comprise the following block before S11.

[0067] S10: the UE may receive the predetermined threshold and / or the predetermined period from the base station of the currently connected cell or determine the predetermined threshold and / or the predetermined period itself.

[0068] The predetermined threshold and / or the predetermined period may be determined according to the condition of the user equipment. The condition of the

user equipment may comprise a moving speed of the user equipment and / or a signal quality of the candidate objective / measurement objective measured by the user equipment. The moving speed may be calculated by the user equipment itself, or may be calculated by the base station according to location information of the user equipment at different times.

[0069] In a case with the same predetermined period, the greater the predetermined threshold means the more the times that conditional handover can be performed; in a case with the same predetermined threshold, the shorter the predetermined period, the shorter the predetermined period means the shorter the time of prohibiting the conditional handover.

[0070] Specifically, the faster the moving speed means the greater the possibility of the user equipment to initiate an actual handover, and the greater the predetermined threshold and / or the shorter the predetermined period. The better the signal quality of the candidate objective / measurement objective measured by the user equipment means the greater the possibility to initiate the actual handover, and the greater the predetermined threshold and / or the shorter the predetermined period.

[0071] Referring to FIG. 7, a flowchart is depicted illustrating a seventh embodiment of a communication handover method according to the present disclosure. The present method can be implemented on a base station. The base station can be connected to a core network and can perform wireless communication with UE to provide communication coverage for the corresponding geographical area. The base station may be a macro base station, a micro base station, a pico base station, or a femtocell. In some embodiments, the base station may also be referred to as a radio base station, an access point, a node B, an evolved node B (eNodeB, eNB), a gNB, or other suitable terminology. For purposes of illustration, the method is illustrated as being sequential. However, portions of the method may be performed in other

orders or in parallel (e.g., simultaneously). The present method may include the following blocks.

[0072] At S21: the base station may determine whether times of initiating a conditional handover or the conditional handover being not completed is greater than a predetermined threshold within a predetermined period.

[0073] The initiating the conditional handover can include receiving a measurement report from the user equipment. The user equipment may transmit the measurement report after determining that a trigger condition is met. Before this block, the base station may transmit a measurement configuration message to the user equipment, wherein the measurement configuration message may include the trigger condition, and the measurement configuration message may further include condition for initiating measurement and / or measurement objective(s).

[0074] The conditional handover being not completed includes a notification of an actual handover is not received within a valid period of the conditional handover. The notification of the actual handover may be from the user equipment or a target base station (i.e., a base station of the target to which the user equipment actually hands over to), such as a notification for releasing the Access Context of the user equipment from the target base station.

[0075] The base station can only count the times of one of initiating the conditional handover and the conditional handover being not completed, or can count the times of the two at the same time. The predetermined period may be greater than a product of the predetermined threshold and the valid period of the conditional handover.

[0076] The base station can use a timer to monitor the predetermined period, and / or use a counter to count the times of initiating the conditional handover and the conditional handover being not completed. The timer and the counter can be started

at the same time, or can be started separately. If the predetermined threshold is 0, it means that there is only one time of initiating the conditional handover or the conditional handover being not completed in the predetermined period, in which case the counter can be omitted.

[0077] S22: the base station may cease to configure a new conditional handover within the predetermined period if the times is greater than the predetermined threshold.

[0078] If the times is greater than the predetermined threshold, the user equipment is likely to stay in a wireless environment which satisfies the trigger condition but does not satisfy the handover condition. In order to avoid the Ping-Pong problem, the base station can cease to configure a new conditional handover within the predetermined period, that is, even if a new measurement report from the user equipment is received in the remaining time, the subsequent conditional handover configuration (includes selecting the candidate objective, negotiating with the base station of the candidate objective, and transmitting a conditional handover instruction to the user equipment, etc.) will not be performed, until the predetermined period expires. In this case, the base station can still perform a conventional handover process controlled by the base station so as to realize the mobility management of the user equipment.

[0079] If the base station still has the ongoing conditional handover configuration(s) when it determines that the time is greater than the predetermined threshold, the base station can complete the current conditional handover configuration(s).

[0080] According to the present embodiment, even if the user equipment stays in the wireless environment which satisfies the trigger condition but does not satisfy the handover condition, after the times of the conditional handover is greater than the predetermined threshold, the base station will not configure a new conditional

handover within the predetermined period to avoid the Ping-Pong problem, thereby reducing the resource and power consumption as well as the signaling overhead.

[0081] Referring to FIG. 8, a flowchart is depicted illustrating an eighth embodiment of a communication handover method according to the present disclosure, which is based on the seventh embodiment of the communication handover method and in which a timer and a counter are utilized for determination. The present embodiment is a further extension of the seventh embodiment of the communication handover method, hence common contents as those of the seventh embodiment will not be detailed again. The method according to the present embodiment may include the following blocks.

[0082] At S211: the base station may start a timer and initialize a counter, wherein the timer may have a valid period of the predetermined period;

[0083] The initial value of the counter can be 0, the predetermined threshold, or other values. The sequence of starting the timer and initializing the counter is not limited.

[0084] S212: the base station may increase / decrease a value of the counter by one if the conditional handover is initiated or not completed within the valid period of the timer.

[0085] S213: the base station may determine whether a difference between a current value and an initial value of the counter is greater than the predetermined threshold.

[0086] If the difference is greater than the predetermined threshold, it means that the times of initiating the conditional handover or the conditional handover being not completed is greater than the predetermined threshold within the predetermined period, and the process proceeds to step S214.

[0087] If the initial value of the counter is 0 and counted in an increasing manner,

that is, increased by one each time, the user equipment can directly determine whether the current value of the counter is greater than the predetermined threshold in this block. If the initial value of the counter is the predetermined threshold and counted in a decreasing manner, that is, decremented by one each time, the user equipment can directly determine whether the current value of the counter is smaller than 0 in this block. And so on, how to perform the determination according to the current value of the counter while the initial value of the counter is other value and / or other counting method is utilized can therefore be derived.

[0088] At S214: the base station may cease to configure a new conditional handover within the predetermined period.

[0089] Referring to FIG. 9, a flowchart is depicted illustrating a ninth embodiment of a communication handover method according to the present disclosure, which is based on the seventh embodiment of the communication handover method, and in which merely the timer is utilized for determination, and the timer is started before monitoring whether the conditional handover is initiated or not completed. The present embodiment is a further extension of the seventh embodiment of the communication handover method, hence common contents as those of the seventh embodiment will not be detailed again. The method according to the present embodiment may include the following blocks.

[0090] At S221: the base station may start a timer, wherein the timer may have a valid period of the predetermined period.

[0091] At S222: the base station may cease to configure a new conditional handover if the conditional handover is initiated or not completed within the valid period of the timer.

[0092] In the present embodiment, the predetermined threshold is 0, which means that the base station should cease to configure a new conditional handover once the

conditional handover is initiated or not completed, hence the counter can be omitted.

[0093] Referring to FIG. 10, a flowchart is depicted illustrating a tenth embodiment of a communication handover method according to the present disclosure, which is based on the seventh embodiment of the communication handover method, and in which merely the timer is utilized for determination, and the timer is started after monitoring whether the conditional handover is initiated or not completed. The present embodiment is a further extension of the seventh embodiment of the communication handover method, hence common contents as those of the seventh embodiment will not be detailed again. The method according to the present embodiment may include the following blocks.

[0094] At S231: the base station may initiate the conditional handover or the conditional handover can be not completed.

[0095] At S232: the base station may start a timer, wherein the timer may have a valid period of the predetermined period.

[0096] At S233: the base station may cease to configure a new conditional handover within the valid period of the timer.

[0097] Similar to the previous embodiment, the predetermined threshold is also 0 in the present embodiment, which means that the base station should cease to configure a new conditional handover once the conditional handover is initiated or not completed, hence the counter can be omitted.

[0098] Referring to FIG. 11, a flowchart is depicted illustrating an eleventh embodiment of a communication handover method according to the present disclosure, which is based on the seventh embodiment of the communication handover method, and in which merely the timer is utilized for determination, and the timer is started after monitoring whether the conditional handover is initiated or not completed. The present embodiment is a further extension of the seventh embodiment of the

communication handover method, hence common contents as those of the seventh embodiment will not be detailed again. The method according to the present embodiment may include the following blocks.

[0099] S241: the base station may initialize a counter.

[00100] The initial value of the counter can be 0, the predetermined threshold, or other values.

[00101] Since the predetermined period includes the connection period of the user equipment and the base station, that is, for the same user equipment, once the times of the base station to initiate the conditional handover or the conditional handover being not completed is greater than the predetermined threshold, then within the connection period of the user equipment and the base station, that is, before the user equipment is hands over another base station, the base station will not configure a new conditional handover for the user equipment, hence the timer can be omitted in this embodiment.

[00102] S242: the base station may increase / decrease a value of the counter by one if the conditional handover is initiated or not completed.

[00103] S243: the base station may determine whether a difference between a current value and an initial value of the counter is greater than the predetermined threshold.

[00104] If the difference is greater than the predetermined threshold, it means that the times of initiating the conditional handover or the conditional handover being not completed is greater than the predetermined threshold within the predetermined period, and the process proceeds to step S244.

[00105] If the initial value of the counter is 0 and counted in an increasing manner, that is, increased by one each time, the user equipment can directly determine whether the current value of the counter is greater than the predetermined threshold in this

block. If the initial value of the counter is the predetermined threshold and counted in a decreasing manner, that is, decremented by one each time, the user equipment can directly determine whether the current value of the counter is smaller than 0 in this block. And so on, how to perform the determination according to the current value of the counter while the initial value of the counter is other value and / or other counting method is utilized can therefore be derived.

[00106] S244: the base station may cease to configure a new conditional handover.

[00107] Referring to FIG. 12, a flowchart is depicted illustrating a twelfth embodiment of a communication handover method according to the present disclosure, which is based on the seventh embodiment of the communication handover method and further comprise the following block before S21.

[00108] At S20: the base station may transmit the predetermined threshold and / or the predetermined period to the user equipment.

[00109] The predetermined threshold and / or the predetermined period may be determined according to the condition of the user equipment. The condition of the user equipment can comprise a moving speed of the user equipment and / or a signal quality of the measurement objective in the measurement report reported by the user equipment. The moving speed may be calculated by the user equipment itself and then reported, or may be calculated by the base station according to location information of the user equipment at different times.

[00110] In a case with the same predetermined period, the greater the predetermined threshold means the more the times that conditional handover can be performed; in a case with the same predetermined threshold, the shorter the predetermined period, the shorter the predetermined period means the shorter the time of prohibiting the conditional handover.

[00111] Specifically, the faster the moving speed means the greater the possibility of

the user equipment to initiate an actual handover, and the greater the predetermined threshold and / or the shorter the predetermined period. The better the signal quality of the measurement objective means the greater the possibility to initiate the actual handover, and the greater the predetermined threshold and / or the shorter the predetermined period.

[00112] Referring to FIG. 13, a block diagram is depicted illustrating a first embodiment of a communication handover apparatus according to the present disclosure. The communication handover apparatus may comprise a processor 110 and a communication circuit 120 coupled to the processor 110.

[00113] The communication circuit 120 can be configured to transmit and receive data, and serve as an interface for the communication handover apparatus to communicate with other communication apparatuses.

[00114] The processor 110 can control the operation of the communication handover apparatus, which may also be referred to as a central processing unit (CPU). The processor 110 may be an integrated circuit chip with signal processing capability, or a general purpose processor, a digital signal processor (DSP), an application specific integrated circuit (ASIC), a field programmable gate array (FPGA) or other programmable logic apparatus, a discrete gate or transistor logic apparatus, a discrete hardware component. The general purpose processor may be a microprocessor or any conventional processor.

[00115] The processor 110 can be configured to execute instructions to implement the method proposed by any one of the first to the sixth embodiments and non-collision combinations of embodiments of the communication handover method according to the present disclosure.

[00116] The communication handover apparatus in the present embodiment may be a user equipment, or a stand-alone component which can be integrated in the user

equipment such as a baseband chip.

[00117] Referring to FIG. 14, a block diagram is depicted illustrating a second embodiment of a communication handover apparatus according to the present disclosure. The communication handover apparatus may comprise a processor 210 and a communication circuit 220 coupled to the processor 110.

[00118] The communication circuit 220 can be configured to transmit and receive data, and serve as an interface for the communication handover apparatus to communicate with other communication apparatuses.

[00119] The processor 510 can control the operation of the communication handover apparatus, which may also be referred to as a central processing unit (CPU). The processor 210 may be an integrated circuit chip with signal processing capability, or a general purpose processor, a digital signal processor (DSP), an application specific integrated circuit (ASIC), a field programmable gate array (FPGA) or other programmable logic apparatus, a discrete gate or transistor logic apparatus, a discrete hardware component. The general purpose processor may be a microprocessor or any conventional processor.

[00120] The processor 210 can be configured to execute instructions to implement the method proposed by any one of the seventh to the twelfth embodiments and non-collision combinations of embodiments of the communication handover method according to the present disclosure.

[00121] The communication handover apparatus in this embodiment may be a base station, or a stand-alone component which can be integrated in the base station, such as a baseband board.

[00122] Referring to FIG. 15, a block diagram is depicted illustrating a third embodiment of a scheduling apparatus using an unlicensed spectrum according to the present disclosure. The communication handover apparatus may comprise a

storage 310 in which instructions are stored, and the method proposed by any one of the first to the sixth embodiments and non-collision combinations of embodiments of the communication handover method according to the present disclosure can be implemented while the instruction are executed.

[00123] The storage 310 may include a read-only memory (ROM), a random access memory (RAM), a flash memory, a hard disk, an optical disk, etc.

[00124] The communication handover apparatus in the present embodiment may be a user equipment, or a stand-alone component which can be integrated in the user equipment such as a baseband chip.

[00125] Referring to FIG. 16, a block diagram is depicted illustrating a fourth embodiment of a scheduling apparatus using an unlicensed spectrum according to the present disclosure. The communication handover apparatus may comprise a storage 410 in which instructions are stored, and the method proposed by any one of the seventh to the twelfth embodiments and non-collision combinations of embodiments of the communication handover method according to the present disclosure can be implemented while the instruction are executed.

[00126] The storage 410 may include a read-only memory (ROM), a random access memory (RAM), a flash memory, a hard disk, an optical disk, etc.

[00127] The communication handover apparatus in this embodiment may be a base station, or a stand-alone component which can be integrated in the base station, such as a baseband board.

[00128] The above-mentioned embodiments respectively describe how the user equipment and the base station control the times of the conditional handover in the predetermined period. In a practical application, it is possible to control the times of the conditional handover by one of them, or can control the times of the conditional handover by both of them at the same time.

[00129] The function of each part and the feasible extension of each embodiment of the communication handover apparatus according to the present disclosure can refer to the description in the corresponding embodiments of the communication handover method according to the present disclosure, and will not be detailed again.

[00130] It can be appreciated that the apparatuses and methods disclosed herein can also be implemented in other forms. Rather, the apparatuses as described are merely illustrative. For example, the division of modules or units is performed solely based on logic functions, thus in actual implementations there may be other division methods, e.g., multiple units or components may be combined or integrated onto another system, or some features may be ignored or simply not executed. In addition, mutual couplings, direct couplings, or communications connections as displayed or discussed may be achieved through some interfaces, apparatuses, or units, and may be achieved electrically, mechanically, or in other forms.

[00131] Separated units as described may or may not be physically separated. Components displayed as units may or may not be physical units, and may reside at one location or may be distributed to multiple networked units. Part or all of the units may be selectively adopted according to actual requirements to achieve objectives of the disclosure.

[00132] Additionally, various functional units described herein may be integrated into one processing unit or may be present as a number of physically separated units, and two or more units may be integrated into one. The integrated units may be implemented by hardware or as software functional units.

[00133] If the integrated units are implemented as software functional units and sold or used as standalone products, they may be stored in a computer readable storage medium. On the basis of such an understanding, the essential technical solution or all or part of the technical solution of the disclosure may be embodied as software

products. Computer software products can be stored in a storage medium and can include multiple instructions enabling a computing apparatus (e.g., a personal computer, a server, a network apparatus, etc.) or a processor to execute all or part of the methods as described in the disclosure. The storage medium may include all kinds of media that can store program codes, such as a USB flash disk, mobile hard drive, read-only memory (ROM), random access memory (RAM), magnetic disk, or optical disk.

[00134] The above description merely illustrates some exemplary embodiments of the disclosure, which however are not intended to limit the scope of the disclosure to these specific embodiments. Any equivalent structural or flow modifications or transformations made to the disclosure, or any direct or indirect applications of the disclosure on any other related fields, shall all fall in the scope of the disclosure.

What is claimed is:

1. A communication handover method, comprising:
determining, by a user equipment, whether times of initiating a conditional handover or the conditional handover being not completed is greater than a predetermined threshold within a predetermined period; and
ceasing, by the user equipment, to initiate the conditional handover within the predetermined period when the times is greater than the predetermined threshold.
2. The method of claim 1, wherein the conditional handover being not completed comprises a failure of an actual handover or the actual handover being not initiated within a valid period of the conditional handover, the initiating the conditional handover comprises transmitting a measurement report to a base station of a currently connected cell.
3. The method of claim 1, wherein the user equipment determining whether the times of initiating the conditional handover or the conditional handover being not completed is greater than the predetermined threshold within a predetermined period comprises:
starting a timer and initializing a counter by the user equipment, the timer having a valid period of the predetermined period;
increasing / decreasing, by the user equipment, a value of the counter by one when the conditional handover is initiated or not completed within the valid period of the timer; and
determining, by the user equipment, whether a difference between a current value and an initial value of the counter is greater than the predetermined threshold.
4. The method of claim 1, wherein the predetermined threshold is 0, and the user equipment determining whether the times of initiating the conditional handover

or the conditional handover being not completed is greater than the predetermined threshold within a predetermined period comprises:

starting, by the user equipment, a timer, the timer having a valid period of the predetermined period; and

determining, by the user equipment, that the times of initiating the conditional handover or the conditional handover being not completed is greater than the predetermined threshold when the conditional handover is initiated or not completed within the valid period of the timer.

5. The method of claim 1, wherein the predetermined threshold is 0, and the user equipment determining whether the times of initiating the conditional handover or the conditional handover being not completed is greater than the predetermined threshold within a predetermined period comprises:

initiating, by the user equipment, the conditional handover or the conditional handover being not completed by the user equipment;

starting, by the user equipment, a timer, the timer having a valid period of the predetermined period; and

determining, by the user equipment, that the times of initiating the conditional handover or the conditional handover being not completed is greater than the predetermined threshold within the valid period of the timer.

6. The method of claim 1, further comprising, before the user equipment determining whether the times of initiating the conditional handover or the conditional handover being not completed is greater than the predetermined threshold within a predetermined period:

receiving, by the user equipment, at least one of the predetermined threshold and the predetermined period from a base station of a currently connected cell; or

determining, by the user equipment itself, at least one of the predetermined threshold and the predetermined period.

7. The method of any one of claims 1-6, wherein at least one of the predetermined threshold and the predetermined period is determined according to a condition of the user equipment.

8. The method of claim 7, wherein the condition comprises a moving speed, the faster the moving speed, at least the greater the predetermined threshold or the shorter the predetermined period.

9. The method of claim 7, wherein the condition comprises a signal quality of a candidate objective / measurement objective obtained by measuring, the better the signal quality of the candidate objective / measurement objective, at least the greater the predetermined threshold or the shorter the predetermined period.

10. The method of any one of claims 1-6, wherein the predetermined period comprises a connection period of the user equipment and a base station of a currently connected cell.

11. A communication handover method, comprising:

determining, by a base station, whether times of initiating a conditional handover or the conditional handover being not completed is greater than a predetermined threshold within a predetermined period; and

ceasing, by the base station, to configure a new conditional handover within the predetermined period when the times is greater than the predetermined threshold.

12. The method of claim 11, wherein the conditional handover being not completed comprises a notification of an actual handover being not received within a valid period of the conditional handover, the initiating the conditional handover comprises receiving a measurement report from a user equipment.

13. The method of claim 11, wherein the base station determining whether the times of initiating the conditional handover or the conditional handover being not completed is greater than the predetermined threshold within the predetermined period comprises:

starting a timer and initializing a counter by the base station, the timer having a valid period of the predetermined period;

increasing / decreasing, by the base station, a value of the counter by one when the conditional handover is initiated or not completed within the valid period of the timer; and

determining, by the base station, whether a difference between a current value and an initial value of the counter is greater than the predetermined threshold.

14. The method of claim 11, wherein the predetermined threshold is 0, and the base station determining whether the times of initiating the conditional handover or the conditional handover being not completed is greater than the predetermined threshold within the predetermined period comprises:

starting, by the base station, a timer, the timer having a valid period of the predetermined period; and

determining, by the base station, that the times of initiating the conditional handover or the conditional handover being not completed is greater than the predetermined threshold when the conditional handover is initiated or not completed within the valid period of the timer.

15. The method of claim 11, wherein the predetermined threshold is 0, and the base station determining whether the times of initiating the conditional handover or the conditional handover being not completed is greater than the predetermined threshold within the predetermined period comprises:

initiating, by the base station, the conditional handover or the conditional handover being not completed by the base station;

starting, by the base station, a timer, the timer having a valid period of the predetermined period; and

determining, by the base station, that the times of initiating the conditional handover or the conditional handover being not completed is greater than the predetermined threshold within the valid period of the timer.

16. The method of claim 11, further comprising, before the base station determining whether the times of initiating the conditional handover or the conditional handover being not completed is greater than the predetermined threshold within the predetermined period:

transmitting, by the base station, at least one of the predetermined threshold and the predetermined period to a user equipment.

17. The method of any one of claims 11-16, wherein at least one of the predetermined threshold and the predetermined period is determined according to a condition of a user equipment.

18. The method of claim 17, wherein the condition comprises a moving speed of the user equipment, the faster the moving speed, at least the greater the predetermined threshold or the shorter the predetermined period.

19. The method of claim 17, wherein the condition comprises a signal quality of a measurement objective in the measurement report, the better the signal quality of the measurement objective, at least the greater the predetermined threshold or the shorter the predetermined period.

20. The method of any one of claims 11-16, wherein the predetermined period comprises a connection period of a user equipment and the base station.

21. A communication handover apparatus, comprising a processor and a communication circuit connected to the processor;

the processor being configured to execute instructions to implement the method of any one of claims 1-10 and 11-20.

22. A communication handover apparatus storing instructions, wherein the instructions implement the method of any one of claims 1-10 and 11-20 while executed.

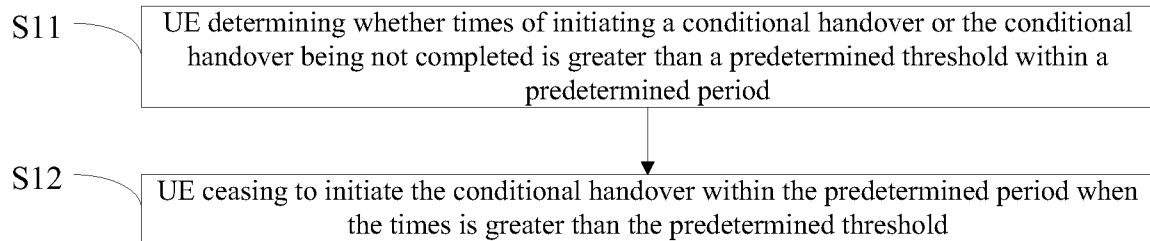


FIG. 1

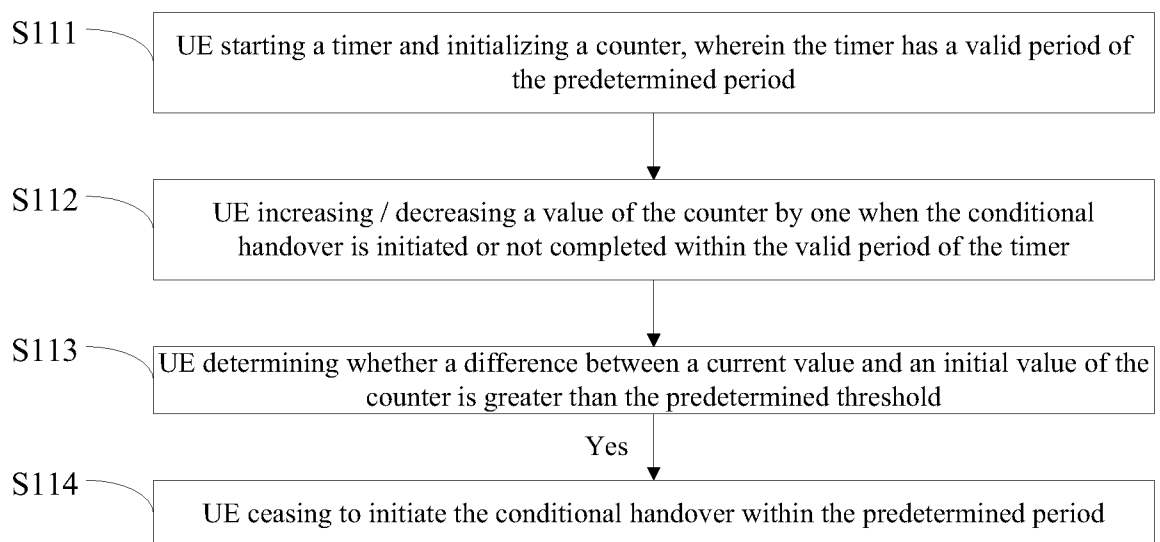


FIG. 2

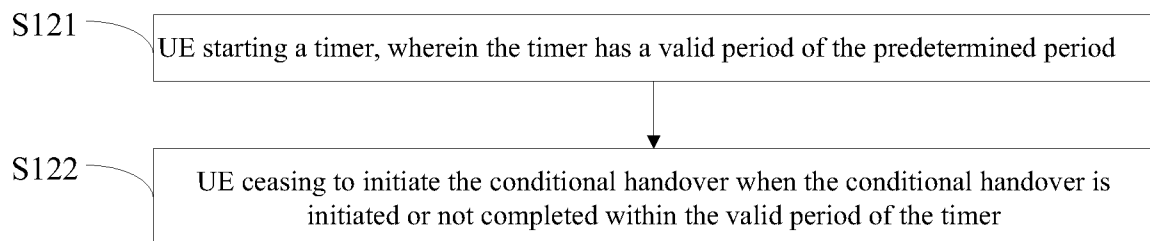


FIG. 3

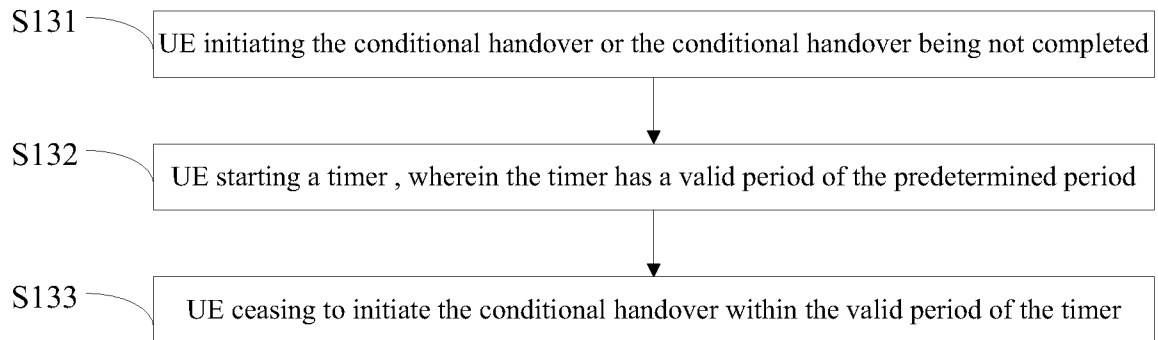


FIG. 4

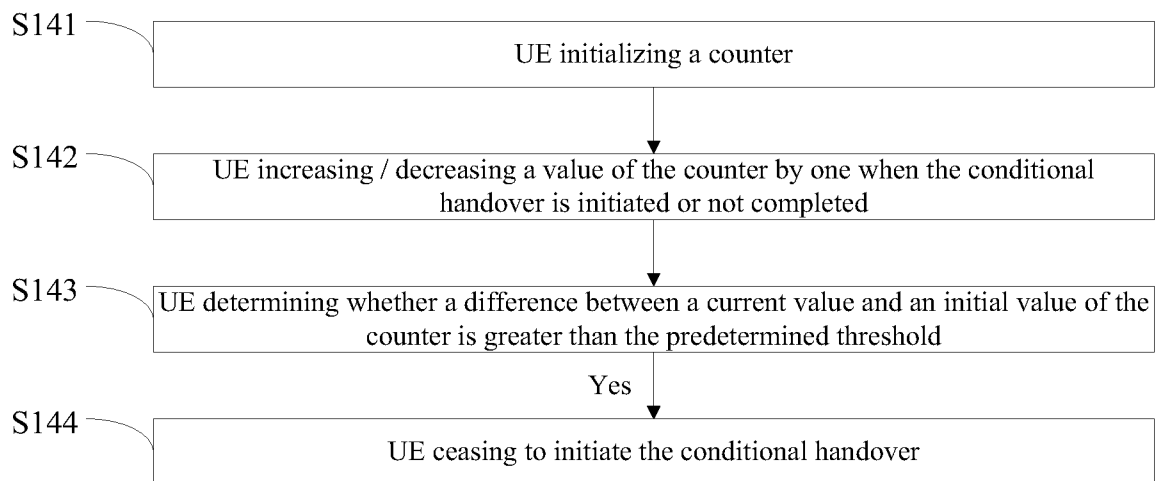


FIG. 5

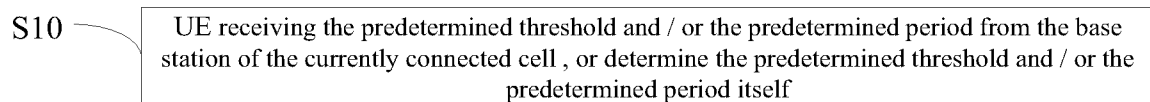


FIG. 6

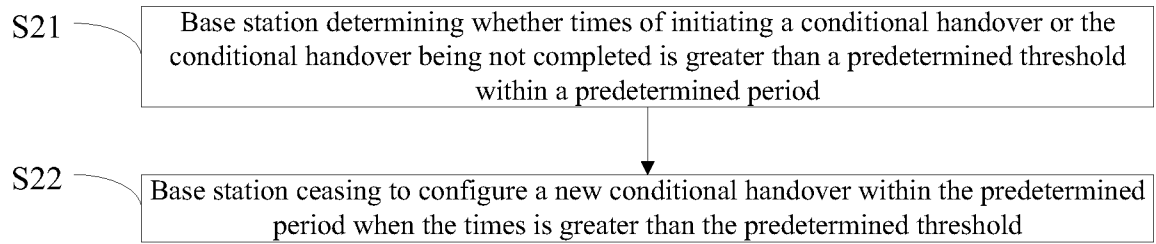


FIG. 7

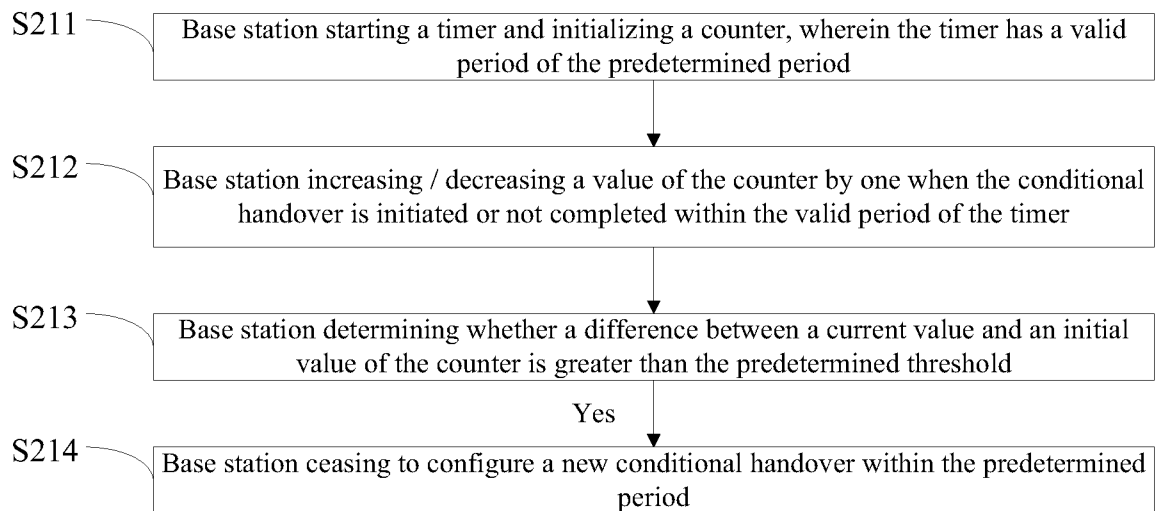


FIG. 8

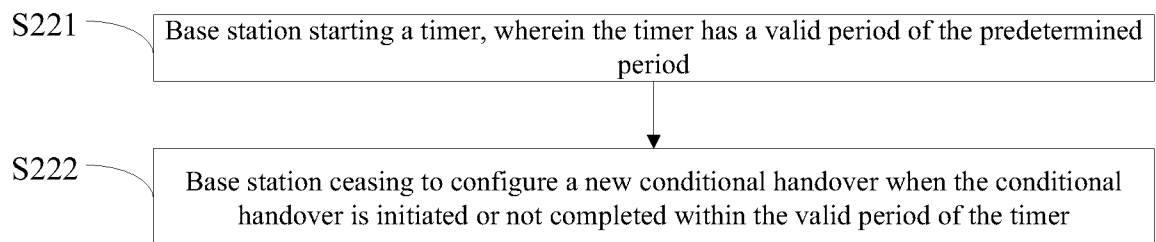


FIG. 9

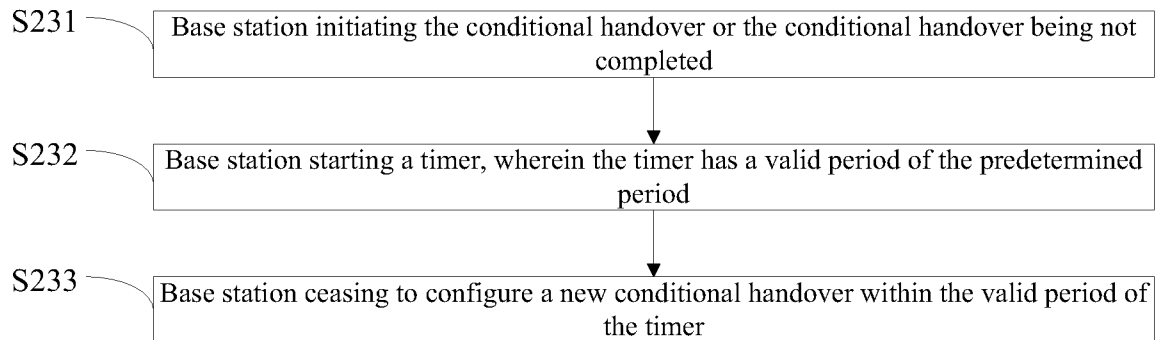


FIG. 10

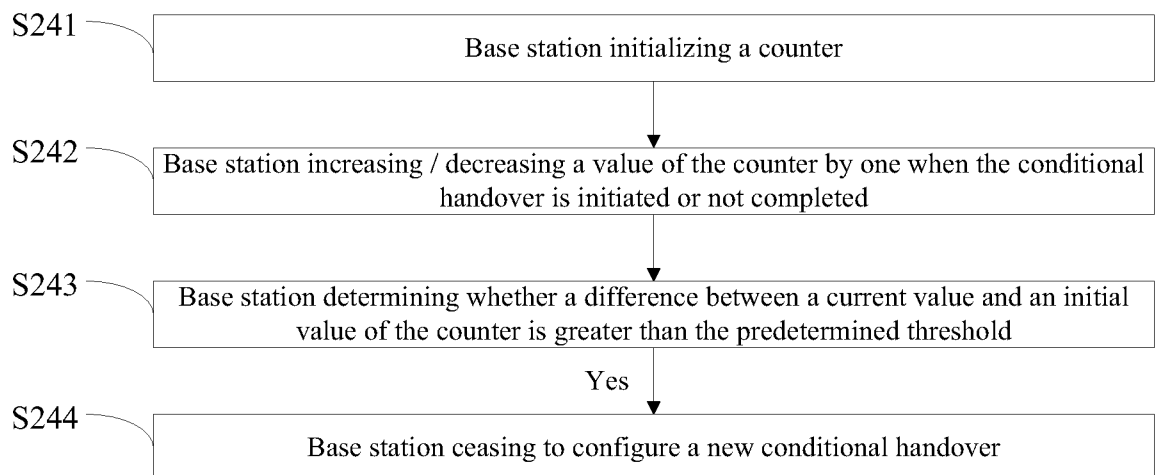


FIG. 11

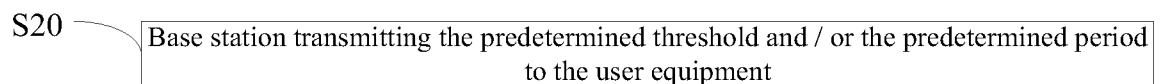


FIG. 12

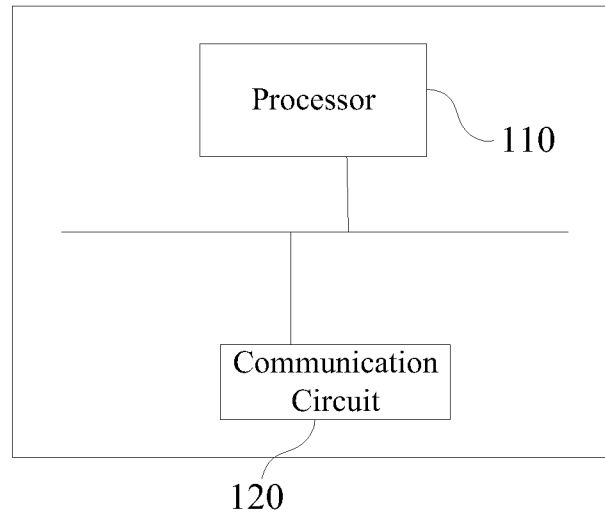


FIG. 13

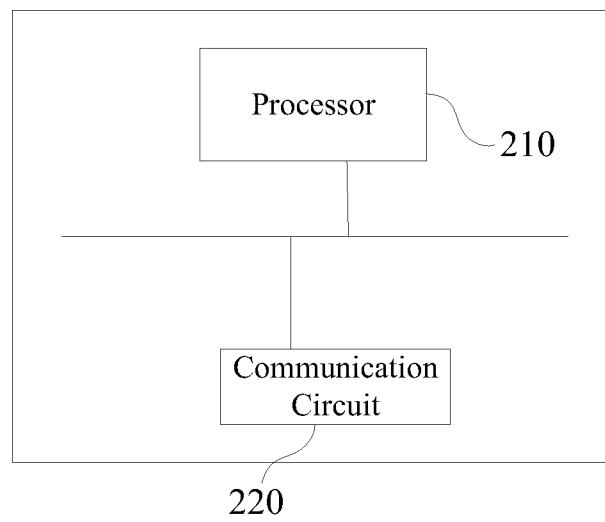


FIG. 14

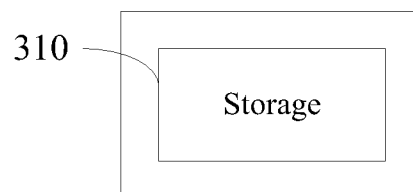


FIG. 15

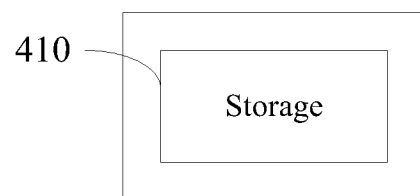


FIG. 16

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2017/107979

A. CLASSIFICATION OF SUBJECT MATTER

H04W 36/00(2009.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H04W; H04Q; H04L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNABS;WOTXT;VEN;CNKI;3GPP:preset, threshold, handover, failure, count,number of times, handoff, autonomous handover, conditional handover, stop+, ceas+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	CN 106028404 A (NUBIA TECHNOLOGY CO LTD) 12 October 2016 (2016-10-12) description, paragraphs [0120]-[0133]	1-22
Y	CN 104244342 A (UNIV BEIJING POSTS & TELECOMM) 24 December 2014 (2014-12-24) description, paragraphs [0047]-[0093]	1-22
A	CN 104486784 A (UNIV SOUTHEAST) 01 April 2015 (2015-04-01) the whole document	1-22
A	JP 2013135282 A (KDDI CORP) 08 July 2013 (2013-07-08) the whole document	1-22
A	EP 3122117 A1 (WIPRO LTD) 25 January 2017 (2017-01-25) the whole document	1-22

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:

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 “L” document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
 “O” document referring to an oral disclosure, use, exhibition or other means
 “P” document published prior to the international filing date but later than the priority date claimed

“T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
 “X” document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
 “Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
 “&” document member of the same patent family

Date of the actual completion of the international search

25 April 2018

Date of mailing of the international search report

03 May 2018

Name and mailing address of the ISA/CN

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Telephone No. **86-(010)-62411393**

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/CN2017/107979

Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)			Publication date (day/month/year)
CN	106028404	A	12 October 2016	None			
CN	104244342	A	24 December 2014	CN	104244342	B	29 December 2017
CN	104486784	A	01 April 2015	None			
JP	2013135282	A	08 July 2013	None			
EP	3122117	A1	25 January 2017	IN	3715CH2015	A	31 July 2015
				US	9510258	B1	29 November 2016