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(71) Applicant(s):
Samsung Electronics Co., Ltd.
(Incorporated in the Republic of Korea)
129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do 16677, Republic of Korea

(72) Inventor(s):
Himke Van Der Velde
Mangesh Abhimanyu Ingale
Fasil Abdul Latheef

(74) Agent and/or Address for Service:
Appleyard Lees IP LLP
15 Clare Road, HALIFAX, West Yorkshire, HX1 2HY, United Kingdom

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EP 3909292 A1 **EP 3766274 A1**
EP 3358901 A1 **US 20190223073 A1**
3GPP TSG RAN WG2 Meeting 106 Failure Handling on CHO, R2-1906292, (INTEL) http://www.3gpp.org/ftp/tsg%5Fran/WG2%5FRL2/TSGR2%5F106/Docs/R2%2D1906292%2Ezip

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(54) Title of the Invention: **Improvements in and relating to conditional handover in a telecommunications network**
Abstract Title: **Starting a timer when a User Equipment (UE) initiates conditional handover (CHO)**

(57) A method of performing conditional handover (CHO) of a User Equipment (UE) in a telecommunication network, comprising the steps of the UE receiving a CHO instruction; the UE starting a timer with a predetermined value when the UE initiates CHO to a first CHO candidate; if the timer expires, the UE attempting reestablishment. The timer may be similar to a T304 timer. If a condition is met before the timer expires, the UE may stop trying to connect to the first CHO candidate and, if another candidate is available, the UE may attempt CHO with that other candidate. If the timer expires and another candidate is available, the UE may attempt CHO with that other candidate and restart the timer. The UE may stop the timer when it successfully completes the CHO.

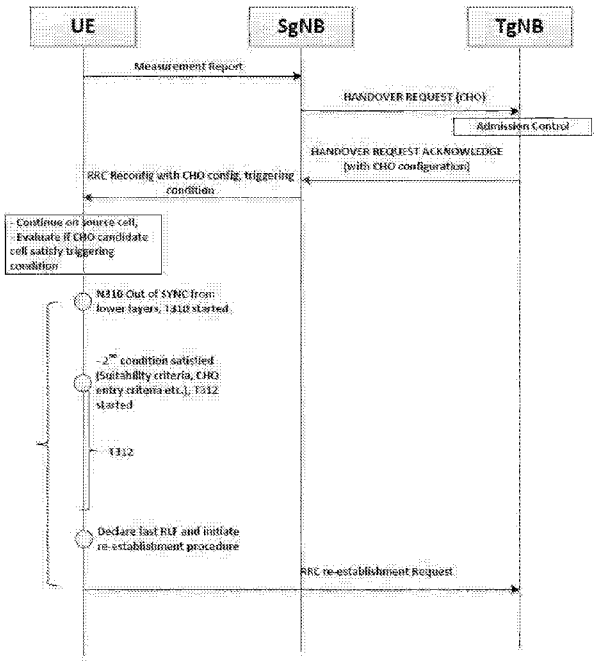

FIG 3a

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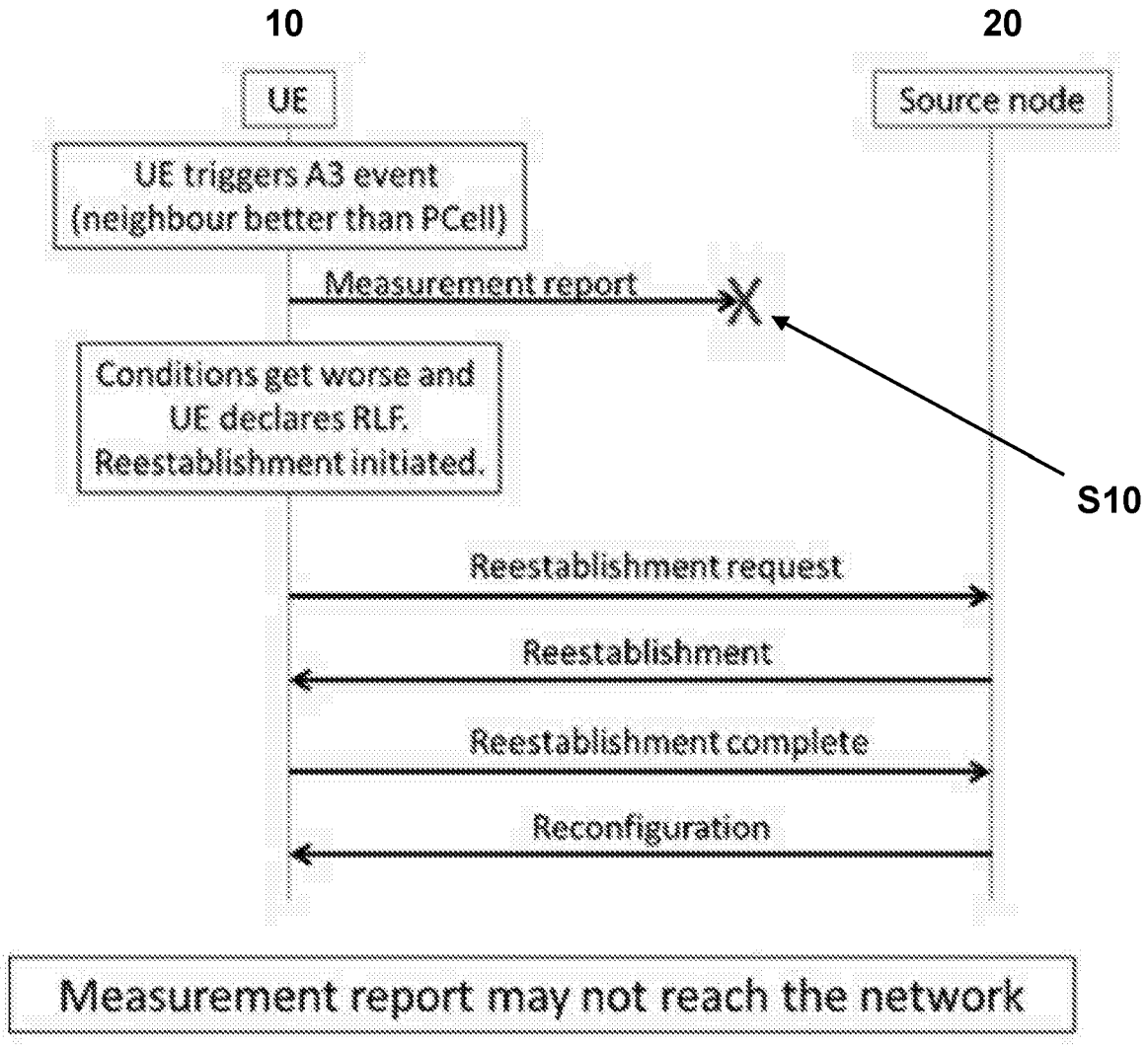
10
20
UE
Source node
UE triggers A3 event
(neighbour better than PCell)
Measurement report
Conditions get worse and
UE declares RLF.
Reestablishment initiated.
S10
Reestablishment request
Reestablishment
Reestablishment complete
Reconfiguration
Measurement report may not reach the network

Fig. 1a

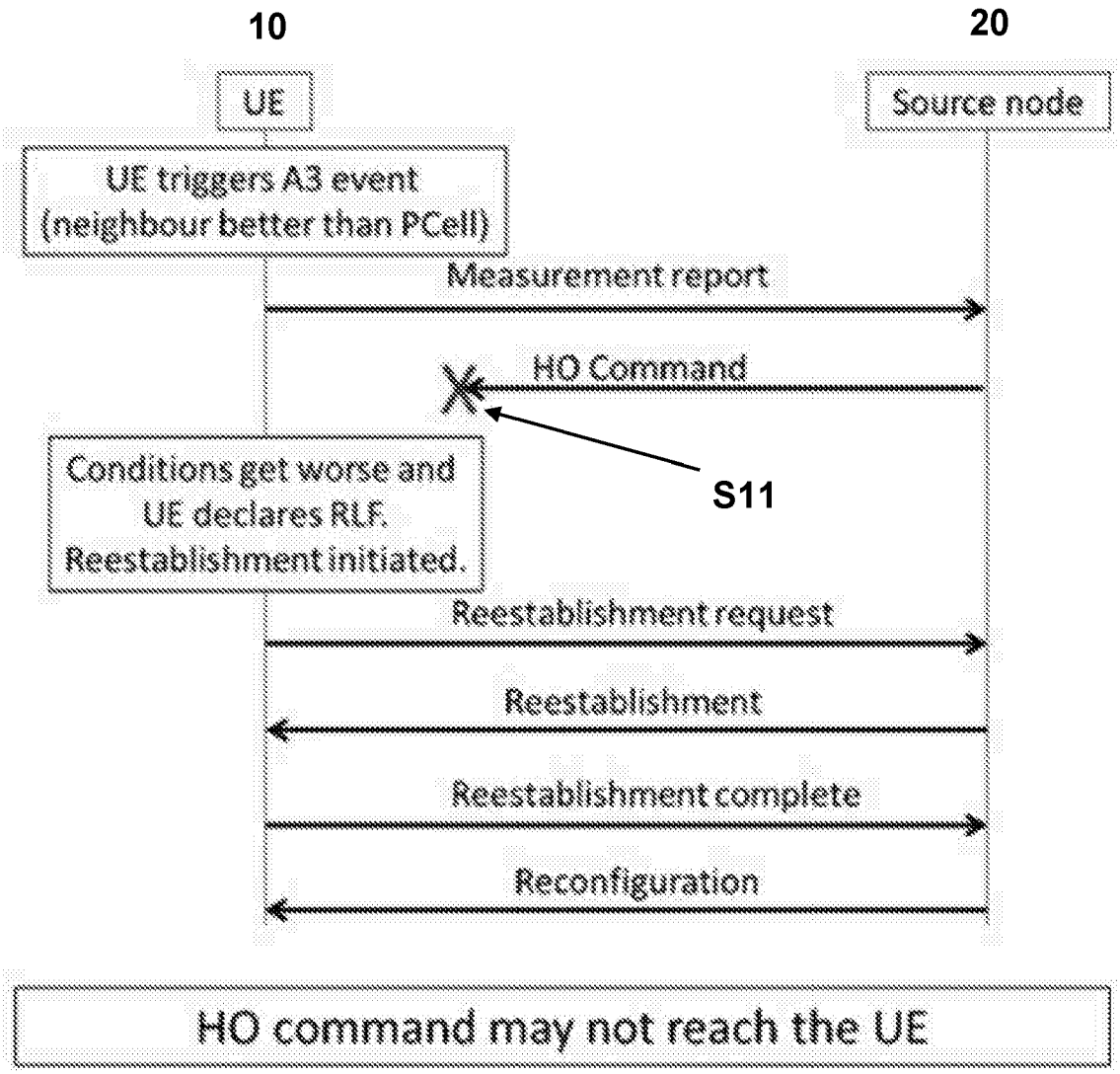
10
20
UE
Source node
UE triggers A3 event
(neighbour better than PCell)
Measurement report
HO Command
S11
Conditions get worse and
UE declares RLF.
Reestablishment initiated.
Reestablishment request
Reestablishment
Reestablishment complete
Reconfiguration
HO command may not reach the UE

Fig. 1b

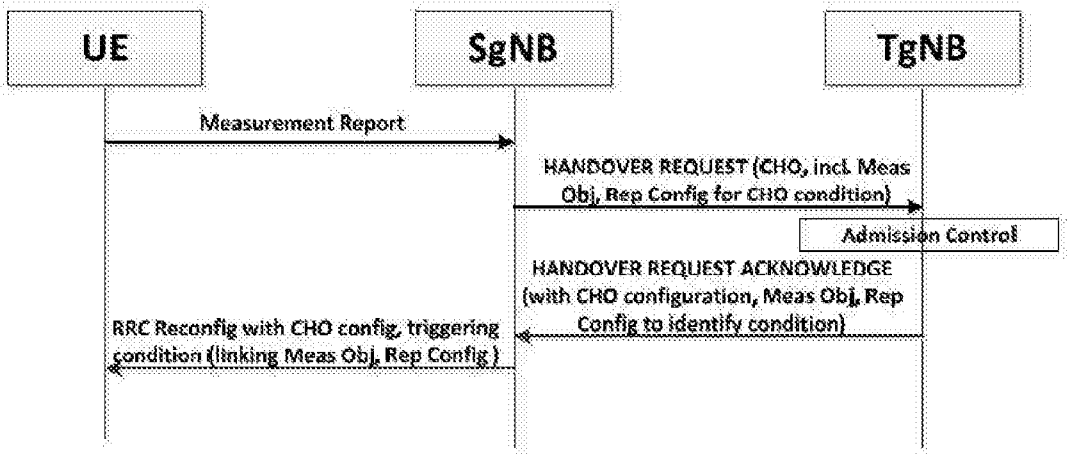
UE
SgNB
TgNB
Measurement Report
HANDOVER REQUEST (CHO, incl. Meas Obj, Rep Config for CHO condition)
Admission Control
HANDOVER REQUEST ACKNOWLEDGE (with CHO configuration, Meas Obj, Rep Config to identify condition)
RRC Reconfig with CHO config, triggering condition (linking Meas Obj, Rep Config)

Fig. 2a

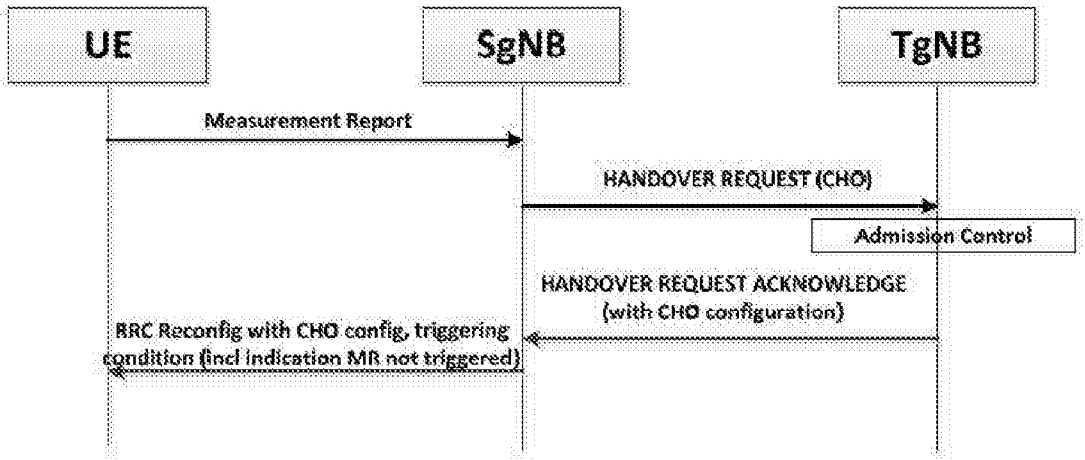
UE
SgNB
TgNB
Measurement Report
HANDOVER REQUEST (CHO)
Admission Control
HANDOVER REQUEST ACKNOWLEDGE (with CHO configuration)
RRC Reconfig with CHO config, triggering condition (incl indication MR not triggered)

Fig. 2b

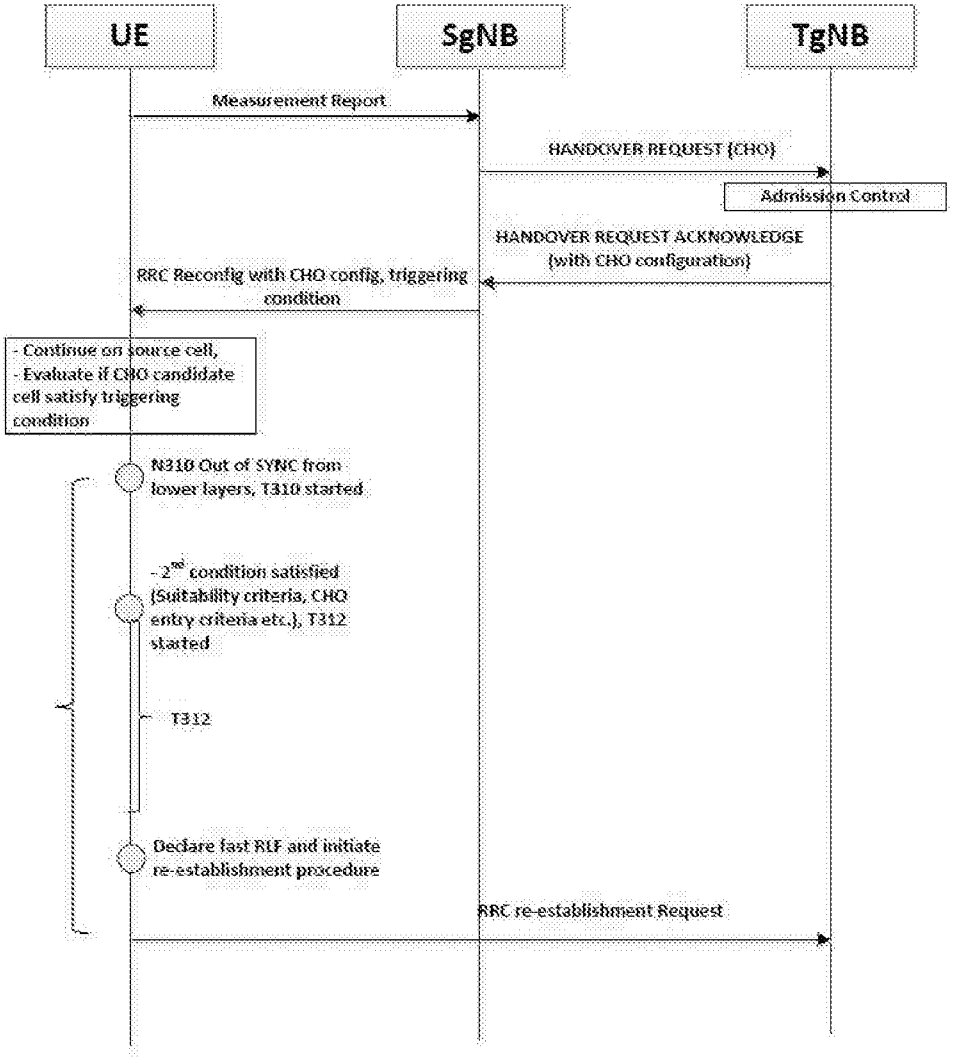
UE
SgNB
TgNB
Measurement Report
HANDOVER REQUEST (CHO)
Admission Control
HANDOVER REQUEST ACKNOWLEDGE
(with CHO configuration)
RRC Reconfig with CHO config, triggering condition
- Continue on source cell,
- Evaluate if CHO candidate cell satisfy triggering condition
N310 Out of SYNC from lower layers, T310 started
- 2nd condition satisfied (Suitability criteria, CHO entry criteria etc.), T312 started
T312
Declare fast RLF and initiate re-establishment procedure
RRC re-establishment Request

FIG 3a

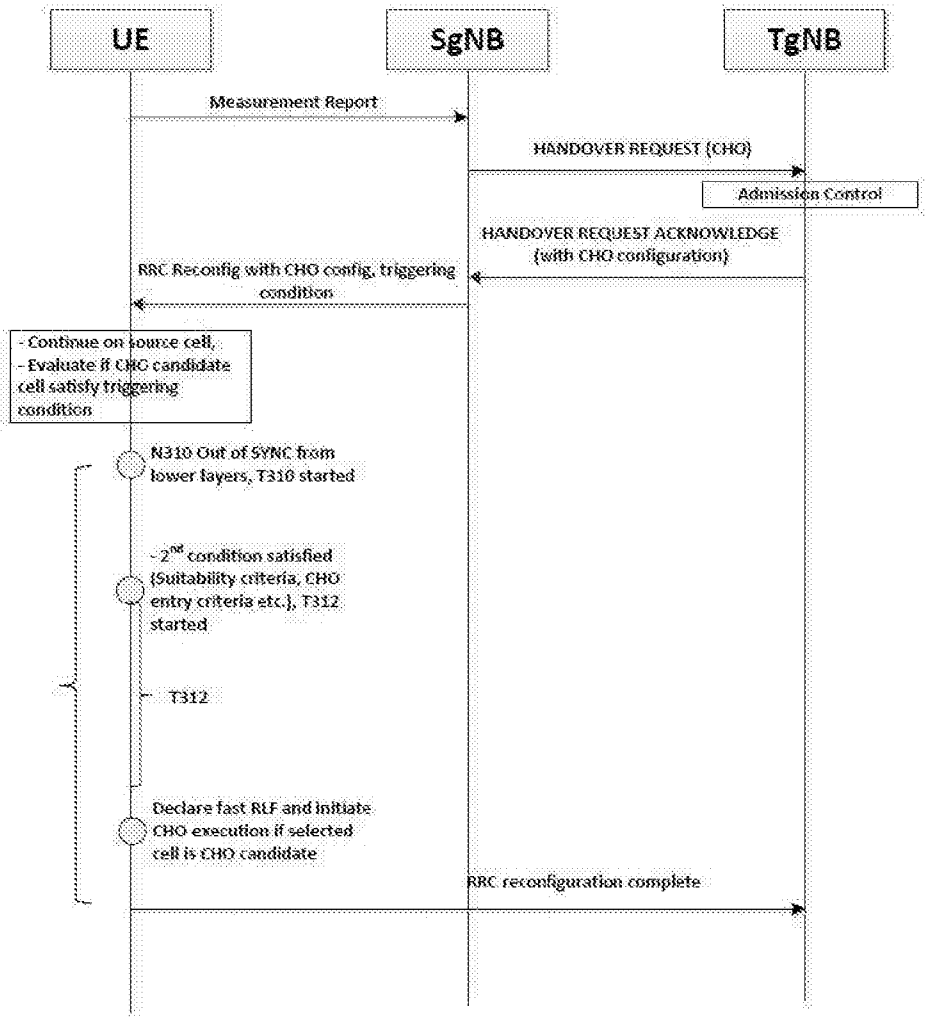
UE
SgNB
TgNB
Measurement Report
HANDOVER REQUEST (CHO)
Admission Control
HANDOVER REQUEST ACKNOWLEDGE (with CHO configuration)
RRC Reconfig with CHO config, triggering condition
- Continue on source cell,
- Evaluate if CHO candidate cell satisfy triggering condition
N310 Out of SYNC from lower layers, T310 started
- 2nd condition satisfied (Suitability criteria, CHO entry criteria etc.), T312 started
T312
Declare fast RLF and initiate CHO execution if selected cell is CHO candidate
RRC reconfiguration complete

FIG 3b

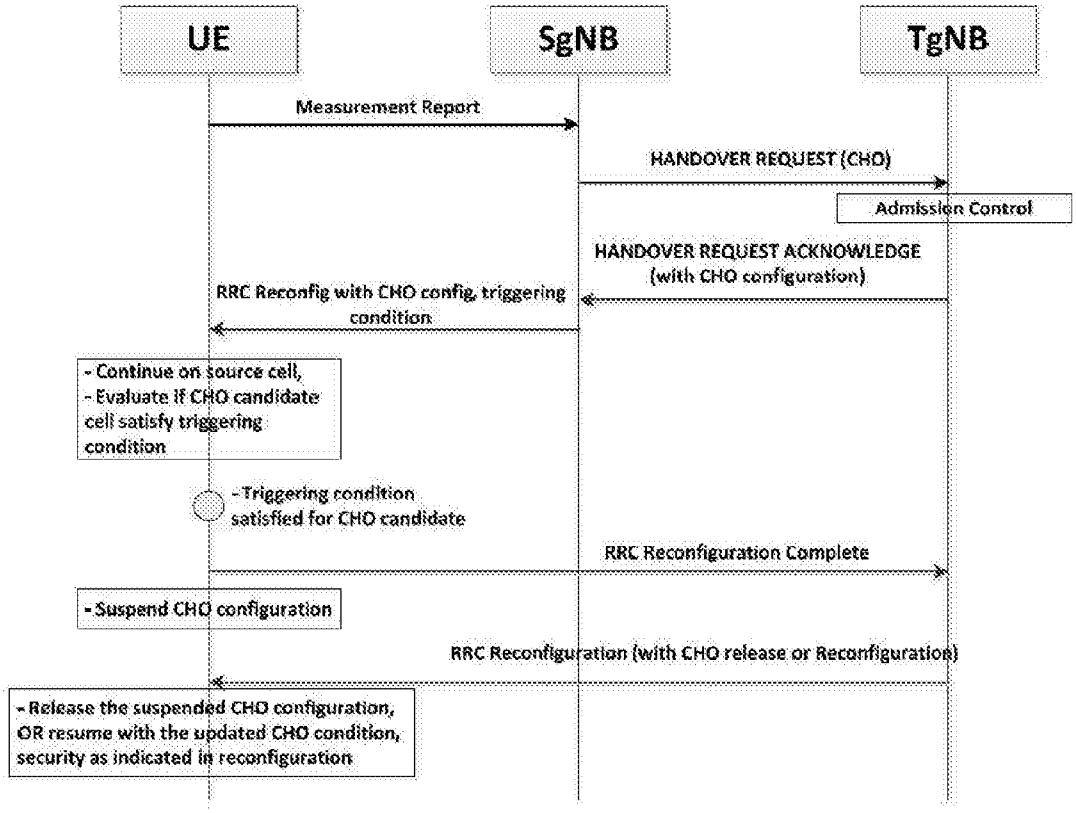
UE
SgNB
TgNB
Measurement Report
HANDOVER REQUEST (CHO)
Admission Control
HANDOVER REQUEST ACKNOWLEDGE
(with CHO configuration)
RRC Reconfig with CHO config, triggering condition
- Continue on source cell,
- Evaluate if CHO candidate cell satisfy triggering condition
- Triggering condition satisfied for CHO candidate
RRC Reconfiguration Complete
- Suspend CHO configuration
RRC Reconfiguration (with CHO release or Reconfiguration)
- Release the suspended CHO configuration, OR resume with the updated CHO condition, security as indicated in reconfiguration

Fig. 4

Improvements in and relating to Conditional Handover in a telecommunications network

The present invention relates to conditional handover come up which is a new form of managing handovers in fifth generation (5G) mobile networks.

In 5G networks, there are new requirements for low latency and high reliability. There are many techniques utilised to achieve these goals, conditional handover being just one of them.

In conditional handover, CHO, instead of preparing one target cell, as known in the prior art, multiple candidate target cells are prepared in advance by the network, which enables the handover command to be sent to the mobile terminal or user equipment, UE, earlier than would normally be the case and, importantly, when radio conditions are still good, rather than when conditions begin to degrade as is known in the case of prior art handovers. Note that in this invention the terms handover and PCell change are used interchangeably.

When received by the UE, it stores the conditional handover command rather than applying it immediately. The conditional handover command includes one or more candidate target cells, and for each, a condition and the configuration. The UE only applies the concerned configuration when the condition configured in the UE is satisfied for concerned candidate target cells. At this point, the UE executes the handover and connects to the target cell as if it were carrying out a prior art handover instructed by the network.

In the prior art, mobility in a connected mode, which is when a mobile terminal is active, is controlled by the network, assisted by measurements performed by the UE. The UE transmits measurement reports if the link to the serving cell is becoming degraded and/or another neighbouring cell is getting better than the serving cell. Based on these measurement reports sent by the UE, the network may possibly move or handover the mobile terminal connection from this serving cell to the improved neighbour cell, so that the mobile terminal will receive better radio conditions and consequently a better user experience. Note that UE may connect to multiple cells i.e. in case of carrier aggregation (CA) or dual connectivity (DC). This invention addresses the change of the primary Cell (PCell) i.e. from source PCell to target PCell. The source PCell is controlled by the source node and likewise the target PCell is controlled by the target node, which may be the same or a different RAN node (e.g. gNB or eNB).

In terms of known conditional handover techniques, it is known in the prior art that when the radio link in question becomes degraded and the mobile terminal needs to send measurement reports ,the uplink is degraded and the reports may never reach the network. Further, even if such reports do reach the network, and the network tries to respond with a handover command, that may never reach the UE, perhaps because the downlink is also degraded. Figures 1A and 1B illustrates situations where a degraded uplink and downlink affect the ability to handover successfully. In Figure 1a, a UE 10 is in communication with a source node 20. After the UE triggers an A3 event, where a neighbouring cell is better than the current cell, it sends a measurement report to the source node 20. However, due to an uplink error S10, this is never received at the source node 20 and eventually a Radio Link Failure, RLF, is declared and a reestablishment process is initiated as known in the prior art.

In Figure 1b. the measurement report from the UE 10 arrives at the source node 20, but the handover command never arrives at the UE 10 due to a downlink failure S11. Again, a reestablishment process is triggered, as known in the prior art.

In both cases, user experience is adversely affected by this interruption to communications.

In known conditional handover techniques, the UE receives a handover command and stores it without applying it immediately. The conditional handover command comprises, for each candidate target cell, the configuration to be applied in the concerned cell and an associated condition to be monitored by the UE. When the condition is fulfilled, the UE applies the previously stored handover command as if the network had just sent it, instead of first sending a measurement report as in traditional handover techniques.

The condition that defines the criteria to apply the stored handover command is based on the quality of the serving cell and neighbouring cells, somewhat similar to the condition in traditional handover techniques which would lead the UE to transmit a measurement report. For instance, in the prior art, the network can configure the UE to transmit a measurement report when a neighbouring cell becomes somehow better than the currently serving cell, as a way to indicate to the network that a handover maybe needed. In known conditional handover techniques, a similar condition can be configured, except that instead of transmitting the measurement reports, the UE applies the stored message. Sending the handover command conditionally when the radio conditions are favourable reduces the risk of failure of either the measurement report from the UE or the handover command from the network.

It is an aim of embodiments of the present invention to address shortcomings in known conditional handover techniques whether mentioned herein or not.

According to the present invention there is provided an apparatus and method as set forth in the appended claims. Other features of the invention will be apparent from the dependent claims, and the description which follows.

According to an aspect of the invention, there is provided a method of configuring a conditional handover, CHO, condition for a User Equipment, UE, in a mobile telecommunication network, wherein the condition comprises a measurement object and a report configuration field

In an embodiment, the measurement object and the report configuration field are included in a measConfig field.

In an embodiment, included in the measConfig field is an identifier, measID, linking the measurement object to one or more report configuration fields.

In an embodiment, the measConfig field includes an indicator to inform the UE whether it should perform measurement reporting for the concerned measID.

In an embodiment, the measurement object defines a frequency of a CHO candidate to be measured.

In an embodiment, the report configuration field defines details of an event upon which the UE triggers CHO to a target.

According to another aspect of the invention, there is provided a method of configuring conditional handover of a UE in a telecommunication network comprising the step of updating a source configuration while a CHO candidate is configured.

In an embodiment, a source node sends a reconfiguration message to change a source Pcell configuration.

In an embodiment, the reconfiguration message comprises a first part comprising parameters set by a node controlling source Pcell and a second part comprising parameters set by a node controlling target Pcell.

In an embodiment, if the second part is signalled for a particular CHO candidate, then the UE considers that a target configuration of the particular CHO candidate requires updating.

In an embodiment, the second part comprises delta signalling compared to updated source configuration

According to another aspect of the invention, there is provided a method of performing conditional handover, CHO, of a User Equipment, UE, in a telecommunication network, comprising the steps of:

the UE receiving a CHO instruction;
the UE starting a timer with a predetermined value when the UE initiates CHO to a first CHO candidate;
if the timer expires, the UE attempts reestablishment

In an embodiment, If, before the timer expires, a condition is met, the UE stops trying to connect to the first CHO candidate and if another candidate is available, the UE attempts CHO with that other candidate.

In an embodiment, If the timer expires and another candidate is available, the UE attempts CHO with the other candidate and starts the timer again.

In an embodiment, the UE stops the timer when it successfully completes CHO.

All aspects of the present invention comprise a method and corresponding apparatus. The apparatus are configured to perform the respective methods. The apparatus comprise one or more network entities and may include a UE, a gNB, eNB or other network entity as appropriate.

Although a few preferred embodiments of the present invention have been shown and described, it will be appreciated by those skilled in the art that various changes and modifications might be made without departing from the scope of the invention, as defined in the appended claims. Further aspects of the invention are included in the following description.

For a better understanding of the invention, and to show how embodiments of the same may be carried into effect, reference will now be made, by way of example only, to the accompanying diagrammatic drawings in which:

Figures 1a and 1b illustrate issues in the uplink and downlink which provide a motivation for CHO, in general;

Figures 2a and 2b illustrate message exchanges in connection with an embodiment of the invention;

Figures 3a and 3b illustrate message exchanges in connection with an embodiment of the invention;

Figure 4 illustrates a message exchange in connection with an embodiment of the invention;

The following description relates to several different areas for improvement of CHO and are presented, generally, in as close to a chronological order as possible, beginning with configuration steps and ending with actual execution of handover.

Throughout the following, it is important to note that one gNB or eNB (in the case of LTE) can control several cells. In general, UE operations are specified in terms which are agnostic of the Radio Access Network, RAN, architecture. In other words, the UE is aware of different cells and connects to them in accordance with commands received from the network. Handover, of any sort, is just a change of Pcell, regardless of whether the target Pcell is actually controlled by the same gNB or eNB.

An aspect of the present invention relates to CHO candidate configuration. It is known that CHO configuration may include two types of parameter: a first part of the CHO configuration that is set by the source node e.g. a condition to be met, and a second part of the CHO configuration that is set by the target node e.g. a configuration to be used in the candidate Pcell upon CHO execution. In an embodiment, the first part set by the source may include a parameter related to security, such as a parameter used to derive KgNB, such as NCC, NH. The parameter may further indicate explicitly or implicitly that the security key is to be refreshed.

A further aspect of the present invention relates to the condition that is part of the CHO candidate configuration and in particular how to signal it. As for RRM measurements, the condition comprises a Measurement Object (MO) and a reporting configuration field (reportConfig). The MO defines the frequency of a CHO candidate to be measured or evaluated for CHO while the reporting configuration defines the details of the condition i.e. the event upon which UE should trigger CHO execution for the concerned target.

In an embodiment of the invention, illustrated in Figure 2a, these parameters – MO and reportConfig – are signalled as follows. Firstly, the MO for CHO is included in the existing measConfig field, as used for measurements performed for RRM, as in a conventional

handover, even if this is specific to CHO. Figure 2a illustrates the UE, a source node (SgNB) and a Target node (TgNB).

Further, and likewise, the reportConfig for CHO is included in the existing measConfig field even if this is specific to CHO, rather than a regular (or RRM) handover.

In the CHO configuration, the identity of the applicable MO is included as well as one or more identities of the applicable reportConfigs. This is included in the part of the CHO configuration set by the node controlling the source Pcell and the identities refer to the corresponding measConfig. In other words, the CHO configuration is set by the same node.

In an alternative embodiment, illustrated in Figure 2b, the existing measConfig includes a measurement identity for CHO that links the MO and reportConfig to be used for CHO alike for a regular RRM measurements included in measConfig i.e. in this case the linking of the MO and the one or more reportConfig is done within the measConfig rather than within the CHO configuration. In this alternative approach, there is an indication included in measConfig that the UE should not perform measurement reporting for the concerned measID, as the measurement only defines the condition for CHO. This may be achieved by introducing a new field e.g. noMeasReport.

By adopting the above approach(es), which feature multiple triggering conditions (i.e. defined by multiple reportConfigs), these can be made specific to CHO only and don't impact on regular RRM measurements as, e.g. used for conventional handovers.

Further, supporting multiple triggers for multiple reportConfigs enables the use of the A3 message (Neighbour becomes offset better than SpCell) for a first quantity and the A4 (Neighbour becomes better than threshold) message for a second quantity, thereby, for instance, allowing a comparison for one quantity and an absolute criterion for another e.g. use A3 for Reference Signal Received Power (RSRP) and A4 for Reference Signal Received Quality (RSRQ)

Further options are available. A first option is to re-use the same reportConfig as used for RRM or traditional HO. It is noted that a network may configure a regular RRM measurement for normal HO to the same CHO candidate, with CHO being merely used as fallback in case such normal HO fails as explained above. In such case, the configuration for the regular RRM measurement can be re-used by just configuring some minor differences regarding the parameters defining the condition.

It is noted that for several parameters (e.g. TTT, hysteresis) it seems possible to use the same value for the RRM measurement to assist normal handover and for CHO. For some other parameters it is not appropriate to use the same value. i.e. some CHO specific parameter would be needed as the condition for triggering the MR message and CHO would be somewhat different. As an example, when re-using a reportConfig, CHO may just require the addition of a single offset that ensures that UE initiates CHO for same candidate target PCell when the condition is slightly worse than the condition for sending an MR message to trigger a regular handover. For instance, a single offset is applied, which would, either be applied to serving PCell/ PSCell or to a CHO candidate cell. This is an offset added either to Mn or Mp in the relevant conditions e.g. as shown below for the entering condition for A3 in NR (for the case where offset is added to Mn).

Alternatively, the condition for CHO may be specified completely separately from the ones used for regular RRM measurements e.g. by a separate reportConfig. This may be because there may not be a suitable reportConfig configured for RRM

It is noted that some parameters are not relevant for CHO and are simply not used for CHO by UE i.e. they are ignored, such as parameters controlling what to include in a MeasurementReport message.

In a second option, reportConfig, which is also used for RRM, is re-used by introducing extensions for CHO.

A prior art RRM measurement has an associated identity (measId), a measurement object (measObject i.e. basically the frequency) and a reporting configuration (defining when report is triggered and what is to be reported).

In an embodiment, the network may configure a regular or prior art RRM measurement for normal or prior art HO to the same CHO candidate cell also, so that CHO is used merely as a fallback option in case the regular HO fails due to difficulty or failure in transferring the measurement report (MR, UL) message or handover command/ synchronous reconfiguration to change PCell (DL). In such a case, the same configuration may be re-used along with some minor differences regarding the parameters controlling when the UE takes action.

In a normal RRC HO, the UE initiates MR message for a potential target PCell on a given frequency when a first condition is met e.g. signal below a certain threshold.

In CHO, the UE initiates CHO for the same candidate target PCell when the condition is slightly worse than the aforementioned first condition i.e. an offset is configured.

This arrangement reduces the signalling and thereby UE complexity, but may also reduce measurement burden on the UE, since the measurement and condition evaluation are nearly the same.

According to an aspect of the invention, when multiple CHO candidates meet the condition for CHO execution the UE selects which candidate to initiate CHO for. This CHO candidate selection process may be left up to UE implementation. However, the CHO candidate selection process could be constrained i.e. the candidates can be assessed in some manner such that only certain candidates are considered. In one embodiment, the candidates can be ranked according to a criterion (R) such that the UE is allowed to select only those candidates where the value of R is within some defined range from the value achieved by the best candidate. The network may signal some configuration parameters related to the ranking, so it is able to control the UE selection performed by the UE.

According to an aspect of the present invention, it is possible to update the source configuration while a CHO candidate is configured. An example of source reconfiguration is the configuration of new data bearers or configuration of new radio resources. As mentioned previously, part of the configuration concerning a CHO candidate is provided by the target node i.e. the configuration to be used upon executing CHO to the concerned candidate.

While a CHO candidate has been configured, it is possible to modify source PCell configuration as well as the actual configuration of the CHO candidate.

The message may include reconfiguration of CHO candidates e.g. by a field named cho-CandidateToAddModList that may comprise two parts:

- Part A: Parameters set by node controlling source Pcell (source node)
- Part B: Parameters set by node controlling target Pcell (target node)

If the UE updates the configuration of a CHO candidate (target configuration), it considers the updated source configuration as the baseline for the delta included in Part B. More specifically:

a) If part B is not signalled for a CHO candidate, the UE considers that the target configuration for the concerned CHO remains same (no change). In this case there may still be changes to the configuration of the concerned CHO candidate i.e. changes due to parameters signalled by the source node e.g. changes to the parameters defining the condition upon which UE shall execute CHO and/or change of the security key due to the change of the security key KgNB of the Pcell (due to HO/ change of Pcell or key refresh). In this case the source node may

provide: an indication that key update is required and/ or parameters that may be used when deriving a new security key.

b) If part B is signalled for a CHO candidate, the UE considers that the target configuration for the concerned CHO needs to be updated. In this case, the UE considers part B to be the delta compared to the updated source configuration (i.e. not the delta compared to current target configuration).

A subsequent reconfiguration message can, besides including cho-CandidateToAddModList, with part A set by node controlling source PCell (condExecutionCond) and part B set by node CHO controlling candidate (condRRCReconfig i.e. Reconfiguration message embedded in octet string)

When part B is signalled, the UE considers the updated source PCell configuration resulting after processing the Reconfiguration message as the baseline for the delta signalling indicated by Part B (condRRCReconfig)

According to an aspect of the invention, it is possible to update source PCell after CHO has been configured, and as mentioned previously, this may also require the update of a prepared CHO candidate. To support this, the internode signalling supports the following: the Source node contacts the node controlling the CHO target in order to provide the updated source configuration, upon which the target node may or may not provide an updated target configuration (as it is a delta to the source PCell configuration). The Inter-node signalling between source and target node should support such a modification case, with the option for the target to return or not to return an updated configuration to be signalled to the UE

Note that inter-node signalling thus need not only support the initial preparation of a CHO candidate, but that there is a need to support modification of a CHO candidate as the source PCell configuration may change after such initial CHO preparation and that this may require update of the CHO candidate.

As the source PCell configuration is used as baseline for the configuration of the CHO candidate, the change of the source PCell may require a change of the CHO configuration also. For this, the source node contacts the node controlling the CHO target and informs it that it can subsequently provide an updated CHO configuration, if required. The internode signalling supports this option, which may be performed by using the same inter-node message as for normal (prior art) HO preparation, but with some different setting, as detailed below:

It should be noted that the updating handover preparation is not used for conventional handover, as conventional handover is executed immediately i.e. it concerns a one shot action.

For CHO, the source Pcell may initiate modification of a candidate target Pcell after preparation is applicable

The inter node messages should thus support modification of a prepared CHO candidate. This may involve, amongst other messages the HandoverPreparationInfo. It is possible to indicate the requested changes to the preparation for CHO e.g. by indicating the changes compared to what was requested by a previous inter-node message. e.g delta signalling, rather than full configuration

Regarding the inter-node messages to use upon modification of a prepared CHO candidate, the possible options include: use of the same inter-node message as for prior art HO (contents may be set different); and/or use a different inter-node message as for prior art HO, but it may be set differently i.e. there may be some indication that it concerns a modification e.g. and that contents concern changes (delta signalling) rather than full configuration, as upon initial configuration.

According to an aspect of the invention, there are various options for handling Radio Link Failure, RLF. These options make use of a timer, similar to known timer T312 in the prior art.

In a first option, the situation illustrated in Figure 3a is relevant.

Upon detecting physical problems, the UE starts a timer T310. While T310 runs the UE attempts recovery (i.e. before declaring RLF)

While T310 runs, the UE performs radio link monitoring and stops T310 if the link recovers. If a cell meets the condition for CHO, the UE executes CHO to the concerned cell. If a cell meets a second condition, the UE starts a second timer (similar to T312). This second condition can be another condition e.g. the suitability criterion.

Upon T312 or T310 expiry, whichever comes first, the UE performs Reestablishment
If it was the second timer that expired, a reestablishment process is performed to the cell for which the second timer was started.

In a second option, the situation illustrated in Figure 3b is relevant.

Upon detecting physical problems UE starts timer T310. While T310 runs the UE attempts recovery (i.e. before declaring RLF)

While T310 runs, the UE performs radio link monitoring and stops T310 if the link recovers. If a cell meets a first condition, the UE starts a second timer (similar to T312).

Examples of the first condition include:

- The entry condition of a measurement that is configures and for which the second timer applies
- The condition for performing CHO for a CHO candidate that is configured
- Another condition e.g. suitability criterion for any cell detected by the UE

Upon T312 or T310 expiry, whichever comes first, if the cell the UE selects concerns a CHO candidate, the UE performs CHO. Otherwise, the UE performs a reestablishment, possibly to the cell for which the second timer was started.

According to an aspect of the invention, there is an option for suspension of CHO candidates upon performing HO/ executing CHO to another candidate.

This concerns the UE operations for the CHO candidate configuration upon HO/ CHO. The current working assumption is that the UE autonomously releases the CHO candidate configuration

In a first option, upon HO/ CHO, the UE maintains CHO candidate configuration unless and until the network explicitly requests the UE to release it, but the UE suspends CHO operation until they are resumed. This is illustrated in Figure 4.

The UE autonomously resumes upon the 1st reconfiguration (i.e. may not be signalled explicitly). Suspension is required as, following HO/ CHO, the security configuration of the CHO candidates needs updating. The node controlling the target PCell (i.e. new source cell) should provide the node controlling the CHO candidate with an updated KgNB.

That (new source) node may need to provide the UE with new security parameters i.e. NCC/ NH. Based on the master key of the target PCell (i.e. new source cell) the UE calculates the key applicable for the CHO candidate with NCC or NH if received. That (new source) node cannot provide the new security parameters while sending the HO command to the UE but can only provide them after the UE successfully completes the CHO or HO (i.e. based on input it may receive during path switch following HO/ CHO).

The condition for performing CHO may also need to be updated if for target PCell a different offset applies than for source PCell i.e. to accommodate differences in frequency (upon inter-frequency HO/ CHO) and/ or cell specific offsets. If the UE continues CHO based on incorrect offset (e.g. case of CHO), the UE applies incorrect condition and may erroneously trigger CHO. For CHO, the condition can only be updated upon the first reconfiguration following CHO.

Here, the general principle is to specify UE autonomous operations e.g. release only if really essential while upon any reconfiguration, the convention is to maintain configuration while changes are indicated by signalling the delta. At least some CHO candidates may still be good candidates for CHO after completing (C)HO.

According to an aspect of the invention, the use of timers for monitoring CHO is provided.

Upon executing CHO the UE starts one or more timers and options relate to the handling of start, stop and actions upon expiry of the timer, in particular.

In a first option, a single (similar to T304) timer is provided covering the multiple CHO candidates that the UE may successively try. The timer is started when the UE initiates CHO to a first CHO candidate. If a certain condition is met, then the UE stops trying to connect to a given CHO candidate and if another candidate is available, the UE attempts CHO towards it, unless the timer expires, for which see below.

If the timer expires, the UE performs reestablishment. The UE stops the timer when it successfully completes CHO

In a second option, a single (similar to T304) timer is provided, monitoring CHO to one particular CHO candidate. The timer is started when the UE initiates CHO to a first CHO candidate. If the timer expires and another candidate is available, the UE attempts CHO and again starts the timer. If the timer expires and no other candidate is available, the UE performs Reestablishment. The UE stops the timer when it successfully completes CHO

At least some of the example embodiments described herein may be constructed, partially or wholly, using dedicated special-purpose hardware. Terms such as ‘component’, ‘module’ or ‘unit’ used herein may include, but are not limited to, a hardware device, such as circuitry in the form of discrete or integrated components, a Field Programmable Gate Array (FPGA) or Application Specific Integrated Circuit (ASIC), which performs certain tasks or provides the associated functionality. In some embodiments, the described elements may be configured to reside on a tangible, persistent, addressable storage medium and may be configured to

execute on one or more processors. These functional elements may in some embodiments include, by way of example, components, such as software components, object-oriented software components, class components and task components, processes, functions, attributes, procedures, subroutines, segments of program code, drivers, firmware, microcode, circuitry, data, databases, data structures, tables, arrays, and variables. Although the example embodiments have been described with reference to the components, modules and units discussed herein, such functional elements may be combined into fewer elements or separated into additional elements. Various combinations of optional features have been described herein, and it will be appreciated that described features may be combined in any suitable combination. In particular, the features of any one example embodiment may be combined with features of any other embodiment, as appropriate, except where such combinations are mutually exclusive. Throughout this specification, the term "comprising" or "comprises" means including the component(s) specified but not to the exclusion of the presence of others.

Attention is directed to all papers and documents which are filed concurrently with or previous to this specification in connection with this application and which are open to public inspection with this specification, and the contents of all such papers and documents are incorporated herein by reference.

All of the features disclosed in this specification (including any accompanying claims, abstract and drawings), and/or all of the steps of any method or process so disclosed, may be combined in any combination, except combinations where at least some of such features and/or steps are mutually exclusive.

Each feature disclosed in this specification (including any accompanying claims, abstract and drawings) may be replaced by alternative features serving the same, equivalent or similar purpose, unless expressly stated otherwise. Thus, unless expressly stated otherwise, each feature disclosed is one example only of a generic series of equivalent or similar features.

The invention is not restricted to the details of the foregoing embodiment(s). The invention extends to any novel one, or any novel combination, of the features disclosed in this specification (including any accompanying claims, abstract and drawings), or to any novel one, or any novel combination, of the steps of any method or process so disclosed.

CLAIMS

1. A method of performing conditional handover, CHO, of a User Equipment, UE, in a telecommunication network, comprising the steps of:

the UE receiving a CHO instruction;
the UE starting a timer with a predetermined value when the UE initiates CHO to a first CHO candidate;
if the timer expires, the UE attempts reestablishment.

2. The method of claim 1 wherein If, before the timer expires, a condition is met, the UE stops trying to connect to the first CHO candidate and if another candidate is available, the UE attempts CHO with that other candidate.

3. The method of claim 1 or 2 wherein If the timer expires and another candidate is available, the UE attempts CHO with the other candidate and starts the timer again.

4. The method of any of claim 1 to 3 wherein the UE stops the timer when it successfully completes CHO.

Intellectual Property Office

Application No:	GB2208433.9	**Examiner:**	Usman Asghar
Claims searched:	1-4	**Date of search:**	23 June 2022

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
X	1-4	3GPP TSG RAN WG2 Meeting 106 Failure Handling on CHO, R2-1906292, (INTEL) http://www.3gpp.org/ftp/tsg%5Fran/WG2%5FRL2/TSGR2%5F106/Docs/R2%2D1906292%2Ezip see s. 2
X	1-4	US 2019/223073 A1 (FG INNOVATION) fig. 18 and pars. [0105], [0184-0185] and [0193]
X,E	1-4	EP 3909292 A1 (SAMSUNG) see figs. 13, 16 and pars. [0163] and [0229]
X	1, 4	EP 3358901 A1 (SAMSUNG) see par. [0125]
X,E	1	EP 3766274 A1 (NOKIA) see fig. 6 and pp. 10-11

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC^{X} :

Worldwide search of patent documents classified in the following areas of the IPC

H04W

The following online and other databases have been used in the preparation of this search report

WPI, EPODOC

Intellectual Property Office

International Classification:

Subclass	Subgroup	Valid From
H04W	0036/36	01/01/2009
H04W	0036/24	01/01/2009