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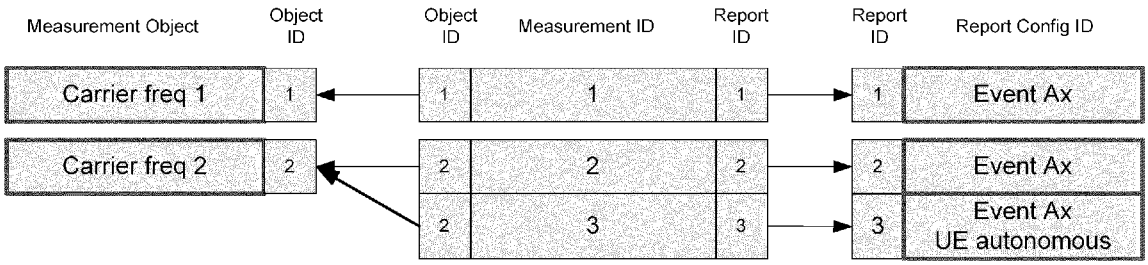

Fig. 3

(57) Abstract: An apparatus for use by a communication element or function configured to execute an autonomous handover procedure in a communication network, the apparatus comprising at least one processing circuitry, and at least one memory for storing instructions to be executed by the processing circuitry, wherein the at least one memory and the instructions are configured to, with the at least one processing circuitry, cause the apparatus at least: to conduct a first handover related measurement processing in which signaling received from at least one communication network control element or function being capable of providing access to the communication network is measured and processed, to report measurement results of the first handover related measurement processing to a serving communication network control element or function to which the communication element or function is connected, to receive, from the serving communication network control element or function, and process an indication of at least one handover target candidate, wherein the at least one handover target candidate is one or more of the at least one communication network control element or function for which measurement results are reported, to conduct a second handover related measurement processing in which signaling received from the at least one handover target candidate is measured and processed, wherein a measurement setting of the second handover related measurement processing is modified in comparison to that of the first handover related measurement processing for achieving a higher accuracy of measurement results in the second handover related measurement processing.

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MEASUREMENT CONTROL MECHANISM FOR AUTONOMOUS HANDOVER PROCEDURE

DESCRIPTION

BACKGROUND

Field

The present invention relates to apparatuses, methods, systems, computer programs, computer program products and computer-readable media usable for controlling an autonomous handover procedure of a communication element or function, in particular for controlling measurements conducted in the handover procedure.

Background Art

The following description of background art may include insights, discoveries, understandings or disclosures, or associations, together with disclosures not known to the relevant prior art, to at least some examples of embodiments of the present invention but provided by the invention. Some of such contributions of the invention may be specifically pointed out below, whereas other of such contributions of the invention will be apparent from the related context.

The following meanings for the abbreviations used in this specification apply:

3GPP:	3rd Generation Partner Project
5G:	5th generation
BS:	base station
cHO:	conditional handover (autonomous handover)
CPU:	central processing unit
CSI-RS:	channel state information reference signal
ETSI	European Telecommunications Standards Institute
gNB:	5G base station
GPRS:	general packet radio system
HO:	handover

ID:	identification
LTE:	Long Term Evolution
LTE-A:	LTE Advanced
NR:	new radio
PCI:	physical cell identifier
PRB:	physical resource block
RACH:	random access channel
RAN:	radio access network
RAT:	radio access technology
RRC:	radio resource control
RRM:	radio resource management
RS:	reference signal
RSRP:	reference signal received power
RSRQ:	reference signal received quality
SINR:	signal to interference plus noise ratio
SS:	synchronization signal
TTI:	transmission time interval
TTT, ttt:	time to trigger
UE:	user equipment
UL:	uplink
UMTS:	universal mobile telecommunication system

Embodiments of the present invention are related to a mechanism which allows to improve control of handover processing of a communication element like an UE or the like, in particular in case of an autonomous or conditional handover, wherein a more efficient handover related measurement processing for signaling of target(s) and/or source for the handover is implemented.

SUMMARY

According to an example of an embodiment, there is provided, for example, an apparatus for use by a communication element or function (which is e.g. configured to execute an autonomous or conditional handover procedure in a communication network), the apparatus comprising at least one processing circuitry, and at least one memory for storing instructions to be executed by the processing circuitry, wherein the at least one

memory and the instructions are configured to, with the at least one processing circuitry, cause the apparatus at least: to conduct a first handover related measurement processing in which signaling received from at least one communication network control element or function being capable of providing access to a communication network is measured and processed, to report measurement results of the first handover related measurement processing to a serving communication network control element or function to which the communication element or function is connected, to receive, from the serving communication network control element or function, and process an indication of at least one handover target candidate, wherein the at least one handover target candidate is one or more of the at least one communication network control element or function for which measurement results are reported, to conduct a second handover related measurement processing in which signaling received from the at least one handover target candidate is measured and processed, wherein a measurement setting of the second handover related measurement processing is modified in comparison to that of the first handover related measurement processing for achieving a higher accuracy of measurement results in the second handover related measurement processing.

Furthermore, according to an example of an embodiment, there is provided, for example, a method for use by a communication element or function (which is e.g. configured to execute an autonomous or conditional handover procedure in a communication network), the method comprising conducting a first handover related measurement processing in which signaling received from at least one communication network control element or function being capable of providing access to a communication network is measured and processed, reporting measurement results of the first handover related measurement processing to a serving communication network control element or function to which the communication element or function is connected, receiving, from the serving communication network control element or function, and processing an indication of at least one handover target candidate, wherein the at least one handover target candidate is one or more of the at least one communication network control element or function for which measurement results are reported, conducting a second handover related measurement processing in which signaling received from the at least one handover target candidate is measured and processed, wherein a measurement setting of the second handover related measurement processing is modified in comparison to that of the first handover related measurement processing for achieving

a higher accuracy of measurement results in the second handover related measurement processing.

According to further refinements, these examples may include one or more of the following features:

the first handover related measurement processing for signaling received from another communication network control element or function being different to the at least one handover target candidate may be continued to be conducted while conducting the second handover related measurement processing;

on the basis of the second handover related measurement processing, it may be determined whether a predetermined trigger event is valid for at least one of the at least one handover candidate target, wherein the trigger event may indicate that a handover of a communication connection from the serving communication network control element or function to the determined handover target candidate is to be performed, and the handover to the determined handover target candidate may be performed;

the trigger event may be based on information being preset in the communication element or function, or on information being received by handover configuration information from the serving communication network control element or function, wherein the handover configuration information may include, for each handover target candidate, system information and identification information, and an allowance for performing a handover autonomously;

the indication of the at least one handover target candidate may be received with handover configuration information from the serving communication network control element or function, wherein the handover configuration information may include, for each handover target candidate, system information and identification information for accessing the handover target candidate, and an allowance for performing a handover on the basis of a pre-configured trigger event;

the measurement setting of the second handover related measurement processing may be modified on the basis of rules being preset in the communication element or function or being received from the serving communication network control element or function;

the modification of the measurement setting of the second handover related measurement processing may include at least one of modifying a filter setting used for measuring the signaling of the at least one handover target candidate,

increasing a bandwidth used for measuring and evaluating the signaling of the at least one handover target candidate, increasing a frequency domain density used for measuring and evaluating the signaling of the at least one handover target candidate, decreasing a sample spacing in time domain used for measuring and evaluating the signaling of the at least one handover target candidate, adding measurement quantities used for measuring and evaluating the signaling of the at least one handover target candidate, in comparison to the first handover related measurement processing, and replacing measurement quantities used for measuring and evaluating the signaling of the at least one handover target candidate, in comparison to the first handover related measurement processing;

measurement quantities used for the first handover related measurement processing and measurement quantities used for the second handover related measurement processing may be the same;

measurement quantities used for the second handover related measurement processing ma include at least one parameter being related to a signal to interference ratio;

the second handover related measurement processing may use dedicated signal components received from the at least one handover target candidate;

the at least one communication network control element or function and the serving communication network control element or function may be part of at least one of a base station, an access point, a distributed unit and a relay station connected to the communication network and to which the communication element or function is connectable, wherein the communication element or function may be a part of a terminal device or user equipment communicating in the communication network.

Furthermore, according to an example of an embodiment, there is provided, for example, an apparatus for use by a communication network control element or function configured to be a handover target for an autonomous handover procedure of a communication element or function in a communication network, the apparatus comprising at least one processing circuitry, and at least one memory for storing instructions to be executed by the processing circuitry, wherein the at least one memory and the instructions are configured to, with the at least one processing circuitry, cause the apparatus at least: to receive and process an indication from a serving communication network control element or function to which the communication element or function is currently connected, the indication informs about the fact that a handover of the communication element or

function from the serving communication network element or function is possible, to identify the communication element or function, to initiate transmission of a dedicated signal component for the identified communication element or function to be used for a second handover related measurement processing by the communication element of function, and to provide information identifying the dedicated signal component to the serving communication network control element or function to be forwarded to the identified communication element or function.

In addition, according to an example of an embodiment, there is provided, for example, a method for use by a communication network control element or function configured to be a handover target for an autonomous handover procedure of a communication element or function in a communication network, the method comprising receiving and processing an indication from a serving communication network control element or function to which the communication element or function is currently connected, the indication informs about the fact that a handover of the communication element or function from the serving communication network element or function is possible, identifying the communication element or function, initiating transmission of a dedicated signal component for the identified communication element or function to be used for an enhanced (i.e. the second) handover related measurement processing by the communication element of function, and providing information identifying the dedicated signal component to the serving communication network control element or function to be forwarded to the identified communication element or function.

According to a further refinement, these examples may include the following feature:

the dedicated signal component provided to the communication element or function may be a channel state information reference signal configuration.

In addition, according to embodiments, there is provided, for example, a computer program product for a computer, including software code portions for performing the steps of the above defined methods, when said product is run on the computer. The computer program product may include a computer-readable medium on which said software code portions are stored. Furthermore, the computer program product may be directly loadable into the internal memory of the computer and/or transmittable via a network by means of at least one of upload, download and push procedures.

BRIEF DESCRIPTION OF THE DRAWINGS

Some embodiments of the present invention are described below, by way of example only, with reference to the accompanying drawings, in which:

Fig. 1 shows a diagram illustrating a configuration of a communication network environment where some examples of embodiments are implementable;

Fig. 2 shows a signaling diagram illustrating an example for an autonomous or conditional handover processing in a network environment according to Fig. 1;

Fig. 3 shows a diagram illustrating an example of a measurement configuration according to some examples of embodiments;

Fig. 4 shows a flow chart of a processing conducted in a communication element or function according to some examples of embodiments;

Fig. 5 shows a flow chart of a processing conducted in a communication network control element or function according to some examples of embodiments;

Fig. 6 shows a diagram of a network element or function acting as a communication element or function according to some examples of embodiments; and

Fig. 7 shows a diagram of a network element or function acting as a communication network control element or function according to some examples of embodiments.

DESCRIPTION OF EMBODIMENTS

In the last years, an increasing extension of communication networks, e.g. of wire based communication networks, such as the Integrated Services Digital Network (ISDN), DSL, or wireless communication networks, such as the cdma2000 (code division multiple access) system, cellular 3rd generation (3G) like the Universal Mobile Telecommunications System (UMTS), fourth generation (4G) communication networks or enhanced communication networks based e.g. on LTE or LTE-A, fifth generation (5G) communication networks, cellular 2nd generation (2G) communication networks like the

Global System for Mobile communications (GSM), the General Packet Radio System (GPRS), the Enhanced Data Rates for Global Evolution (EDGE), or other wireless communication system, such as the Wireless Local Area Network (WLAN), Bluetooth or Worldwide Interoperability for Microwave Access (WiMAX), took place all over the world. Various organizations, such as the European Telecommunications Standards Institute (ETSI), the 3rd Generation Partnership Project (3GPP), Telecoms & Internet converged Services & Protocols for Advanced Networks (TISPAN), the International Telecommunication Union (ITU), 3rd Generation Partnership Project 2 (3GPP2), Internet Engineering Task Force (IETF), the IEEE (Institute of Electrical and Electronics Engineers), the WiMAX Forum and the like are working on standards or specifications for telecommunication network and access environments.

Generally, for properly establishing and handling a communication connection between two or more end points (e.g. communication stations or elements, such as terminal devices, user equipments (UEs), or other communication network elements, a database, a server, host etc.), one or more network elements such as communication network control elements, for example access network elements like access points, radio base stations, relay stations, eNBs, gNBs etc., and core network elements or functions, for example control nodes, support nodes, service nodes, gateways etc., may be involved, which may belong to one communication network system or different communication network systems.

Future communication networks, such as the fifth generation of mobile technology (5G), are developed for fulfilling growing demands on telecommunication systems. Those demands include a growth in connectivity and density/volume of traffic, a multi-layer densification in enabling this, and a broad range of use cases and business models.

Therefore, in new telecommunication systems like 5G, it is necessary to provide, where needed, greater throughput, lower latency, ultra-high reliability, higher connectivity density, and higher mobility range. This is expected to be provided along with the capability to control a highly heterogeneous environment, and capability to, among others, ensure security and trust, identity, and privacy.

When a communication element like an UE (i.e. the user) is moving in an area covered by the communication network by means of a plurality base stations (e.g. cells), the

connection to a currently serving base station becomes weaker while a connection to another (neighboring) base station can become stronger. In this case, a so-called handover (or handoff) is made. Handover refers generally to a process of transferring an ongoing call or data session from one channel connected to the communication network to another channel. In case of changing the position, this often involves a change of the base station serving the UE.

Handover in mobile communications in “new radio” (NR or 5G) may provide the possibility to execute a so-called “UE autonomous” handover, also referred to as “conditional” handover (cHO). In a cHO, during a first phase also referred to as preconfiguration phase, the handover is prepared in the network, for example according to a default configuration or sequence, wherein a handover command is sent to a UE which may require channel switching e.g. due to movement in the network.

However, different to a conventional HO processing, the UE does not immediately complete the HO, i.e. does not immediately access, for example, a target cell when a corresponding cell configuration (e.g. in HO command) is provided. Rather, in a second phase following the preconfiguration phase, which is also referred to as handover phase, the UE decides autonomously about the exact point in time when to access the target cell. This decision can be based on a predetermined condition provided by the network. For example, the condition may involve a specific threshold for a connection quality value between the UE and the serving cell and/or the target cell, wherein this specific threshold is different to a threshold for the connection quality on which the issuance of the HO command is based.

By means of this cHO, it is possible to separate the HO processing in several parts; the preparation and provision of the handover command can be done at an earlier stage, e.g. when the UE is still safe in the source cell coverage area. On the other hand, the actual handover can be done at a later stage when the UE is safe in the target cell coverage area. Hence, the risk that a measurement report or handover command is lost can be reduced, as well as the risk of unsuccessful access to the target cell.

In the following, different exemplifying embodiments will be described using, as an example of a communication network to which the embodiments may be applied, a communication network architecture based on 3GPP standards, such as 5G

communication networks, without restricting the embodiments to such architectures, however. It is obvious for a person skilled in the art that the embodiments may also be applied to other kinds of communication networks having suitable means by adjusting parameters and procedures appropriately, e.g. 4G (LTE) networks, WiFi, worldwide interoperability for microwave access (WiMAX), Bluetooth®, personal communications services (PCS), ZigBee®, wideband code division multiple access (WCDMA), systems using ultra-wideband (UWB) technology, mobile ad-hoc networks (MANETs), wired access, or even future communication networks, etc..

The following examples and embodiments are to be understood only as illustrative examples. Although the specification may refer to “an”, “one”, or “some” example(s) or embodiment(s) in several locations, this does not necessarily mean that each such reference is related to the same example(s) or embodiment(s), or that the feature only applies to a single example or embodiment. Single features of different embodiments may also be combined to provide other embodiments. Furthermore, terms like “comprising” and “including” should be understood as not limiting the described embodiments to consist of only those features that have been mentioned; such examples and embodiments may also contain features, structures, units, modules etc. that have not been specifically mentioned.

A basic system architecture of a (tele)communication network including a communication system where some examples of embodiments are applicable may include an architecture of one or more communication networks including a wired or wireless access network subsystem and a core network. Such an architecture may include one or more communication network control elements, access network elements, radio access network elements, access service network gateways or base transceiver stations, such as a base station (BS), an access point (AP), a NodeB (NB), an eNB or a gNB, a distributed or a centralized unit, which control a respective coverage area or cell(s) and with which one or more communication stations such as communication elements, user devices or terminal devices, like a UE or a vehicle, or another device having a similar function, such as a modem chipset, a chip, a module etc., which can also be part of a station, an element, a function or an application capable of conducting a communication, such as a UE, an element or function usable in a machine-to-machine communication architecture, or attached as a separate element to such an element, function or application capable of conducting a communication, or the like, are capable to

communicate via one or more channels for transmitting several types of data in a plurality of access domains. Furthermore, core network elements such as gateway network elements, mobility management entities, a mobile switching center, servers, databases and the like may be included.

The general functions and interconnections of the described elements, which also depend on the actual network type, are known to those skilled in the art and described in corresponding specifications, so that a detailed description thereof is omitted herein. However, it is to be noted that several additional network elements and signaling links may be employed for a communication to or from an element, function or application, like a communication endpoint, a communication network control element, such as a server, a radio network controller, and other elements of the same or other communication networks besides those described in detail herein below.

A communication network as being considered in examples of embodiments may also be able to communicate with other networks, such as a public switched telephone network or the Internet. The communication network may also be able to support the usage of cloud services for virtual network elements or functions thereof, wherein it is to be noted that the virtual network part of the telecommunication network can also be provided by non-cloud resources, e.g. an internal network or the like. It should be appreciated that network elements of an access system, of a core network etc., and/or respective functionalities may be implemented by using any node, host, server, access node or entity etc. being suitable for such a usage.

Furthermore, a network element, such as communication elements, like a UE, a terminal device, control elements or functions, such as access network elements, like a base station, an gNB, a radio network controller, other network elements as well as corresponding functions as described herein, and other elements, functions or applications may be implemented by software, e.g. by a computer program product for a computer, and/or by hardware. For executing their respective functions, correspondingly used devices, nodes, functions or network elements may include several means, modules, units, components, etc. (not shown) which are required for control, processing and/or communication/signaling functionality. Such means, modules, units and components may include, for example, one or more processors or processor units including one or more processing portions for executing instructions and/or

programs and/or for processing data, storage or memory units or means for storing instructions, programs and/or data, for serving as a work area of the processor or processing portion and the like (e.g. ROM, RAM, EEPROM, and the like), input or interface means for inputting data and instructions by software (e.g. floppy disc, CD-ROM, EEPROM, and the like), a user interface for providing monitor and manipulation possibilities to a user (e.g. a screen, a keyboard and the like), other interface or means for establishing links and/or connections under the control of the processor unit or portion (e.g. wired and wireless interface means, radio interface means including e.g. an antenna unit or the like, means for forming a radio communication part etc.) and the like, wherein respective means forming an interface, such as a radio communication part, can be also located on a remote site (e.g. a radio head or a radio station etc.). It is to be noted that in the present specification processing portions should not be only considered to represent physical portions of one or more processors, but may also be considered as a logical division of the referred processing tasks performed by one or more processors.

It should be appreciated that according to some examples, a so-called “liquid” or flexible network concept may be employed where the operations and functionalities of a network element, a network function, or of another entity of the network, may be performed in different entities or functions, such as in a node, host or server, in a flexible manner. In other words, a “division of labor” between involved network elements, functions or entities may vary case by case.

Fig. 1 shows a diagram illustrating a configuration of communication network environment where some examples of embodiments are implementable. It is to be noted that the configuration indicated in Fig. 1 shows only a simplified architecture and hence those parts which are useful for understanding principles underlying some examples of embodiments of the invention. As also known by those skilled in the art there may be several other network elements or devices involved e.g. in a communication which are omitted here for the sake of simplicity. Furthermore, it is to be noted that links indicated in Fig. 1 are intended to show only principle examples of connections between respective network parts. It is possible that also additional or alternative links besides those indicated in Fig. 1 are provided in a corresponding network, and/or that respective network elements or functions communicate with other network elements or functions by using intermediate nodes shown or not shown in Fig. 1. It is to be noted that examples

of embodiments are not limited to the number of communication stations, elements, functions, and links as indicated in Fig. 1, i.e. there may be implemented or present less of or more of the corresponding stations, elements, functions, and links than those shown in Fig. 1.

As shown in Fig. 1, a communication element 10, such as a UE, is located within a communication network environment. It is assumed in the scenario according to Fig. 1 that the UE 10 is capable of being connected to at least one type of communication network (e.g. a 5G cellular communication network), but it is also possible that different types of communication networks can be used.

Access to a communication network (i.e. core network) 30 is provided by one or more communication network control elements or functions 20, 21, 22, 23, such as access points or a base stations like BS or gNB providing a wireless interface between the communication element 10 and the network. An access network element like a gNB 20 can be configured to cover one or more corresponding coverage areas, also referred to as cells, in which a communication with the UE 10 is possible. It is to be noted that the gNB to which the UE 10 is connected (in Fig. 1 gNB 20) is also referred to as serving gNB (serving communication network control element), which is also referred to as source gNB (or source cell) when HO processing is considered. It is to be noted that a communication network control element or function may also have a distributed configuration where a centralized unit (e.g. in a cloud environment) acts as the BS entity towards the core network while one or more distributed units for lower layers acts as BS entity towards UEs.

It is to be noted that a plurality of access network elements may be provided in the network, each covering a corresponding coverage area. Furthermore, additional or alternative access network elements may be provided, which use the same or another RAT, such as relay nodes, micro cells, wireless local area network nodes and the like. Furthermore, even though Fig. 1 shows an example of one UE 10 and four gNBs, it is to be noted that examples of embodiments are not limited to these numbers. More elements or functions can be involved in a control procedure according to examples of embodiments. For example, a group of users including a plurality of UEs may be connected to the network.

In a communication network environment as shown in Fig. 1, information or data can be transmitted between the UE 10 and the gNBs 20, 21, 22, 23.

Fig. 2 describes an example of a cHO procedure in a network environment as shown in **Fehler! Verweisquelle konnte nicht gefunden werden.**.

It is assumed that the UE 10 is connected to gNB 20 (which corresponds to the communication network control element or function of a cell A) as a serving gNB. Thus, in S10, information such as user data are exchanged between the UE 10 and the gNB 20.

In S20, in the pre-configuration phase, the source gNB 20 sends measurement configuration information to the UE 10. The measurement configuration information may comprise, for example, information regarding handover related measurements to be conducted by the UE 10 with regard to other communication network control elements or functions, such as neighboring cells or different communication network types (e.g. WLAN or the like) to which a handover could be made in case the current communication connection to the serving gNB 20 has to be switched (e.g. due to movement of the UE in the network area, changing load situations or the like). The information regarding handover related measurements may define, for example, which type of measurements are to be conducted, configurations of the measurements such as thresholds for trigger events, timing setting etc., lists or IDs of possible candidate cells (gNBs or the like) being reachable for the UE for a handover, policy settings and the like. It is to be noted that according to examples of embodiments of the invention, necessary settings for conducting handover related measurements can also be pre-stored in the UE 10 which could then conduct these measurements autonomously.

Next, in S30, the UE 10 determines that entry conditions for the cHO are fulfilled. For example, the determination may be based on an evaluation of connection or signaling quality parameters for the serving gNB 20 and/or neighboring cells, a change in a communication setting of the UE 10 (e.g. due to an increased bandwidth requirement), or the like. When the entry condition is fulfilled, the UE 10 conducts a handover related measurement processing in which signaling received from gNBs (or other communication network elements or function) being in a communication range with the UE are evaluated for determining communication connection parameters allowing to

estimate the quality of a connection towards the respective gNB in case of a handover. It is to be noted that according to some examples of embodiments, the handover related measurement processing conducted at this stage corresponds to a first handover related measurement processing as indicated below. The handover related measurements is, for example, basically a conventional RRM measurement for evaluating the respective connection qualities.

In the example shown in Fig. 2, it is assumed that UE 10 receives and evaluates signaling from cells B, C and D (i.e. gNBs 21, 22, 23), e.g. common reference signals or CSI-reference signals. Consequently, a corresponding measurement report reflecting the results of the handover related measurement processing is prepared and sent to the serving gNB 20. The serving gNB 20 decides, for example on the basis of the measurement reports, that cell B (gNB 21) and cell C (gNB 22) are suitable handover target candidates for a handover of the UE. This decision is based, for example, on information provided by the measurement report, information provided by the network (e.g. information reflecting a current load situation of the cells), and the like.

Thus, in S50 and S55, the serving gNB 20 conducts a preparation processing for preparing the corresponding target gNBs 21 and 22. In this preparation, the target gNBs 21 and 22 sends, for example, configuration information to be provided to the UE 10 which is necessary for conducting a handover to the corresponding cell, e.g. a handover command.

In S60, the serving gNB 20 sends corresponding configuration information, such as RRC configurations, to the UE 10. For example, the RRC configuration includes information related to a handover command (for every target cell), such as system information, dedicated preamble, temporary C-RNTI, etc. for each target.

According to examples of embodiments, the configuration information includes also an indication concerning one or more conditions which is/are to be considered by the UE 10 when finally triggering the handover. It is to be noted that according to further examples of embodiments corresponding conditions may also be pre-stored in the UE 10, or provided to the UE 10 from the serving gNB 20 with a separate signaling (i.e. not with a handover command or configuration information).

The purpose of the condition(s) is to allow the UE 10 to autonomously conduct the handover once such a condition (or a UE internal condition) is met or expires for one of the pre-configured targets. That is, the UE 10 conducts a handover for accessing the corresponding target gNB without any further instruction from the network.

For example, the condition may be based on one or more of the following setting examples. Specifically, different types of trigger events representing a corresponding condition can be set. These events may be based, for example, on RSRP or RSRQ.

A criteria for triggering and subsequently cancelling each event may be evaluated after filtering, e.g. layer-3 filtering, has been applied. Furthermore, the criteria for each event has to be satisfied during at least the time to trigger (TTT), which may be configured independently for each event.

One example of such an event, which may be referred to as event A2, which is triggered when the serving cell becomes worse than a threshold. A still further example, which may be referred to as event A3, is triggered when a neighboring cell becomes better than the serving cell by an offset. The offset can be either positive or negative. Another example is referred to as event A4 which is triggered when a neighboring cell becomes better than a threshold. Another example, referred to as event A5, is triggered when the serving cell becomes worse than a first threshold while a neighboring cell becomes better than a second threshold. It is to be noted that also other conditions or trigger events can be set besides those described above.

In the example of Fig. 2, a further possible case is illustrated where another target cell (i.e. cell D or gNB 23) is determined to be a potential handover target candidate. That is, due to ongoing handover related measurements in in S70 resulting in the detection that also cell D (gNB 23) fulfills the necessary conditions for being a handover target, and after sending a measurement report in S73 to the serving gNB 20, the serving gNB 20 decides, for example on the basis of the measurement report, that cell D (gNB 23) is also a suitable handover target candidate for a handover of the UE. Again, this decision is based, for example, on information provided by the measurement report, information provided by the network (e.g. information reflecting a current load situation of the cells), and the like.

Thus, in S75, the serving gNB 20 conducts a preparation processing for preparing the target gNB 23, and forwards in S77 corresponding configuration information necessary for conducting a handover to the corresponding cell, such as RRC configurations, to the UE 10 (including information related to a handover command (for target cell D), such as system information, dedicated preamble, temporary C-RNTI, etc.).

It is to be noted that according to some examples of embodiments the setting of a target cell (i.e. of a handover target candidate) may also change. That is, for example, when due to the movement of the UE the corresponding gNB signaling becomes weak, the previous setting of the gNB as a target cell may be removed.

In the actual handover phase, in S80, the UE 10 determines, for example, that the condition for a handover to cell B (i.e. gNB 21) is fulfilled. Thus, in S90, the UE 10 conducts an autonomous handover to cell B, i.e. it accesses autonomously cell B upon network configured trigger. That it, the UE 10 does not wait for a (further) handover command from the source cell.

It is to be noted that according to some example, in connection with the handover processing, the UE 10 can indicate to the source cell (i.e. source gNB 20) that it will leave it. By means of this, it is possible that the source gNB 20 stops transmission towards the UE 10 and initiates a packet forwarding to the new serving gNB (e.g. gNB 21). However, such an indication may not reach the source cell, for example in the case of significant mobility of the UE 10. In such a situation (or in case such an indication is not used at all), the target cell (i.e. gNB 21) sends, when the handover is conducted, e.g. after identifying the RACH of the UE, a corresponding indication to the former serving cell (i.e. gNB 20) in order to start packet forwarding.

With regard to the example indicated in Fig. 2, in the following, an example is considered where the condition triggering the UE to access the target cell is an event corresponding to event A3 described above. For example, the condition can be based on the following relation:

$$M_T + CIO_{cHO} > M_S + off_{cHO}$$

where M_T is the measurement result of the preconfigured target (i.e. gNB 21 in this example), M_S is the measurement result of the serving cell (i.e. gNB 20 in this example),

off is an offset value (also called HO hysteresis or HO margin) for the conditional handover, and CIO is a cell individual offset for the conditional handover.

As described above, the event expires if the condition above is fulfilled for a certain time to trigger (TTT_{cHO}). The role of TTT_{cHO} in the event A3 is to avoid reacting on individual measurements outliers.

In order to avoid handover failures, it has to be avoided that the condition expires erroneously. For example, an erroneous expiry leads to a lot of unnecessary signaling, it may lead to ping-pong effects and even to failures in case the selected cell does not have stable radio conditions. That is, it is required that the switching condition in the autonomous handover procedure is highly reliable. For this purpose, the measurements have to be solid. Consequently, conservative L3 filtering, TTT_{cHO} and offset/CIO settings are used.

The measurements which are used for preparing candidate cells for UE autonomous handover and removing prepared cells from the candidate set, as well as measurements for conventional handover, have to be designed economically since the UE has to detect and measure the signal strength (or quality) of a plurality of potential neighboring cells or access points. One reason is that there is only little *a priori* knowledge, for example in which direction the UE is moving or how the load condition develops. That is, in principle, all possible PCIs have to be measured regularly.

One way to cope with this situation is to use time multiplexing for the measurement of different PCIs. However, especially in a communication network environment having a large number of communication layers or RATs to be measures, such as in a NR/5G environment, challenges caused by the high number of required handover measurements (e.g. RRM measurements, RSRP/RSRQ) further increase. For those, there is also little *a priori* information.

It is possible to use a variety of methods for measuring the signal strength (or quality) of the potential target cells, which can be UE vendor specific. Standardization organizations, such as 3GPP, typically specify requirements which guarantee a certain accuracy of the measurements. However, it is possible that due to the possible variations

between actually used methods, deviations (= measurement errors) causing failed handovers and ping-pong handovers are still possible.

It is to be noted that UE measurements are also challenged to cope with a fast degradation of the propagation channel in high-frequency cellular bands. For example, in case of LTE networks, a UE is required (verified by a conformance test) to sample the L1 measurements at least every 50 ms to achieve sufficient decorrelation in terms of fast fading. While this is justified for the low-frequency bands, it may not be sufficient for high frequency bands, where the link may become blocked in a short time (e.g. within 50 ms), in particular at the cell edge. On the other hand, due to constrained UE measurement capability, it may not be economical to allow the UE to sample the channel of all neighboring cells any faster (e.g. once per 5-10 ms) to overcome this problem.

Another aspect to be considered is which signals are to be used for a measurement. For example, it is possible to provide two (or more) signals being different to each other for measurement purposes. As one example, 3GPP proposes e.g. two signals for the UE measurements: NR-SS (NR-SS is used to measure SS-block RSRP) and CSI-RS.

As described above, there are different ways how an UE autonomous handover processing can be conducted. One possibility is that the UE autonomous switch to a prepared target cell uses the same measurements which are used for preparing a target cell for UE autonomous handover (which are also the same as for a conventional, fully network based handover).

However, when implementing such a processing, it can be observed that there is typically only a small number of handover target candidates selected by the serving communication network control element or function which are deemed to be suitable for handover, while other cells, even though being in range for the UE 10 and hence part of the handover related measurement processing, are not deemed to be suitable. That is, only a limited number of cells are usually prepared for the UE autonomous handover.

Consequently, according to examples of embodiments of the invention, it is considered to use an increased accuracy for handover related measurements of handover target candidate cells. That is, instead of using the same measurement accuracy for candidate and non-candidate cells, the accuracy of the measurements of those cells of which one will be the final handover target is increased. Thus, according to examples of

embodiments, the (comparable) small number of handover target candidates is measured with an increased accuracy; even though there is an increased measurement and hence processing effort for these (few) neighboring cells, the costs are justified in view of the fact that much more accurate measurements can be produced. That is, instead of increasing the accuracy generally for all available cells in the preconfiguration phase, the accuracy is increased only for those cells to which the actual handover target(s) belongs.

It is to be noted that present measurement paradigms allow the network to influence the measurement accuracy, for example, by modifying a filter coefficient, e.g. coefficient k in a Layer 3 filtering formula according to LTE specifications.

Such a filtering formula has e.g. the form of

$F_n=(1-a)*F_{n-1}+a*M_n$,

where $\boldsymbol{M_n}$ is the latest received measurement result from the physical layer; $\boldsymbol{F_n}$ is the updated filtered measurement result, that is used for evaluation of reporting criteria or for measurement reporting; $\boldsymbol{F_{n-1}}$ is the old filtered measurement result, where $\boldsymbol{F_0}$ is set to $\boldsymbol{M_1}$ when the first measurement result from the physical layer is received; and $\boldsymbol{a} = 1/2^{(\boldsymbol{k}/4)}$, where $\boldsymbol{k}$ is the *filterCoefficient* for the corresponding measurement quantity received by the *quantityConfig*.

That is, for example, a larger k will make the measurements more effectively average out fast fading and hence improve measurement accuracy. However, at the same time, more delay for the measurements is caused, which is generally not desired. Similarly, modifying the time to trigger and/or measurement offsets lead only to a trade between accuracy against measurement delay.

On the other hand, the accuracy of the layer 1 measurements is left for UE implementation. However, a certain minimum accuracy is guaranteed by the means of performance requirements. In principle, the UE can select any L1 sampling rate, filter realization, or L3 output rate as long as the minimum requirements are satisfied. Hence, it is possible to improve the measurement accuracy by a vendor specific manner e.g. by sampling the channel with a rate higher than the nominal sampling rate (e.g. 1/50 ms),

and averaging those samples over the measurement period (e.g. 200 ms). Likewise, the reaction time can be improved by applying less averaging in L1, ultimately applying no averaging i.e. sending all samples directly to L3 (i.e. “single shot” measurements).

As indicated above, one aspect of examples of embodiments of the invention is that the UE produces more accurate measurements for cells which are prepared for a UE autonomous handover, i.e. for handover target candidates. For this purpose, another type of handover related measurement processing (also referred to as second handover related measurement processing) is conducted by the UE for signaling being received from the handover target candidates. The difference between the first and second handover related measurement processing is that the latter provides more accurate measurement results compared to the first one.

For example, according to examples of embodiments, such an increased accuracy is achieved by measuring the prepared cells (i.e. the handover target candidates) more often than unprepared cells. For instance, a typical setting is that every 40th TTI a neighboring cell is measured, which may be also a default setting in the first handover related measurement processing. Now, in the second handover related measurement processing, the UE changes this setting to a much smaller cycle for prepared cells, e.g. every 5th TTI.

Alternatively or additionally, the increased accuracy for the second handover related measurement processing is achieved by using a larger measurement bandwidth, or more resource elements in frequency domain, compared to the first handover related measurement processing for non-prepared cells (i.e. the cells being not handover target candidates).

For example, due to complexity reasons, UE 10 uses for the usual measurement (i.e. the first handover related measurement) only a small fraction of reference signals being sent from a cell, e.g. every 50th timeslot, every 5th frequency sample, or only the middle 1.4MHz of a total of 20MHz bandwidth. In order to increase the accuracy, in the second handover related measurement, the UE uses a larger bandwidth, or more time/frequency samples of the same reference signal.

Furthermore, according to some examples of embodiments, in the second handover related measurement processing, SINR measurements are used. That is, measurement quantities for the second handover related measurement processing are parameters related to SINR. Usually, the measurement quantity of the first handover related measurement are parameters related to RSRP or RSRQ. On the other hand, measurement quantities for the second handover related measurement may be different, e.g. SINR related parameters, whose processing is more complex than for e.g. RSRQ (signal quality), but which provide more accurate insight into the channel.

According to further examples of embodiments, the network (i.e. the serving gNB 20, for example) configures the UE to measure prepared cells (handover target candidates) on a beam level in addition to SS block level. In this context, CSI-RS configurations of the neighboring cells are signaled to the UE as part of the cell preparation signaling. On the other hand, non-prepared cells are measured by the UE based on SS block (in the first handover related measurement processing). By means of this, i.e. when measuring handover target candidates on beam level, a quick RACH access on beam specific resources can be achieved, while at the same time more accurate measurement results are achieved. It is to be noted that according to examples of embodiments the CSI-RS configuration may be cell specific.

For example, the UE receives UE specific CSI-RS configuration for the prepared candidate cells (such as periodicity/time-frequency locations, number of ports /explicit port IDs). It is to be noted that the CSI-RS configuration may also be UE group specific. According to some examples, the prepared cell (handover target candidate) provides the UE with a dedicated CSI-RS for measurement while the UE is considered as a candidate for the handover. The CSI-RS configuration may use SS block IDs provided by the UE in a measurement report (e.g. in S40 of Fig. 2).

The UE receives a dedicated measurement configuration, for example, as a result of a data exchange between source cell and target cell, i.e. a request message from the source cell to the prepared target candidate cell, a response message from the candidate cell to the source cell, and finally a configuration message from the source cell to the UE containing the CSI-RS configuration.

It is to be noted that according to some examples of embodiments protocol details regarding the increased accuracies do not have to be specified in detail or not at all. For example, it is possible to define an indicator to cells, which are measured with increased accuracy. Another approach is that a second set of (tighter) requirements for measurements of prepared cells is defined which allow a more accurate measurement compared to measurements of unprepared cells.

By means of the increased accuracy of the measurement of the handover target candidates, the final UE autonomous switch to the target cell is based on a more solid decision, with very little risk of missed detection or false alarm. Furthermore, the measurement delay can be reduced, allowing a faster reaction to dynamic changes in the propagation conditions. On the other hand, an increased load or cost due to an added complexity caused by the increased accuracy is limited since the number of prepared cells is low (e.g. less than 5).

That is, according to examples of embodiments of the invention, two accuracy levels for handover related measurements conducted by the UE in preparation of the autonomous HO (or cHO) are configured, wherein the handover related measurement allowing higher accuracy is used for the prepared cells for the UE cHO, while the other handover related measurement is used for all other cells being measured. In this connection, the same signaling components, such as the same reference signals, received from the respective target cell can be used for both handover related measurements, but with different measurement accuracies. Alternatively or additionally, signaling components which are not used in the first handover related measurement are used by the second handover related measurement. The second handover related measurement is initiated in response to an indication by the network, e.g. when configuring the UE for the cHO, by indicating the handover target candidates.

In other words, according to examples of embodiments of the invention, measurement settings, such as filtering settings, to be used for the second handover related measurement are modified. Hence, the UE is able to produce more accurate measurement results for cells which are prepared for a UE cHO.

In addition, a target cell (i.e. a handover target candidate) is configured to send, in response to an indication from the serving gNB, for example, that it is a potential target

for a HO of a UE, a dedicated signal component, such as a dedicated CSI-RS, for the UE in question. That is, the target candidate initiate the sending of the signal component (the CSI-RS) when it generates a handover command (i.e. an indication) for the UE, and transmits CSI-RS configuration details into the handover command (to be transmitted via the serving gNB to the UE). In other words, the handover target candidate (e.g. gNB 21, 22, 23) uses the preparation message in S40, for example, for the conditional handover as a trigger to send a dedicated CSI-RS, wherein configuration details of the dedicated CSI-RS are forwarded into the HO command in S60, for example, so as to provide the UE with *a priori* knowledge to measure this dedicated signal component (the CSI-RS).

Fehler! Verweisquelle konnte nicht gefunden werden. shows a diagram which illustrates a measurement configuration according to some examples of embodiments.

As shown in Fig. 3, the measurement configuration consists of a measurement object and a reporting configuration, linked together with measurement ID. The respective measurements objects are identified by object IDs, and the report configurations are identified by report IDs. The link between them is provided by measurement ID.

According to examples of embodiments, the measurement object is a respective single carrier frequency of a signaling from the communication network control elements or functions to be measured in connection with the handover related measurement procedure. In the example of Fig. 3, a carrier frequency 1 and a carrier frequency 2 are shown, but it is evident that more carrier frequencies can be used as measurement object.

The measurement object comprises a list of cell IDs or object IDs (1 and 2 in the example of Fig. 3), which the UE has to measure. According to **Fehler! Verweisquelle konnte nicht gefunden werden.**, it is now assumed that the carrier frequency 2 has been configured with reporting configuration for network based mobility (measurement ID 2) and UE autonomous handover (measurement ID 3).

Now, when the UE identifies a cell belonging to the list of prepared cells for autonomous handover, the UE increases the measurement accuracy towards these cells (and the source cell) by using the second handover related measurement processing, wherein it applies the configuration of the UE autonomous handover procedure. When the

associated trigger event (even Ax, e.g. one of events A2 to A5 described above) is fulfilled, the UE triggers the UE autonomous handover procedure towards the prepared target cell.

The configuration of the conventional measurement events (measuring all neighbors with the typical measurement accuracy) and the configuration of the measurement events for UE autonomous handovers (measuring only prepared cells with higher accuracy) may be different measurement IDs within the same measurement object.

Fig. 4 shows a flow chart of a processing conducted in a communication element or function according to some examples of embodiments. Specifically, the example according to Fig. 4 is related to a procedure conducted by a communication element or function, such as the UE 10 as shown in connection with Fig. 1.

In S100, the communication element or function, like the UE 10, starts to execute an autonomous handover procedure or cHO procedure in the communication network, for example as described in connection with S20 and S30 of Fig. 2, on the basis of measurement configuration information being received from the network or being preset.

In S110, the UE 10 conduct, in the cHO procedure, a first handover related measurement processing in which signaling received from at least one communication network control element or function being capable of providing access to the communication network is measured and processed. That is, signaling from the serving communication network control element or function to which the UE 10 is connected, like the gNB 20, and signaling from other communication network control elements or functions, like gNBs 21, 22, 23, is processed for evaluation signaling strength/quality or the like on the basis of measurement settings which corresponds, for example, to default settings for handover related measurements.

In S120, measurement results of the first handover related measurement processing are reported to the serving communication network control element or function to which the communication element or function is connected, i.e. the gNB 20, for example.

In S130, the UE 10 receives and processes, from the serving communication network control element or function, an indication of at least one handover target candidate. The

at least one handover target candidate is one (or more) of the at least one communication network control element or function for which measurement results are reported, i.e. which were measured during the first handover related measurement processing.

According to some examples of embodiments, the indication can be provided in the form of configuration information, handover command indications or the like which were part of conventional cHO procedures. Alternatively, the indication of the handover target candidates can be also provided by other means, e.g. by a separate information.

In S140, the UE 10 conducts a second (i.e. enhanced) handover related measurement processing in which signaling received from the at least one handover target candidate being indicated in S130 is measured and processed in a modified manner. It is to be noted that according to further examples of embodiments, also the signaling received from the serving communication network control element or function is measured in the second handover related measurement processing.

Specifically, according to some examples of embodiments, in the second handover related measurement processing, a measurement setting of the second handover related measurement processing is modified in comparison to that of the first handover related measurement processing. By means of this modification, a higher accuracy of measurement results in the second handover related measurement processing is achieved.

According to some examples of embodiments, the first handover related measurement processing is continued for signaling received from any other communication network control element or function being different to the at least one handover target candidate while conducting the second handover related measurement processing. Depending on whether or not the serving communication network control element or function is included in the second handover related measurement procedure, the first handover related measurement procedure is continued or not for serving communication network control element or function accordingly.

According to some examples of embodiments, the measurement setting of the second handover related measurement processing is modified on the basis of rules being preset in the communication element or function (i.e. predetermined, for example, by network

operator, vendor or the like) or being received from the serving communication network control element or function, for example in connection with S20 or S60 in Fig. 2.

According to some further examples of embodiments, the modification of the measurement setting of the second handover related measurement processing includes at least one of the following procedures. A filter setting used for measuring the signaling of the at least one handover target candidate (and possibly the serving communication network control element or function) is modified. For example, a bandwidth used for measuring and evaluating the signaling of the at least one handover target candidate is increased (i.e. a larger bandwidth is considered by the UE). Alternatively or additionally, a frequency domain density used for measuring and evaluating the signaling of the at least one handover target candidate is increased. Alternatively or additionally, a sample spacing in time domain used for measuring and evaluating the signaling of the at least one handover target candidate is decreased (i.e. a smaller number of TTIs is waited between sampling compared to a default setting).

Regarding measurement quantities used for the first handover related measurement processing and measurement quantities used for the second handover related measurement processing, according to some examples of embodiments, they may be the same (for example, RSRP/RSRQ related parameters in both cases). Alternatively, measurement quantities used for measuring and evaluating the signaling of the at least one handover target candidate may be added to the configuration of the handover related measurement processing, in comparison to that of the first handover related measurement processing. In other words, the increased accuracy is achieved by considering further measurement quantities in the second handover related measurement processing. On the other hand, it is also conceivable to replace measurement quantities used for measuring and evaluating the signaling of the at least one handover target candidate in the second handover related measurement processing, in comparison to the first handover related measurement processing. In other words, only a subset of measurement quantities (e.g. RSRQ) of the first handover related measurement processing is reused in the second handover related measurement processing, or all measurement quantities of the first handover related measurement processing are replace by new ones (e.g. CSI-RS, SINR related parameters, etc.) in the second handover related measurement processing.

According to some examples of embodiments, measurement quantities used for the second handover related measurement processing includes at least one parameter being related to a signal to interference ratio, which is more complex regarding a processing compared to e.g. RSRP, but allows a better insight in channel quality. Furthermore, according to some examples of embodiments, the second handover related measurement processing uses dedicated signal components received from the at least one handover target candidate, such as a dedicated CSI-RS. Corresponding configuration information is provided, for example, in S60 of Fig. 2.

In S150, the UE 10 determines, on the basis of the second handover related measurement processing, whether a predetermined trigger event is valid for at least one of the at least one handover candidate target. The trigger event indicates that a handover of a communication connection from the serving communication network control element or function to the determined handover target candidate is to be performed. That is the trigger event represent the condition to be fulfilled for a conditional or autonomous handover. In this case, the UE 10 performs the handover to the determined handover target candidate.

According to examples of embodiments, the trigger event is based on information being preset in the communication element or function (i.e. preset by network operator or vendor), or on information being received by handover configuration information from the serving communication network control element or function (e.g. in S20 or S60, for example in connection with the handover command). The handover configuration information (e.g. the information in S60 or S77 in Fig. 2) includes, for each handover target candidate, system information and identification information, and an allowance for performing a handover autonomously.

It is to be noted that according to examples of embodiments the at least one communication network control element or function (e.g. the gNB 21, 22, 23) and the serving communication network control element or function (e.g. the gNB 20) is part of at least one of a base station, an access point, a distributed unit and a relay station connected to the communication network and to which the communication element or function is connectable, wherein the communication element or function (i.e. the UE 10) is a part of a terminal device or user equipment communicating in the communication network.

Fig. 5 shows a flow chart of a processing conducted in a communication network control element or function in the communication network according to some examples of embodiments. Specifically, the example according to Fig. 5 is related to a procedure conducted by a target gNB, such as gNB 21as shown in connection with Fig. 1, which are configured to be a handover target for an autonomous or conditional handover procedure of a communication element or function in a communication network.

In S200, the communication network control element or function like the gNB 21 receives and processes an indication from a serving communication network control element or function (i.e. the gNB 20) to which the communication element or function is currently connected (for example, preparation signaling in S50 of Fig. 2). This indication informs the gNB 21 about the fact that a handover of the communication element or function from the serving communication network element or function is possible,

In S210, the communication element or function is identified, e.g. by using an SS block ID provided by the UE in the measurement report in S40 of Fig. 2).

In S220, triggered by the preparation indication, the communication network control element or function (e.g. gNB 21) initiates the transmission of a dedicated signal component for the identified communication element or function to be used for an enhanced handover related measurement processing by the communication element of function. The enhanced handover related measurement processing is the second handover related measurement processing described above, for example. Furthermore, according to some examples of embodiments, the dedicated signal component provided to the communication element or function is a dedicated CSI-RS.

In S230, information identifying the dedicated signal component are provided to the serving communication network control element or function to be forwarded to the identified communication element or function. The information is sent e.g. in connection with S50 signaling and forwarded to the UE in connection with S60 signaling, for example.

Fig. 6 shows a diagram of a network element or function acting as a communication element or function according to some examples of embodiments, e.g. as the UE 10,

which is configured to implement a procedure for a HO control processing as described in connection with some of the examples of embodiments. It is to be noted that the network element or function, like the UE 10 of Fig. 1, may include further elements or functions besides those described herein below. Furthermore, even though reference is made to a network element or function, the element or function may be also another device or function having a similar task, such as a chipset, a chip, a module, an application etc., which can also be part of a network element or attached as a separate element to a network element, or the like. It should be understood that each block and any combination thereof may be implemented by various means or their combinations, such as hardware, software, firmware, one or more processors and/or circuitry.

The network element 10 shown in Fig. 6 may include a processing circuitry, a processing function, a control unit or a processor 101, such as a CPU or the like, which is suitable for executing instructions given by programs or the like related to the control procedure. The processor 101 may include one or more processing portions or functions dedicated to specific processing as described below, or the processing may be run in a single processor or processing function. Portions for executing such specific processing may be also provided as discrete elements or within one or more further processors, processing functions or processing portions, such as in one physical processor like a CPU or in one or more physical or virtual entities, for example. Reference sign 102 denotes input/output (I/O) units or functions (interfaces) connected to the processor or processing function 101. The I/O units 102 may be used for communicating with communication network control elements like gNB 20, as described in connection with Fig. 1, for example. The I/O units 102 may be a combined unit including communication equipment towards several entities, or may include a distributed structure with a plurality of different interfaces for different entities. Reference sign 104 denotes a memory usable, for example, for storing data and programs to be executed by the processor or processing function 101 and/or as a working storage of the processor or processing function 101. It is to be noted that the memory 104 may be implemented by using one or more memory portions of the same or different type of memory.

The processor or processing function 101 is configured to execute processing related to the above described procedure for HO control. In particular, the processor or processing circuitry or function 101 includes one or more of the following sub-portions. Sub-portion 1011 is a processing portion which is usable as a portion for conducting a first HO related

measurement processing. The portion 1011 may be configured to perform processing according to S110 of Fig. 4. Furthermore, the processor or processing circuitry or function 101 may include a sub-portion 1012 usable as a portion for processing an indication of HO target candidates. The portion 1012 may be configured to perform a processing according to S120 and S130 of Fig. 4. In addition, the processor or processing circuitry or function 101 may include a sub-portion 1013 usable as a portion for conducting a second HO related measurement processing. The portion 1013 may be configured to perform a processing according to S140 of Fig. 4. Moreover, the processor or processing circuitry or function 101 may include a sub-portion 1014 usable as a portion for executing or completing a cHO procedure. The portion 1014 may be configured to perform a processing according to S150 of Fig. 4.

Fig. 7 shows a diagram of a network element or function acting as a communication network control element or function according to some examples of embodiments, e.g. as gNB 21, which is configured to implement a procedure for a HO control processing as described in connection with some of the examples of embodiments. It is to be noted that the network element or function, like the gNB 21 of Fig. 1, may include further elements or functions besides those described herein below. Furthermore, even though reference is made to a communication element, the element or function may be also another device or function having a similar task, such as a chipset, a chip, a module, an application etc., which can also be part of a communication network element or attached as a separate element to a communication network element, or the like. It should be understood that each block and any combination thereof may be implemented by various means or their combinations, such as hardware, software, firmware, one or more processors and/or circuitry.

The gNB 21 shown in Fig. 7 may include a processing circuitry, a processing function, a control unit or a processor 201, such as a CPU or the like, which is suitable for executing instructions given by programs or the like related to the control procedure. The processor 201 may include one or more processing portions or functions dedicated to specific processing as described below, or the processing may be run in a single processor or processing function. Portions for executing such specific processing may be also provided as discrete elements or within one or more further processors, processing functions or processing portions, such as in one physical processor like a CPU or in one or more physical or virtual entities, for example. Reference sign 202 denotes input/output

(I/O) units or functions (interfaces) connected to the processor or processing function 201. The I/O units 202 may be used for communicating with the communication network and/or other entities or functions, like the gNB 20, as described in connection with Fig. 1, for example. The I/O units 202 may be a combined unit including communication equipment towards several entities, or may include a distributed structure with a plurality of different interfaces for different entities. Reference sign 204 denotes a memory usable, for example, for storing data and programs to be executed by the processor or processing function 201 and/or as a working storage of the processor or processing function 201. It is to be noted that the memory 204 may be implemented by using one or more memory portions of the same or different type of memory.

The processor or processing function 201 is configured to execute processing related to the above described procedure for transmission control processing. In particular, the processor or processing circuitry or function 201 includes one or more of the following sub-portions. Sub-portion 2011 is a processing portion which is usable as a portion for processing an indication of a possible HO of a UE. The portion 2011 may be configured to perform processing according to S200 of Fig. 5. Moreover, the processor or processing circuitry or function 201 may include a sub-portion 2012 usable as a portion for identifying the UE. The portion 2012 may be configured to perform a processing according to S210 of Fig. 5. Furthermore, the processor or processing circuitry or function 201 may include a sub-portion 2013 usable as a portion for initiating transmission of a dedicated signal component. The portion 2013 may be configured to perform a processing according to S220 of Fig. 5. Moreover, the processor or processing circuitry or function 201 may include a sub-portion 2014 usable as a portion for providing information to the UE regarding the dedicated signal component. The portion 2014 may be configured to perform a processing according to S230 of Fig. 5.

It is to be noted that examples of embodiments of the invention are applicable to various different network configurations. In other words, the example shown in Fig. 1, which is used as a basis for the above discussed examples, is only illustrative and does not limit the present invention in any way. That is, additional further existing and proposed new functionalities available in a corresponding operating environment may be used in connection with examples of embodiments of the invention based on the principles defined.

Furthermore, it is to be noted that according to examples of embodiments, the second handover related measurement procedure, which is described above for the measurement of the handover target candidates, can be also applied to measurements of the serving cell, i.e. signaling from the serving gNB 20, for example. In other words, the serving cell may be seen, from the point of view of the second handover related measurement processing, as an additiona handover target candidate (i.e. handover switching to another cell is not conducted). By means of this, i.e. when applying the second (and more accurate) handover related measurement processing also to the signaling of the serving cell, the decision regarding the execution of the handover can be based on a yet more accurate decision.

By means of the measures described above with regard to a handover procedure for a UE and in particular with regard to the increased accuracy of handover related measurements conducted in the handover procedure, a more robust handover is achievable due to the higher measurement accuracy. That is, the handover conducted on the basis of examples of embodiments of the invention allows to decrease the number of late handovers, early handovers, and handovers to a wrong cell.

Furthermore, according to examples of embodiments of the invention, it is possible to reduce the number of ping-pong handovers and hence to reduce unnecessary HO signaling and handover failures.

Moreover, a faster reaction to dynamic channel changes is possible, improving the handover robustness e.g. in millimeter-wave bands

In addition, an optimized use of configuration like dual-RS (i.e. NR-SS and CSI-RS) can be made, allowing the UE to exploit e.g. the simpler NR-SS in most neighbor cell measurements

It is to be noted that the measures described in the present specification can be executed on top of common/general measures or communication procedures. Some of the measures described in the present specification can be applied separately, some in various combinations, or all measures can be combined in one procedure.

According to a further example of embodiments, there is provided, for example, an apparatus for use by a communication element or function, the apparatus comprising means configured to conduct a first handover related measurement processing in which signaling received from at least one communication network control element or function being capable of providing access to a communication network is measured and processed, means configured to report measurement results of the first handover related measurement processing to a serving communication network control element or function to which the communication element or function is connected, means configured to receive, from the serving communication network control element or function, and process an indication of at least one handover target candidate, wherein the at least one handover target candidate is one or more of the at least one communication network control element or function for which measurement results are reported, means configured to conduct a second handover related measurement processing in which signaling received from the at least one handover target candidate is measured and processed, wherein a measurement setting of the second handover related measurement processing is modified in comparison to that of the first handover related measurement processing for achieving a higher accuracy of measurement results in the second handover related measurement processing.

Furthermore, according to some other examples of embodiments, the above defined apparatus may further comprise means for conducting at least one of the processing defined in the above described methods, for example a method according that described in connection with Fig 4.

According to a further example of embodiments, there is provided, for example, an apparatus for use by a communication network control element or function configured to be a handover target for an autonomous handover procedure of a communication element or function in a communication network, the apparatus comprising means configured to receive and process an indication from a serving communication network control element or function to which the communication element or function is currently connected, the indication informs about the fact that a handover of the communication element or function from the serving communication network element or function is possible, means configured to identify the communication element or function, means configured to initiate transmission of a dedicated signal component for the identified communication element or function to be used for an enhanced (i.e. the second)

handover related measurement processing by the communication element of function, and means configured to provide information identifying the dedicated signal component to the serving communication network control element or function to be forwarded to the identified communication element or function.

Furthermore, according to some other examples of embodiments, the above defined apparatus may further comprise means for conducting at least one of the processing defined in the above described methods, for example a method according that described in connection with Fig 5.

It should be appreciated that

- an access technology via which traffic is transferred to and from an entity in the communication network may be any suitable present or future technology, such as WLAN (Wireless Local Access Network), WiMAX (Worldwide Interoperability for Microwave Access), LTE, LTE-A, 5G, Bluetooth, Infrared, and the like may be used; additionally, embodiments may also apply wired technologies, e.g. IP based access technologies like cable networks or fixed lines.
- embodiments suitable to be implemented as software code or portions of it and being run using a processor or processing function are software code independent and can be specified using any known or future developed programming language, such as a high-level programming language, such as objective-C, C, C++, C#, Java, Python, Javascript, other scripting languages etc., or a low-level programming language, such as a machine language, or an assembler.
- implementation of embodiments is hardware independent and may be implemented using any known or future developed hardware technology or any hybrids of these, such as a microprocessor or CPU (Central Processing Unit), MOS (Metal Oxide Semiconductor), CMOS (Complementary MOS), BiMOS (Bipolar MOS), BiCMOS (Bipolar CMOS), ECL (Emitter Coupled Logic), and/or TTL (Transistor-Transistor Logic).
- embodiments may be implemented as individual devices, apparatuses, units, means or functions, or in a distributed fashion, for example, one or more processors or processing functions may be used or shared in the processing, or one or more processing sections or processing portions may be used and shared in the processing, wherein one physical processor or more than one physical processor may be used for implementing one or more processing portions dedicated to specific processing as described,

- an apparatus may be implemented by a semiconductor chip, a chipset, or a (hardware) module including such chip or chipset;
- embodiments may also be implemented as any combination of hardware and software, such as ASIC (Application Specific IC (Integrated Circuit)) components, FPGA (Field-programmable Gate Arrays) or CPLD (Complex Programmable Logic Device) components or DSP (Digital Signal Processor) components.
- embodiments may also be implemented as computer program products, including a computer usable medium having a computer readable program code embodied therein, the computer readable program code adapted to execute a process as described in embodiments, wherein the computer usable medium may be a non-transitory medium.

Although the present invention has been described herein before with reference to particular embodiments thereof, the present invention is not limited thereto and various modifications can be made thereto.

CLAIMS

1. An apparatus for use by a communication element or function, the apparatus comprising

at least one processing circuitry, and

at least one memory for storing instructions to be executed by the processing circuitry,

wherein the at least one memory and the instructions are configured to, with the at least one processing circuitry, cause the apparatus at least:

to conduct a first handover related measurement processing in which signaling received from at least one communication network control element or function being capable of providing access to a communication network is measured and processed,

to report measurement results of the first handover related measurement processing to a serving communication network control element or function to which the communication element or function is connected,

to receive, from the serving communication network control element or function, and process an indication of at least one handover target candidate, wherein the at least one handover target candidate is one or more of the at least one communication network control element or function for which measurement results are reported,

to conduct a second handover related measurement processing in which signaling received from the at least one handover target candidate is measured and processed, wherein a measurement setting of the second handover related measurement processing is modified in comparison to that of the first handover related measurement processing for achieving a higher accuracy of measurement results in the second handover related measurement processing.

2. The apparatus according to claim 1, wherein the at least one memory and the instructions are further configured to, with the at least one processing circuitry, cause the apparatus at least

to continue to conduct the first handover related measurement processing for signaling received from another communication network control element or function being different to the at least one handover target candidate while conducting the second handover related measurement processing.

3. The apparatus according to claim 1 or 2, wherein the at least one memory and the instructions are further configured to, with the at least one processing circuitry, cause the apparatus at least

to determine, on the basis of the second handover related measurement processing, whether a predetermined trigger event is valid for at least one of the at least one handover

candidate target, wherein the trigger event indicates that a handover of a communication connection from the serving communication network control element or function to the determined handover target candidate is to be performed, and

to perform the handover to the determined handover target candidate.

4. The apparatus according to claim 3, wherein the trigger event is based on information being preset in the communication element or function, or on information being received by handover configuration information from the serving communication network control element or function, wherein the handover configuration information includes, for each handover target candidate, system information and identification information, and an allowance for performing a handover autonomously.

5. The apparatus according to any of claims 1 to 4, wherein the indication of the at least one handover target candidate is received with handover configuration information from the serving communication network control element or function, wherein the handover configuration information includes, for each handover target candidate, system information and identification information for accessing the handover target candidate, and an allowance for performing a handover on the basis of a pre-configured trigger event.

6. The apparatus according to any of claims 1 to 5, wherein the at least one memory and the instructions are further configured to, with the at least one processing circuitry, cause the apparatus at least

to modify the measurement setting of the second handover related measurement processing on the basis of rules being preset in the communication element or function or being received from the serving communication network control element or function.

7. The apparatus according to claim 6, wherein the modification of the measurement setting of the second handover related measurement processing includes at least one of

modifying a filter setting used for measuring the signaling of the at least one handover target candidate,

increasing a bandwidth used for measuring and evaluating the signaling of the at least one handover target candidate,

increasing a frequency domain density used for measuring and evaluating the signaling of the at least one handover target candidate,

decreasing a sample spacing in time domain used for measuring and evaluating the signaling of the at least one handover target candidate,

adding measurement quantities used for measuring and evaluating the signaling of the at least one handover target candidate, in comparison to the first handover related measurement processing, and

replacing measurement quantities used for measuring and evaluating the signaling of the at least one handover target candidate, in comparison to the first handover related measurement processing.

8. The apparatus according to any of claims 1 to 7, wherein measurement quantities used for the first handover related measurement processing and measurement quantities used for the second handover related measurement processing are the same.

9. The apparatus according to any of claims 1 to 8, wherein measurement quantities used for the second handover related measurement processing includes at least one parameter being related to a signal to interference ratio.

10. The apparatus according to any of claims 1 to 9, wherein the second handover related measurement processing uses dedicated signal components received from the at least one handover target candidate.

11. The apparatus according to any of claims 1 to 10, wherein

the at least one communication network control element or function and the serving communication network control element or function is part of at least one of a base station, an access point, a distributed unit and a relay station connected to the communication network and to which the communication element or function is connectable, wherein the communication element or function is a part of a terminal device or user equipment communicating in the communication network.

12. A method for use by a communication element or function, the method comprising

conducting a first handover related measurement processing in which signaling received from at least one communication network control element or function being capable of providing access to a communication network is measured and processed,

reporting measurement results of the first handover related measurement processing to a serving communication network control element or function to which the communication element or function is connected,

receiving, from the serving communication network control element or function, and processing an indication of at least one handover target candidate, wherein the at least one

handover target candidate is one or more of the at least one communication network control element or function for which measurement results are reported,

conducting a second handover related measurement processing in which signaling received from the at least one handover target candidate is measured and processed, wherein a measurement setting of the second handover related measurement processing is modified in comparison to that of the first handover related measurement processing for achieving a higher accuracy of measurement results in the second handover related measurement processing.

13. The method according to claim 12, further comprising

continuing to conduct the first handover related measurement processing for signaling received from another communication network control element or function being different to the at least one handover target candidate while conducting the second handover related measurement processing.

14. The method according to claim 12 or 13, further comprising

determining, on the basis of the second handover related measurement processing, whether a predetermined trigger event is valid for at least one of the at least one handover candidate target, wherein the trigger event indicates that a handover of a communication connection from the serving communication network control element or function to the determined handover target candidate is to be performed, and

performing the handover to the determined handover target candidate.

15. The method according to claim 14, wherein the trigger event is based on information being preset in the communication element or function, or on information being received by handover configuration information from the serving communication network control element or function, wherein the handover configuration information includes, for each handover target candidate, system information and identification information, and an allowance for performing a handover autonomously.

16. The method according to any of claims 12 to 15, wherein the indication of the at least one handover target candidate is received with handover configuration information from the serving communication network control element or function, wherein the handover configuration information includes, for each handover target candidate, system information and identification information for accessing the handover target candidate, and an allowance for performing a handover on the basis of a pre-configured trigger event.

17. The method according to any of claims 12 to 16, further comprising

modifying the measurement setting of the second handover related measurement processing on the basis of rules being preset in the communication element or function or being received from the serving communication network control element or function.

18. The method according to claim 17, wherein the modification of the measurement setting of the second handover related measurement processing includes at least one of

modifying a filter setting used for measuring the signaling of the at least one handover target candidate,

increasing a bandwidth used for measuring and evaluating the signaling of the at least one handover target candidate,

increasing a frequency domain density used for measuring and evaluating the signaling of the at least one handover target candidate,

decreasing a sample spacing in time domain used for measuring and evaluating the signaling of the at least one handover target candidate,

adding measurement quantities used for measuring and evaluating the signaling of the at least one handover target candidate, in comparison to the first handover related measurement processing, and

replacing measurement quantities used for measuring and evaluating the signaling of the at least one handover target candidate, in comparison to the first handover related measurement processing.

19. The method according to any of claims 12 to 18, wherein measurement quantities used for the first handover related measurement processing and measurement quantities used for the second handover related measurement processing are the same.

20. The method according to any of claims 12 to 19, wherein measurement quantities used for the second handover related measurement processing includes at least one parameter being related to a signal to interference ratio.

21. The method according to any of claims 12 to 20, wherein the second handover related measurement processing uses dedicated signal components received from the at least one handover target candidate.

22. The method according to any of claims 12 to 21, wherein

the at least one communication network control element or function and the serving communication network control element or function is part of at least one of a base station, an

access point, a distributed unit and a relay station connected to the communication network and to which the communication element or function is connectable, wherein the communication element or function is a part of a terminal device or user equipment communicating in the communication network.

23. An apparatus for use by a communication network control element or function configured to be a handover target for a handover procedure of a communication element or function in a communication network, the apparatus comprising

at least one processing circuitry, and

at least one memory for storing instructions to be executed by the processing circuitry,

wherein the at least one memory and the instructions are configured to, with the at least one processing circuitry, cause the apparatus at least:

to receive and process an indication from a serving communication network control element or function to which the communication element or function is currently connected, the indication informs about the fact that a handover of the communication element or function from the serving communication network element or function is possible,

to identify the communication element or function,

to initiate transmission of a dedicated signal component for the identified communication element or function to be used for an enhanced handover related measurement processing by the communication element of function, and

to provide information identifying the dedicated signal component to the serving communication network control element or function to be forwarded to the identified communication element or function.

24. The apparatus according to claim 23, wherein the dedicated signal component provided to the communication element or function is a channel state information reference signal configuration.

25. A method for use by a communication network control element or function configured to be a handover target for a handover procedure of a communication element or function in a communication network, the method comprising

receiving and processing an indication from a serving communication network control element or function to which the communication element or function is currently connected, the indication informs about the fact that a handover of the communication element or function from the serving communication network element or function is possible,

identifying the communication element or function,

initiating transmission of a dedicated signal component for the identified communication element or function to be used for an enhanced handover related measurement processing by the communication element of function, and

providing information identifying the dedicated signal component to the serving communication network control element or function to be forwarded to the identified communication element or function.

26. The method according to claim 25, wherein the dedicated signal component provided to the communication element or function is a channel state information reference signal configuration.

27. A computer program product for a computer, including software code portions for performing the steps of any of claims 12 to 22 or of claim 25 or 26 when said product is run on the computer.

28. The computer program product according to claim 27, wherein

the computer program product includes a computer-readable medium on which said software code portions are stored, and/or

the computer program product is directly loadable into the internal memory of the computer and/or transmittable via a network by means of at least one of upload, download and push procedures.

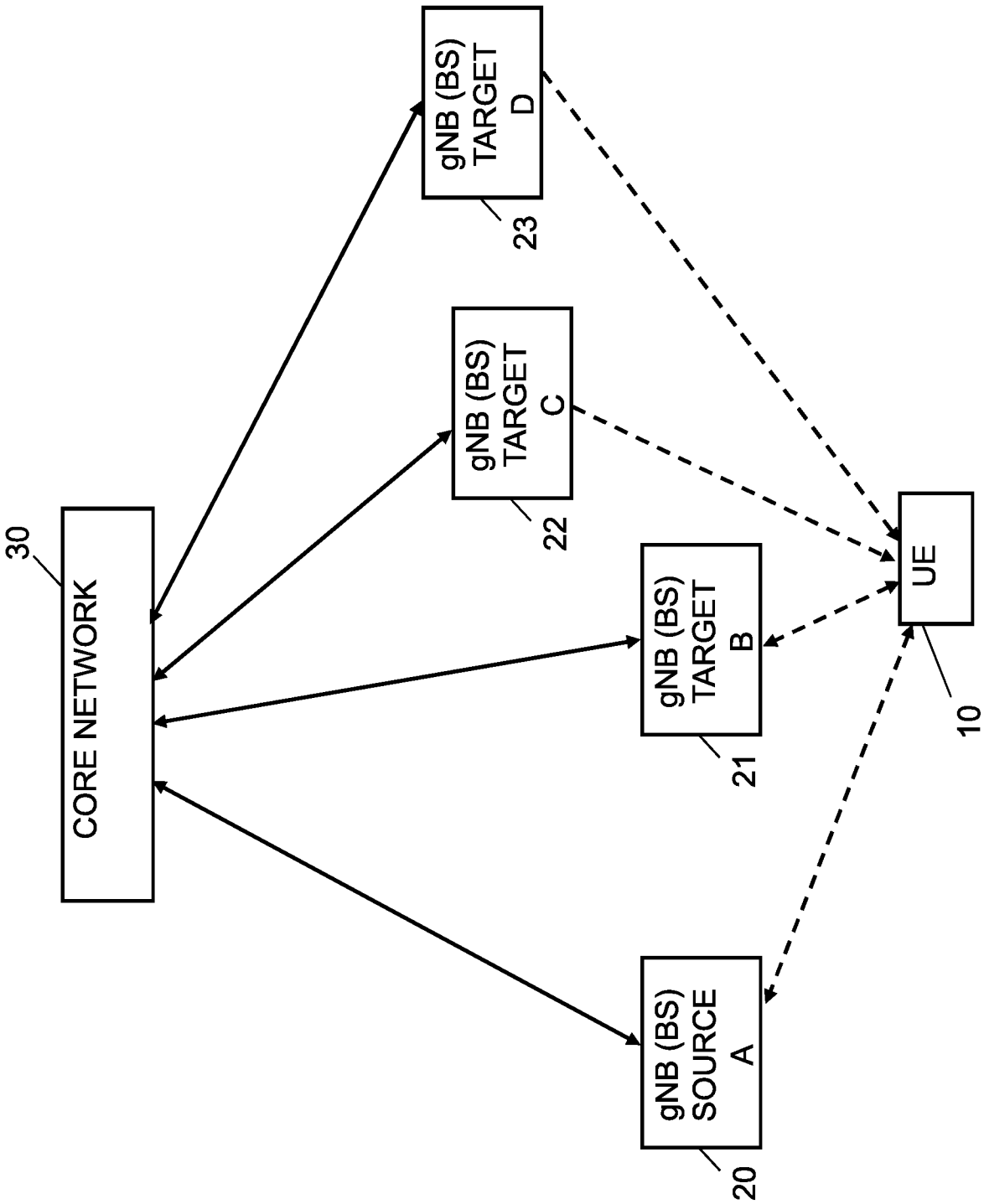
gNB (BS) TARGET D
23
gNB (BS) TARGET C
22
30
CORE NETWORK
gNB (BS) TARGET B
21
UE
10
gNB (BS) SOURCE A
20

Fig. 1

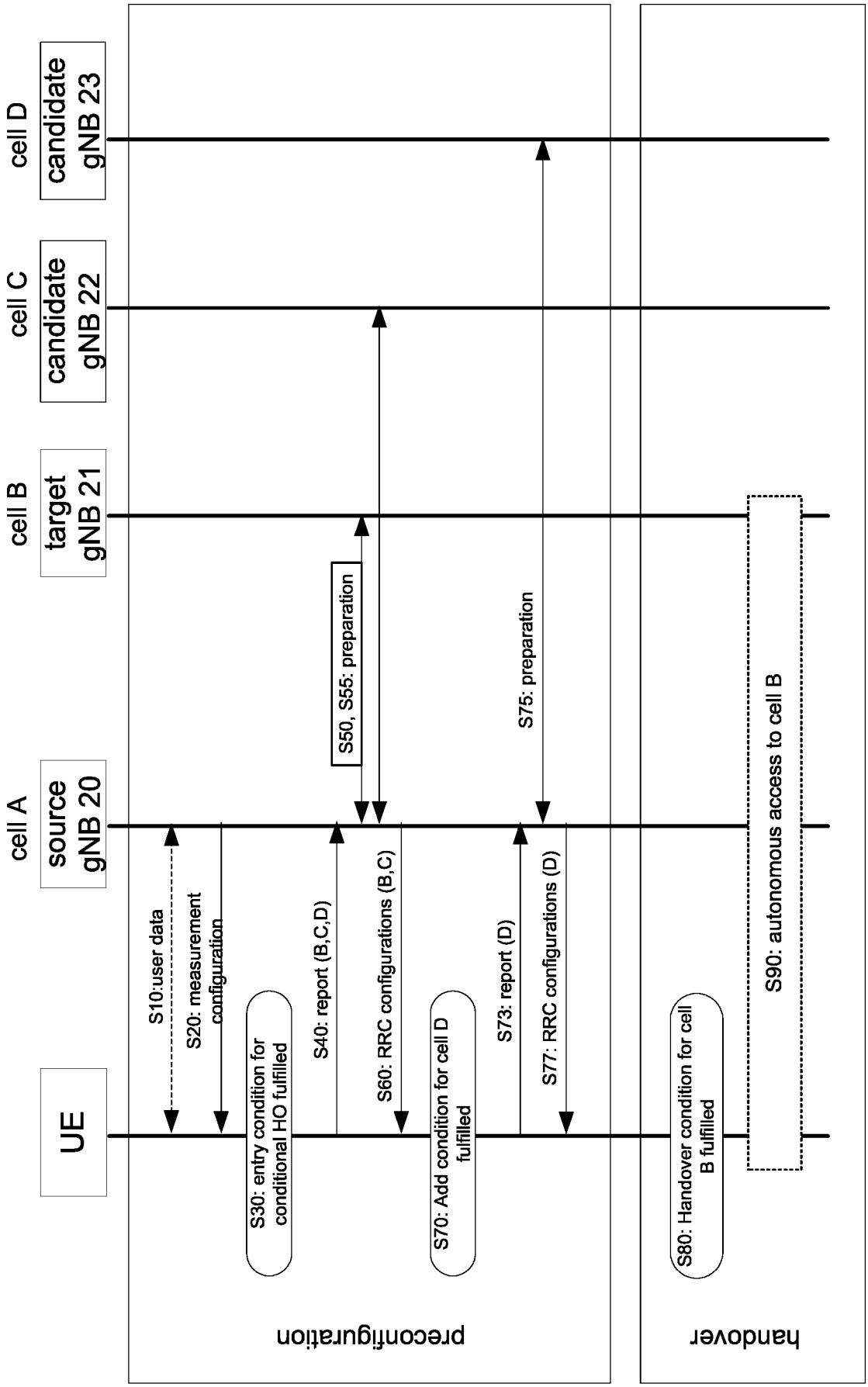
UE
cell A source gNB 20
cell B target gNB 21
cell C candidate gNB 22
cell D candidate gNB 23
S10:user data
S20: measurement configuration
S30: entry condition for conditional HO fulfilled
S40: report (B,C,D)
S50, S55: preparation
S60: RRC configurations (B,C)
S70: Add condition for cell D fulfilled
S73: report (D)
S75: preparation
S77: RRC configurations (D)
S80: Handover condition for cell B fulfilled
S90: autonomous access to cell B
preconfiguration
handover

FIG. 2

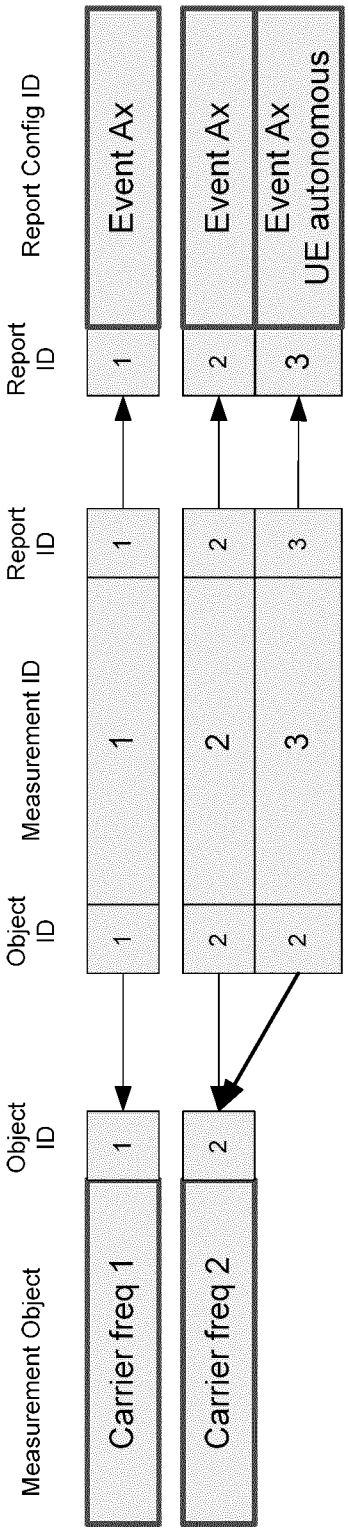
Measurement Object
Object ID
Carrier freq 1
Carrier freq 2
Object ID
1
2
Measurement ID
1
2
3
Report ID
1
2
3
Report ID
1
2
3
Report Config ID
Event Ax
Event Ax
Event Ax
UE autonomous

Fig. 3

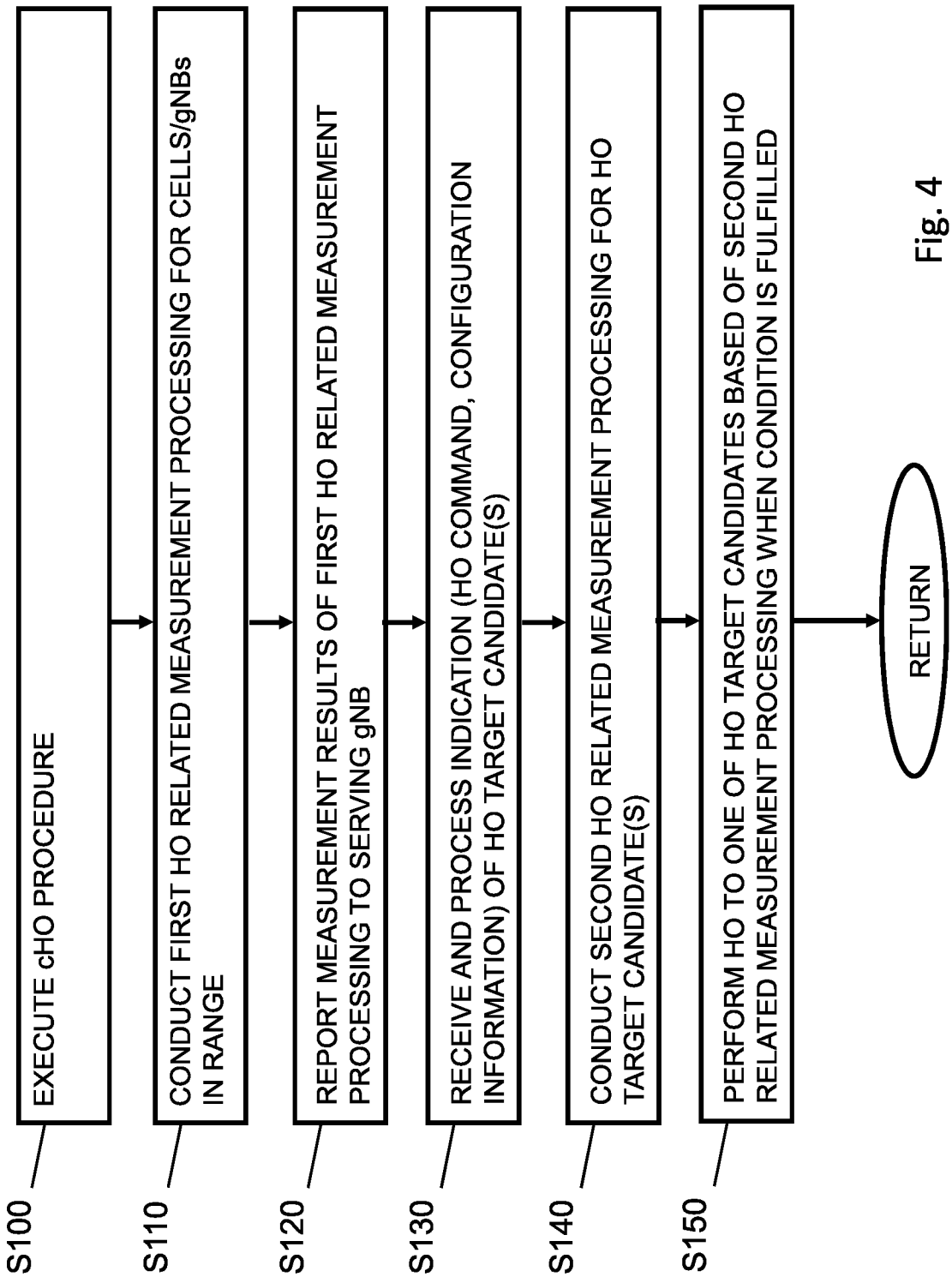
S100
EXECUTE cHO PROCEDURE
S110
CONDUCT FIRST HO RELATED MEASUREMENT PROCESSING FOR CELLS/gNBs IN RANGE
S120
REPORT MEASUREMENT RESULTS OF FIRST HO RELATED MEASUREMENT PROCESSING TO SERVING gNB
S130
RECEIVE AND PROCESS INDICATION (HO COMMAND, CONFIGURATION INFORMATION) OF HO TARGET CANDIDATE(S)
S140
CONDUCT SECOND HO RELATED MEASUREMENT PROCESSING FOR HO TARGET CANDIDATE(S)
S150
PERFORM HO TO ONE OF HO TARGET CANDIDATES BASED OF SECOND HO RELATED MEASUREMENT PROCESSING WHEN CONDITION IS FULFILLED
RETURN

Fig. 4

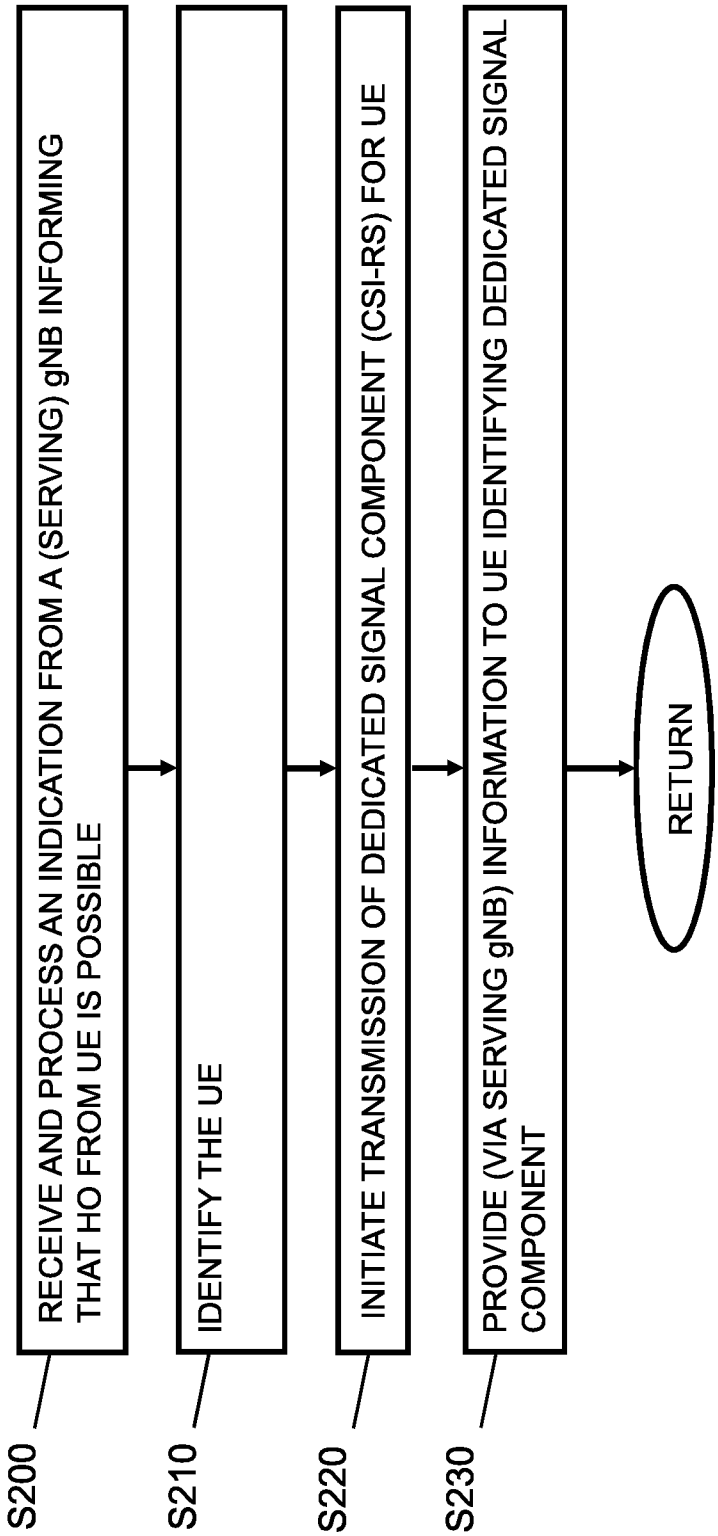
S200
RECEIVE AND PROCESS AN INDICATION FROM A (SERVING) gNB INFORMING THAT HO FROM UE IS POSSIBLE
S210
IDENTIFY THE UE
S220
INITIATE TRANSMISSION OF DEDICATED SIGNAL COMPONENT (CSI-RS) FOR UE
S230
PROVIDE (VIA SERVING gNB) INFORMATION TO UE IDENTIFYING DEDICATED SIGNAL COMPONENT
RETURN

Fig. 5

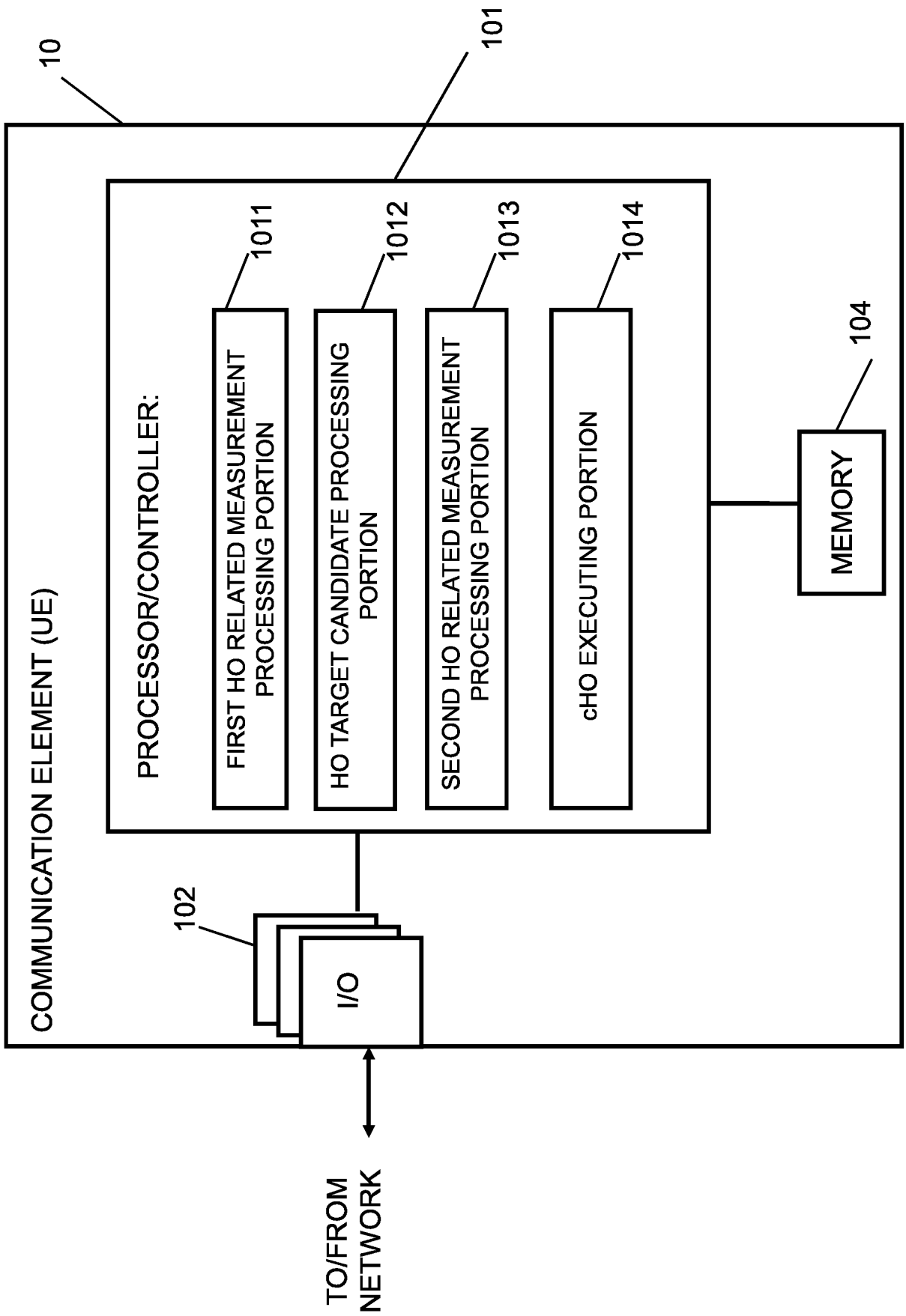
10
101
COMMUNICATION ELEMENT (UE)
PROCESSOR/CONTROLLER:
1011
FIRST HO RELATED MEASUREMENT PROCESSING PORTION
1012
HO TARGET CANDIDATE PROCESSING PORTION
1013
SECOND HO RELATED MEASUREMENT PROCESSING PORTION
1014
cHO EXECUTING PORTION
104
MEMORY
102
I/O
TO/FROM NETWORK

Fig. 6

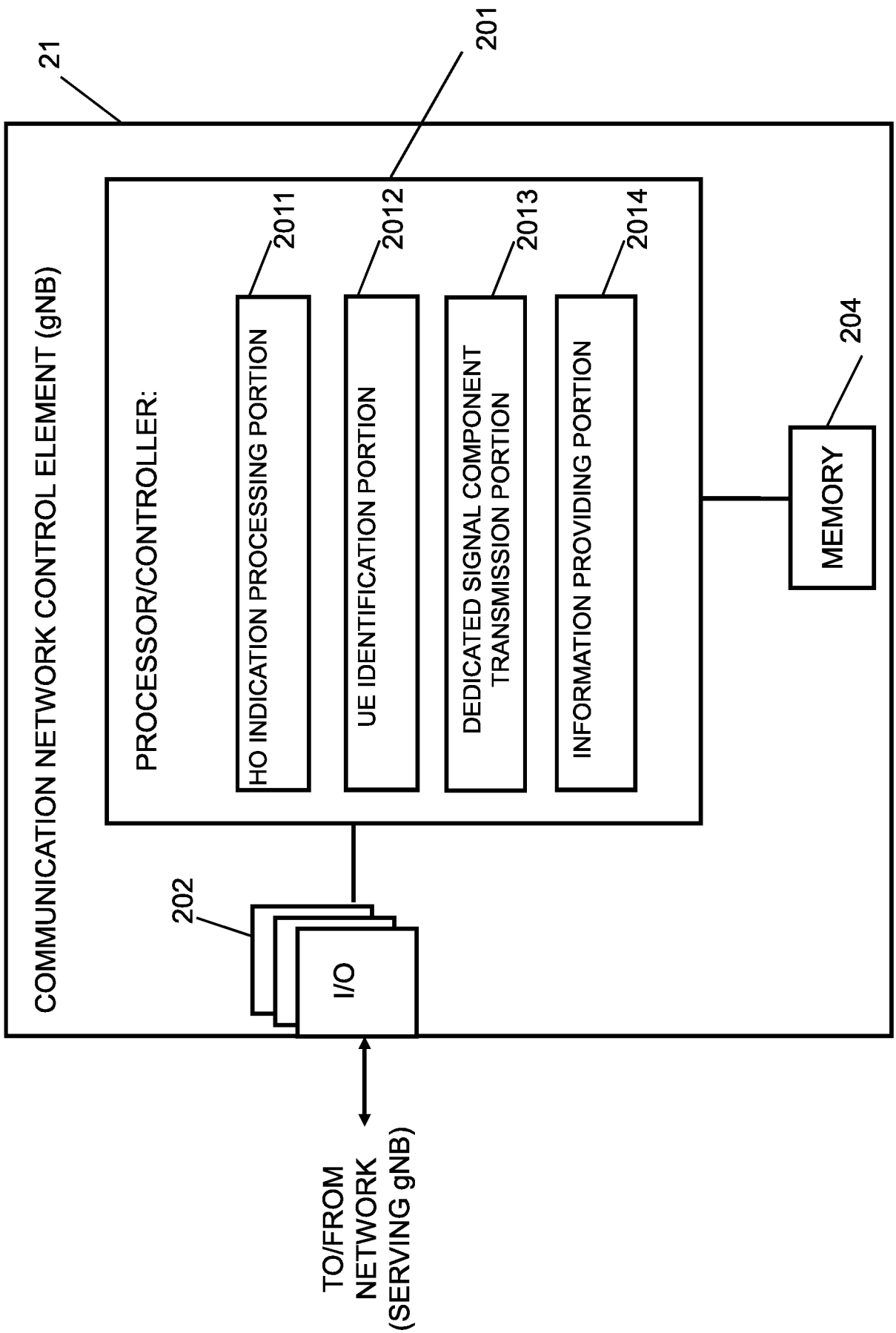
21
201
COMMUNICATION NETWORK CONTROL ELEMENT (gNB)
PROCESSOR/CONTROLLER:
2011
2012
2013
2014
HO INDICATION PROCESSING PORTION
UE IDENTIFICATION PORTION
DEDICATED SIGNAL COMPONENT TRANSMISSION PORTION
INFORMATION PROVIDING PORTION
204
MEMORY
202
I/O
TO/FROM NETWORK (SERVING gNB)

Fig. 7

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2017/064795

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04W36/00
ADD.

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H04W

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	SAMSUNG: "Performance Evaluation of Conditional Handover", 3GPP DRAFT; R2-1704694 PERFORMANCE OF UE AUTONOMOUS HANDOVER, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE , vol. RAN WG2, no. Hangzhou, China; 20170515 - 20170519 14 May 2017 (2017-05-14), XP051275238, Retrieved from the Internet: URL:http://www.3gpp.org/ftp/Meetings_3GPP_SYNC/RAN2/Docs/ [retrieved on 2017-05-14]	1,12,27
Y	paragraph 2 figure 1	2-11, 13-22,28

-/--

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

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
22 September 2017	22/12/2017

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

1

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

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	HUAWEI ET AL: "Analysis on conditional handover", 3GPP DRAFT; R2-1703384 ANALYSIS ON CONDITIONAL HANDOVER, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE , vol. RAN WG2, no. Spokane, USA; 20170403 - 20170407 3 April 2017 (2017-04-03), XP051245246, Retrieved from the Internet: URL:http://www.3gpp.org/ftp/Meetings_3GPP_SYNC/RAN2/Docs/ [retrieved on 2017-04-03] paragraphs 2.1 and 2.2 figures 1 and 2	2-11, 13-22,28
A	EP 2 557 850 A1 (ALCATEL LUCENT [FR]) 13 February 2013 (2013-02-13) paragraph [0079]	1-22,27, 28
A	SAMSUNG: "Introduction of UE autonomous handover", 3GPP DRAFT; R2-1704693 INTRODUCTION OF UE AUTONOMOUS MOBILITY, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE , vol. RAN WG2, no. Hangzhou, China; 20170515 - 20170519 14 May 2017 (2017-05-14), XP051275237, Retrieved from the Internet: URL:http://www.3gpp.org/ftp/Meetings_3GPP_SYNC/RAN2/Docs/ [retrieved on 2017-05-14] paragraph 2 figure 1	1-22,27, 28

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	SAMSUNG: "Conditional Handover: Event Design Aspects", 3GPP DRAFT; R2-1705591 - CONDITIONAL HO EVENT DESIGN ASPECTS, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE , vol. RAN WG2, no. Hangzhou, China; 20170515 - 20170519 14 May 2017 (2017-05-14), XP051275914, Retrieved from the Internet: URL:http://www.3gpp.org/ftp/Meetings_3GPP_SYNC/RAN2/Docs/ [retrieved on 2017-05-14] paragraph 2 figure 1 -----	1-22,28

INTERNATIONAL SEARCH REPORT

International application No.
PCT/EP2017/064795

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-22, 27, 28

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-22, 27, 28

Apparatus and method for use by a communication element or function, as well as corresponding computer program product, comprising conducting a first handover related measurement processing in which signaling received from at least one communication network control element or function being capable of providing access to a communication network is measured and processed, reporting measurement results of the first handover related measurement processing to a serving communication network control element or function to which the communication element or function is connected, receiving, from the serving communication network control element or function, and processing an indication of at least one handover target candidate, wherein the at least one handover target candidate is one or more of the at least one communication network control element or function for which measurement results are reported, and conducting a second handover related measurement processing in which signaling received from the at least one handover target candidate is measured and processed, wherein a measurement setting of the second handover related measurement processing is modified in comparison to that of the first handover related measurement processing for achieving a higher accuracy of measurement results in the second handover related measurement processing.
The technical effect achieved by this first invention is that the accuracy for handover related measurements of handover target candidate cells is increased.

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2. claims: 23-28

Apparatus and method for use by a communication network control element or function configured to be a handover target for a handover procedure of a communication element or function in a communication network, as well as corresponding computer program product, comprising receiving and processing an indication from a serving communication network control element or function to which the communication element or function is currently connected, the indication informing about the fact that a handover of the communication element or function from the serving communication network element or function is possible, identifying the communication element or function, initiating transmission of a dedicated signal component for the identified communication element or function to be used for an enhanced handover related measurement processing by the communication element of function, and providing information identifying the dedicated signal component to the serving communication network control element or function to be forwarded to the identified communication

element or function.
The technical effect achieved by this second invention is that information (identifying a dedicated signal component) to be used for an enhanced handover related measurement processing is provided to the UE.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2017/064795

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 2557850 A1	13-02-2013	CN 103733685 A	16-04-2014
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