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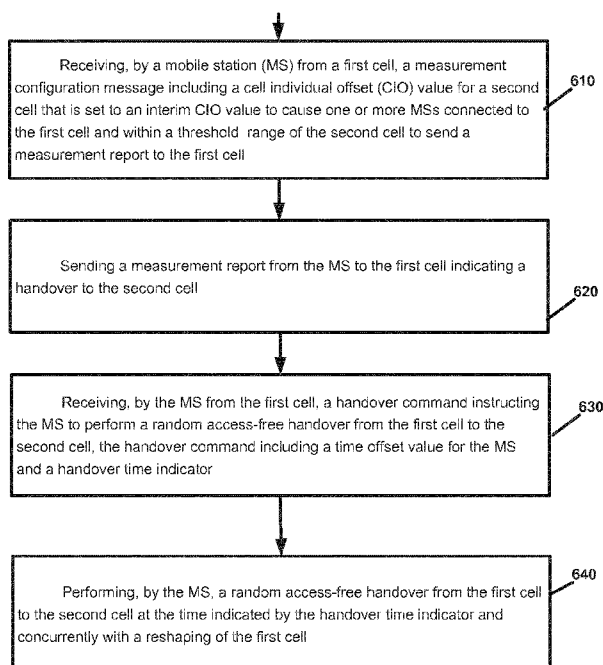
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(54) Title: USER HANDOFF MECHANISM FOR CELL SPLITTING IN WIRELESS NETWORK



(57) Abstract: A technique includes receiving, by a MS from a first cell, a measurement configuration message including a cell individual offset (CIO) value for a second cell that causes one or more MSs within a threshold range of the second cell to send a measurement report to the first cell, sending a measurement report from the MS to the first cell indicating a handover to the second cell, receiving, by the MS from the first cell, a handover command instructing the MS to perform a random access-free handover from the first cell to the second cell, the handover command including a time offset value for the MS and a handover time indicator, and performing, by the MS, a random access-free handover from the first cell to the second cell at the time indicated by the handover time indicator and concurrently with a reshaping of the first cell.

FIG. 6

5 DESCRIPTION

TITLE

USER HANDOFF MECHANISM FOR CELL SPLITTING IN WIRELESS NETWORK

10 TECHNICAL FIELD

[0001] This description relates to wireless networks.

BACKGROUND

[0002] A communication system may be a facility that enables communication between two or more nodes or devices, such as fixed or mobile communication devices.
15 Signals can be carried on wired or wireless carriers.

[0003] An example of a cellular communication system is an architecture that is being standardized by the 3rd Generation Partnership Project (3GPP). A recent development in this field is often referred to as the long-term evolution (LTE) of the Universal Mobile Telecommunications System (UMTS) radio-access technology. E-
20 UTRA (evolved UMTS Terrestrial Radio Access) is the air interface of 3GPP's Long Term Evolution (LTE) upgrade path for mobile networks. In LTE, base stations (BS), which are referred to as enhanced Node Bs (eNBs), provide wireless access within a coverage area or cell. In LTE, mobile devices, or mobile stations are referred to as user equipments (UE). LTE has included a number of improvements or developments.

25 [0004] In LTE, a handover of a UE (or mobile station (MS)) from a current (or source) cell to a target cell is triggered by measuring signal quality for one or more neighbor cells and reporting them to a current eNB or current cell. If the channel quality for a neighbor cell is better than the current cell, then the UE may receive a handover command in the form of a RRCConnectionReconfiguration message including the
30 physical cell ID (PCI) of the target cell, a C-RNTI (temporary identifier for the UE within the target cell), and possibly a random access preamble. The UE may then use a random access procedure to obtain a timing advance (or time offset or time advance) from the target cell to allow the UE to transmit data in the uplink (UL) direction. For a contention-less random access, the UE may send a random access request including

5 the random access preamble to the target cell, and the target cell may return a random access response including an uplink grant and a time offset value (e.g., timing advance). The UE may then indicate that the handover to the target cell is completed by sending a Handover confirm message, e.g., a RRCConnectionReconfigurationComplete message, to the target cell.

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SUMMARY

[0005] According to an example implementation, a method may include providing, by a base station (BS), a first cell, making a decision, by the BS, to activate a second cell that at least partially overlaps the first cell, sending, from the BS for the first cell to one or more mobile stations (MSs) connected to the first cell, a measurement configuration message instructing one or more of the MSs to measure a signal strength received from one or more neighbor cells including the second cell, the measurement configuration message including at least a cell identifier identifying the second cell and a cell individual offset (CIO) value for the second cell to be applied by the one or more MSs, the CIO value set to an interim CIO value to cause one or more MSs connected to the first cell and within a threshold range of the second cell to send a measurement report to the first cell, receiving a measurement report by the BS for the first cell from one or more of the MSs, the measurement report indicating a handover from the first cell to the second cell, sending, by the BS for the first cell to one or more of the MSs that provided a measurement report indicating a handover to the second cell, a handover command to perform a random access-free handover to the second cell, the handover command including a cell identifier that identifies the second cell, a time offset value for the MS to use for transmitting to the second cell, and a handover time indicator that indicates a time the MS should handover or switch from the first cell to the second cell, and reshaping the first cell by the BS concurrently with a performing of the handover of the one or more MSs from the first cell to the second cell at the time indicated by the handover time indicator.

[0006] According to an example implementation, the method may further include sending, from the BS for the first cell to one or more MSs connected to the first cell, a second measurement configuration message to provide a reset or default CIO value to be used by one or more of the MSs with respect to measurement of signals received from the second cell.

35

5 **[0007]** According to an example implementation, the CIO offset value is to be applied by the one or more MSs when measuring a signal strength of a signal received from the second cell as compared to a signal strength of a signal received from the first cell, the CIO value set to an interim CIO value to cause one or more MSs connected to the first cell to send a measurement report to the first cell, the measurement report
10 indicating a handover to the second cell based on the CIO value, the signal strength of the signal from the second cell and the signal strength of the signal from the first cell.

[0008] According to an example implementation, the receiving a measurement report may include receiving, by the BS for the first cell from one or more of the MSs, a measurement report indicating a handover for the MS from the first cell to the second
15 cell based on a measured signal strength of the first cell, a measured signal strength of the second cell, and the CIO value.

[0009] According to an example implementation, the second cell has been newly activated by means of beam forming by an active antenna system to apply flexible cell splitting in an azimuth domain.

20 **[0010]** According to an example implementation, the method may further include receiving, by the BS for the second cell from one or more of the MSs, a handover confirm message confirming that a handover of the MS from the first cell to the second cell has been performed.

[0011] According to an example implementation, the measurement configuration
25 message may include a first measurement configuration message that is sent prior to the activation of the second cell applying the interim CIO value with respect to the second cell.

[0012] According to an example implementation, the measurement configuration message may include a first measurement configuration message, the method further
30 comprising sending a second measurement configuration message including an updated CIO value to be used with respect to measurement of a signal received from the second cell.

[0013] According to an example implementation, the reshaping the first cell may include reshaping the first cell to decrease the coverage area of the first cell concurrently
35 with the handover of one or more of the MSs from the first cell to the second cell.

[0014] According to an example implementation, the first cell and the reshaped

5 first cell have the same physical cell identifier (PCI).

[0015] According to an example implementation, the first cell is assigned a first physical cell identifier (PCI), and wherein the reshaped first physical cell is assigned a second PCI that is different than the first PCI.

10 **[0016]** According to an example implementation, the handover is performed as an intra-BS synchronized group handover of at least some MSs from the first cell to the second cell.

[0017] According to an example implementation, an apparatus includes at least one processor and at least one memory including computer instructions, when executed by the at least one processor, cause the apparatus to: provide, by a base station (BS), a
15 first cell, making a decision, by the BS, to activate a second cell that at least partially overlaps the first cell, send, from the BS for the first cell to one or more mobile stations (MSs) connected to the first cell, a measurement configuration message instructing one or more of the MSs to measure a signal strength received from one or more neighbor cells including the second cell, the measurement configuration message including at
20 least a cell identifier identifying the second cell and a cell individual offset (CIO) value for the second cell to be applied by the one or more MSs, the CIO value set to an interim CIO value to cause one or more MSs connected to the first cell and within a threshold range of the second cell to send a measurement report to the first cell, receive a measurement report by the BS for the first cell from one or more of the MSs, the
25 measurement report indicating a handover from the first cell to the second cell, send, by the BS for the first cell to one or more of the MSs that provided a measurement report indicating a handover to the second cell, a handover command to perform a random access-free handover to the second cell, the handover command including a cell identifier that identifies the second cell, a time offset value for the MS to use for
30 transmitting to the second cell, and a handover time indicator that indicates a time the MS should handover or switch from the first cell to the second cell, and reshape the first cell by the BS concurrently with a performing of the handover of the one or more MSs from the first cell to the second cell at the time indicated by the handover time indicator.

[0018] According to another example implementation, a computer program
35 product includes a non-transitory computer-readable storage medium and storing executable code that, when executed by at least one data processing apparatus, is configured to cause the at least one data processing apparatus to perform a method

5 including: providing, by a base station (BS), a first cell, making a decision, by the BS, to
activate a second cell that at least partially overlaps the first cell, sending, from the BS
for the first cell to one or more mobile stations (MSs) connected to the first cell, a
measurement configuration message instructing one or more of the MSs to measure a
signal strength received from one or more neighbor cells including the second cell, the
10 measurement configuration message including at least a cell identifier identifying the
second cell and a cell individual offset (CIO) value for the second cell to be applied by
the one or more MSs, the CIO value set to an interim CIO value to cause one or more
MSs connected to the first cell and within a threshold range of the second cell to send a
measurement report to the first cell, receiving a measurement report by the BS for the
15 first cell from one or more of the MSs, the measurement report indicating a handover
from the first cell to the second cell, sending, by the BS for the first cell to one or more of
the MSs that provided a measurement report indicating a handover to the second cell, a
handover command to perform a random access-free handover to the second cell, the
handover command including a cell identifier that identifies the second cell, a time offset
20 value for the MS to use for transmitting to the second cell, and a handover time indicator
that indicates a time the MS should handover or switch from the first cell to the second
cell, and reshaping the first cell by the BS concurrently with a performing of the
handover of the one or more MSs from the first cell to the second cell at the time
indicated by the handover time indicator.

25 **[0019]** According to another example implementation, an apparatus may include
means for providing, by a base station (BS), a first cell, means for making a decision, by
the BS, to activate a second cell that at least partially overlaps the first cell, means for
sending, from the BS for the first cell to one or more mobile stations (MSs) connected to
the first cell, a measurement configuration message instructing one or more of the MSs
30 to measure a signal strength received from one or more neighbor cells including the
second cell, the measurement configuration message including at least a cell identifier
identifying the second cell and a cell individual offset (CIO) value for the second cell to
be applied by the one or more MSs, the CIO value set to an interim CIO value to cause
one or more MSs connected to the first cell and within a threshold range of the second
35 cell to send a measurement report to the first cell, means for receiving a measurement
report by the BS for the first cell from one or more of the MSs, the measurement report
indicating a handover from the first cell to the second cell, means for sending, by the BS

5 for the first cell to one or more of the MSs that provided a measurement report indicating a handover to the second cell, a handover command to perform a random access-free handover to the second cell, the handover command including a cell identifier that identifies the second cell, a time offset value for the MS to use for transmitting to the second cell, and a handover time indicator that indicates a time the MS should handover
10 or switch from the first cell to the second cell, and means for reshaping the first cell by the BS concurrently with a performing of the handover of the one or more MSs from the first cell to the second cell at the time indicated by the handover time indicator.

[0020] According to another example implementation, a method includes receiving, by a mobile station (MS) from a first cell, a measurement configuration
15 message including a cell individual offset (CIO) value for a second cell that is set to an interim CIO value to cause one or more MSs connected to the first cell and within a threshold range of the second cell to send a measurement report to the first cell, sending a measurement report from the MS to the first cell indicating a handover to the second cell, receiving, by the MS from the first cell, a handover command instructing the
20 MS to perform a random access-free handover from the first cell to the second cell, the handover command including a time offset value for the MS and a handover time indicator, and performing, by the MS, a random access-free handover from the first cell to the second cell at the time indicated by the handover time indicator and concurrently with a reshaping of the first cell.

25 **[0021]** According to an example implementation, the receiving the measurement configuration message includes receiving, by the MS from a first cell, the measurement configuration message including a list of neighbor cells to be measured including at least the second cell, the measurement configuration message including a cell identifier identifying the second cell and the cell individual offset (CIO) value for the second cell
30 that is set to an interim CIO value to cause one or more MSs connected to the first cell and within a threshold range of the second cell to send a measurement report to the first cell indicating a handover to the second cell.

[0022] According to an example implementation, the sending may include sending the measurement report from the MS to the first cell indicating a handover to the
35 second cell based on a strength of signals received by the MS from the first cell and the second cell and the CIO value for the second cell.

[0023] According to an example implementation, the receiving the handover

5 command may include receiving, by the MS from the first cell, the handover command
instructing the MS to perform a random access-free and synchronized group handover
from the first cell to the second cell, the handover command including a cell identifier of
the second cell, a time offset value for the MS to use in transmitting to the second cell,
and a handover time indicator that indicates a time the MS should handover or switch
10 from the first cell to the second cell.

[0024] According to an example implementation, the method may further include
sending, from the MS to the second cell, a handover confirm message indicating that the
handover from the first cell to the second cell is complete.

[0025] According to an example implementation, the handover is a synchronized
15 group handover by a plurality of MSs from the first cell to the second cell at the time
indicated by the handover time indicator.

[0026] According to an example implementation, the reshaping includes
reshaping, by a base station (BS), the first cell to decrease a range or coverage area of
the first cell concurrently with the handover of the MS from the first cell to the second cell
20 at the time indicated by the handover time indicator.

[0027] According to an example implementation, the base station provides both
the first cell and the second cell, wherein the performing the handover includes
performing a random access-free and intra-BS handover including: receiving, by the MS,
a handover command from the BS instructing the MS to perform a handover from the
25 first cell to the second cell, the handover command providing handover information
including at least a cell identifier for the second cell, an identifier for the MS for the
second cell, a resource assignment for the MS for the second cell, and a handover time
indicator that indicates a time when the MS should handover or switch to the second cell,
and sending, based on the handover information received by the MS and the time offset
30 value, a handover confirm message from the MS to the second cell to confirm that the
handover of the MS to the second cell has been completed.

[0028] According to an example implementation, the method may further include
receiving, by the MS from the BS in the handover command, a time offset value for the
second cell, the time offset value for the second cell for the MS being the same as a time
35 offset value for the first cell for the MS.

[0029] According to an example implementation, the sending a measurement
report may include: measuring, by the MS in response to receiving the measurement

5 configuration message, a signal strength of a reference signal from the first cell and a
signal strength of a reference signal from the second cell, determining that the signal
strength of the reference signal from the second cell, taking into account the CIO value
for the second cell, is stronger than the signal strength of the reference signal from the
first cell, and sending, by the MS, a measurement report to the first cell indicating the
10 second cell for handover.

[0030] According to an example implementation, the receiving the measurement
configuration message may include receiving a RRCConnectionReconfiguration
message including a MeasConfig information element.

[0031] According to an example implementation, the handover time indicator
15 may include a transmission time interval (TTI) that indicates a time that the handover to
the second cell and a reshaping of the first cell are to be performed concurrently.

[0032] According to an example implementation, the receiving a handover
command may include receiving, by the MS, a RRCConnectionReconfiguration message
with a MobilityControlInfo information element that includes at least the cell identifier for
20 the second cell, the identifier for the MS for the second cell and the resource assignment
for the MS for the second cell, the handover command also including the handover time
indicator that indicates a time when the MS should handover or switch to the second cell
and a time offset value for the MS for the second cell.

[0033] According to an example implementation, the receiving a handover
25 confirm message may include receiving a RRCConnectionReconfigurationComplete
message.

[0034] According to an example implementation, a computer program product
includes a non-transitory computer-readable storage medium and storing executable
code that, when executed by at least one data processing apparatus, is configured to
30 cause the at least one data processing apparatus to perform a method including:
receiving, by a mobile station (MS) from a first cell, a measurement configuration
message including a cell individual offset (CIO) value for a second cell that is set to an
interim CIO value to cause one or more MSs connected to the first cell and within a
threshold range of the second cell to send a measurement report to the first cell,
35 sending a measurement report from the MS to the first cell indicating a handover to the
second cell, receiving, by the MS from the first cell, a handover command instructing the
MS to perform a random access-free handover from the first cell to the second cell, the

5 handover command including a time offset value for the MS and a handover time indicator, and performing, by the MS, a random access-free handover from the first cell to the second cell at the time indicated by the handover time indicator and concurrently with a reshaping of the first cell.

10 **[0035]** According to an example implementation, an apparatus includes at least one processor and at least one memory including computer instructions, when executed by the at least one processor, cause the apparatus to: receive, by a mobile station (MS) from a first cell, a measurement configuration message including a cell individual offset (CIO) value for a second cell that is set to an interim CIO value to cause one or more MSs connected to the first cell and within a threshold range of the second cell to send a
15 measurement report to the first cell, send a measurement report from the MS to the first cell indicating a handover to the second cell, receive, by the MS from the first cell, a handover command instructing the MS to perform a random access-free handover from the first cell to the second cell, the handover command including a time offset value for the MS and a handover time indicator, and perform, by the MS, a random access-free
20 handover from the first cell to the second cell at the time indicated by the handover time indicator and concurrently with a reshaping of the first cell.

[0036] According to another example implementation, an apparatus may include means for receiving, by a mobile station (MS) from a first cell, a measurement configuration message including a cell individual offset (CIO) value for a second cell that
25 is set to an interim CIO value to cause one or more MSs connected to the first cell and within a threshold range of the second cell to send a measurement report to the first cell, means for sending a measurement report from the MS to the first cell indicating a handover to the second cell, means for receiving, by the MS from the first cell, a handover command instructing the MS to perform a random access-free handover from
30 the first cell to the second cell, the handover command including a time offset value for the MS and a handover time indicator, and means for performing, by the MS, a random access-free handover from the first cell to the second cell at the time indicated by the handover time indicator and concurrently with a reshaping of the first cell.

[0037] According to another example implementation, a method includes
35 receiving, by a mobile station (MS) from a first cell, a measurement configuration message including a cell individual offset (CIO) value to be used by the MS for measurement of signals received from a second cell with respect to signals received

5 from the first cell, the CIO value being set to an interim CIO value to cause one or more MSs connected to the first cell and within a range of the second cell to send a measurement report to the first cell indicating handover to the second cell, the second cell at least partially overlapping the first cell, and resetting, by the MS, the CIO value used by the MS for measurement of the second cell to a default or other updated CIO value beginning at or subsequent to a reshaping of the first cell.

10 **[0038]** According to an example implementation, the MS is not within range of the second cell and does not send a measurement report to the first cell indicating handover to the second cell.

15 **[0039]** According to an example implementation, the default or updated CIO value is reset by the MS concurrently with the reshaping of the first cell.

[0040] According to an example implementation, both the interim CIO value and the default or updated CIO value are received by the MS via the measurement configuration message.

20 **[0041]** According to an example implementation, the resetting comprises resetting, by the MS, the CIO value used by the MS for measurement of the second cell to a default or other updated CIO value beginning at or subsequent to a reshaping of the first cell, the reshaping being performed concurrently with a group handover of one or more MSs from the first cell to the second cell.

25 **[0042]** According to an example implementation, the measurement configuration message comprises a first measurement configuration message, and wherein the default or updated CIO value is received by the MS via a second measurement configuration message.

30 **[0043]** According to an example implementation, a computer program product includes a non-transitory computer-readable storage medium and storing executable code that, when executed by at least one data processing apparatus, is configured to cause the at least one data processing apparatus to perform a method including: receiving, by a mobile station (MS) from a first cell, a measurement configuration message including a cell individual offset (CIO) value to be used by the MS for measurement of signals received from a second cell with respect to signals received from the first cell, the CIO value being set to an interim CIO value to cause one or more MSs connected to the first cell and within a range of the second cell to send a measurement report to the first cell indicating handover to the second cell, the second

5 cell at least partially overlapping the first cell, and resetting, by the MS, the CIO value used by the MS for measurement of the second cell to a default or other updated CIO value beginning at or subsequent to a reshaping of the first cell.

[0044] According to another example implementation, an apparatus includes at least one processor and at least one memory including computer instructions, when
10 executed by the at least one processor, cause the apparatus to: receive, by a mobile station (MS) from a first cell, a measurement configuration message including a cell individual offset (CIO) value to be used by the MS for measurement of signals received from a second cell with respect to signals received from the first cell, the CIO value being set to an interim CIO value to cause one or more MSs connected to the first cell and
15 within a range of the second cell to send a measurement report to the first cell indicating handover to the second cell, the second cell at least partially overlapping the first cell, and reset, by the MS, the CIO value used by the MS for measurement of the second cell to a default or other updated CIO value beginning at or subsequent to a reshaping of the first cell.

20 **[0045]** The details of one or more implementations are set forth in the accompanying drawings and the description below. Other features will be apparent from the description and drawings, and from the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0046] FIG. 1 is a block diagram of a wireless network according to an example
25 implementation.

[0047] FIG. 2 is a diagram illustrating cell deployment changes according to an example implementation.

[0048] FIG. 3 is a diagram illustrating cell deployment changes according to an example implementation.

30 **[0049]** FIG. 4 is a signal timing diagram illustrating operation of a base station and a mobile station according to an example implementation.

[0050] FIG. 5 is a flow chart illustrating operation of a base station (BS) according to an example implementation.

[0051] FIG. 6 is a flow chart illustrating operation of a mobile station (MS)
35 according to an example implementation.

5 **[0052]** FIG. 7 is a flow chart illustrating operation of a mobile station (MS) according to another example implementation.

[0053] FIG. 8 is a block diagram of a wireless station (e.g., BS or MS) 800 according to an example implementation.

DETAILED DESCRIPTION

10 **[0054]** According to an example implementation, a technique is provided that includes receiving, by a MS from a first cell, a measurement configuration message including a neighbor relationship and a corresponding cell individual offset (CIO) value for a second cell to be newly generated and that causes one or more MSs being covered within the range of the second cell to send a measurement report to the first cell, sending
15 a measurement report from the MS to the first cell indicating a handover to the second cell, receiving, by the MS from the first cell, a handover command instructing the MS to perform a random access-free and group synchronized handover from the first cell to the second cell, the handover command including a handover time indicator, and performing, by the MS, a random access-free handover from the first cell to the second
20 cell at the time indicated by the handover time indicator and concurrently with a reshaping of the first cell. For example, this may provide separate wireless coverage via the first cell that is reshaped and the second cell. Also, after handover and cell reshaping have been performed, the signal measurement and comparison functions of the MSs remaining in first reshaped cell may be re-configured with a default CIO value with
25 respect to the second cell.

[0055] FIG. 1 is a block diagram of a wireless network 130 according to an example implementation. In the wireless network 130 of FIG. 1, mobile stations (MSs) 132 and 133, which may also be referred to as user equipments (UEs), may be connected (and in communication) with a base station (BS) 134, which may also be
30 referred to as an enhanced Node B (eNB). BS 134 provides wireless coverage within a cell 136. This is merely one simple example of a wireless network, and others may be used. For example, only two MSs are shown, but any number may be used.

[0056] A mobile station (MS) may also be referred to as a user device, a user terminal or a user equipment (UE), for example. In an example implementation, a MS
35 may refer to a portable computing device that includes wireless mobile communication devices operating with or without a subscriber identification module (SIM), including, but

5 not limited to, the following types of devices: a mobile phone, a cell phone, a
smartphone, a personal digital assistant (PDA), a handset, a device using a wireless
modem (alarm or measurement device, etc.), a laptop and/or touch screen computer, a
tablet, a phablet, a game console, a notebook, and a multimedia device, as examples. It
should be appreciated that a user device may also be a nearly exclusive uplink only
10 device, of which an example is a camera or video camera loading images or video clips
to a network, or a device that may be nearly exclusive downlink only device. Some of
the example implementations, signals and/or messages described herein may refer to
Long Term Evolution (LTE) and/or LTE advanced. However, the various aspects,
features, and implementations described herein may apply to any wireless standard or
15 technology. LTE is merely one example wireless technology used for illustrative
purposes.

[0057] FIG. 2 is a diagram illustrating cell deployment changes according to an
example implementation. A base station 210 is connected to an antenna system 212
which provides an original cell 214. Antenna system 212 may be, for example, an active
20 antenna system that may be used to perform, for example, vertical or horizontal beam
forming (or vertical or horizontal sectorization) or cell splitting in which signal processing
techniques may be used to perform directional signal transmission in order to provide
multiple cells from the same BS and antenna system. For example, in cell splitting, an
additional radiation pattern may be generated from the same active antenna system to
25 provide the new cell within the original range of the original cell, or to provide two cells
within the range of the original cell. In this manner, an active antenna system (AAS)
212 may be used to improve the wireless coverage (e.g., wider coverage areas) and/or
capacity (e.g., can handle a larger number of MSs or users) offered by a BS and
antenna system.

30 **[0058]** As shown in figure 2, one example of cell deployment changes may
involve a dynamic cell splitting which may involve horizontal sectorization or horizontal
cell splitting in which an original cell 214 may be split into two smaller cells 230 and 232.
Cell 230 may have a physical cell identifier (PCI) of PCI_2, while cell 232 may have a
PCI of PCI_3 or PCI_1 (which may be the same as original cell 214). Original cell 214
35 may have a physical cell identifier (PCI) of PCI_1, for example.

[0059] A number of MSs within original cell 214 may be connected to or in
communication with BS 210. For example, MSs 220, 222, 224 and 226 may be within

5 cell 214 prior to cell splitting. According to an example implementation, after cell splitting, some of the MSs may be moved or changed to a different cell, e.g., via MS handover. The handover or cell change may be performed or triggered, for example, based on MS measurement of signals (e.g., signal strength, signal quality or other signal measurement) by the MS from one or more cells.

10 **[0060]** According to one example implementation, new cell 230 (PCI_2) and new cell 232 (e.g., PCI_3) may be activated by BS 210 and antenna system 212 concurrently with operation of original cell 214. MSs (e.g., MSs 220, 222) within range of cell 230 may then be moved or handed over to cell 230. Similarly, MSs (e.g., MSs 224, 226) within range of new cell 232 may be moved to cell 232, e.g., via MS handover. After the
15 MS handovers, e.g., for MSs 220, 222 and 224, 226 to cells 230 and 232, respectively, have been performed, the BS 210 may deactivate original cell 214. However, such an implementation may have a disadvantage of requiring, at least temporarily, three cells to be provided concurrently (at the same time) by the BS 210, to allow the MSs to perform handover from original cell 214 to the new cells 230, 232, without a service interruption
20 for the MSs. This may require, or involve, the BS 210 and/or the antenna system 212 to include three ports for baseband input/output, and three wireless transceivers and amplifiers. This additional cost for a BS to support a third concurrent cell, at least in some cases, may not be justified given that the third cell may be needed only very briefly. Other example implementations are described herein that may use alternative
25 techniques to provide two new cells (e.g., horizontal cells) that avoid service interruption and may not require the use of a third wireless transceiver, at least in some cases.

[0061] FIG. 3 is a diagram illustrating cell deployment changes according to an example implementation. An original cell 214, e.g., having a physical cell identifier (or PCI) of PCI_1, is initially provided by BS 210. MSs 220, 222, 224 and 226 may be
30 initially connected to cell 214. This is merely an example, and other MSs may be connected to cell 214. A cell 230 (e.g., having a PCI of PCI_2) may then be activated or provided by BS 210, and at least partially overlaps with original cell 214. According to an example implementation, a handover may be performed for one or more MSs (e.g., MSs 220, 222) that are within range (or within a threshold range) of cell 230 from original cell
35 214 to new cell 230. A handover for a MS may be performed from a currently serving cell 214 to a neighbor cell when, for example, the signal strength of the neighbor cell is better or greater than the signal strength of the current cell, or other signal condition.

5 This is merely one example condition that may be detected by a MS, which may then be communicated to the currently serving cell 214 in a measurement report, e.g., indicating a handover to the neighbor cell (e.g., indicating a greater signal strength from the neighbor cell as compared to the currently serving cell). In response to the measurement report indicating the greater signal strength of a neighbor cell, the BS 210
10 may make a handover decision for the MS, and then may send a handover command to the reporting MS instructing the MS to perform a handover to the neighbor cell

[0062] In the above example, a measurement report may be sent (which may trigger a handover) when, for example, the signal strength of the signal from the neighbor cell is greater (or having a higher signal quality) than the signal strength/quality
15 of the signal from the currently serving cell. Other signal conditions may be used to trigger sending a measurement report from a measuring MS to the currently serving cell. For example, another trigger condition may require the signal strength of the currently serving cell to be 3dB (or other value) greater than the signal strength of the neighbor cell before a measurement report will be sent. Thus, various measured signal conditions
20 may be used to cause a measurement report to be sent by a MS to the currently serving cell, which may result in triggering a handover for the MS to a neighbor cell having or providing a higher signal quality or greater signal strength as measured by the MS.

[0063] According to an example implementation, a MS may measure a signal strength of a reference signal from one or more neighbor cells and a currently serving
25 cell. For example, a currently serving BS may send a measurement configuration message to a MS with a list of neighbor cells to be measured. The MS may then measure the signal strength of reference signals received from the current serving cell as well as from one or more of the neighbor cells. The signal strength of the current cell may be compared by the MS to the signal strength of reference signals received from
30 each of the neighbor cells to determine if one (or more) of the neighbor cells would be a better serving cell (or would be a handover candidate) for the MS based on better signal strength, for example. In the case where one of the neighbor cells provides a reference signal that satisfies one or more conditions, e.g., having a greater signal strength than a reference signal received from the currently serving cell, then the MS may transmit a
35 measurement report indicating a (possible) handover to the neighbor cell with the greater signal strength. The currently serving cell may then, for example, make a decision to handover the MS to the neighbor cell identified by the measurement report, and may

5 send a handover command to the MS.

[0064] In addition, a cell individual offset (CIO) value may be applied by a MS to make a signal from a neighbor cell appear relatively stronger (or more attractive as a handover candidate), or weaker (less attractive as a handover candidate), as compared to a signal strength of a signal received from the currently serving (or source) cell, depending on whether the CIO value is a positive or negative number, for example. A BS for a currently serving or source cell may, for example, assign a CIO value to a MS for each of one or more neighbor cells, e.g., to actively manage handovers between cells, balance traffic or MSs among multiple cells, etc. For example, a positive CIO value may be applied to a neighbor cell to make that neighbor cell appear more attractive as a handover candidate, and thereby to make it more likely that one or more MSs will send a measurement report based on such cell, which may trigger a MS handover to such cell.

[0065] As one illustrative example, a MS may compare a neighbor cell to the currently serving cell based on the following:

20 **[0066]** Is: Neighbor signal strength + CIO value > Current cell signal strength? (Eqn. 1). If Eqn. 1 is satisfied (answer is yes), then the MS may send a measurement report to the currently serving cell identifying the neighbor cell for handover (e.g., identifying the PCI of the neighbor cell that satisfied the measurement condition), which may cause the BS to send a handover command to the MS to cause a handover of the MS to the neighbor cell.

[0067] Referring to FIG. 3 again, in an example case of horizontal cell splitting, a measured signal strength of a received reference signal (e.g., as received by MS 220) from the new (e.g., horizontal) cell 230 may not be substantially greater than a measured signal strength of a reference signal received by the MS 220 from the original cell 214. For example, the signal strength of the new cell 230 may be similar to the signal strength of the original cell 214 that is serving MSs 220, 222, 224 and 226. Therefore, according to an illustrative example, a measurement report may not necessarily be sent from MS 220 or MS 222 (as examples) to original cell 214 based on the signal strength of the new cell 230. Therefore, at least in some cases, due to similar signal strengths of currently serving (original) cell 214 and new cell 230, the currently serving cell 230 may not necessarily instruct any of MSs 220, 222, etc., within range of new cell 230 to perform a handover from cell 214 to new cell 230.

5 **[0068]** Therefore, according to an example implementation, BS 210 for cell 214 may send a CIO value for new cell 230 to each of MSs 220, 222, 224 and 226 which are connected to cell 214. For example, a positive CIO value may be used for cell 230 to make cell 230 more attractive for handover for these MSs within original cell 214, based on Eqn. 1, as an illustrative example. For example, BS 210 for original cell 214 may send
10 a measurement configuration message to MSs 220, 222, 224 and 226 including a neighbor list including at least the PCI of cell 230 (e.g., PCI_2) to be measured, and a CIO value for the cell 230 set to an interim CIO value to cause the MSs 220 and 222 that are within range of cell 230 to send a measurement report to original (or parent) cell 214 indicating handover to cell 230. Thus, in response to receiving the measurement
15 configuration message, each MS may measure signal strength of reference signals from the original cell 214 and at least the new cell 230. Each MS may then compare the signal strength of the new cell 230, plus the CIO value, to the signal strength of the original cell 214, e.g., based on Eqn. 1, for example.

[0069] For example, Eqn. 1 may not be satisfied by MS 224 and 226, which are
20 not within range or the coverage area of new cell 230. Thus, for MSs 224 and 226, the signal strength of cell 230 plus the CIO value may be less than the signal strength of the current or original cell 214, for example. Thus, in this example, the MSs 224, 226 would not send measurement reports to original cell 214, based on the new cell 230. However, in this example, MSs 220 and 222 are within range of new cell 230. Thus, Eqn. 1 may
25 typically be satisfied for MSs 220 and 222, taking into account the CIO value (set to the interim CIO value) for the new cell 230, e.g., the signal strength of the reference signal from new cell 230 plus the CIO value (set to the interim CIO value) is greater than the signal strength of the reference signal from the original cell 214. Thus, based on such measurements, MSs 220 and 222 may typically send a measurement report to original
30 cell 214, e.g., indicating a handover to cell 230 based on the MS satisfying Eqn. 1 for cell 230, for example.

[0070] Thus, for example, the measurement reports sent by MSs 220 and 222 may operate to inform original cell 214 that MSs 220 and 222 are within range of the new cell 230, and thus, should be switched or handed over to the new cell 230.
35 Similarly, the absence of a measurement report sent from MSs 224 and 226 with respect to new cell 230 may indicate to original cell 214 that MSs 224 and 226 are not within range of new cell 230, and therefore, should not be switched or handed over to new cell

5 230, for example.

[0071] In response to BS 210 of cell 214 receiving the measurement reports from one or more MSs (e.g., MSs 220 and 222) indicating a handover to new cell 230 (e.g., indicating that new cell 230 has a greater signal strength or is more attractive, as compared to the original cell 214), the original cell (or BS 210 for original cell 214) may send a handover command to each reporting MS (e.g., MSs 220, 222). The handover commands may, for example, instruct the reporting MSs to perform a group synchronized and random access-free handover from the original cell 214 to the new cell. The handover command may include, for example, a cell identifier (e.g., PCI_2) for the target cell 230, a time offset value (or time advance value) for each MS to use in transmitting to the new cell 230, and a handover time indicator that indicates a time the MSs should perform handover or switch to new cell 230 (e.g., a time when the MSs of the group for a synchronized group handover should begin receiving and decoding data/signals from the new cell, and cease receiving and/or decoding data/signals from the original cell). A different time offset value (or time advance value) may be used for each MS. The handover time indicator may indicate or identify a transmission time interval (TTI) or subframe when the handover should be performed, for example.

[0072] For a typical handover, a MS may use a random access procedure to obtain a time offset value or time advance, to allow the MS to transmit to the target cell. This may involve the MS sending a random access request (including a random access preamble) to the new cell, and receiving a random access response from the new cell including an uplink grant and the time offset value or time advance for the MS. However, for cell splitting or sectorization, one BS antenna may provide both the original cell and one or more subsequent cells or sectors, such as cells 230 and 232, for example. The time offset value or time advance for a MS is based on the radio link properties between the MS's antenna and the BS's antenna. BS 210 already knows the time offset value or time advance for each MS with respect to original cell 214. In this case, for each MS, the radio link properties between the MS and BS 210 are the same for each of the cells 214, 230, and 232 (since the original cell 214 and new cells 230, 232 are provided by the same BS 210). Therefore, the time offset value or time advance value for each MS is already known by the BS before the cell splitting is performed or before the new cell(s) 230, 232 are activated or provided. As a result, in such a case, the random access procedure may be omitted by the MS, e.g., for cell splitting. Also, the MS may already

5 know its time offset value (which may be the same time offset value to be used by the MS for the new cell), and/or the BS 210 may provide the time offset value or time advance for the MS with respect to the new cell 230 within the handover command.

[0073] A handover of multiple MSs at approximately the same time, e.g., at the start of the same TTI or other time that may be indicated, may be referred to as a
10 synchronized group handover (or group synchronized handover). A handover of a MS to a new cell while skipping or omitting a random access procedure, e.g., determining the time offset value for the MS based on prior knowledge of the time offset value for the MS, may be referred to as a random access-free handover.

[0074] In addition, according to an example implementation, at 235 in FIG. 3, the
15 original cell may be reshaped (e.g., decrease cell size or cell coverage area) to form new cell 232. The new cell 232 may, for example, minimally overlap the new cell 230, e.g., the overlap between the two new horizontal cells 230, 232 may be less than the overlap between original cell 214 and new cell 230, for example. The new cell 232 may have the same PCI as the original cell 214 (e.g., PCI_1). Alternatively, the new cell, 232 may
20 have a different PCI, e.g., PCI_3. According to the example illustrated in FIG. 3, the MSs 224 and 226 are within the range of original cell 214 and within the range or coverage area of reshaped cell 214 (which forms new cell 232, for example). Thus, for example, the MSs 224, 226, that are not within range of the first new cell 230, will typically remain within and/or connected to the reshaped cell 214 or 232 after reshaping
25 of cell 214 has been performed.

[0075] According to an illustrative example implementation, it is desirable or advantageous to perform the reshaping of the original cell 214 to form the second new horizontal cell 232 (e.g., cell 232 having reduced coverage area or range as compared to original cell 214) at the same time or concurrently (e.g., at the same TTI) with the
30 handover of MSs 220, 222 from the original cell 214 to new cell 230. Performing the reshaping or reduction in range or cell size for original cell 214 to form new cell 232 concurrently with the handover of MSs 220, 222 (within range of new cell, 230) to new cell 230 may, for example: 1) avoid or minimize (or at least decrease) the possible interference between data/signals sent to/from MSs 220, 222 of cell 230 and signals
35 and/or data sent to/from MSs 224, 226 that may be within the original cell 214 (since these cells 214 and 230 overlap until cell 214 is reshaped), and 2) may avoid (or at least decrease) a service interruption for MSs 224, 226. The reshaping of original cell 214 to

5 form new cell 232 may be performed at a specified time or at a specified TTI, because, for example, the active antenna system 212 may change the beam for the cell (and hence change the size, shape, etc. of the range or coverage area for the corresponding cell) on a per TTI bases, e.g., the beam may be changed every TTI due to the digital circuits used for the active antenna system 212, for example.

10 **[0076]** Also, for example, after reshaping of the original (or parent) cell 214 to form new cell 232, the measurement configuration for one or more MSs may be updated with respect to cell 230. For example, after reshaping of original cell 214 to form cell 232, the CIO value used by MSs within cell 232 may be reset or updated from the interim CIO to a default CIO value or other updated or reset CIO value, with respect to cell 230.

15 The resetting of the CIO value for MSs within cell 232, with respect to cell 230, may be accomplished a number of different ways, such as, for example: 1) the interim CIO value with respect to cell 230 may be sent or provided to MSs within a first measurement configuration message before cell reshaping, and then the updated or default CIO value may be sent or provided to the MSs within cell 214/232 via a second
20 measurement configuration message after reshaping of cell 214 to form cell 232; 2) Both the interim CIO value and the updated or default CIO value may be provided to MSs via a first measurement configuration message prior to cell reshaping, where one or more of the MSs will use the interim CIO value before cell reshaping, and switches (or resets) to use the updated or default CIO value beginning at the time of cell reshaping, or after cell reshaping (e.g., this use of the updated or default CIO value may be
25 accomplished or performed by MSs automatically without further communication from a BS, or in response to a communication or request message received from a BS); 3) the updated or default CIO value may be previously provided (e.g., via a different signaling or message) to and/or stored by one or more MSs, and may be used by the MSs as the
30 CIO value with respect to cell 230 beginning at the time of the cell reshaping. Thus, different techniques may be used to allow one or more of the MSs to update or reset its CIO value with respect to neighbor cell 230. According to one example implementation, one or more MSs connected to (or within original cell 214/new cell 232) may replace or reset the interim CIO value used with respect to cell 230 with the updated or default CIO
35 value at the same time (e.g., concurrently) as the cell reshaping of cell 214, for example. Various other techniques may be used to allow one or more MSs to update or reset their CIO value used with respect to neighbor cell 230.

5 **[0077]** FIG. 4 is a signal timing diagram illustrating operation of a base station and a mobile station according to an example implementation. A BS 402 (which may be same as BS 210) may provide an original (or parent) cell 214 (FIG. 3) having a PCI of PCI_1, for example. A MS 404 may be within range of and/or connected to the original cell 214. At 410, BS 410 determines sectorization or cell splitting, e.g., for two new
10 horizontal cells 230, 232 (FIG. 3) to replace the original cell 214, where the original cell, 214 may have a broad range or shape, whereas the two new horizontal cells 230 and 232 may each have a much narrower range, and cells 230 and 232 may generally provide a same or substantially similar coverage or range as the original cell, 214. BS 410 may also determine PCIs for each of the new cell (e.g., PCI_2 for cell 230 and
15 PCI_1 for cell 232).

[0078] At 412, the BS 402 may send a measurement configuration message to one or more MSs including to MS 404. In an example implementation, at 412, the measurement configuration message may include (or may be) a
 RRCConnectionReconfiguration message including a measConfig information element
20 which may include, for example, a neighbor list and instructing the MSs to measure a signal (e.g., reference signal) from each of the cells listed in the neighbor list. The measurement configuration message at 412 may include, for example, a cell identifier or PCI (e.g., PCI_2) of at least the new cell 230 that should be measured by the MSs. At 412, the measurement configuration message may also include a cell individual offset
25 (CIO) offset value set to an interim CIO value to cause one or more MSs connected to original cell 214 and within range of the new cell 230 to send a measurement report to original cell 214 indicating handover for the MS to the new cell 230 (e.g., based on the new cell 230 meeting the Eqn. 1, for example). In an alternative implementation, the measurement configuration message at 412 may also include an updated or default CIO
30 value to be used by one or more MSs beginning during a cell reshaping or after a cell reshaping of cell 214.

[0079] At 414, the BS 402 (or BS 210) may make a decision to activate and then may activate the new cell or sector (e.g., new cell, 230). Operations 412 and 414 may be performed in any order, for example. For example, the decision to activate the new
35 cell 230 at 414 may be performed before (or after) the operation 412.

[0080] Next, one or more MSs, such as MS 404, may measure the signals received from the current or original cell, 214 and from one or more neighbor cells

5 including from new cell, 230, for example. For cells 220, 222 within range of the new cell, the Eqn. 1 may be satisfied for the new cell 230.

[0081] Thus, at 416, cells within range of the new cell, 230 (e.g., cells 220 and 222) may send a measurement report to original cell 214, e.g., indicating a handover to new cell 230, e.g., based on Eqn. 1 being satisfied for the MS with respect to the new
10 cell 230. In an example implementation, the measurement report(s) may each be sent to cell 214 as a RRCMeasurementReport message, and may include the PCI of the target cell (e.g., PCI_2 of new cell 230) indicated for handover.

[0082] At 418, the BS 402 may determine which MSs should perform handover or switch from original cell 214 to new cell 230, e.g., based on the measurement reports.
15 For example, receipt of a measurement report from one or more MSs within cell 214 indicating handover to new cell 230 may be used by BS 402 to identify which MSs should perform handover to the new cell 230. Likewise, BS 402 may determine that any MS within cell 214 that does not send a measurement report to cell 214 indicating handover to new cell 230 should remain with the original cell 230 (e.g., not handed over
20 to new cell 230).

[0083] At 422, the BS 402 may schedule the MSs indicating a handover to new cell 230 (e.g., MSs 220, 222) to perform a synchronized group handover to the new cell 230 at a specified time, e.g., at a specified TTI. At 420, the BS 402 may send a handover command to the MSs (e.g., MS 220, 222) that sent a measurement report
25 indicating handover to new cell 230. The handover command may be provided, for example, as a RRCConnectionReconfiguration, including a mobilityControlInfo information element, and indicating synchronized group handover. In an example implementation, the handover command may include a cell identifier (e.g., PCI_2) of the new cell (target cell) 230, a handover time indicator that identifies a time for handover to
30 the new cell. The handover command may optionally include a time offset value for the MS to use for transmitting to the new cell 230. This time offset value may be optional, since it may already be known by the MS, and thus, it may not be necessary to retransmit this time offset value to the MS.

[0084] At the scheduled (or indicated) TTI (424), the BS 210/402 may reshape
35 (at 426) the original cell/sector 214 (to form the new narrow cell or new horizontal cell 232) concurrently or synchronously (e.g., during the same TTI) with the handover of the MSs (at 428) (e.g., MS 220, 222) that were instructed to perform hand over from original

5 cell 214 to new cell 230.

[0085] At 430, one or more of the MSs that performed handover to the new cell 230 may send a handover confirm message to the BS and/or the new cell 230, indicating that the handover from cell 214 to new cell 230 has been completed. In an example implementation, the handover confirm message may be a

10 RRCConnectionReconfigurationComplete message.

[0086] At 432, the BS 402/210 may send an updated or default CIO value to one or more of the MSs to provide an updated CIO value, e.g., which may be reset to zero or other value. For example, BS 402/210 may send the updated CIO value associated with the new cell 230 to the one or more MSs that are connected to the second new cell 232 (or reshaped original cell 214). The updated CIO value may be adjusted to not make the first new cell 230 appear more attractive for handover than the current cell 232/reshaped 214, for example. For example, a function of the CIO value set to the interim CIO value may have been to force a handover of MSs within range of the new cell 230. Once that has been accomplished, e.g., after handover and reshaping of the original cell, then the CIO value may be reset or updated back to zero or other value. As noted above, other techniques may be used to provide or communicate the updated or default CIO value to one or more MSs. For example, the default or updated CIO value may be provided within a first measurement configuration message at 412, or may be provided via a different message or signal. One or more of the MSs connected to cell 214/232, may begin using the default or updated CIO value with respect to cell 230 (instead of interim CIO value) concurrently with the reshaping of cell 214 (e.g., beginning at the identified TTI for cell reshaping and handover), or after the reshaping of cell 214 has been performed to form cell 232, as examples.

[0087] FIG. 5 is a flow chart illustrating operation of a base station according to an example implementation. Operation 510 includes providing, by a base station (BS), a first cell. Operation 520 includes making a decision, by the BS, to activate a second cell that at least partially overlaps the first cell. Operation 520 may include activating the second cell. Operation 530 includes sending, from the BS for the first cell to one or more mobile stations (MSs) connected to the first cell, a measurement configuration message instructing one or more of the MSs to measure a signal strength received from one or more neighbor cells including the second cell, the measurement configuration message including at least a cell identifier identifying the second cell and a cell individual offset

5 (CIO) value for the second cell to be applied by the one or more MSs, the CIO value set to an interim CIO value to cause one or more MSs connected to the first cell and within a threshold range of the second cell to send a measurement report to the first cell.

[0088] Operation 540 includes receiving a measurement report by the BS for the first cell from one or more of the MSs, the measurement report indicating a handover
10 from the first cell to the second cell. Operation 550 includes sending, by the BS for the first cell to one or more of the MSs that provided a measurement report indicating a handover to the second cell, a handover command to perform a random access-free handover to the second cell, the handover command including a cell identifier that identifies the second cell, a time offset value for the MS to use for transmitting to the
15 second cell, and a handover time indicator that indicates a time the MS should handover or switch from the first cell to the second cell. Operation 560 includes reshaping the first cell by the BS concurrently with a performing of the handover of the one or more MSs from the first cell to the second cell at the time indicated by the handover time indicator.

[0089] FIG. 6 is a flow chart illustrating operation of a mobile station according to an example implementation. Operation 610 includes receiving, by a mobile station (MS)
20 from a first cell, a measurement configuration message including a cell individual offset (CIO) value for a second cell that is set to an interim CIO value to cause one or more MSs connected to the first cell and within a threshold range of the second cell to send a measurement report to the first cell. Operation 620 includes sending a measurement
25 report from the MS to the first cell indicating a handover to the second cell. Operation 630 includes receiving, by the MS from the first cell, a handover command instructing the MS to perform a random access-free handover from the first cell to the second cell, the handover command including a time offset value for the MS and a handover time indicator. Operation 640 includes performing, by the MS, a random access-free
30 handover from the first cell to the second cell at the time indicated by the handover time indicator and concurrently with a reshaping of the first cell.

[0090] FIG. 7 is a flow chart illustrating operation of a mobile station (MS) according to another example implementation. Operation 710 includes receiving, by a mobile station (MS) from a first cell, a measurement configuration message including a
35 cell individual offset (CIO) value to be used by the MS for measurement of signals received from a second cell with respect to signals received from the first cell, the CIO value being set to an interim CIO value to cause one or more MSs connected to the first

5 cell and within a range of the second cell to send a measurement report to the first cell indicating handover to the second cell, the second cell at least partially overlapping the first cell. Operation 720 includes resetting (or updating), by the MS, the CIO value used by the MS for measurement of the second cell to a default or other updated CIO value beginning at or subsequent to a reshaping of the first cell.

10 **[0091]** FIG. 8 is a block diagram of a wireless station (e.g., BS or MS) 800 according to an example implementation. The wireless station 800 may include, for example, two RF (radio frequency) or wireless transceivers 802A, 802B, where each wireless transceiver includes a transmitter to transmit signals and a receiver to receive signals. The wireless station also includes a processor 804 to execute instructions or
15 software and control transmission and receptions of signals, and a memory 806 to store data and/or instructions.

[0092] Processor 804 may also make decisions or determinations, generate frames, packets or messages for transmission, decode received frames or messages for further processing, and other tasks or functions described herein. Processor 804, which
20 may be a baseband processor, for example, may generate messages, packets, frames or other signals for transmission via wireless transceiver 802. Processor 804 may control transmission of signals or messages over a wireless network, and may receive signals or messages, etc., via a wireless network (e.g., after being down-converted by wireless transceiver 802, for example). Processor 804 may be programmable and
25 capable of executing software or other instructions stored in memory or on other computer media to perform the various tasks and functions described above, such as one or more of the tasks or methods described above. Processor 804 may be (or may include), for example, hardware, programmable logic, a programmable processor that executes software or firmware, and/or any combination of these. Using other
30 terminology, processor 804 and transceiver 802 together may be considered as a wireless transmitter/receiver system, for example.

[0093] In addition, referring to FIG. 8, a controller (or processor) 808 may execute software and instructions, and may provide overall control for the station 800, and may provide control for other systems not shown in FIG. 8, such as controlling
35 input/output devices (e.g., display, keypad), and/or may execute software for one or more applications that may be provided on wireless station 800, such as, for example, an email program, audio/video applications, a word processor, a Voice over IP

5 application, or other application or software.

[0094] In addition, a storage medium may be provided that includes stored instructions, which when executed by a controller or processor may result in the processor 804, or other controller or processor, performing one or more of the functions or tasks described above.

10 **[0095]** Implementations of the various techniques described herein may be implemented in digital electronic circuitry, or in computer hardware, firmware, software, or in combinations of them. Implementations may implemented as a computer program product, i.e., a computer program tangibly embodied in an information carrier, e.g., in a machine-readable storage device or in a propagated signal, for execution by, or to
15 control the operation of, a data processing apparatus, e.g., a programmable processor, a computer, or multiple computers. A computer program, such as the computer program(s) described above, can be written in any form of programming language, including compiled or interpreted languages, and can be deployed in any form, including as a stand-alone program or as a module, component, subroutine, or other unit suitable for
20 use in a computing environment. A computer program can be deployed to be executed on one computer or on multiple computers at one site or distributed across multiple sites and interconnected by a communication network.

[0096] Method steps may be performed by one or more programmable processors executing a computer program to perform functions by operating on input
25 data and generating output. Method steps also may be performed by, and an apparatus may be implemented as, special purpose logic circuitry, e.g., an FPGA (field programmable gate array) or an ASIC (application-specific integrated circuit).

[0097] Processors suitable for the execution of a computer program include, by way of example, both general and special purpose microprocessors, and any one or
30 more processors of any kind of digital computer. Generally, a processor will receive instructions and data from a read-only memory or a random access memory or both. Elements of a computer may include at least one processor for executing instructions and one or more memory devices for storing instructions and data. Generally, a computer also may include, or be operatively coupled to receive data from or transfer
35 data to, or both, one or more mass storage devices for storing data, e.g., magnetic, magneto-optical disks, or optical disks. Information carriers suitable for embodying computer program instructions and data include all forms of non-volatile memory,

5 including by way of example semiconductor memory devices, e.g., EPROM, EEPROM, and flash memory devices; magnetic disks, e.g., internal hard disks or removable disks; magneto-optical disks; and CD-ROM and DVD-ROM disks. The processor and the memory may be supplemented by, or incorporated in, special purpose logic circuitry.

[0098] To provide for interaction with a user, implementations may be
10 implemented on a computer having a display device, e.g., a cathode ray tube (CRT) or liquid crystal display (LCD) monitor, for displaying information to the user and a keyboard and a pointing device, e.g., a mouse or a trackball, by which the user can provide input to the computer. Other kinds of devices can be used to provide for interaction with a user as well; for example, feedback provided to the user can be any form of sensory
15 feedback, e.g., visual feedback, auditory feedback, or tactile feedback; and input from the user can be received in any form, including acoustic, speech, or tactile input.

[0099] Implementations may be implemented in a computing system that includes a back-end component, e.g., as a data server, or that includes a middleware component, e.g., an application server, or that includes a front-end component, e.g., a
20 client computer having a graphical user interface or a Web browser through which a user can interact with an implementation, or any combination of such back-end, middleware, or front-end components. Components may be interconnected by any form or medium of digital data communication, e.g., a communication network. Examples of communication networks include a local area network (LAN) and a wide area network (WAN), e.g., the Internet.
25

[00100] While certain features of the described implementations have been illustrated as described herein, many modifications, substitutions, changes and equivalents will now occur to those skilled in the art. It is, therefore, to be understood that the appended claims are intended to cover all such modifications and changes as
30 fall within the true spirit of the various embodiments.

5 **WHAT IS CLAIMED IS:**

1. A method comprising:

providing, by a base station (BS), a first cell;

making a decision, by the BS, to activate a second cell that at least partially

10 overlaps the first cell;

 sending, from the BS for the first cell to one or more mobile stations (MSs)

connected to the first cell, a measurement configuration message instructing one or

more of the MSs to measure a signal strength received from one or more neighbor cells

including the second cell, the measurement configuration message including at least a

15 cell identifier identifying the second cell and a cell individual offset (CIO) value for the

second cell to be applied by the one or more MSs, the CIO value set to an interim CIO

value to cause one or more MSs connected to the first cell and within a threshold range
of the second cell to send a measurement report to the first cell;

 receiving a measurement report by the BS for the first cell from one or more of

20 the MSs, the measurement report indicating a handover from the first cell to the second
cell;

 sending, by the BS for the first cell to one or more of the MSs that provided a
measurement report indicating a handover to the second cell, a handover command to

perform a random access-free handover to the second cell, the handover command

25 including a cell identifier that identifies the second cell, a time offset value for the MS to

use for transmitting to the second cell, and a handover time indicator that indicates a

time the MS should handover or switch from the first cell to the second cell; and

 reshaping the first cell by the BS concurrently with a performing of the handover

of the one or more MSs from the first cell to the second cell at the time indicated by the

30 handover time indicator.

2. The method of claim 1 and further comprising sending, from the BS for

the first cell to one or more MSs connected to the first cell, a second measurement

configuration message to provide along with reshaping of the first cell a reset or default

35 CIO value to be used by one or more of the MSs with respect to measurement of signals
received from the second cell.

5 3. The method of claim 1 wherein the CIO offset value is to be applied by
the one or more MSs when measuring a signal strength of a signal received from the
second cell as compared to a signal strength of a signal received from the first cell, the
CIO value set to an interim CIO value to cause one or more MSs connected to the first
cell to send a measurement report to the first cell, the measurement report indicating a
10 handover to the second cell based on the CIO value, the signal strength of the signal
from the second cell and the signal strength of the signal from the first cell.

 4. The method of claim 1 wherein the receiving a measurement report
comprises receiving, by the BS for the first cell from one or more of the MSs, a
15 measurement report indicating a handover for the MS from the first cell to the second
cell based on a measured signal strength of the first cell, a measured signal strength of
the second cell, and the CIO value.

 5. The method of claim 1 wherein the second cell has been newly activated
20 by means of beam forming by an active antenna system to apply flexible cell splitting in
an azimuth domain

 6. The method of claim 1 and further comprising receiving, by the BS for the
second cell from one or more of the MSs, a handover confirm message confirming that a
25 handover of the MS from the first cell to the second cell has been performed.

 7. The method of claim 1, wherein the measurement configuration message
comprises a first measurement configuration message that is sent prior to the activation
of the second cell applying the interim CIO value with respect to the second cell. , the
30 method further comprising sending, by the BS with respect to the reshaped first cell to
one or more MSs that are connected to the reshaped first cell,

 8. The method of claim 1, wherein the measurement configuration message
comprises a first measurement configuration message, the method further comprising
35 sending a second measurement configuration message including an updated CIO value
to be used with respect to measurement of a signal received from the second cell.

5 9. The method of claim 1, wherein the reshaping the first cell comprises reshaping the first cell to decrease the coverage area of the first cell concurrently with the handover of one or more of the MSs from the first cell to the second cell.

10 10. The method of claim 1 wherein the first cell and the reshaped first cell have the same physical cell identifier (PCI).

15 11. The method of claim 1 wherein first cell is assigned a first physical cell identifier (PCI), and wherein the reshaped first physical cell is assigned a second PCI that is different than the first PCI.

 12. The method of claim 1 wherein the handover is performed as an intra-BS synchronized group handover of at least some MSs from the first cell to the second cell.

20 13. An apparatus comprising at least one processor and at least one memory including computer instructions, when executed by the at least one processor, cause the apparatus to:

 provide, by a base station (BS), a first cell;

 making a decision, by the BS, to activate a second cell that at least partially overlaps the first cell;

25 send, from the BS for the first cell to one or more mobile stations (MSs) connected to the first cell, a measurement configuration message instructing one or more of the MSs to measure a signal strength received from one or more neighbor cells including the second cell, the measurement configuration message including at least a cell identifier identifying the second cell and a cell individual offset (CIO) value for the second cell to be applied by the one or more MSs, the CIO value set to an interim CIO value to cause one or more MSs connected to the first cell and within a threshold range of the second cell to send a measurement report to the first cell;

 receive a measurement report by the BS for the first cell from one or more of the MSs, the measurement report indicating a handover from the first cell to the second cell;

35 send, by the BS for the first cell to one or more of the MSs that provided a measurement report indicating a handover to the second cell, a handover command to perform a random access-free handover to the second cell, the handover command

5 including a cell identifier that identifies the second cell, a time offset value for the MS to use for transmitting to the second cell, and a handover time indicator that indicates a time the MS should handover or switch from the first cell to the second cell; and

reshape the first cell by the BS concurrently with a performing of the handover of the one or more MSs from the first cell to the second cell at the time indicated by the

10 handover time indicator.

14. A computer program product, the computer program product comprising a non-transitory computer-readable storage medium and storing executable code that, when executed by at least one data processing apparatus, is configured to cause the at
15 least one data processing apparatus to perform a method comprising:

providing, by a base station (BS), a first cell;

making a decision, by the BS, to activate a second cell that at least partially overlaps the first cell;

sending, from the BS for the first cell to one or more mobile stations (MSs)
20 connected to the first cell, a measurement configuration message instructing one or more of the MSs to measure a signal strength received from one or more neighbor cells including the second cell, the measurement configuration message including at least a cell identifier identifying the second cell and a cell individual offset (CIO) value for the second cell to be applied by the one or more MSs, the CIO value set to an interim CIO
25 value to cause one or more MSs connected to the first cell and within a threshold range of the second cell to send a measurement report to the first cell;

receiving a measurement report by the BS for the first cell from one or more of the MSs, the measurement report indicating a handover from the first cell to the second cell;

30 sending, by the BS for the first cell to one or more of the MSs that provided a measurement report indicating a handover to the second cell, a handover command to perform a random access-free handover to the second cell, the handover command including a cell identifier that identifies the second cell, a time offset value for the MS to use for transmitting to the second cell, and a handover time indicator that indicates a
35 time the MS should handover or switch from the first cell to the second cell; and

5 reshaping the first cell by the BS concurrently with a performing of the handover of the one or more MSs from the first cell to the second cell at the time indicated by the handover time indicator.

15. A method comprising:

10 receiving, by a mobile station (MS) from a first cell, a measurement configuration message including a cell individual offset (CIO) value for a second cell that is set to an interim CIO value to cause one or more MSs connected to the first cell and within a threshold range of the second cell to send a measurement report to the first cell;
 sending a measurement report from the MS to the first cell indicating a handover
15 to the second cell;
 receiving, by the MS from the first cell, a handover command instructing the MS to perform a random access-free handover from the first cell to the second cell, the handover command including a time offset value for the MS and a handover time indicator; and
20 performing, by the MS, a random access-free handover from the first cell to the second cell at the time indicated by the handover time indicator and concurrently with a reshaping of the first cell.

16. The method of claim 15 wherein the receiving the measurement
25 configuration message comprises receiving, by the MS from a first cell, the measurement configuration message including a list of neighbor cells to be measured including at least the second cell, the measurement configuration message including a cell identifier identifying the second cell and the cell individual offset (CIO) value for the second cell that is set to an interim CIO value to cause one or more MSs connected to
30 the first cell and within a threshold range of the second cell to send a measurement report to the first cell indicating a handover to the second cell.

17. The method of claim 15 wherein the sending comprises sending the measurement report from the MS to the first cell indicating a handover to the second cell
35 based on a strength of signals received by the MS from the first cell and the second cell and the CIO value for the second cell.

5 18. The method of claim 15 wherein the receiving the handover command comprises receiving, by the MS from the first cell, the handover command instructing the MS to perform a random access-free and synchronized group handover from the first cell to the second cell, the handover command including a cell identifier of the second cell, a time offset value for the MS to use in transmitting to the second cell, and a handover
10 time indicator that indicates a time the MS should handover or switch from the first cell to the second cell.

 19. The method of claim 15 and further comprising sending, from the MS to the second cell, a handover confirm message indicating that the handover from the first
15 cell to the second cell is complete.

 20. The method of claim 15 wherein the handover is a synchronized group handover by a plurality of MSs from the first cell to the second cell at the time indicated by the handover time indicator.

20 21. The method of claim 15 wherein the reshaping comprises reshaping, by a base station (BS), the first cell to decrease a range or coverage area of the first cell concurrently with the handover of the MS from the first cell to the second cell at the time indicated by the handover time indicator.

25 22. The method of claim 15 wherein a base station provides both the first cell and the second cell, wherein the performing the handover comprises performing a random access-free and intra-BS handover including:

 receiving, by the MS, a handover command from the BS instructing the MS to
30 perform a handover from the first cell to the second cell, the handover command providing handover information including at least a cell identifier for the second cell, an identifier for the MS for the second cell, a resource assignment for the MS for the second cell, and a handover time indicator that indicates a time when the MS should handover or switch to the second cell; and

35 sending, based on the handover information received by the MS and the time offset value, a handover confirm message from the MS to the second cell to confirm that the handover of the MS to the second cell has been completed.

5

23. The method of claim 15 and further comprising:

receiving, by the MS from the BS in the handover command, a time offset value for the second cell, the time offset value for the second cell for the MS being the same as a time offset value for the first cell for the MS.

10

24. The method of claim 15 wherein the sending a measurement report comprises:

measuring, by the MS in response to receiving the measurement configuration message, a signal strength of a reference signal from the first cell and a signal strength of a reference signal from the second cell;

15

determining that the signal strength of the reference signal from the second cell, taking into account the CIO value for the second cell, is stronger than the signal strength of the reference signal from the first cell; and

sending, by the MS, a measurement report to the first cell indicating the second cell for handover.

20

25. The method of claim 15 wherein the receiving the measurement configuration message comprises receiving RRCConnectionReconfiguration message including a MeasConfig information element.

25

26. The method of claim 15 wherein the handover time indicator comprises a transmission time interval (TTI) that indicates a time that the handover to the second cell and a reshaping of the first cell are to be performed concurrently.

30

27. The method of claim 15 wherein the receiving a handover command comprises receiving, by the MS, a RRCConnectionReconfiguration message with a MobilityControlInfo information element that includes at least the cell identifier for the second cell, the identifier for the MS for the second cell and the resource assignment for the MS for the second cell, the handover command also including the handover time indicator that indicates a time when the MS should handover or switch to the second cell and a time offset value for the MS for the second cell.

35

5 28. The method of claim 22 wherein the receiving a handover confirm message comprises receiving a RRCConnectionReconfigurationComplete message.

 29. A computer program product, the computer program product comprising a non-transitory computer-readable storage medium and storing executable code that,
10 when executed by at least one data processing apparatus, is configured to cause the at least one data processing apparatus to perform a method comprising:

 receiving, by a mobile station (MS) from a first cell, a measurement configuration message including a cell individual offset (CIO) value for a second cell that is set to an interim CIO value to cause one or more MSs connected to the first cell and within a
15 threshold range of the second cell to send a measurement report to the first cell;

 sending a measurement report from the MS to the first cell indicating a handover to the second cell;

 receiving, by the MS from the first cell, a handover command instructing the MS to perform a random access-free handover from the first cell to the second cell, the
20 handover command including a time offset value for the MS and a handover time indicator; and

 performing, by the MS, a random access-free handover from the first cell to the second cell at the time indicated by the handover time indicator and concurrently with a reshaping of the first cell.
25

 30. An apparatus comprising at least one processor and at least one memory including computer instructions, when executed by the at least one processor, cause the apparatus to:

 receive, by a mobile station (MS) from a first cell, a measurement configuration
30 message including a cell individual offset (CIO) value for a second cell that is set to an interim CIO value to cause one or more MSs connected to the first cell and within a threshold range of the second cell to send a measurement report to the first cell;

 send a measurement report from the MS to the first cell indicating a handover to the second cell;

35 receive, by the MS from the first cell, a handover command instructing the MS to perform a random access-free handover from the first cell to the second cell, the

5 handover command including a time offset value for the MS and a handover time indicator; and

 perform, by the MS, a random access-free handover from the first cell to the second cell at the time indicated by the handover time indicator and concurrently with a reshaping of the first cell.

10

31. A method comprising:

 receiving, by a mobile station (MS) from a first cell, a measurement configuration message including a cell individual offset (CIO) value to be used by the MS for measurement of signals received from a second cell with respect to signals received
15 from the first cell, the CIO value being set to an interim CIO value to cause one or more MSs connected to the first cell and within a range of the second cell to send a measurement report to the first cell indicating handover to the second cell, the second cell at least partially overlapping the first cell;

 resetting, by the MS, the CIO value used by the MS for measurement of the
20 second cell to a default or other updated CIO value beginning at or subsequent to a reshaping of the first cell.

32. The method of claim 31 wherein the MS is not within range of the second cell and does not send a measurement report to the first cell indicating handover to the
25 second cell.

33. The method of claim 31 wherein the default or updated CIO value is reset by the MS concurrently with the reshaping of the first cell.

30 34. The method of claim 31 wherein both the interim CIO value and the default or updated CIO value are received by the MS via the measurement configuration message.

35 35. The method of claim 31 wherein the resetting comprises resetting, by the MS, the CIO value used by the MS for measurement of the second cell to a default or other updated CIO value beginning at or subsequent to a reshaping of the first cell, the

- 5 reshaping being performed concurrently with a group handover of one or more MSs from the first cell to the second cell.

36. The method of claim 31 wherein the measurement configuration message comprises a first measurement configuration message, and wherein the default or
10 updated CIO value is received by the MS via a second measurement configuration message.

37. A computer program product, the computer program product comprising a non-transitory computer-readable storage medium and storing executable code that,
15 when executed by at least one data processing apparatus, is configured to cause the at least one data processing apparatus to perform a method comprising:

receiving, by a mobile station (MS) from a first cell, a measurement configuration message including a cell individual offset (CIO) value to be used by the MS for measurement of signals received from a second cell with respect to signals received
20 from the first cell, the CIO value being set to an interim CIO value to cause one or more MSs connected to the first cell and within a range of the second cell to send a measurement report to the first cell indicating handover to the second cell, the second cell at least partially overlapping the first cell; and

resetting, by the MS, the CIO value used by the MS for measurement of the
25 second cell to a default or other updated CIO value beginning at or subsequent to a reshaping of the first cell.

38. An apparatus comprising at least one processor and at least one memory including computer instructions, when executed by the at least one processor, cause the
30 apparatus to:

receive, by a mobile station (MS) from a first cell, a measurement configuration message including a cell individual offset (CIO) value to be used by the MS for measurement of signals received from a second cell with respect to signals received from the first cell, the CIO value being set to an interim CIO value to cause one or more
35 MSs connected to the first cell and within a range of the second cell to send a measurement report to the first cell indicating handover to the second cell, the second cell at least partially overlapping the first cell; and

- 5 reset, by the MS, the CIO value used by the MS for measurement of the second cell to a default or other updated CIO value beginning at or subsequent to a reshaping of the first cell.

Example Wireless Network 130

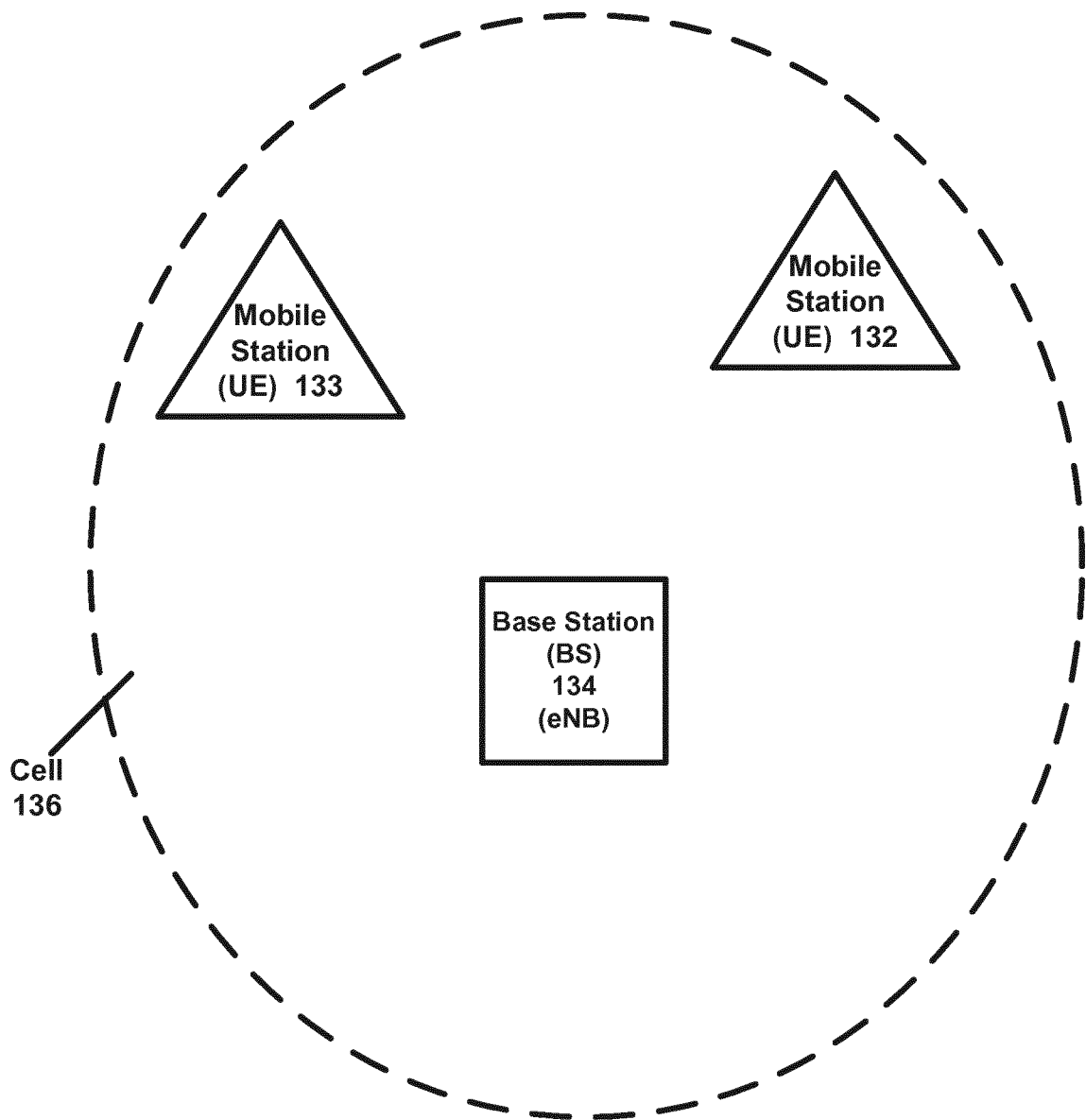


FIG. 1

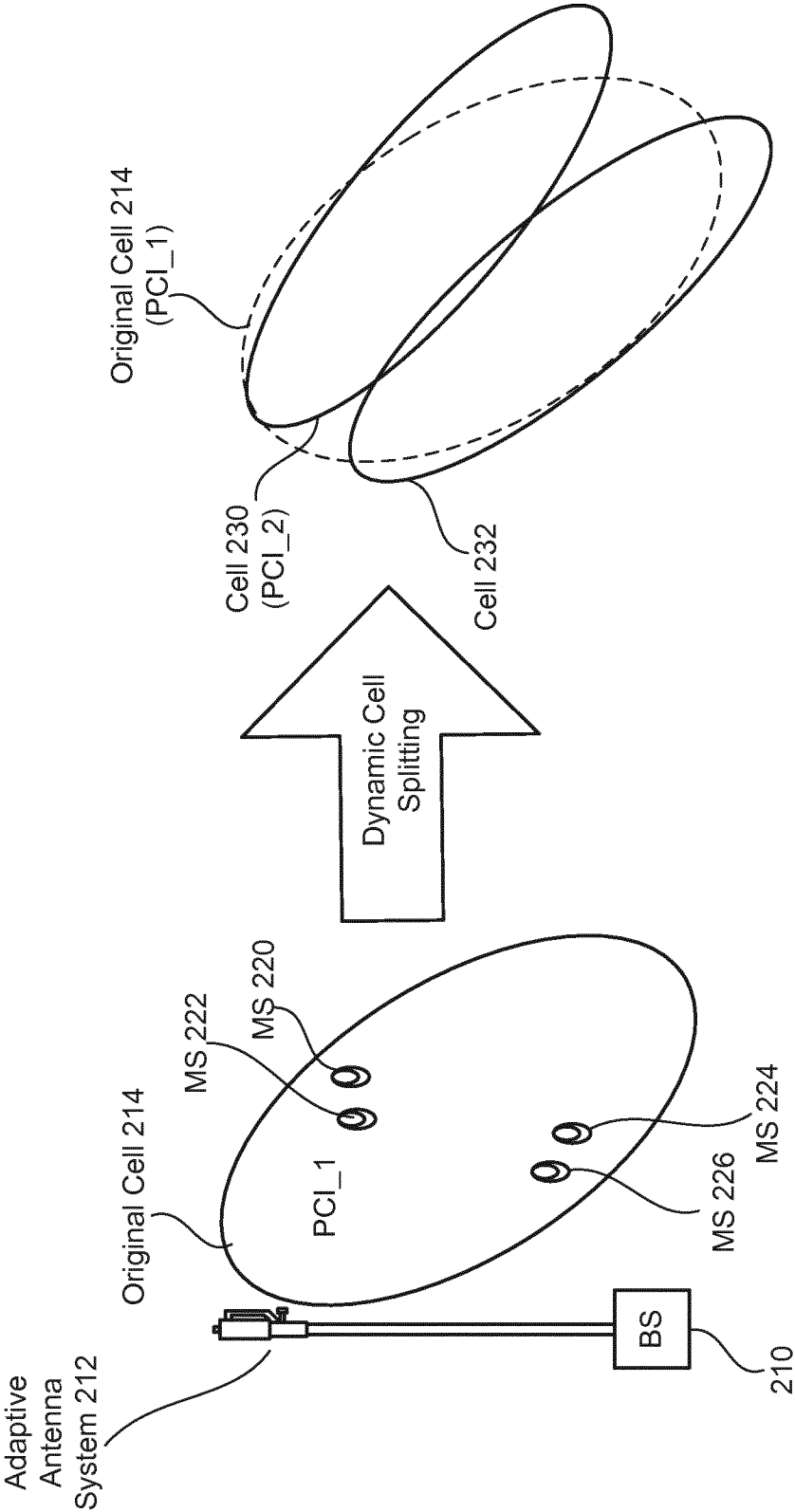


FIG. 2

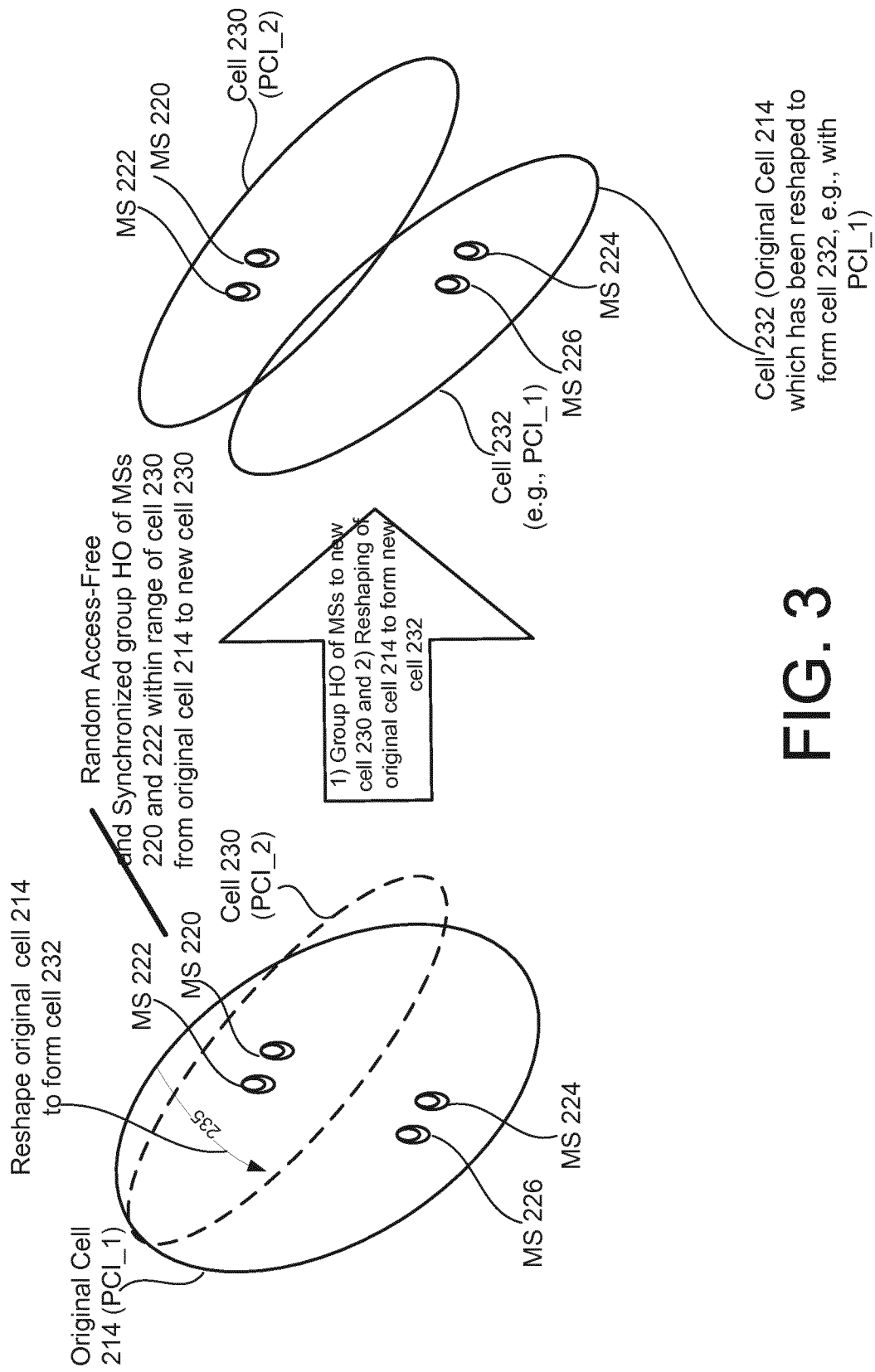


FIG. 3

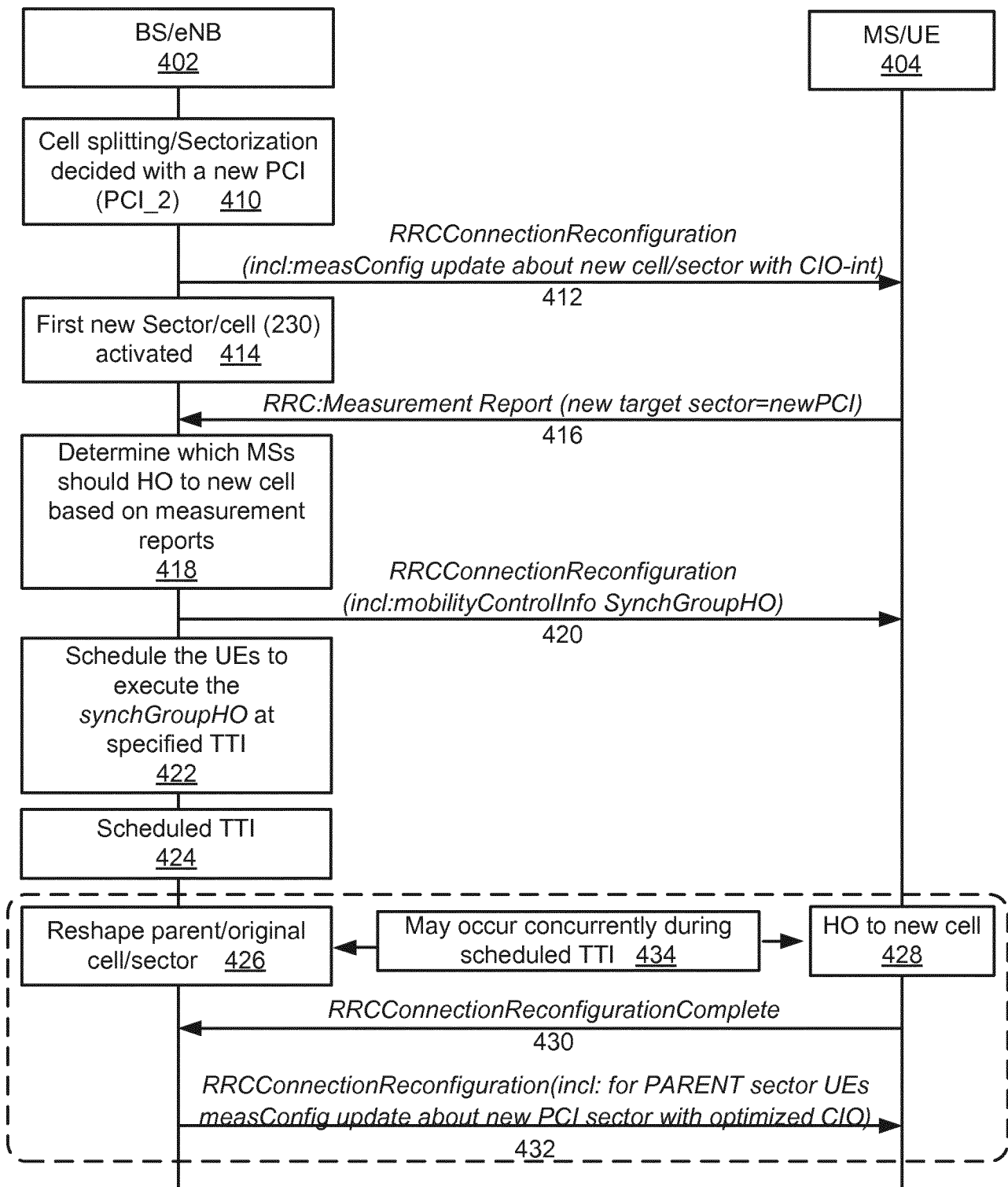
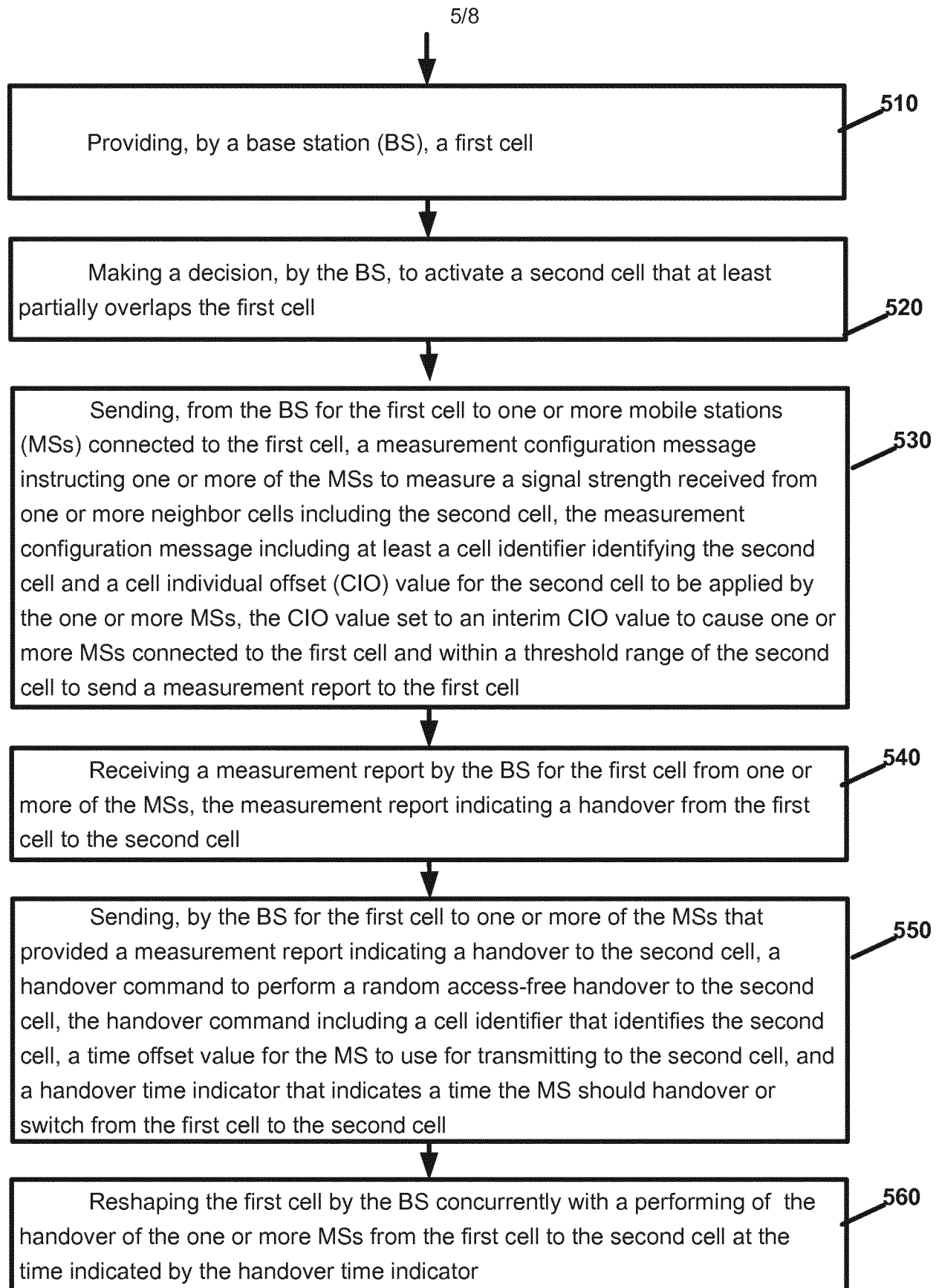
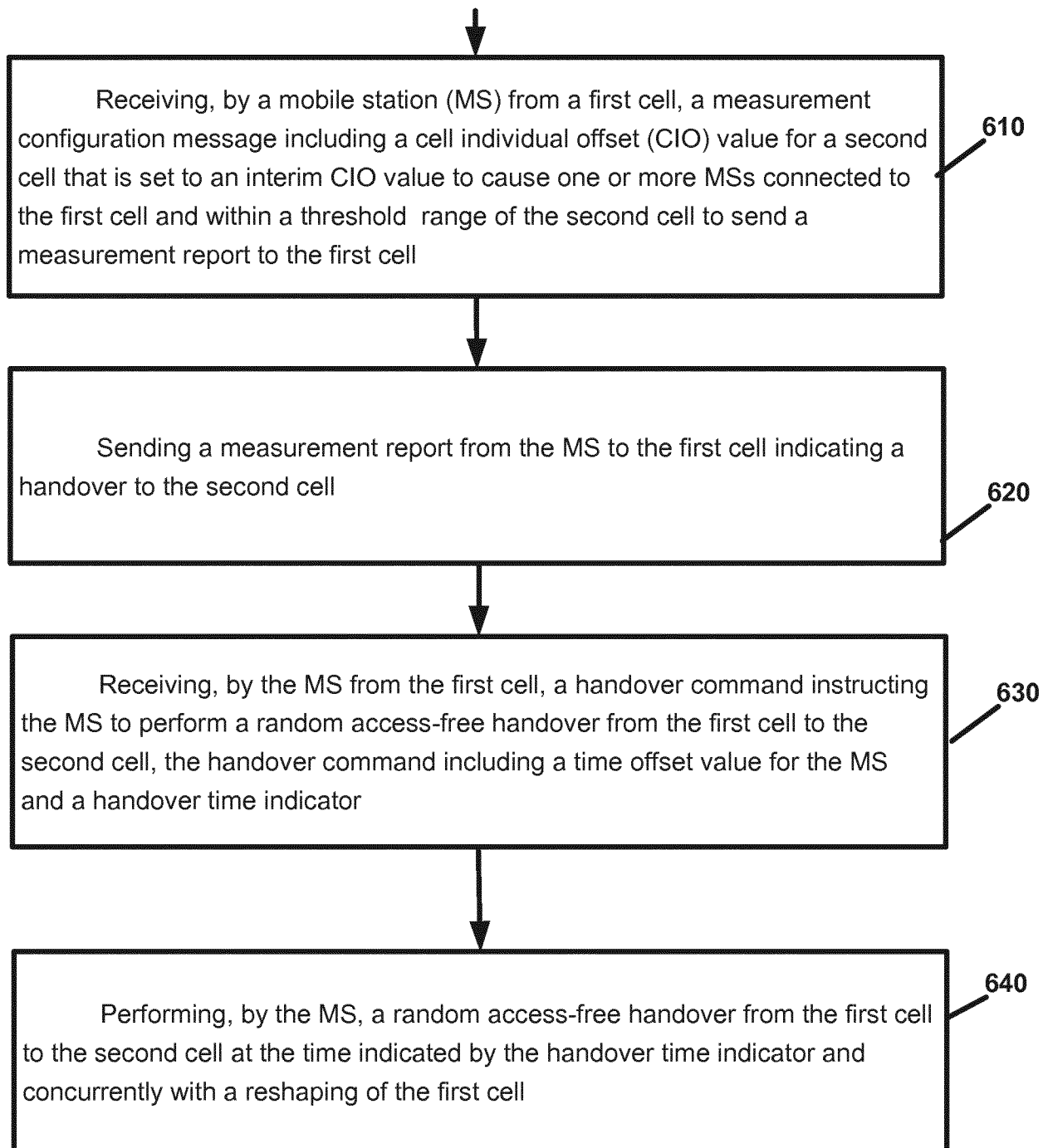
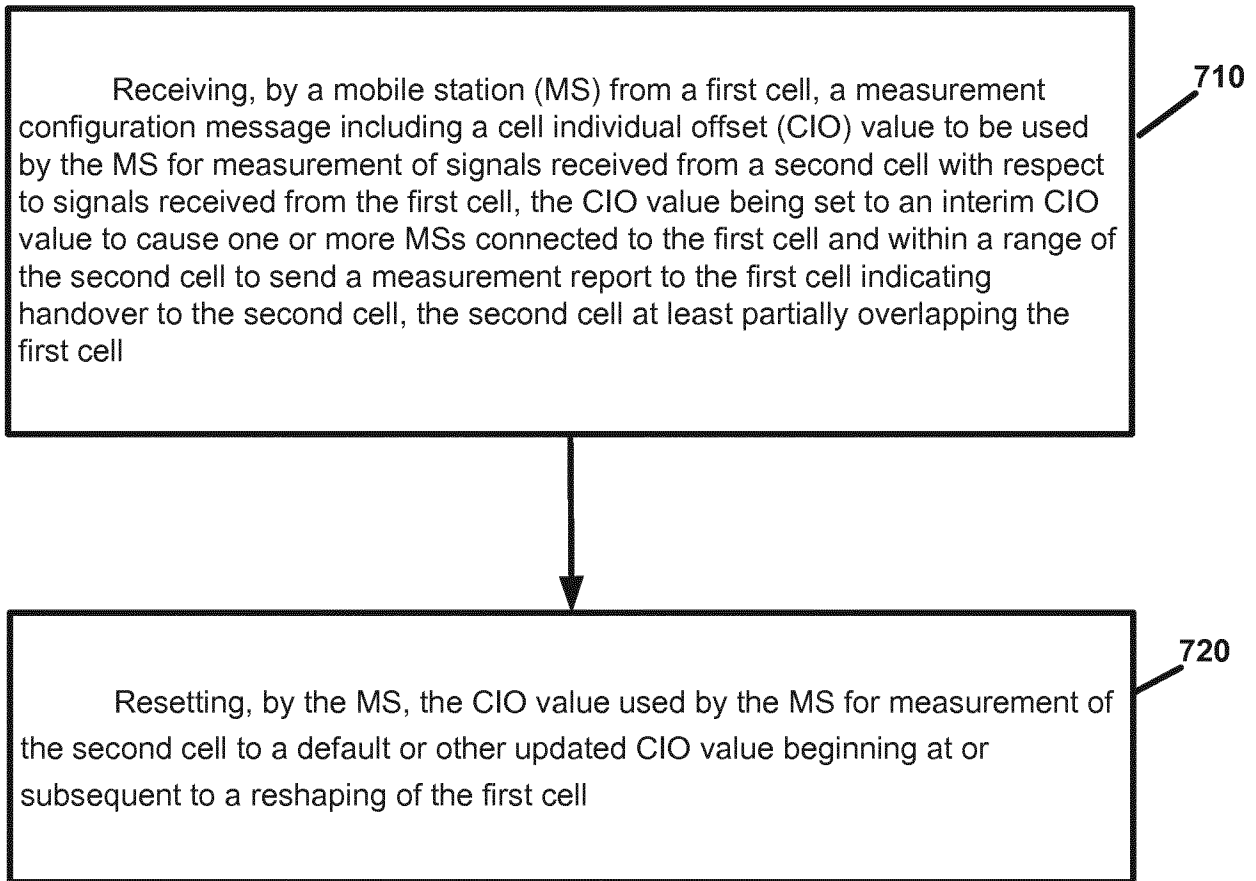
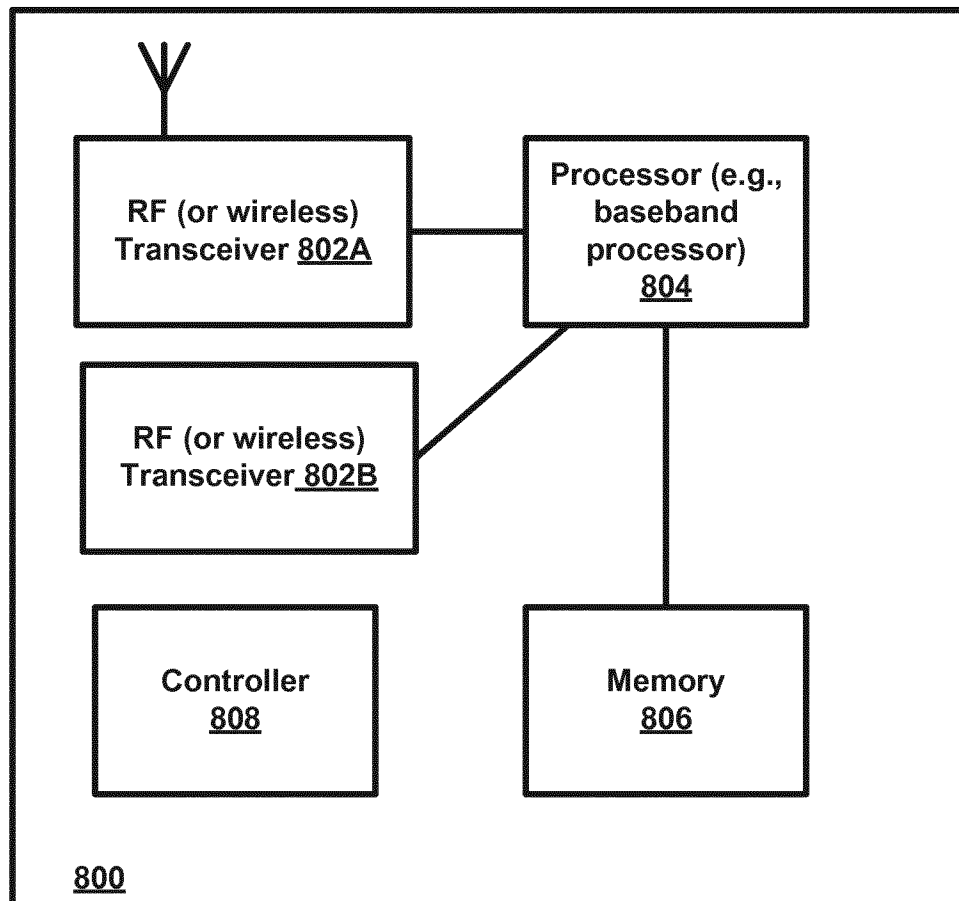


FIG. 4

**FIG. 5**

**FIG. 6**

**FIG. 7**

**FIG. 8**

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2014/055608

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	NSN: "Analysis of the problem related to providing acceptable connection continuity in case of cell splitting / merging", 3GPP DRAFT; R3-131762 SON AAS HOS, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE , vol. RAN WG3, no. Venice, Italy; 20131007 - 20131011 27 September 2013 (2013-09-27), XP050719934, Retrieved from the Internet: URL:http://www.3gpp.org/ftp/tsg_ran/WG3_Iu/TSGR3_81bis/Docs/ [retrieved on 2013-09-27]	31-38
Y	page 1, lines 9-14, paragraph 1 page 3, lines 15-26 -/--	1-30



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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

"E" earlier 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

9 February 2015

Date of mailing of the international search report

13/02/2015

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
 NL - 2280 HV Rijswijk
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 Fax: (+31-70) 340-3016

Authorized officer

Cantagallo, Marco

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2014/055608

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	----- NSN: "Service continuity during cell splitting / merging", 3GPP DRAFT; R3-132086 SON AAS CONTINUITY, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE , vol. RAN WG3, no. San Francisco, USA; 20131111 - 20131115 12 November 2013 (2013-11-12), XP050738178, Retrieved from the Internet: URL:http://www.3gpp.org/ftp/Meetings_3GPP_SYNC/RAN/RAN3/Docs/ [retrieved on 2013-11-12] page 4, paragraph 4	1-30
A	----- page 4, paragraph 4	31-38
A	----- "3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification (Release 12)", 3GPP STANDARD; 3GPP TS 36.331, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE, vol. RAN WG2, no. V12.1.0, 19 March 2014 (2014-03-19), pages 1-356, XP050769960, [retrieved on 2014-03-19] pages 90-94, paragraphs 5.5.4, 5.5.4.4	1-38
A	----- NSN: "Analysis of the impact of AAS-based techniques on SON features", 3GPP DRAFT; R3-131763 SON AAS, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE , vol. RAN WG3, no. Venice, Italy; 20131007 - 20131011 27 September 2013 (2013-09-27), XP050719935, Retrieved from the Internet: URL:http://www.3gpp.org/ftp/tsg_ran/WG3_Iu_TSGR3_81bis/Docs/ [retrieved on 2013-09-27] page 2, paragraph 2.3 ----- -/--	1-38

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2014/055608

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CATT: "Discussion of load balancing parameter and procedure", 3GPP DRAFT; R3-090911, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE, no. Seoul, Korea; 20090318, 18 March 2009 (2009-03-18), XP050341279, [retrieved on 2009-03-18] page 1, paragraph 2.1 -----	1-38

INTERNATIONAL SEARCH REPORT

International application No.
PCT/EP2014/055608

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.:

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: 1-30

Method of splitting a cell based on random access-free handover of the mobile stations at a predetermined timing.

2. claims: 31-38

Method of controlling handover of a mobile station based on the usage of different values of the cell individual offset field.
