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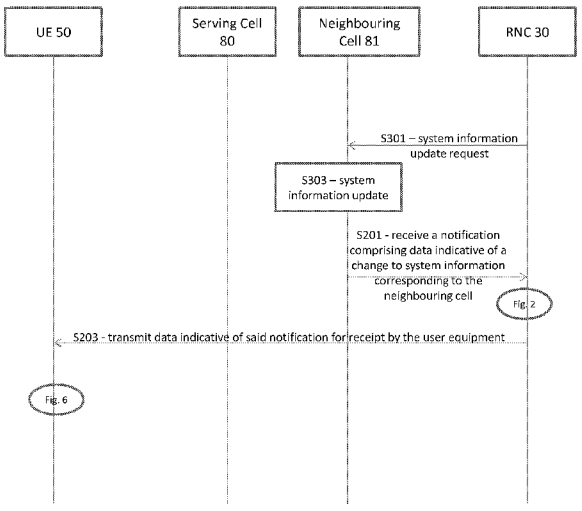

Figure 3

(57) Abstract: Embodiments of the invention provide methods, devices and computer programs arranged to facilitate provisioning of system information to a user equipment in a communications network. One embodiment comprises an apparatus for use in maintaining system information at a user equipment in a communications network, the system information corresponding to a plurality of cells, the plurality of cells comprising a serving cell currently serving the user equipment and a neighbouring cell that is a neighbour of the serving cell, the user equipment comprising a memory arranged to store at least system information corresponding to the neighbouring cell, wherein the apparatus comprises a processing system arranged to cause the apparatus to: whilst being served by the serving cell, receive a notification, said notification comprising data indicative of a change to system information corresponding to the neighbouring cell; and thereafter selectively monitor for a BCCH corresponding to the neighbouring cell, whereby to update the stored system information corresponding to the neighbouring cell.

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Wireless Communication System and Method

Technical Field

The present invention relates to wireless communication systems, methods, devices and computer programs, and more specifically relates to provisioning of system information to a user equipment in a communications network.

Background

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

AICH	acquisition indicator channel
BCCH	Broadcast Control Channel
CN	core network
DTCH	dedicated transport channel
E-AI	Extended acquisition indicator
E-DCH	Enhanced dedicated channel
eNB	enhanced node B
eNodeB	enhanced node B
IE	Information Element
MIB	Master Information Block
NB	Node B
NW	Network
PCCPCH	Primary Common Control Physical Channel
PRACH	Physical random access channel
PSC	Primary Scrambling Code
RACH	Random access channel
RB	radio bearer
RNC	radio network controller
RRC	radio resource control
SI	System Information
SIB	System Information Block
TTI	Transmission Time Interval

UE	user equipment
UL	uplink

In a typical cellular communications system, a geographical area is divided into several "cells" each of which is served by a base station (BS) having a radio coverage area. Base stations are in turn connected to a radio network controller (RNC). The wireless communications link (e.g., radio interface) between a mobile terminal or a wireless transmit/receive unit or a user equipment, and a corresponding base station includes a number of different logical channels which may be separated into two broad categories: traffic channels and control channels. Traffic channels are utilized by a serving base station controller to communicate call data (e.g., voice data) with a user equipment travelling within the cell defined by the base station. Control channels are utilized by the serving radio network controller or serving cell to communicate control data (e.g., system information) necessary to implement the connection of call data with the user equipment. Exemplary control channels include broadcast channels (BCH), Common Control Channels (CCCH) and Dedicated Control Channels (DCCH).

Each of the above three categories of control channels may still further be sub-divided into a number of logical channels for transporting different types of information between the serving base station (BS) and a user equipment. Broadcast control channels, for example, may be used to broadcast general system information defined by the broadcasting base station about the cell to mobile stations located within or near the cell.

In a cellular communications system or network, system information parameters are defined in order to provide network configuration, adaptation, and optimization options. Exemplary cell parameters (or system information parameters) include cell descriptions, location area identity, neighbouring cell description or relation, physical cell parameters, cell traffic load, traffic measurement information and/or core network information. Certain of these parameter values must be known by a user equipment before a first attempt to access the network can be made by that user equipment. Therefore, the parameters (cell parameters or system information

parameters) are typically broadcast regularly via control channel(s) in every cell of the network via so-called system information blocks (SIB).

The table below shows an overview of the categorization and types of system information blocks in a UMTS legacy system as defined in 3GPP TS 25.331, "Radio Resource Control (RRC)", version 11.1.0, the contents of which are incorporated herein by reference.

SIB	Content
SIB1	NAS info, UE timers/counters
SIB2	URA identity
SIB3	Cell selection parameters
SIB4	Cell selection par. for connected mode
SIB5	Common physical channels configuration
SIB6	Common physical channels configuration
SIB7	Interference/dynamic persistence level
SIB11	Measurement control
SIB11bis	IDLE mode neighbour cells
SIB12	Measurement control information for connected mode
SIB13	ANSI-41 info
SIB14	Outer loop power control information
SIB15	Positioning information
SIB16	Preconfiguration
SIB17	Configuration of shared physical channels in connected mode
SIB18	PLMN IDs of neighbouring cells

The serving cell may communicate limited system information in relation to one or more neighbouring cells via SIBs 11, 11bis and 12, or user equipments may acquire system information in relation to neighbouring cell by monitoring a BCCH corresponding to the neighbouring cell. However, there are no mechanisms for updating neighbouring cell's system information maintained at the user equipment.

Embodiments are directed towards providing updated neighbouring cell system information to user equipments.

Summary

In a first exemplary embodiment of the invention there is provided an apparatus for use in maintaining system information at a user equipment in a communications network, the system information corresponding to a plurality of cells, the plurality of cells comprising a serving cell currently serving the user equipment and a neighbouring cell that is a neighbour of the serving cell, and the user equipment comprising a memory arranged to store at least system information corresponding to the neighbouring cell, wherein the apparatus comprises a processing system arranged to cause the apparatus to: whilst being served by the serving cell, receive a notification, said notification comprising data indicative of a change to system information corresponding to the neighbouring cell; and thereafter selectively monitor for a BCCH corresponding to the neighbouring cell, whereby to update the stored system information corresponding to the neighbouring cell.

In a second exemplary embodiment of the invention there is provided a method of maintaining system information at a user equipment in a communications network, the system information corresponding to a plurality of cells, the plurality of cells comprising a serving cell currently serving the user equipment and a neighbouring cell that is a neighbour of the serving cell, and the user equipment comprising a memory arranged to store at least system information corresponding to the neighbouring cell, the method comprises: whilst being served by the serving cell, receiving a notification, said notification comprising data indicative of a change to system information corresponding to the neighbouring cell; and thereafter selectively monitoring for a BCCH corresponding to the neighbouring cell, whereby to update the stored system information corresponding to the neighbouring cell.

The first and second exemplary embodiments are most conveniently implemented in a user equipment. Embodiments also include a computer program comprising a set of instructions, which, when executed by a user equipment, cause the user equipment to perform a method according to the second embodiment.

In a third exemplary embodiment of the invention there is provided an apparatus for use in facilitating provisioning of system information to a user equipment in a communications network, said system information corresponding to a plurality of cells, the plurality of cells comprising a serving cell currently serving the user equipment and a neighbouring cell that is a neighbour of the serving cell, the apparatus comprising a processing system arranged to cause the apparatus to: receive a notification comprising data indicative of a change to system information corresponding to the neighbouring cell; and whilst the user equipment is being served by the serving cell, transmit data indicative of said notification for receipt by the user equipment, whereby to cause the user equipment to selectively monitor for a Broadcast Control Channel (BCCH) corresponding to said neighbouring cell in order to update the system information corresponding to the neighbouring cell maintained thereon.

In a fourth exemplary embodiment of the invention there is provided a method of facilitating provisioning of system information to a user equipment in a communications network, said system information corresponding to a plurality of cells, the plurality of cells comprising a serving cell currently serving the user equipment and a neighbouring cell that is a neighbour of the serving cell, the method comprising: receiving a notification comprising data indicative of a change to system information corresponding to the neighbouring cell; and whilst the user equipment is being served by the serving cell, transmitting data indicative of said notification for receipt by the user equipment, whereby to cause the user equipment to selectively monitor for a Broadcast Control Channel (BCCH) corresponding to said neighbouring cell in order to update the system information corresponding to the neighbouring cell maintained thereon.

The third and fourth exemplary embodiments are most conveniently implemented in a radio network controller or a base station. Embodiments also include a computer program comprising a set of instructions, which, when executed by a radio network controller or a base station, cause the radio access node or the base station to perform a method according to the fourth embodiment.

Embodiments generally involve methods, computer programs and apparatus for notifying a user equipment of a change to system information relating to a cell that

is a neighbour of the cell currently serving the user equipment. The notification may be provided via an RRC message sent directly from a radio access node, or via system information block information broadcast by the serving cell. These notifications can cause the user equipment to monitor for a BCCH corresponding to the neighbour cell and the user equipment can thereafter identify and store changed system information for the neighbour cell.

Further features and advantages of the invention will become apparent from the following description of preferred embodiments of the invention, given by way of example only, which is made with reference to the accompanying drawings.

Brief Description of the Drawings

Figure 1 is a simplified block diagram of a communication network within which embodiments operate.

Figure 2 is a logic flow diagram that illustrates the operation of a method, and a result of execution of computer program instructions embodied on a computer readable memory, in accordance with exemplary embodiments.

Figure 3 is a flow diagram that illustrates the various steps performed by UE, serving cell, neighbouring cell and radio network controller according to embodiments.

Figure 4 is a logic flow diagram that illustrates the operation of a method, and a result of execution of computer program instructions embodied on a computer readable memory, in accordance with exemplary embodiments.

Figure 5 is a flow diagram that illustrates the various steps performed by UE, serving cell, neighbouring cell and radio network controller according to embodiments.

Figure 6 is a logic flow diagram that illustrates the operation of a method, and a result of execution of computer program instructions embodied on a computer readable memory, in accordance with exemplary embodiments.

Figure 7 is a simplified block diagram of various network devices, which are exemplary electronic devices suitable for use in practicing the exemplary embodiments.

Detailed Description

Embodiments are concerned with facilitating provisioning of system information to a user equipment in a communications network.

In the following, examples and embodiments of the present invention are described with reference to the drawings. For illustrating the present invention, the examples and embodiments will be described in connection with a cellular communication network based on a 3GPP-type cellular system, such as universal mobile telecommunication system. However, it is to be noted that the present invention is not limited to an application using such types of communication system, but is also applicable in other types of communication systems and the like.

A basic system architecture of a communication network where examples of embodiments are practised may comprise a commonly known architecture of one or more communication networks comprising a wired or wireless access network subsystem and a core network. An exemplary communication network will now be described with reference to Figure 1. The communication network 10 may comprise a serving cell 80 that is currently serving a user equipment 50, a neighbouring cell 81 that is a neighbour of the serving cell 80 and a radio network controller (RNC) 30. The serving cell 80 and the neighbouring cell 81 each comprise a base station for serving user equipments within their radio coverage area. The user equipment 50 or another wireless transmit/receive device having a similar function, such as a modem chipset, a chip, a module etc., which can also be part of a user equipment or attached as a separate element to a user equipment, or the like, is able to communicate with the serving cell 80 or the neighbouring cell 81 via one or more channels for transmitting several types of data.

The communication network 10 may additionally be in communication with various mobility management entities (not shown), which facilitate mobility of user equipments across various carriers, and/or network management entities, which manage resources of the communication network 10.

The general functions and interconnections of the described elements, which also depend on the actual network type, are known to those skilled in the art and described in corresponding specifications, so that a detailed description thereof is omitted herein. However, it is to be noted that several additional network elements

and signalling links may be employed for a communication connection to or from user equipments, cells or RNCs, besides those described in detail herein below.

Referring to Figures 2 and 3, in accordance with an exemplary embodiment, the RNC 30 facilitates provisioning of system information to the user equipment 50 in the communications network 10. In particular, the RNC 30 provisions system information corresponding to individual cells, such as serving cell 80 and neighbouring cell 81, to user equipments within the respective cells. The RNC 30 is configured to provision the system information in response to receipt of a notification (hereinafter 'change notification') indicating that a change has been made to system information held by the neighbouring cell 81 (step 201). Such a change notification may be received from the neighbouring cell 81 that has received a system information update request from the RNC 30 (step 301). In response to receiving the system information update request (step 301), the neighbouring cell 81 updates its Master Information Block (MIB), Scheduling Block (SB) and one or more information elements of System Information Block (SIB) in accordance with the system information update request, and confirms to the RNC 30 that its system information has been updated via the aforementioned notification (step 201).

Once the notification has been received, the RNC 30 transmits data indicative of the change notification for receipt by the user equipment via the serving cell 80, whereby to cause the user equipment to selectively monitor for a Broadcast Control Channel (BCCH) corresponding to said neighbouring cell in order to update the system information corresponding to the neighbouring cell (step 203).

Alternatively, the RNC 30 may transmit the message indicated at step 203 automatically, e.g. the RNC 30 may automatically generate the message a predetermined time after transmitting a system information update request to the neighbouring cell 81, i.e. it being implicit that the neighbouring cell 81 has updated the system information as instructed by the RNC 30.

As will be explained further below, the user equipment 50, in response to receiving the change notification, then monitors for the BCCH corresponding to the neighbouring cell 81 in order to obtain system information corresponding to the neighbouring cell 81. This system information may include a number of SIBs and a MIB. As is well known in the art, the MIB comprises data indicative of a

corresponding Public Land Mobile Network (PLMN) identity to which a corresponding cell is associated with and the SIBs comprise system information corresponding to the cell. By provisioning the change notification to the user equipment, the RNC 30 causes the system information corresponding to the neighbouring cell 81 to be updated, thereby providing a mechanism for maintaining up-to-date neighbouring cell system information. Prior to the invention there were no mechanisms for triggering user equipments to update their stored neighbouring cell system information.

In at least some arrangements, the aforementioned change notification comprises data indicative of a MIB value tag corresponding to said neighbouring cell 81. As is well known in the art, the MIB value tag is indicative of whether or not system broadcasted on a corresponding BCCH has changed. Thus, by sending the MIB value tag to user equipments, the RNC 30 can indicate to user equipments whether or not system information corresponding to the neighbouring cell 81 has changed. As will be explained further below, the user equipment 50, in response to receiving the MIB value tag corresponding to the neighbouring cell 81, compares the received MIB value tag with a stored MIB value tag corresponding to the neighbouring cell 81 in order to determine whether or not the stored system information has changed, in which case the user equipment 50 acquires the updated system information by monitoring for the BCCH corresponding to the neighbouring cell 81. In effect, the RNC 30 can notify user equipments of changes to the system information by utilising conventional system information elements.

In at least some alternative arrangements, the RNC 30 may transmit a Radio Resource Control (RRC) message comprising the change notification, which may include the MIB value tag corresponding to the neighbouring cell 81. The RNC 30 could transmit the RRC message to every user equipment under its control, or only to user equipments that are being served by the serving cell 80. The RNC 30 may include change notifications relating to one or more further neighbouring cells in the RRC message.

The RRC message may further comprise data indicative of a Primary Scrambling Code (PSC) corresponding to the neighbouring cell 81. As will be

explained further below, the user equipments identify a BCCH corresponding to a given cell on the basis of the PSC.

In an alternative arrangement, the RNC 30 may transmit the aforementioned change notification for receipt by the aforementioned serving cell 80, which then broadcasts the change notification for receipt by the user equipment 50. An overview of this process will now be explained with reference to Figures 4 and 5.

In a first step, the serving cell 80, in response to receiving the aforementioned change notification from the RNC 30 or another network entity (step 401), transmits data indicative of the received change notification for receipt by the user equipment 50. The serving cell 80 may, for example, transmit the received change notification via an RRC message, or it may broadcast the received change notification on a BCCH of the serving cell for receipt by the user equipment 50. In at least some arrangements, the RNC 30 may instruct the serving cell 80 to select a particular transmission mechanism for transmitting the change notification to the user equipment 50. For example, the RNC 30 may instruct the serving cell 80 to transmit the received change notification via an RRC message.

In this arrangement the RNC 30 transmits a monitoring notification for receipt by the user equipment 50 (step 505), thereby triggering the user equipment 50 to monitor the BCCH corresponding to the serving cell. In effect, the RNC 30 notifies the user equipment 50 when to monitor for and receive transmissions on the BCCH associated with the serving cell 80, thereby relieving the user equipment 50 from repeatedly monitoring the BCCH associated with the serving cell 80. This means that the resources of the user equipment 50 can be utilised more efficiently.

The serving cell 80 subsequently broadcasts the aforementioned change notification in one of the SIBs, such as SIB 11, 11bis or 12, transmitted on the BCCH associated therewith. In this case, a conventional SIB, such as SIB 11, 11bis or 12, may be expanded by addition of an information element for providing the change notification. In at least some arrangements, this information element comprises data indicative of the MIB value tag corresponding to the neighbouring cell 81. In effect, the user equipment 50 is notified of changes to the system information corresponding to the neighbouring cell by means of data received via the BCCH of the serving cell 80.

It will be appreciated that the monitoring notification may alternatively be transmitted to the user equipment 50 by the serving cell 80 or the neighbouring cell 81.

An overview of the steps performed by the user equipment 50 in response to receiving the aforementioned change notification will now be described with reference to Figure 6. The user equipment 50 comprises a memory for storing system information corresponding to the neighbouring cell 81, which may have been provided earlier by the serving cell 80 by means of SIBs 11, 11bis and 12, and/or by means of data received on the BCCH associated with the neighbouring cell 81.

Whilst being served by the serving cell 80, the user equipment 50 receives the change notification (step 601). This causes the user equipment 50 to monitor for the BCCH corresponding to the neighbouring cell 81 in order to update the stored system information corresponding to the neighbouring cell (step 603). In one arrangement the change notification itself comprises sufficient information to enable the user equipment 50 to determine whether or not the neighbour cell system information has changed, and only monitors for the BCCH channel in the event that this information has changed. In an alternative arrangement, in response to receiving the change notification, the user equipment 50 may monitor for the BCCH associated with the neighbouring cell 81 and acquire the MIB value tag corresponding to the neighbouring cell 81 via the BCCH. This MIB value tag is then compared with the stored system information for the neighbour cell.

In either arrangements, and in response to the comparison, the user equipment 50 may selectively receive one or more SIBs transmitted on the BCCH corresponding to the neighbouring cell 81 in order to acquire one or more changes to the stored system information for the neighbour cell. As is well known in the art, each of the SIBs transmitted on the BCCH is accompanied by a value tag for use by user equipments in determining whether or not system information in the corresponding SIB has changed. Accordingly, for each of the SIBs transmitted on the BCCH associated with the neighbouring cell 81, the user equipment 50 acquires the value tag corresponding thereto, and in the event that the value tag is indicative of a change to the corresponding SIB, the user equipment 50 proceeds with acquiring the

corresponding SIB, thereby updating the stored system information for the neighbour cell.

As described above, the change notification may be received by the user equipment 50 via the aforementioned RRC message. The RRC message may further comprise data indicative of the aforementioned PSC corresponding to the neighbouring cell 81, in which case the user equipment 50 may identify the aforementioned BCCH associated with the neighbouring cell 81 on the basis of the received PSC.

Alternatively, and as described above, the user equipment 50 may receive the change notification via the aforementioned BCCH corresponding to the serving cell 80, in which case the change notification may comprise data indicative of at least in part of one of the aforementioned SIBs 11, 11bis or 12, which may in turn comprise data indicative of the MIB value tag associated with the neighbouring cell 81. The user equipment 50 may continuously or periodically monitor for transmissions on the BCCH associated with the serving cell 80, or, as described above, it may do so in response to receiving the aforementioned monitoring notification from a network entity, such as the RNC 30 or the serving cell 80.

As a further alternative, the user equipment 50 may monitor the BCCH corresponding to the neighbouring cell 81 on the basis of, for example, whether the neighbouring cell's 81 system information is relevant to the user equipment 50. For example, if the user equipment 50 is transiting into the coverage area of a further cell (not shown in the Figures), of which the neighbouring cell 81 is not considered to be a neighbour, then the user equipment 50 may disregard the change notification.

Figure 2 is a logic flow diagram which describes, broadly, the above exemplary embodiments from the perspective of a RNC 30.

Figure 4 is a logic flow diagram which describes, broadly, the above exemplary embodiments from the perspective of a serving cell 80.

Figure 6 is a logic flow diagram which describes, broadly, the above exemplary embodiments from the perspective of a user equipment 50.

Figures 2, 4 and 6 represent results from executing a computer program or an implementing algorithm stored in the local memory of the RNC 30, the serving cell 80 and the user equipment 50 respectively as well as illustrating the operation of a

method and a specific manner in which the processor and memory with computer program/algorithm are configured to cause the RNC 30, the serving cell 80 and the user equipment 50 respectively (or one or more components thereof) to operate. The various blocks shown in these Figures may also be considered as a plurality of coupled logic circuit elements constructed to carry out the associated function(s), or specific result or function of strings of computer program code stored in a computer readable memory. Such blocks and the functions they represent are non-limiting examples, and may be practiced in various components such as integrated circuit chips and modules, and that the exemplary embodiments of this invention may be realized in an apparatus that is embodied as an integrated circuit. The integrated circuit, or circuits, may comprise circuitry (as well as possibly firmware) for embodying at least one or more of a data processor or data processors, a digital signal processor or processors, baseband circuitry and radio frequency circuitry that are configurable so as to operate in accordance with the exemplary embodiments of this invention.

Reference is now made to Figure 7 for illustrating a simplified block diagram of various electronic devices and apparatus that are suitable for use in practicing the exemplary embodiments of this invention. In Figure 7 a serving cell 80 or a neighbouring cell 81 is adapted for communication over a wireless link with a user equipment 50, such as a mobile terminal. The serving cell 80 or the neighbouring cell 81 may be a macro Node B, an eNodeB, a remote radio head, relay station, a femto cell or home NodeB, or other type of base station/cellular network access node.

The user equipment 50 may include processing means such as at least one data processor (DP) 50A, storing means such as at least one computer-readable memory (MEM) 50B storing at least one computer program (PROG) 50C, and also communicating means such as a transmitter TX 50D and a receiver RX 50E for bidirectional wireless communications with the serving cell 80 and/or the neighbouring cell 81 via one or more antennas 50F.

The serving cell 80 includes its own processing means such as at least one data processor (DP) 80A, storing means such as at least one computer-readable memory (MEM) 80B storing at least one computer program (PROG) 80C, and communicating means such as a transmitter TX 80D and a receiver RX 80E for bidirectional wireless

communications with other devices under its control via one or more antennas 80F. There is a data and/or control path, termed at Figure 7 as a control link which in the 3GPP cellular system may be implemented as an Iub interface, coupling the serving cell 80 with the RNC 30, and over which the RNC 30 and the serving cell 80 may exchange control messages, such as change notifications. The serving cell 80 also has stored in its local memory at 80B the database which may comprise data indicative of system information transmitted on a BCCH corresponding thereto, as the case may be for the various embodiments detailed above.

Similarly, the neighbouring cell 81 includes its own processing means such as at least one data processor (DP) 81A, storing means such as at least one computer-readable memory (MEM) 81B storing at least one computer program (PROG) 81C, and communicating means such as a transmitter TX 81D and a receiver RX 81E for bidirectional wireless communications with other devices under its control via one or more antennas 81F. There is a data and/or control path, termed at Figure 7 as a control link which in the 3GPP cellular system may be implemented as an Iub interface, coupling the neighbouring cell 81 with the RNC 30, and over which the RNC 30 and the neighbouring cell 81 may exchange control messages, such as system information update requests and/or change notifications. The neighbouring cell 81 also has stored in its local memory at 81B the database which may comprise data indicative of system information transmitted on a BCCH corresponding thereto, as the case may be for the various embodiments detailed above.

The RNC 30 includes processing means such as at least one data processor (DP) 30A, storing means such as at least one computer-readable memory (MEM) 30B storing at least one computer program (PROG) 30C, and communicating means such as a modem 30H for bidirectional communication with the Node B 80 over the control link.

While not particularly illustrated for the user equipment 50, the serving cell 80, the neighbouring cell 81 and the RNC 30, those devices are also assumed to include as part of their wireless communicating means a modem which may be inbuilt on a radiofrequency RF front end chip within those devices 50, 80, 81 30 and which chip also carries the TX 50D/80D/81D/30D and the RX 50E/80E/81E/30E.

Various embodiments of the user equipment 50 can include, but are not limited to: cellular telephones; data cards, USB dongles, laptop computers, personal portable digital devices having wireless communication capabilities including but not limited to laptop/palmtop/tablet computers, digital cameras and music devices, and Internet appliances.

At least one of the PROGs 50C in the user equipment 50 is assumed to include program instructions that, when executed by the associated DP 50A, enable the device to operate in accordance with the exemplary embodiments of this invention, as detailed above. The serving cell 80, the neighbouring cell 81 and the RNC 30 also have software stored in their respective MEMs to implement certain aspects of these teachings. In these regards the exemplary embodiments of this invention may be implemented at least in part by computer software stored on the MEM 50B, 80B, 81B, 30B which is executable by the DP 50A of the user equipment 50, DP 80A of the serving cell 80, DP 81A of the neighbouring cell 81 and/or DP 30A of the RNC 30, or by hardware, or by a combination of tangibly stored software and hardware (and tangibly stored firmware). Electronic devices implementing these aspects of the invention need not be the entire devices as depicted at Figure 7, but exemplary embodiments may be implemented by one or more components of same such as the above described tangibly stored software, hardware, firmware and DP, or a system on a chip SOC, an application specific integrated circuit ASIC or a digital signal processor DSP.

Various embodiments of the computer readable MEMs 50B, 80B, 81B and 30B include any data storage technology type which is suitable to the local technical environment, including but not limited to semiconductor based memory devices, magnetic memory devices and systems, optical memory devices and systems, fixed memory, removable memory, disc memory, flash memory, DRAM, SRAM, EEPROM and the like. Various embodiments of the DPs 50A, 30A, 81A and 80A include but are not limited to general purpose computers, special purpose computers, microprocessors, digital signal processors (DSPs) and multi-core processors.

Further, some of the various features of the above non-limiting embodiments may be used to advantage without the corresponding use of other described features. The foregoing description should therefore be considered as merely illustrative of the

principles, teachings and exemplary embodiments of this invention, and not in limitation thereof.

The above embodiments are to be understood as illustrative examples of the invention. Further embodiments of the invention are envisaged. It is to be understood that any feature described in relation to any one embodiment may be used alone, or in combination with other features described, and may also be used in combination with one or more features of any other of the embodiments, or any combination of any other of the embodiments. Furthermore, equivalents and modifications not described above may also be employed without departing from the scope of the invention, which is defined in the accompanying claims.

Claims

1. An apparatus for use in maintaining system information at a user equipment in a communications network, the system information corresponding to a plurality of cells, the plurality of cells comprising a serving cell currently serving the user equipment and a neighbouring cell that is a neighbour of the serving cell, the user equipment comprising a memory arranged to store at least system information corresponding to the neighbouring cell, wherein the apparatus comprises a processing system arranged to cause the apparatus to:

whilst being served by the serving cell, receive a notification, said notification comprising data indicative of a change to system information corresponding to the neighbouring cell; and thereafter

selectively monitor for a BCCH corresponding to the neighbouring cell, whereby to update the stored system information corresponding to the neighbouring cell.

2. An apparatus according to claim 1, wherein the stored system information comprises data indicative of a first MIB value tag corresponding to said neighbouring cell and said notification comprises data indicative of a second MIB value tag corresponding to said neighbouring cell, the processing system being arranged to cause the apparatus to:

compare said first and second MIB value tags, whereby to determine whether the stored system information corresponding to the neighbouring cell has changed, and,

responsive to a determination that the stored system information corresponding to the neighbouring cell has changed, monitor for the BCCH corresponding to said neighbouring cell.

3. An apparatus according to claim 2, wherein the second MIB value tag is received via the BCCH corresponding to the neighbouring cell, wherein the processing system is arranged to cause the apparatus to selectively receive a further

broadcast on said BCCH in order to acquire one or more changes to the stored system information.

4. An apparatus according to any one of the preceding claims, wherein the notification is received via an RRC message.

5. An apparatus according to claim 4, wherein the RRC message further comprises data indicative of a PSC corresponding to the neighbouring cell, and the processing system is arranged to cause the apparatus to identify said BCCH corresponding to the neighbouring cell on the basis received PSC corresponding to the neighbouring cell.

6. An apparatus according to claim 2 or claim 3, wherein the notification is received via a further BCCH corresponding to the serving cell, said notification comprising data indicative of at least one of a SIB 11, 11bis or 12, wherein the at least one of a SIB 11, 11bis or 12 comprises said second MIB value tag.

7. An apparatus according to claim 6, wherein, responsive to receiving a further notification, the processing system is arranged to cause the apparatus to monitor for the further BCCH, whereby to receive said notification.

8. An apparatus according to any one of the preceding claims, wherein the apparatus comprises a modem.

9. An apparatus for use in facilitating provisioning of system information to a user equipment in a communications network, said system information corresponding to a plurality of cells, the plurality of cells comprising a serving cell currently serving the user equipment and a neighbouring cell that is a neighbour of the serving cell, the apparatus comprising a processing system arranged to cause the apparatus to:

receive a notification comprising data indicative of a change to system information corresponding to the neighbouring cell; and

whilst the user equipment is being served by the serving cell, transmit data indicative of said notification for receipt by the user equipment, whereby to cause the user equipment to selectively monitor for a Broadcast Control Channel (BCCH) corresponding to said neighbouring cell in order to update the system information corresponding to the neighbouring cell maintained thereon.

10. An apparatus according to claim 9, wherein said notification comprises data indicative of a Master Information Block (MIB) value tag corresponding to said neighbouring cell.

11. An apparatus according to claim 9 or claim 10, wherein the processing system is arranged to cause the apparatus to transmit a Radio Resource Control (RRC) message comprising said notification.

12. An apparatus according to claim 11, wherein the RRC message further comprises data indicative of a Primary Scrambling Code (PSC) corresponding to said neighbouring cell.

13. An apparatus according to claim 9 or claim 10, wherein the processing system is arranged to cause the apparatus to transmit data indicative of a further notification, whereby to cause the user equipment to receive a transmission on a further BCCH corresponding to the serving cell, said transmission comprising data indicative of said notification.

14. An apparatus according to claim 13, wherein said transmission comprises data indicative of at least one of a System Information Block (SIB) 11, 11bis or 12 corresponding to the serving cell, said at least one of SIB 11, 11bis or 12 comprising said notification, and the processing system is arranged to cause the apparatus to transmit said transmission on said further BCCH corresponding to the serving cell.

15. An apparatus according to claim 14, wherein the SIB 11, 11bis or 12 comprises said data indicative of the MIB value tag.

16. A base station comprising an apparatus according to any one of claim 9 to claim 15.

17. A radio network controller comprising an apparatus according to any one of claim 9 to claim 15.

18. A method of maintaining system information at a user equipment in a communications network, the system information corresponding to a plurality of cells, the plurality of cells comprising a serving cell currently serving the user equipment and a neighbouring cell that is a neighbour of the serving cell, the user equipment comprising a memory arranged to store at least system information corresponding to the neighbouring cell, in which the method comprises:

whilst being served by the serving cell, receiving a notification, said notification comprising data indicative of a change to system information corresponding to the neighbouring cell; and thereafter

selectively monitoring for a BCCH corresponding to the neighbouring cell, whereby to update the stored system information corresponding to the neighbouring cell.

19. A method according to claim 18, wherein the stored system information comprises data indicative of a first MIB value tag corresponding to said neighbouring cell and said notification comprises data indicative of a second MIB value tag corresponding to said neighbouring cell, the method further comprising:

comparing said first and second MIB value tags, whereby to determine whether the stored system information corresponding to the neighbouring cell has changed, and,

responsive to a determination that the stored system information corresponding to the neighbouring cell has changed, monitoring for the BCCH corresponding to said neighbouring cell.

20. A method according to claim 19, wherein the second MIB value tag is received via the BCCH corresponding to the neighbouring cell, in which the method further comprises selectively receiving a further broadcast on said BCCH in order to acquire one or more changes to the stored system information.

21. A method according to any one of claim 18 to claim 20, wherein the notification is received via an RRC message.

22. A method according to claim 21, wherein the RRC message further comprises data indicative of a PSC corresponding to the neighbouring cell, and the method further comprises identifying said BCCH corresponding to the neighbouring cell on the basis received PSC corresponding to the neighbouring cell.

23. A method according to claim 19 or claim 20, wherein the notification is received via a further BCCH corresponding to the serving cell, said notification comprising data indicative of at least one of a SIB 11, 11bis or 12, wherein the at least one of a SIB 11, 11bis or 12 comprises said second MIB value tag.

24. A method according to claim 23, wherein, responsive to receiving a further notification, the method comprises monitoring for the further BCCH, whereby to receive said notification.

25. A method of facilitating provisioning of system information to a user equipment in a communications network, said system information corresponding to a plurality of cells, the plurality of cells comprising a serving cell currently serving the user equipment and a neighbouring cell that is a neighbour of the serving cell, the method comprising:

receiving a notification comprising data indicative of a change to system information corresponding to the neighbouring cell; and

whilst the user equipment is being served by the serving cell, transmitting data indicative of said notification for receipt by the user equipment, whereby to cause the

user equipment to selectively monitor for a Broadcast Control Channel (BCCH) corresponding to said neighbouring cell in order to update the system information corresponding to the neighbouring cell maintained thereon.

26. A method according to claim 25, wherein said notification comprises data indicative of a Master Information Block (MIB) value tag corresponding to said neighbouring cell.

27. A method according to claim 25 or claim 26, comprising transmitting a Radio Resource Control (RRC) message comprising said notification.

28. A method according to claim 27, wherein the RRC message further comprises data indicative of a Primary Scrambling Code (PSC) corresponding to said neighbouring cell.

29. A method according to claim 25 or claim 26, comprising transmitting data indicative of a further notification, whereby to cause the user equipment to receive a transmission on a further BCCH corresponding to the serving cell, said transmission comprising data indicative of said notification.

30. A method according to claim 29, wherein said transmission comprises data indicative of at least one of a System Information Block (SIB) 11, 11bis or 12 corresponding to the serving cell, said at least one of SIB 11, 11bis or 12 comprising said notification, and the method comprising transmitting said transmission on said further BCCH corresponding to the serving cell.

31. A method according to claim 30, wherein the SIB 11, 11bis or 12 comprises said data indicative of the MIB value tag.

32. A computer program comprising a set of instructions, which, when executed by a user equipment in a communications network, causes the user equipment to perform a method of maintaining system information at the user

equipment, the system information corresponding to a plurality of cells, the plurality of cells comprising a serving cell currently serving the user equipment and a neighbouring cell that is a neighbour of the serving cell, the user equipment comprising a memory arranged to store at least system information corresponding to the neighbouring cell, the set of instructions causing the user equipment to perform the steps of:

whilst being served by the serving cell, receiving a notification, said notification comprising data indicative of a change to system information corresponding to the neighbouring cell; and thereafter

selectively monitoring for a BCCH corresponding to the neighbouring cell, whereby to update the stored system information corresponding to the neighbouring cell.

33. A computer program comprising a set of instructions, which, when executed by a network node in a communications network, causes the network node to perform a method of facilitating provisioning of system information to a user equipment in the communications network, said system information corresponding to a plurality of cells, the plurality of cells comprising a serving cell currently serving the user equipment and a neighbouring cell that is a neighbour of the serving cell, the set of instructions causing the network node to perform the steps of:

receiving a notification comprising data indicative of a change to system information corresponding to the neighbouring cell; and

whilst the user equipment is being served by the serving cell, transmitting data indicative of said notification for receipt by the user equipment, whereby to cause the user equipment to selectively monitor for a Broadcast Control Channel (BCCH) corresponding to said neighbouring cell in order to update the system information corresponding to the neighbouring cell maintained thereon.

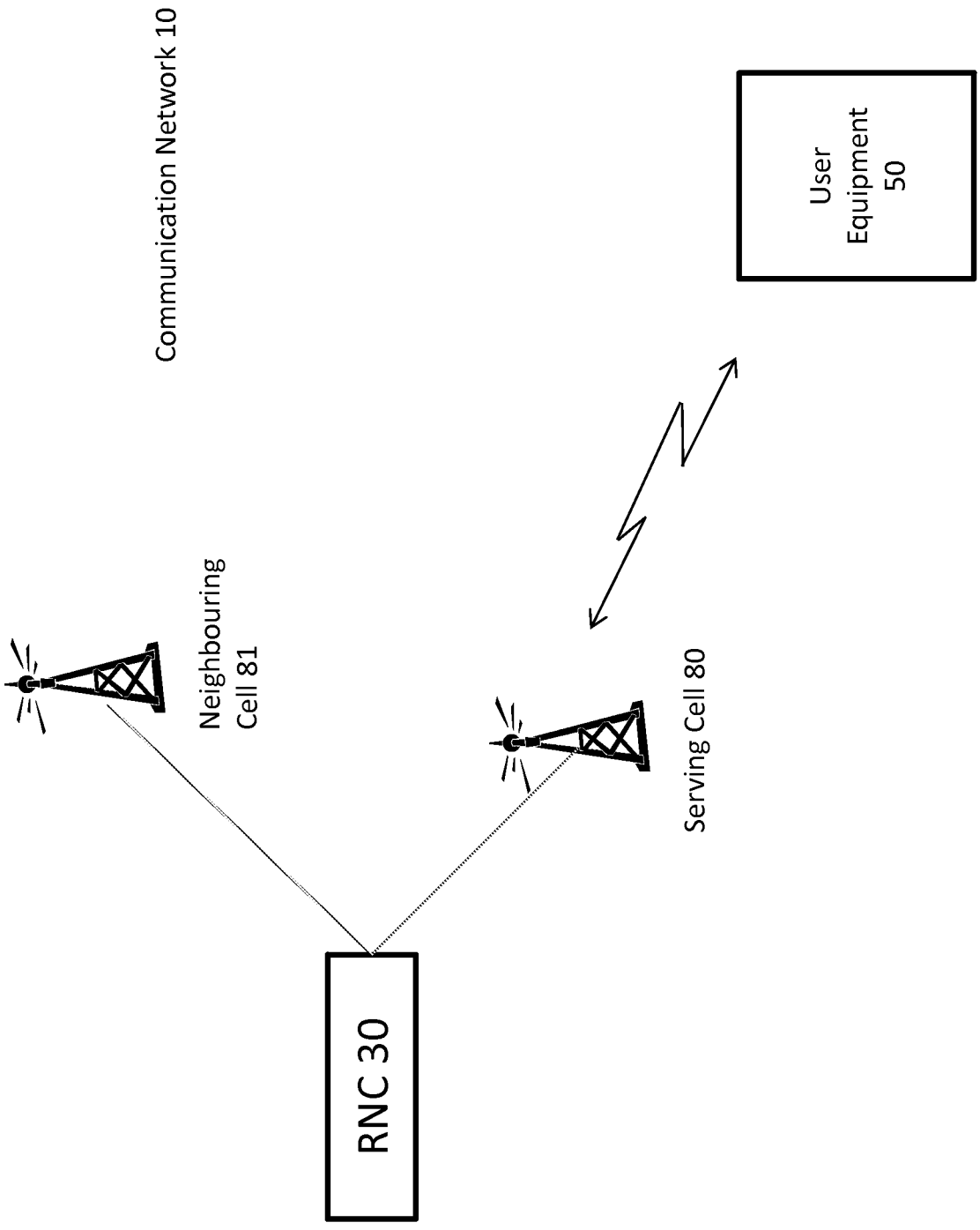
Communication Network 10
User Equipment 50
Neighbouring Cell 81
Serving Cell 80
RNC 30

Figure 1

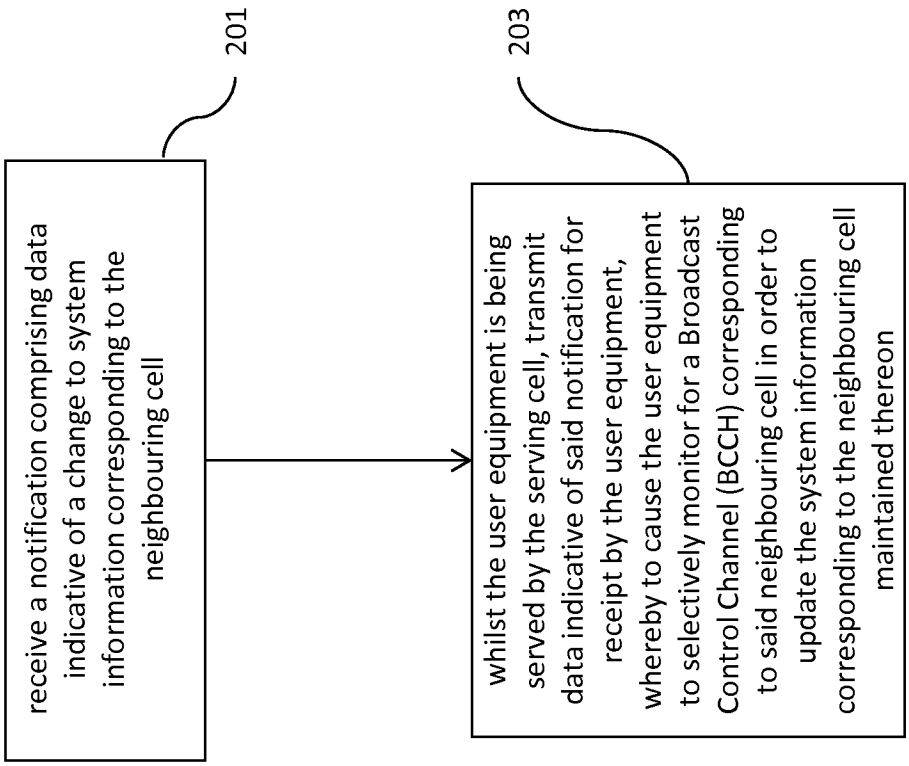
201
203
receive a notification comprising data indicative of a change to system information corresponding to the neighbouring cell
whilst the user equipment is being served by the serving cell, transmit data indicative of said notification for receipt by the user equipment, whereby to cause the user equipment to selectively monitor for a Broadcast Control Channel (BCCH) corresponding to said neighbouring cell in order to update the system information corresponding to the neighbouring cell maintained thereon

Figure 2

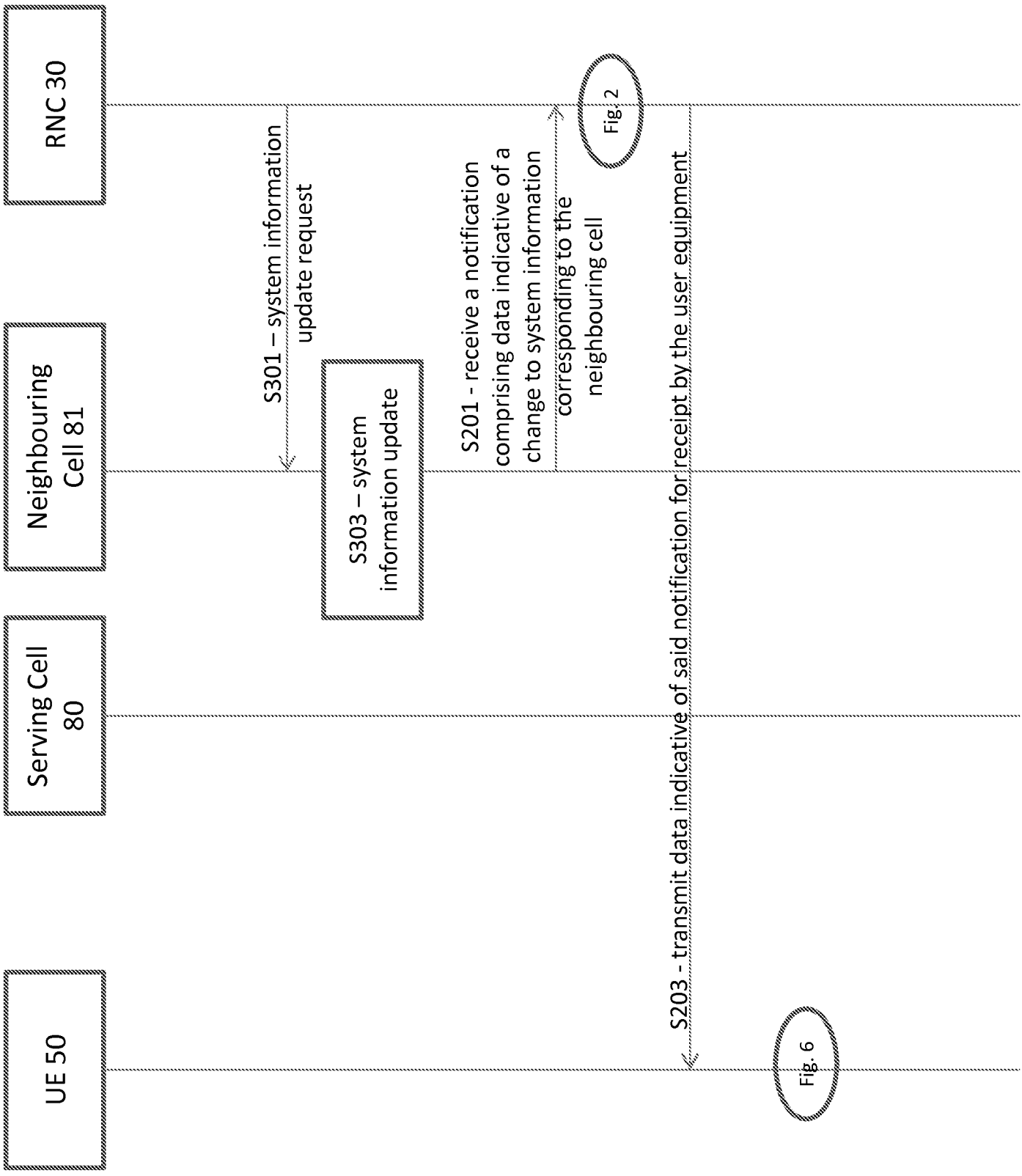
UE 50
Serving Cell 80
Neighbouring Cell 81
RNC 30
S301 – system information update request
S303 – system information update
S201 - receive a notification comprising data indicative of a change to system information corresponding to the neighbouring cell
Fig. 2
S203 - transmit data indicative of said notification for receipt by the user equipment
Fig. 6

Figure 3

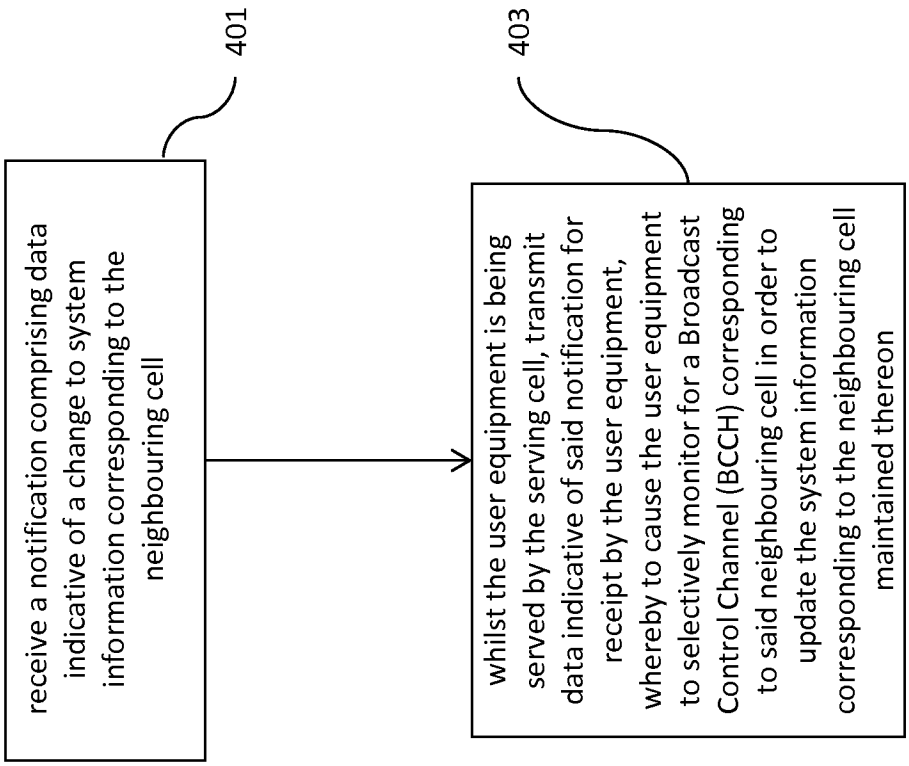
401
403
receive a notification comprising data indicative of a change to system information corresponding to the neighbouring cell
whilst the user equipment is being served by the serving cell, transmit data indicative of said notification for receipt by the user equipment, whereby to cause the user equipment to selectively monitor for a Broadcast Control Channel (BCCH) corresponding to said neighbouring cell in order to update the system information corresponding to the neighbouring cell maintained thereon

Figure 4

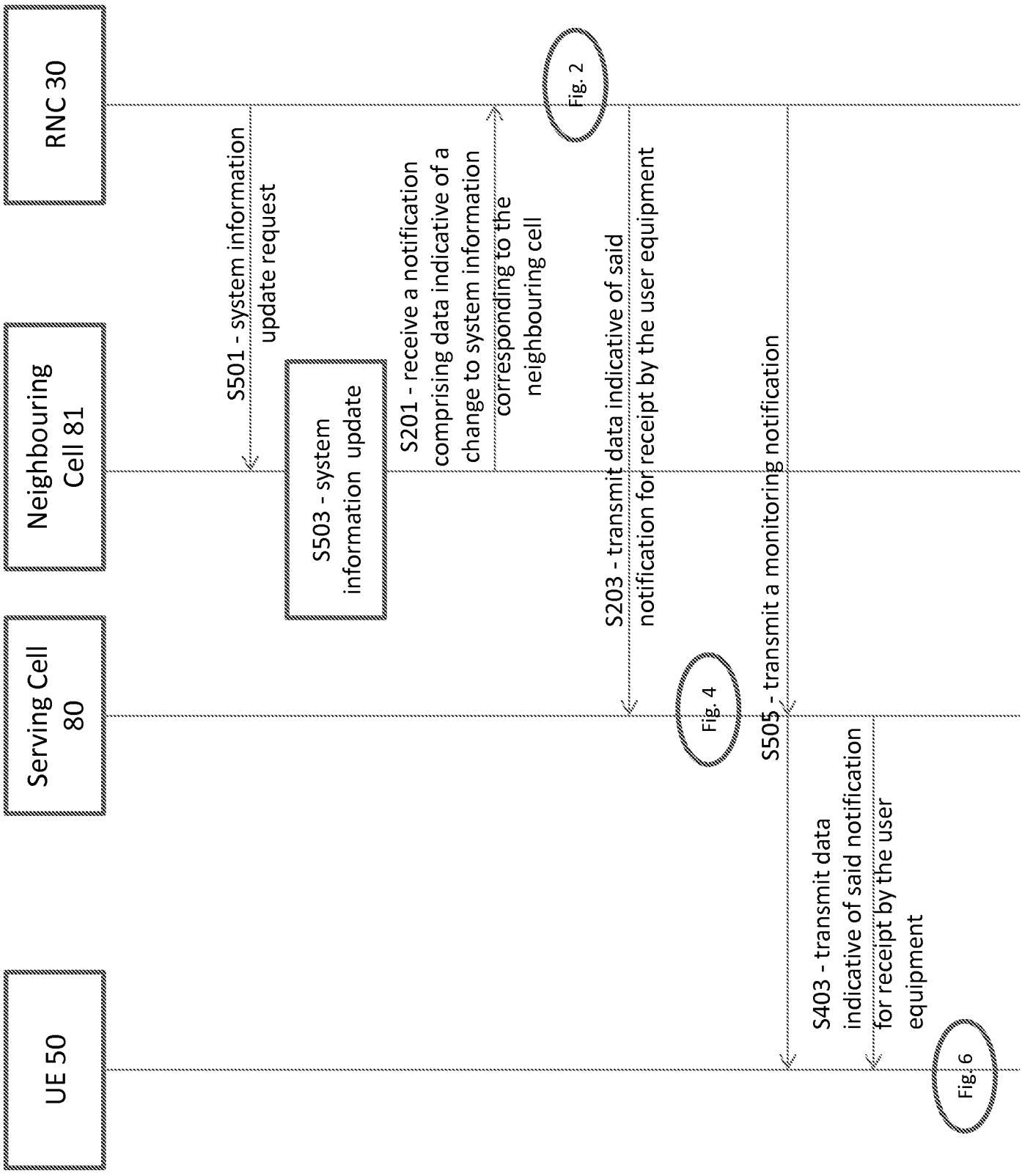
UE 50
Serving Cell 80
Neighbouring Cell 81
RNC 30
S501 - system information update request
S503 - system information update
S201 - receive a notification comprising data indicative of a change to system information corresponding to the neighbouring cell
Fig. 2
S203 - transmit data indicative of said notification for receipt by the user equipment
Fig. 4
S505 - transmit a monitoring notification
S403 - transmit data indicative of said notification for receipt by the user equipment
Fig. 6

Figure 5

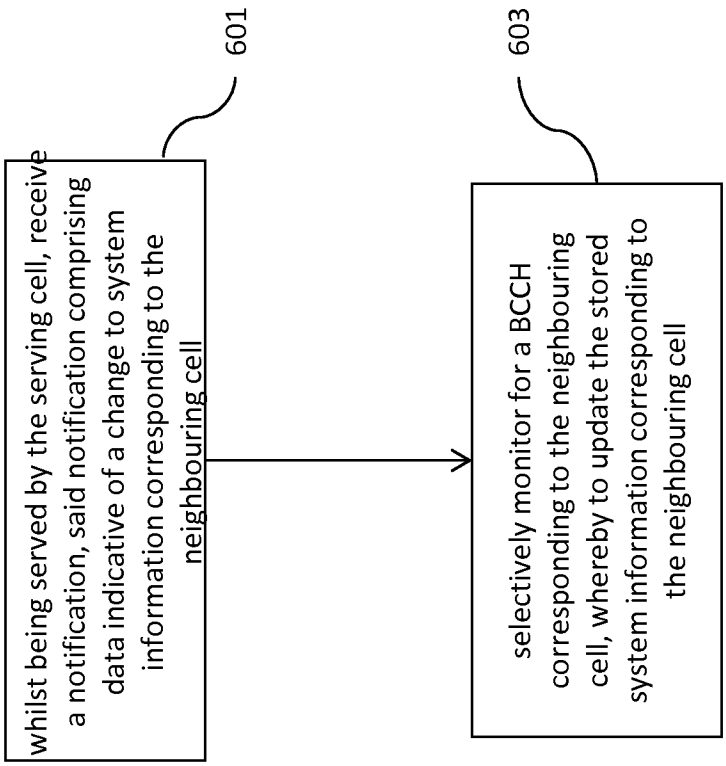
601
603
whilst being served by the serving cell, receive a notification, said notification comprising data indicative of a change to system information corresponding to the neighbouring cell
selectively monitor for a BCCH corresponding to the neighbouring cell, whereby to update the stored system information corresponding to the neighbouring cell

Figure 6

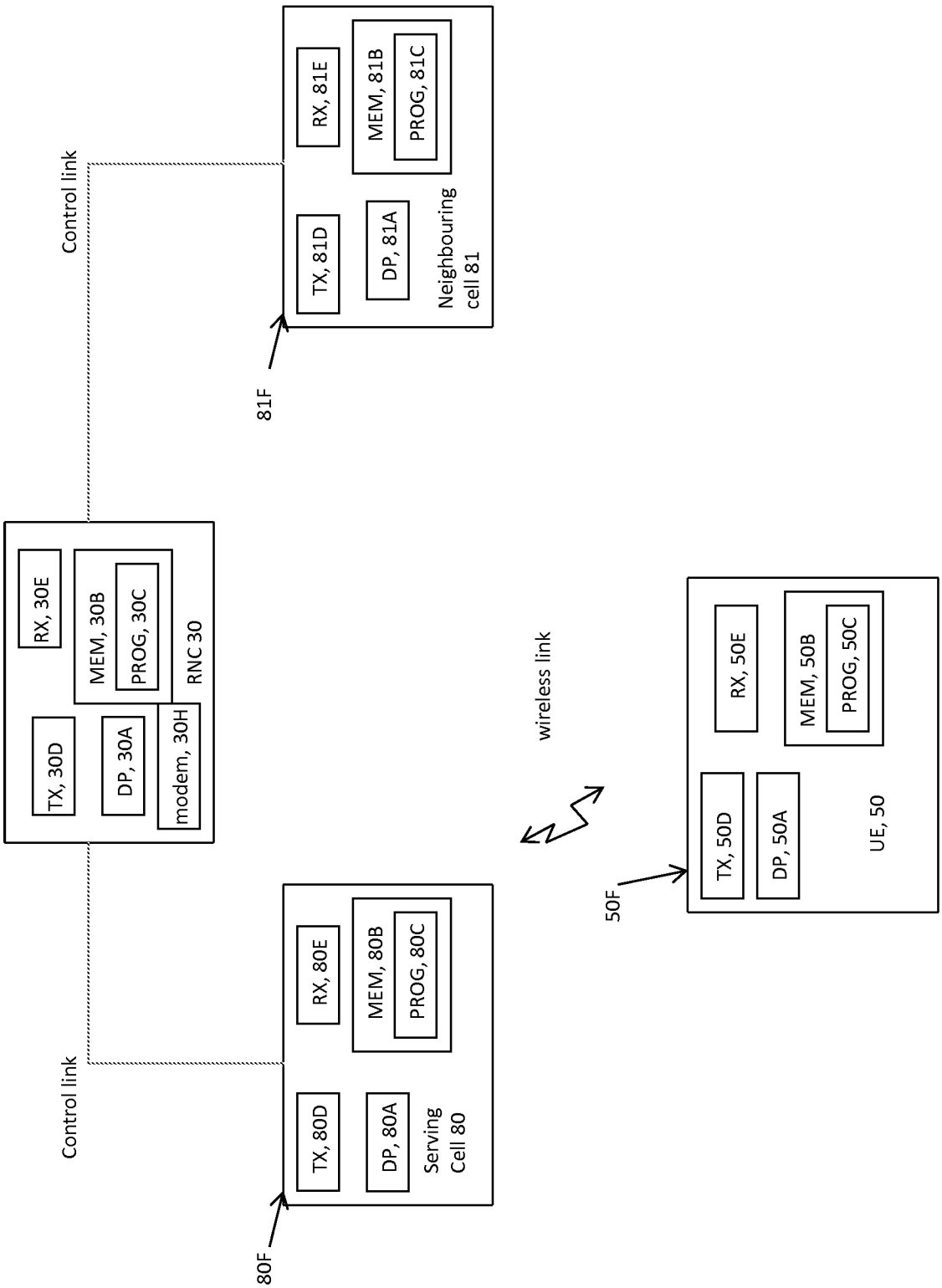
Control link
RX, 30E
MEM, 30B
PROG, 30C
TX, 30D
DP, 30A
modem, 30H
RNC 30
81F
RX, 81E
MEM, 81B
PROG, 81C
TX, 81D
DP, 81A
Neighbouring cell 81
wireless link
50F
RX, 50E
MEM, 50B
PROG, 50C
TX, 50D
DP, 50A
UE, 50
Control link
80F
RX, 80E
MEM, 80B
PROG, 80C
TX, 80D
DP, 80A
Serving Cell 80

Figure 7