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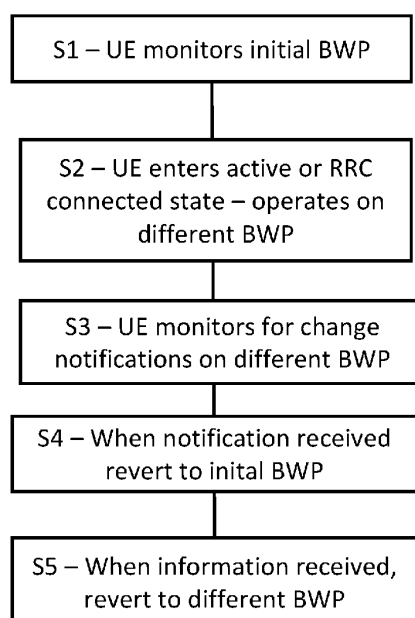


Figure 4

(57) Abstract: A method comprises receiving an indication on a first bandwidth part at a user device. The user device, in response to receiving said indication, receives a second bandwidth part. The second bandwidth part is different to said first bandwidth part. The first and second bandwidth parts are part of a same carrier and the second bandwidth part comprises information associated with said indication.

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COMMUNICATIONS METHOD, APPARATUS AND COMPUTER PROGRAM**Field**

This disclosure relates to communications, and more particularly to a method,
5 apparatus and computer program in a wireless communication system. In particular
but not exclusively, some embodiments relate to use of bandwidth parts.

Background

A communication system can be seen as a facility that enables communication
between two or more devices such as user terminals, machine-like terminals, base
10 stations and/or other nodes by providing communication channels for carrying
information between the communicating devices. A communication system can be
provided for example by means of a communication network and one or more
compatible communication devices. The communication may comprise, for example,
communication of data for carrying data for voice, electronic mail (email), text
15 message, multimedia and/or content data communications and so on. Non-limiting
examples of services provided include two-way or multi-way calls, data
communication or multimedia services and access to a data network system, such
as the Internet.

In a wireless system at least a part of communications occurs over wireless
20 interfaces. Examples of wireless systems include public land mobile networks
(PLMN), satellite based communication systems and different wireless local
networks, for example wireless local area networks (WLAN). A local area wireless
networking technology allowing devices to connect to a data network is known by the
tradename WiFi (or Wi-Fi). WiFi is often used synonymously with WLAN. The
25 wireless systems can be divided into cells, and are therefore often referred to as
cellular systems. A base station provides at least one cell.

A user can access a communication system by means of an appropriate
communication device or terminal capable of communicating with a base station.
Hence nodes like base stations are often referred to as access points. A
30 communication device of a user is often referred to as user equipment (UE). A
communication device is provided with an appropriate signal receiving and
transmitting apparatus for enabling communications, for example enabling
communications with the base station and/or communications directly with other user

devices. The communication device can communicate on appropriate channels, e.g. listen to a channel on which a station, for example a base station of a cell, transmits.

A communication system and associated devices typically operate in accordance with a given standard or specification which sets out what the various entities associated with the system are permitted to do and how that should be achieved. Communication protocols and/or parameters which shall be used for the connection are also typically defined. Non-limiting examples of standardised radio access technologies include GSM (Global System for Mobile), EDGE (Enhanced Data for GSM Evolution) Radio Access Networks (GERAN), Universal Terrestrial Radio Access Networks (UTRAN) and evolved UTRAN (E-UTRAN). An example communication system architecture is the long-term evolution (LTE) of the Universal Mobile Telecommunications System (UMTS) radio-access technology. The LTE is standardized by the third Generation Partnership Project (3GPP). The LTE employs the Evolved Universal Terrestrial Radio Access Network (E-UTRAN) access and a further development thereof which is sometimes referred to as LTE Advanced (LTE-A).

Since introduction of fourth generation (4G) services increasing interest has been paid to the next, or fifth generation (5G) standard. 5G may also be referred to as a New Radio (NR) network. Standardization of 5G or New Radio networks is an on-going study item.

Summary

According to an aspect, there is provided a method comprising: causing receiving, on a first bandwidth part, at a user device, an indication; and in response to said indication, causing said user device to receive a second bandwidth part, said second bandwidth part being different to said first bandwidth part, said first and second bandwidth parts being part of a same carrier and said second bandwidth part comprising information associated with said indication

The carrier may be a wideband carrier.

The first and second bandwidth parts may belong to the same serving cell.

The method may comprise causing tuning of said user device to a frequency associated with said second bandwidth part, in response to said indication.

The indication may comprises an indication of one or more of alert information and change information. The change information may be update information.

The method may comprise causing receiving, as said information, one or more of said change information and alert information on said second bandwidth part.

The alert information may comprise one or more of earthquake and tsunami warning system information and commercial mobile alert system information.

5 The change information may comprise one or more changes in system information.

The method may comprise monitoring a paging occasion on said first bandwidth part.

The indication may be provided in a paging message.

10 The indication may be provided by downlink control information.

The information may be provided periodically on said second bandwidth part.

The method may comprise after receiving said information associated with said indication, causing receiving a different bandwidth part to said second bandwidth part.

15 The different bandwidth part may comprise said first bandwidth part.

The method may comprise causing information to be transmitted from said user device to cause said user device to receive said different bandwidth part.

The second bandwidth part may be an initial bandwidth part.

The second bandwidth part may comprise system information blocks.

20 The method may comprise causing receiving said first bandwidth part and said second bandwidth part at the same time.

According to another aspect, there is provided a method comprising: causing transmission, on a first bandwidth part, to a user device, an indication; and causing transmission to said user device of a second bandwidth part, said second bandwidth part being different to said first bandwidth part, said first and second bandwidth parts being part of a same carrier and said second bandwidth part comprising information associated with said indication

The carrier may be a wideband carrier.

The first and second bandwidth parts may belong to the same serving cell.

30 The indication may comprises an indication of one or more of alert information and change information. The change information may be update information.

The method may comprise causing transmission, as said information, one or more of said change information and alert information on said second bandwidth part.

The alert information may comprise one or more of earthquake and tsunami warning system information and commercial mobile alert system information.

The change information may comprise one or more changes in system information.

5 The method may comprise providing a paging occasion on said first bandwidth part.

The indication may be provided in a paging message.

The indication may be provided by downlink control information.

The information may be provided periodically on said second bandwidth part.

10 The method may comprise after causing transmitting of said information associated with said indication to the user device, causing transmission to said user device using a different bandwidth part to said second bandwidth part.

The different bandwidth part may comprise said first bandwidth part.

15 The method may comprise receiving information from said user device to cause transmission to said user device of said different bandwidth part.

The second bandwidth part may be an initial bandwidth part.

The second bandwidth part may comprise system information blocks.

The method may comprise transmitting said first bandwidth part and said second bandwidth part to said user device at the same time.

20 According to another aspect, there is provided an apparatus in a user device comprising: means for causing said user device to receive, on a first bandwidth part, an indication; and in response to said indication, means for causing said user device to receive a second bandwidth part, in response to said indication, said second bandwidth part being different to said first bandwidth part, said first and second
25 bandwidth parts being part of a same carrier and said second bandwidth part comprising information associated with said indication

The carrier may be a wideband carrier.

The first and second bandwidth parts may belong to the same serving cell.

30 The indication may comprises an indication of one or more of alert information and change information. The change information may be update information.

The means for causing said receiving may be for causing said user device to receive, as said information, one or more of said change information and alert information on said second bandwidth part.

The alert information may comprise one or more of earthquake and tsunami warning system information and commercial mobile alert system information.

The change information may comprise one or more changes in system information.

5 The apparatus may comprise means for monitoring a paging occasion on said first bandwidth part.

The indication may be provided in a paging message.

The indication may be provided by downlink control information.

The information may be provided periodically on said second bandwidth part.

10 After receiving said information associated with said indication, said causing means may cause said user device to receive a different bandwidth part to said second bandwidth part.

The different bandwidth part may comprise said first bandwidth part.

15 The apparatus may comprise means for causing information to be transmitted from said user device to cause said user device to receive said different bandwidth part.

The second bandwidth part may be an initial bandwidth part.

The second bandwidth part may comprise system information blocks.

20 The causing means may be for causing said user device to receive said first bandwidth part and said second bandwidth part at the same time.

According to another aspect, there is provided an apparatus comprising: means for causing transmission, on a first bandwidth part, to a user device, an indication; and means for causing transmission to said user device of a second bandwidth part, said second bandwidth part being different to said first bandwidth part, said first and second bandwidth parts being part of a same carrier and said
25 second bandwidth part comprising information associated with said indication

The carrier may be a wideband carrier.

The first and second bandwidth parts may belong to the same serving cell.

30 The indication may comprises an indication of one or more of alert information and change information. The change information may be update information.

The means for causing transmission may cause transmission, as said information, one or more of said change information and alert information on said second bandwidth part.

The alert information may comprise one or more of earthquake and tsunami warning system information and commercial mobile alert system information.

The change information may comprise one or more changes in system information.

5 The apparatus may comprise means for providing a paging occasion on said first bandwidth part.

The indication may be provided in a paging message.

The indication may be provided by downlink control information.

The information may be provided periodically on said second bandwidth part.

10 The means for causing transmitting may be for, after causing transmitting of said information associated with said indication to the user device, causing transmission to said user device using a different bandwidth part to said second bandwidth part.

The different bandwidth part may comprise said first bandwidth part.

15 The apparatus may comprise means for receiving information from said user device to cause transmission to said user device of said different bandwidth part.

The second bandwidth part may be an initial bandwidth part.

The second bandwidth part may comprise system information blocks.

20 The means for causing transmitting may be for causing transmitting of said first bandwidth part and said second bandwidth part to said user device at the same time.

According to another aspect, there is provided an apparatus in a user device, said apparatus comprising at least one processor, and at least one memory including computer program code, wherein the at least one memory and the computer
25 program code are configured, with the at least one processor, to: cause receiving, on a first bandwidth part, an indication; and in response to said indication, causing receiving of a second bandwidth part, said second bandwidth part being different to said first bandwidth part, said first and second bandwidth parts being part of a same carrier and said second bandwidth part comprising information associated with said
30 indication

The carrier may be a wideband carrier.

The first and second bandwidth parts may belong to the same serving cell.

The at least one memory and the computer code may be configured with the at least one processor to causing tuning of said user device to a frequency associated with said second bandwidth part, in response to said indication.

The indication may comprises an indication of one or more of alert information
5 and change information. The change information may be update information.

The at least one memory and the computer code may be configured with the at least one processor to cause receiving, as said information, one or more of said change information and alert information on said second bandwidth part.

The alert information may comprise one or more of earthquake and tsunami
10 warning system information and commercial mobile alert system information.

The change information may comprise one or more changes in system information.

The at least one memory and the computer code may be configured with the at least one processor to cause monitoring of a paging occasion on said first
15 bandwidth part.

The indication may be provided in a paging message.

The indication may be provided by downlink control information.

The information may be provided periodically on said second bandwidth part.

The at least one memory and the computer code may be configured with the
20 at least one processor to after receiving said information associated with said indication, cause receiving of a different bandwidth part to said second bandwidth part.

The different bandwidth part may comprise said first bandwidth part.

The at least one memory and the computer code may be configured with the
25 at least one processor to cause information to be transmitted from said user device to cause said user device to receive said different bandwidth part.

The second bandwidth part may be an initial bandwidth part.

The second bandwidth part may comprise system information blocks.

The at least one memory and the computer code may be configured with the
30 at least one processor to cause receiving of said first bandwidth part and said second bandwidth part at the same time.

According to another aspect, there is provided an apparatus, said apparatus comprising at least one processor, and at least one memory including computer program code, wherein the at least one memory and the computer program code are

configured, with the at least one processor, to: cause transmission, on a first bandwidth part, to a user device, an indication; and cause transmission to said user device of a second bandwidth part, said second bandwidth part being different to said first bandwidth part, said first and second bandwidth parts being part of a same carrier and said second bandwidth part comprising information associated with said indication

The carrier may be a wideband carrier.

The first and second bandwidth parts may belong to the same serving cell.

The indication may comprises an indication of one or more of alert information and change information. The change information may be update information.

The at least one memory and the computer code may be configured with the at least one processor to cause transmission, as said information, one or more of said change information and alert information on said second bandwidth part.

The alert information may comprise one or more of earthquake and tsunami warning system information and commercial mobile alert system information.

The change information may comprise one or more changes in system information.

The at least one memory and the computer code may be configured with the at least one processor to provide a paging occasion on said first bandwidth part.

The indication may be provided in a paging message.

The indication may be provided by downlink control information.

The information may be provided periodically on said second bandwidth part.

The at least one memory and the computer code may be configured with the at least one processor to, after causing transmitting of said information associated with said indication to the user device, cause transmission to said user device using a different bandwidth part to said second bandwidth part.

The different bandwidth part may comprise said first bandwidth part.

The at least one memory and the computer code may be configured with the at least one processor to receive information from said user device to cause transmission to said user device of said different bandwidth part.

The second bandwidth part may be an initial bandwidth part.

The second bandwidth part may comprise system information blocks.

The at least one memory and the computer code may be configured with the at least one processor to cause transmitting of said first bandwidth part and said second bandwidth part to said user device at the same time.

5 A device and/or a communication system comprising an apparatus configured to provide at least one of the embodiments can also be provided. The device may comprise a communication device such as a user equipment or another node capable of wireless communication, or a network node.

A computer program comprising program code means adapted to perform the herein described methods may also be provided.

10 In accordance with further embodiments apparatus and/or computer program product that can be embodied on a computer readable medium for providing at least one of the above methods is provided.

Various other aspects and further embodiments are also described in the following detailed description of examples embodying the invention and in the
15 attached claims.

Brief description of Figures

Some embodiments will now be described in further detail, by way of example only, with reference to the following examples and accompanying drawings, in which:

Figure 1 shows a schematic example of a wireless communication system
20 where the invention may be implemented;

Figure 2 shows an example of a communication device;

Figure 3 shows an example of a control apparatus, for example provided in a base station;

Figure 4 is a flow chart of a method according to an example;

25 Figure 5 schematically shows BWP (bandwidth parts) used by a user equipment; and

Figure 6 is a flow chart of a method according to an example.

Detailed description

Before explaining in detail the examples, certain general principles of a
30 wireless communication system and mobile communication devices are briefly explained with reference to Figures 1 to 2 to assist in understanding the technology underlying the described examples.

In a wireless communication system 100, such as that shown in Figure 1, a wireless communication devices, for example, user equipment (UE) or MTC devices

102, 104, 105 are provided wireless access via at least one base station or similar wireless transmitting and/or receiving wireless infrastructure node or point. Such a node can be, for example, a base station or an eNodeB (eNB), or in a 5G system a Next Generation NodeB (gNB), or other wireless infrastructure node. These nodes
5 will be generally referred to as base stations. Base stations are typically controlled by at least one appropriate controller apparatus, so as to enable operation thereof and management of mobile communication devices in communication with the base stations. The controller apparatus may be located in a radio access network (e.g. wireless communication system 100) or in a core network (CN) (not shown) and may
10 be implemented as one central apparatus or its functionality may be distributed over several apparatus. The controller apparatus may be part of the base station and/or provided by a separate entity such as a Radio Network Controller. In Figure 1 control apparatus 108 and 109 are shown to control the respective macro level base stations 106 and 107. In some systems, the control apparatus may additionally or
15 alternatively be provided in a radio network controller. Other examples of radio access system comprise those provided by base stations of systems that are based on technologies such as 5G or new radio, wireless local area network (WLAN) and/or WiMax (Worldwide Interoperability for Microwave Access). A base station can provide coverage for an entire cell or similar radio service area.

20 In Figure 1 base stations 106 and 107 are shown as connected to a wider communications network 113 via gateway 112. A further gateway function may be provided to connect to another network.

The smaller base stations 116, 118 and 120 may also be connected to the network 113, for example by a separate gateway function and/or via the controllers
25 of the macro level stations. The base stations 116, 118 and 120 may be pico or femto level base stations or the like. In the example, stations 116 and 118 are connected via a gateway 111 whilst station 120 connects via the controller apparatus 108. In some embodiments, the smaller stations may not be provided.

A possible wireless communication device will now be described in more
30 detail with reference to Figure 2 showing a schematic, partially sectioned view of a communication device 200. Such a communication device is often referred to as user equipment (UE) or terminal. An appropriate mobile communication device may be provided by any device capable of sending and receiving radio signals. Non-limiting examples comprise a mobile station (MS) or mobile device such as a mobile

phone or what is known as a 'smart phone', a computer provided with a wireless interface card or other wireless interface facility (e.g., USB dongle), personal data assistant (PDA) or a tablet provided with wireless communication capabilities, or any combinations of these or the like. A mobile communication device may provide, for example, communication of data for carrying communications such as voice, electronic mail (email), text message, multimedia and so on. Users may thus be offered and provided numerous services via their communication devices. Non-limiting examples of these services comprise two-way or multi-way calls, data communication or multimedia services or simply an access to a data communications network system, such as the Internet. Users may also be provided broadcast or multicast data. Non-limiting examples of the content comprise downloads, television and radio programs, videos, advertisements, various alerts and other information.

A wireless communication device may be for example a mobile device, that is, a device not fixed to a particular location, or it may be a stationary device. The wireless device may need human interaction for communication, or may not need human interaction for communication. In the present teachings the terms UE or "user" are used to refer to any type of wireless communication device.

The wireless device 200 may receive signals over an air or radio interface 207 via appropriate apparatus for receiving and may transmit signals via appropriate apparatus for transmitting radio signals. In Figure 2 transceiver apparatus is designated schematically by block 206. The transceiver apparatus 206 may be provided for example by means of a radio part and associated antenna arrangement. The antenna arrangement may be arranged internally or externally to the wireless device. The transceiver apparatus may comprise a tuner 210 which tunes the transceiver to the desired receiving frequency.

A wireless device is typically provided with at least one data processing entity 201, at least one memory 202 and other possible components 203 for use in software and hardware aided execution of tasks it is designed to perform, including control of access to and communications with access systems and other communication devices. The data processing, storage and other relevant control apparatus can be provided on an appropriate circuit board and/or in chipsets. This feature is denoted by reference 204. The user may control the operation of the wireless device by means of a suitable user interface such as key pad 205, voice

commands, touch sensitive screen or pad, combinations thereof or the like. A display 208, a speaker and a microphone can be also provided. Furthermore, a wireless communication device may comprise appropriate connectors (either wired or wireless) to other devices and/or for connecting external accessories, for example hands-free equipment, thereto. The communication devices 102, 104, 105 may access the communication system based on various access techniques.

Figure 3 shows an example of a control apparatus. This control apparatus may, for example, be provided in a base station or a gNB. The control apparatus 300 comprises at least one memory 301, at least one data processing unit 302, 303 and an input/output interface 304. Via the interface the control apparatus can be coupled to a receiver and a transmitter of the base station. The receiver and/or the transmitter may be implemented as a radio front end or a remote radio head. For example the control apparatus 300 or processor 301 can be configured to execute an appropriate software code to provide the control functions.

In NR, new concept of bandwidth part (BWP) has been introduced where each UE may be operating on different bandwidth part within a single wideband carrier. It is defined in 3GPP TS 38.211 V1.0.0 (section 4.4.5) as a contiguous subset of the physical resource blocks for a given numerology on a given carrier. As opposed to previous 3GPP systems, where system bandwidth was cell-specific, bandwidth parts can be configured specifically for particular UEs only using dedicated signalling from gNB and may, e.g. depend on UE's capabilities. According to current development of NR system and current agreements in 3GPP BWP may operate with or without SS (Synchronization Signal) block, which is used to carry NR-SS as well as a MIB (Master Information Block) and the physical cell identity (PCI).

One reason for BWPs was to be able to support UEs with limited capabilities (for example in terms of Tx/Rx bandwidth) even on a wideband carrier deployed from the system perspective.

In some scenarios, BPW may be used to enable reduced power energy consumption.

3GPP TS 38.213 V1.0.0 (section 11) suggests that "A UE configured for operation in bandwidth parts (BWPs) of a serving cell, is configured by higher layers for the serving cell a set of bandwidth parts (BWPs) for receptions by the UE (DL (downlink) BWP set) or a set of BWPs for transmissions by the UE (UL (uplink) BWP

set).” The higher layer signalling means dedicated RRC (radio resource control) signalling in this case. It has been proposed that there is at most one active DL BWP and at most one active UL BWP at a given time for a serving cell for a UE, at least for UEs implemented according to Release 15 of 3GPP NR specifications. However
5 in other implementations there may be more than one active DL BWP and more than one active UL BWP.

In 3GPP TS 38.211 V1.0.0 (section 4.4.5) it is indicated that the UE is not expected to receive a PDSCH (Physical Downlink Shared Channel) or a PDCCH (Physical Downlink Control Channel) outside an active bandwidth part and that the
10 UE should not transmit a PUSCH (Physical Uplink Shared Channel) or a PUCCH (Physical Uplink Control Channel) outside an active bandwidth part. An active BWP within a serving cell can be switched for the UE at least using layer 1 signalling from the gNB such as a scheduling DCI (downlink control information). More specifically, it has been proposed that NR supports the case that a single scheduling DCI can
15 switch the UE’s active BWP from one to another (of the same link direction) within a given serving cell.

Some aspects of BWP are described in the following specifications:

- 3GPP TS 38.211 V1.0.0 “NR; Physical channels and modulation”
- 3GPP TS 38.213 V1.0.0 “NR; Physical layer procedures for control”

20 Currently, it has been proposed that a UE can operate with a single active BWP at a time for a serving cell. As opposed to Component Carriers (CC) known from Carrier Aggregation (CA) feature of LTE technology, BWPs belong to the same serving cell and are part of the same wideband carrier. This allows for network deployments with wide bandwidth carriers without the need to combine multiple
25 carriers with CA for the UEs with high bandwidth capabilities, but at the same time UEs with lower capabilities can be served by the means of narrower BWPs.

There may be an initial BWP, which carries a SS block. This may also have RMSI (Remaining Minimum System Information).

An initial BWP’s bandwidth may be set such that even UEs with bandwidth
30 limitations are able to receive basic information such as the SS block and/or RMSI. Thus, the maximum bandwidth of an initial BWP may depend on the width of a physical broadcast channel’ (PBCH) width. The width of the PBCH may, with current NR proposals depend on the numerology configured for the carrier and may be for

example 4.3MHz for 15 kHz subcarrier spacing (SCS) 8.6MHz for 30 kHz SCS, 34.5 MHz for 120KHz SCS or 69.12 MHz for 240 kHz SCS.

The initial BWP may be used by the UE for the sake of idle mode measurements and mobility and/or for initial access to a cell.

5 Once the UE is in connected state, it may be configured with a default BWP by the network, which may be set to the initial BWP of the cell. The default BWP may be the same or different to the initial BWP. The initial BWP may broadcast other SIBs (System Information Blocks) either periodically or on request from UEs.

10 However, with current proposals, once the UE in a RRC Connected state is configured to operate on a BWP different from the initial one, that UE has no access to the latest System Information (SI) when it gets updated.

One option would be to replicate the same SI on all active BWPs. This has the advantage that it is straightforward to implement. This may be inefficient in terms of radio resources usage.

15 Another option would be to require UE to periodically retune back to the initial BWP to check if there is any SI update. This option may require a measurement gap and interrupts the data transmission on the active BWP.

Some embodiments may provide a more efficient way of ensuring UE always gets updated system information.

20 Some embodiments may support, for BWP, single and multiple SS block transmissions in wideband CC (component carrier) in the frequency domain.

For a non (carrier aggregation) CA UE with a smaller BW capability and potentially for CA UE, the measurement gap for RRM measurement and potentially other purposes (e.g., path loss measurement for UL power control) using a SS block is supported.

25 In some embodiments one or more of the following rules may be applied. This may be for SI change notifications and/or public warning system related notifications such as for example ETWS (earthquake tsunami warning system) and/or CMAS (commercial mobile alert system).

30 It should be appreciated that this may apply to how a UE acquires updated SI.

An example of a method will now be described with reference to Figure 4. This is from the perspective of the UE and will be described with reference to Figure 5.

In step S1, the UE will monitor an initial BWP. In some embodiments, the initial BWP may provide system information. In some embodiments, the initial BWP will carry the SIB. The initial BWP may be used when, for example, a UE is in an idle mode or unconnected mode, in some embodiments.

5 In Figure 5 which shows which BWP a UE is using. Figure 5 plots frequency against time. Between time t_0 and t_1 , the UE is in the idle mode and monitoring the initial BWP. It should be appreciated, that the initial BWP may always be in a particular location in the BW or may be dependent on the particular BW.

10 In step S2, the UE enters the active or RRC connected mode and will use a different BWP. This different BWP is a different frequency band to that of the default BWP, but still resides within the limits of a utilized wideband carrier. This is shown in Figure 5. The UE enters the connected mode at time t_1 .

In step S3, the UE monitors for change notifications on its active BWP (the different BWP). This may be done using one or more of the following options:

15 By monitoring paging occasions with P-RNTI (paging radio network temporary identifier) and reading a paging message on UE's active BWP. Connected UEs on a certain active BWP may be configured with a common PO (Paging Occasion) to receive the possible notification. One or more BWPs may not serve the idle or inactive UEs through paging. In some embodiments, it may be configured that the
20 UE should follow the regular PO calculation method. In this case the UE may be configured with the paging configuration on a per BWP basis; and

By receiving so called direct indication information with layer 1 signalling (DCI). This information may be scrambled with P-RNTI either in the CSS (Common Search Space) or USS (user specific search space).

25 In step S4, a notification is received by the UE and the UE is configured to receive the initial BWP. For example, the UE may retune the receiver to the initial BWP to acquire the updated system information or ETWS/CMAS related information. The updated system information or ETWS/CMAS information may be broadcasted periodically or provided on demand (so called on-demand SI) by the initial BWP of a
30 wideband carrier. This can be achieved using one or more of the following options:

1) The network or gNB may configure measurement gaps that match the times where the SI can be read by the UE on the initial BWP.

The network or base station may assume these are only used by the UE when the SI notification has been signalled;

2) The network or gNB may assume the UE's unavailability for data transmissions on the non-initial BWP for a specified time corresponding to the time required by the UE to acquire updated SI from initial BWP.

The UE may monitor at least one or both of the CSS and USS on the initial
5 BWP.

Data transmission may be continued on the initial BWP part as well, in some embodiments.

Alternatively or additionally if implicit switching based on data activity is specified, when the UE is switched to the initial BWP for SI update, the UE may not
10 automatically switch back to the other BWP based on data activity until the SI is correctly received; and

3) The network or gNB may switch the active BWP of the UE to the initial BWP for a specified time allowing it to acquire updated SI.

The switching may use one or more of layer-1 signalling/DCI, a MAC CE
15 (media access control element) or dedicated RRC signalling.

The signalling used to switch the BWP may contain information that the BWP switch is made because of a SI update required (or can contain related notifications such as a SI change, ETWS/CMAS notification etc.) so that the UE will read SIBs at the correct time, such as a next modification period or immediately.

20 In this option, the step S3 may be omitted as the paging notification may be merged with the switching command.

Figure 5 shows the UE receiving the initial BWP between times t_2 and t_3 .

In step S5, the UE may revert to the different BWP. This may occur automatically in some embodiments, for example after a given period of time. In
25 other embodiments, for example additional signalling (e.g. using PUCCH/UCI/RRC) from the UE to gNB or RAN (radio access network) could be used to inform the gNB that the UE finished acquiring the updated SI and the BWP can be switched back to the previous one (the different one).

Figure 5 shows the UE receiving the different BWP again after time t_3 .

30 In some embodiments, the UE may be capable of receiving both the initial BWP and the dedicated BWP at the same time, without needing to interrupt one or other of the initial and dedicated BWP. In this embodiment, the UE may receive SIBs on the initial and continue activity on active BWP at the same time.

For those embodiments where the UE needs to retune to switch between receiving the initial and active BWP, this may cause interruptions in the receiving of packets. In some embodiments, the gNB or other network entity will need to take this into account to understand why some packets are lost during retuning. Some options
5 for dealing with this are mentioned previously. For example the gNB may suspend transmission for the duration of a given time period. This may be controlled by a timer. The gNB may send data packets over the initial BWP. In some embodiments, the UE will send an indication or information to the gNB indicating when it has acquired the necessary information or the like and/or that it is ready to switch from
10 the initial bandwidth.

Reference is made to Figure 6 which shows a method, from the perspective of a gNB.

In step T1, the gNB transmits the initial BWP with reference information such as system information, or the like.

15 In step T2 the UE enters the RRC connected state and the gNB will transmit information to the UE to cause the UE to switch to a different BWP.

In step T3, the gNB send a notification, such as previously discussed to the UE on the different BWP.

In step T4, the gNB transmits the information on the initial BWP.

20 The method of Figure 6 may be performed at least partly by or under the control of the control apparatus.

Some embodiments have been described in relation to SI change notifications and/or ETWAS/CMAS notifications. It should be appreciated that other embodiments may alternatively or additionally be used with other notifications. Some embodiments,
25 may be used with a notification requiring a reading of updated information from SI on the initial BWP. For example, EAB (extended access barring) parameters may be modified. In this example, a notification would be provided on the current BWP indicating that there are modified EAB parameters, requiring a reading of the modified EAB parameters on the initial BWP.

30 Some embodiments may provide a saving in terms of radio resources as the SI does not need to be replicated on each active BWP.

In some embodiments, the UE may need to retune to the initial BWP only when the SI actually changes. This is because the SI change notifications and/or ETWS/CMAS notifications are provided on the active BWP.

In general, the various embodiments may be implemented in hardware or special purpose circuits, software, logic or any combination thereof. Some aspects of the invention may be implemented in hardware, while other aspects may be implemented in firmware or software which may be executed by a controller, microprocessor or other computing device, although the invention is not limited thereto. While various aspects of the invention may be illustrated and described as block diagrams, flow charts, or using some other pictorial representation, it is well understood that these blocks, apparatus, systems, techniques or methods described herein may be implemented in, as non-limiting examples, hardware, software, firmware, special purpose circuits or logic, general purpose hardware or controller or other computing devices, or some combination thereof.

The embodiments of this invention may be implemented by computer software executable by a data processor of the mobile device, such as in the processor entity, or by hardware, or by a combination of software and hardware. Computer software or program, also called program product, including software routines, applets and/or macros, may be stored in any apparatus-readable data storage medium and they comprise program instructions to perform particular tasks. A computer program product may comprise one or more computer-executable components which, when the program is run, are configured to carry out embodiments. The one or more computer-executable components may be at least one software code or portions of it.

Further in this regard it should be noted that any blocks of the logic flow as in the Figures may represent program steps, or interconnected logic circuits, blocks and functions, or a combination of program steps and logic circuits, blocks and functions. The software may be stored on such physical media as memory chips, or memory blocks implemented within the processor, magnetic media such as hard disk or floppy disks, and optical media such as for example DVD and the data variants thereof, CD. The physical media is a non-transitory media.

The memory may be of any type suitable to the local technical environment and may be implemented using any suitable data storage technology, such as semiconductor based memory devices, magnetic memory devices and systems, optical memory devices and systems, fixed memory and removable memory. The data processors may be of any type suitable to the local technical environment, and may comprise one or more of general purpose computers, special purpose

computers, microprocessors, digital signal processors (DSPs), application specific integrated circuits (ASIC), FPGA, gate level circuits and processors based on multi core processor architecture, as non-limiting examples.

5 Embodiments of the inventions may be practiced in various components such as integrated circuit modules. The design of integrated circuits is by and large a highly automated process. Complex and powerful software tools are available for converting a logic level design into a semiconductor circuit design ready to be etched and formed on a semiconductor substrate.

10 The foregoing description has provided by way of non-limiting examples a full and informative description of the exemplary embodiment of this invention. However, various modifications and adaptations may become apparent to those skilled in the relevant arts in view of the foregoing description, when read in conjunction with the accompanying drawings and the appended claims. However, all such and similar modifications of the teachings of this invention will still fall within the scope of this
15 invention as defined in the appended claims. Indeed there is a further embodiment comprising a combination of one or more embodiments with any of the other embodiments previously discussed.

Claims

1. A method comprising:
5 causing receiving, on a first bandwidth part at a user device, of an indication;
and
in response to receiving said indication, causing said user device to receive a
second bandwidth part, said second bandwidth part being different to said first
bandwidth part, said first and second bandwidth parts being part of a same carrier
10 and said second bandwidth part comprising information associated with said
indication.
2. A method as claimed in claim 1, wherein said indication comprises an
indication of one or more of alert information and change information.
15
3. A method as claimed in claim 2, comprising causing receiving, as said
information, one or more of said change information and alert information on said
second bandwidth part.
- 20 4. A method as claimed in claim 2 or 3, wherein said alert information comprises
one or more of earthquake and tsunami warning system information and commercial
mobile alert system information.
5. A method as claimed in any of claims 2 to 4, wherein said change information
25 comprises one or more changes in system information.
6. A method as claimed in any preceding claim, comprising monitoring a paging
occasion on said first bandwidth part.
- 30 7. A method as claimed in claim 6, wherein said indication is provided in a
paging message.
8. A method as claimed in any preceding claim, wherein said indication is
provided by downlink control information.

9 A method as claimed in any preceding claim, wherein said information is provided periodically on said second bandwidth part.

5 10. A method as claimed in any preceding claim, comprising, after receiving said information associated with said indication, causing receiving of a different bandwidth part to said second bandwidth part.

11. A method as claimed in claim 10, wherein said different bandwidth part
10 comprises said first bandwidth part.

12. A method as claimed in claim 10 or 11, comprising causing information to be transmitted from said user device to cause said user device to receive said different bandwidth part.

15

13. A method as claimed in any preceding claim, wherein said second bandwidth part is an initial bandwidth part.

14. A method as claimed in any preceding claim, wherein said second bandwidth
20 part comprises system information blocks.

15. A method as claimed in any preceding claim, comprising causing receiving of said first bandwidth part and said second bandwidth part at the same time.

25 16. A method comprising:
causing transmission, on a first bandwidth part, to a user device, an indication;
and

causing transmission to said user device of a second bandwidth part, said
second bandwidth part being different to said first bandwidth part, said first and
30 second bandwidth parts being part of a same carrier and said second bandwidth part comprising information associated with said indication.

17. A method as claimed in claim 16, wherein the indication comprises an indication of one or more of alert information and change information.

18. A method as claimed in claim 16 or 17, wherein said indication is provided in one or more of a paging message and downlink control information.

5 19. A method as claimed any of claims 16 to 18, comprising providing the information periodically on said second bandwidth part.

20. A method as claimed any of claims 16 to 19, comprising causing transmitting of said information associated with said indication to the user device, causing
10 transmission to said user device using a different bandwidth part to said second bandwidth part.

21. A method as claimed in claim 20, comprising receiving information from said user device to cause transmission to said user device of said different bandwidth
15 part.

22. A method as claimed in any of claims 16 to 21, wherein second bandwidth part comprises system information blocks.

20 23. A computer program product comprising computer executable code which when run on at least one processor causes the method of any of the preceding claim to be performed.

24. An apparatus in a user device, said apparatus comprising at least one
25 processor, and at least one memory including computer program code, wherein the at least one memory and the computer program code are configured, with the at least one processor, to:

cause receiving, on a first bandwidth part, an indication; and
in response to said indication, cause receiving of a second bandwidth part,
30 said second bandwidth part being different to said first bandwidth part, said first and second bandwidth parts being part of a same carrier and said second bandwidth part comprising information associated with said indication.

25. An apparatus, said apparatus comprising at least one processor, and at least one memory including computer program code, wherein the at least one memory and the computer program code are configured, with the at least one processor, to:

cause transmission, on a first bandwidth part, to a user device, an indication;

5 and

cause transmission to said user device of a second bandwidth part, said second bandwidth part being different to said first bandwidth part, said first and second bandwidth parts being part of a same carrier and said second bandwidth part comprising information associated with said indication.

10

Figure 1

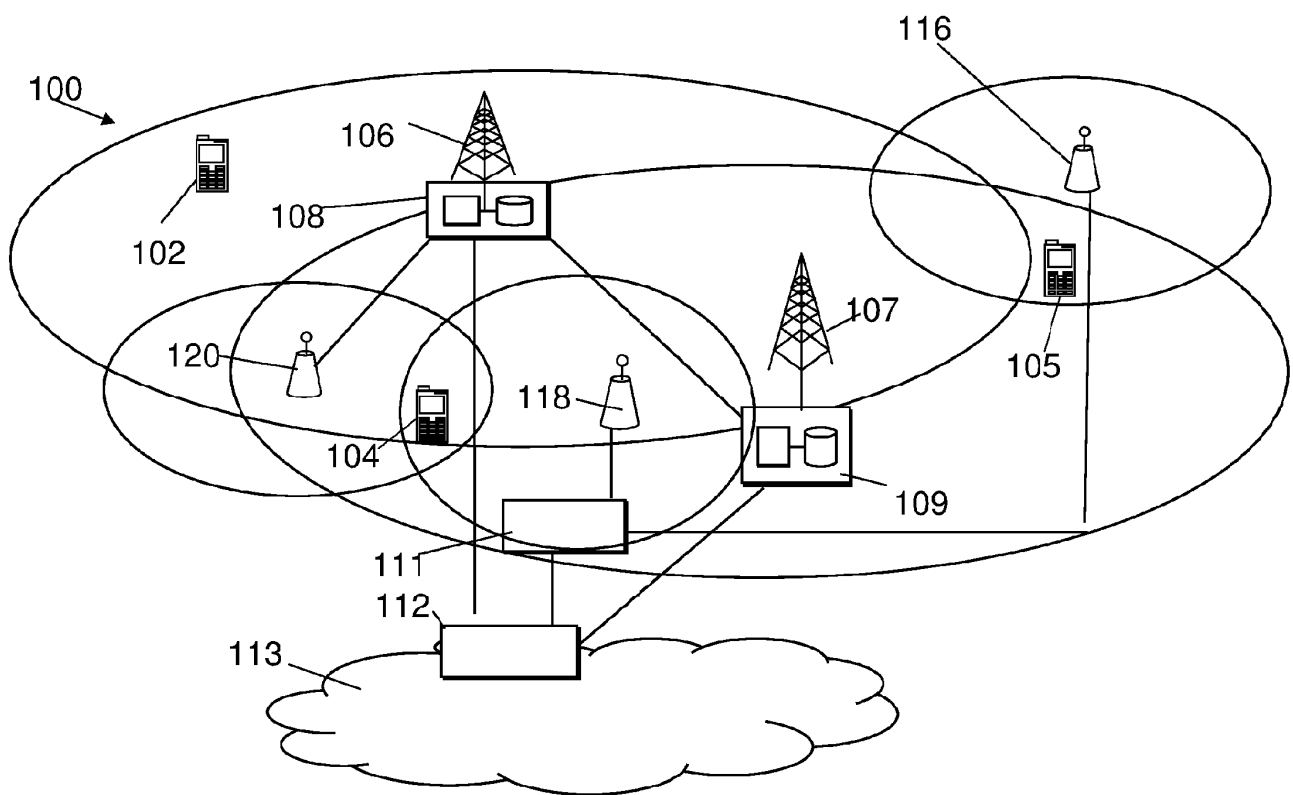


Figure 2

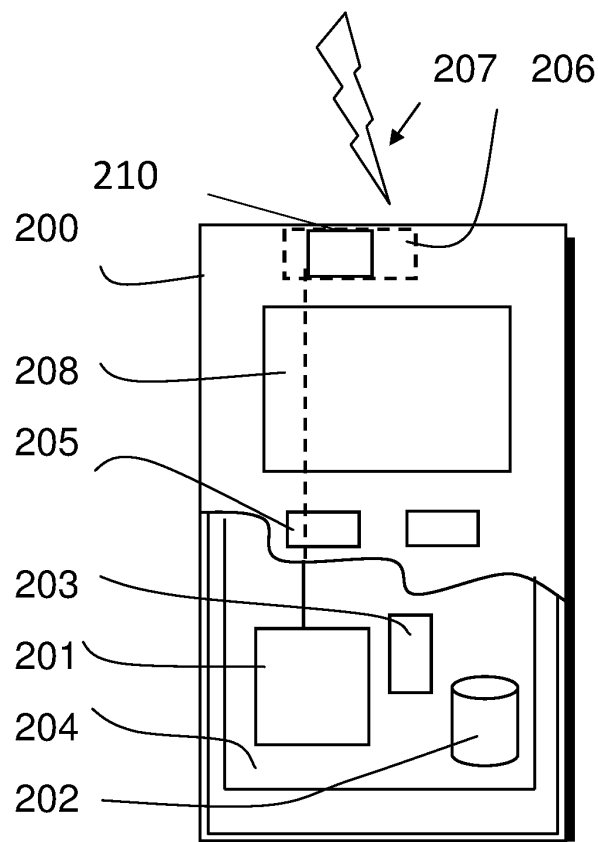


Figure 3

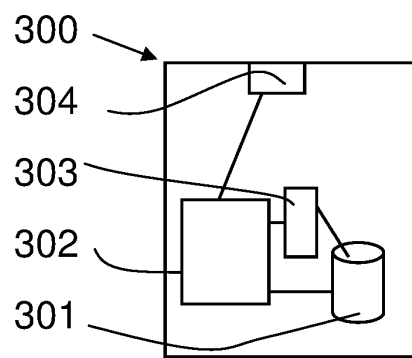


Figure 4

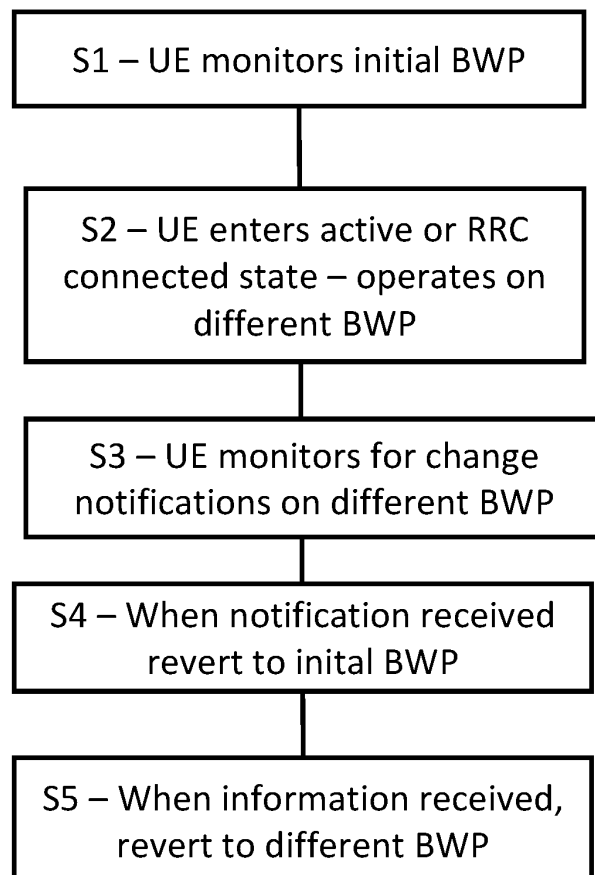


Figure 5

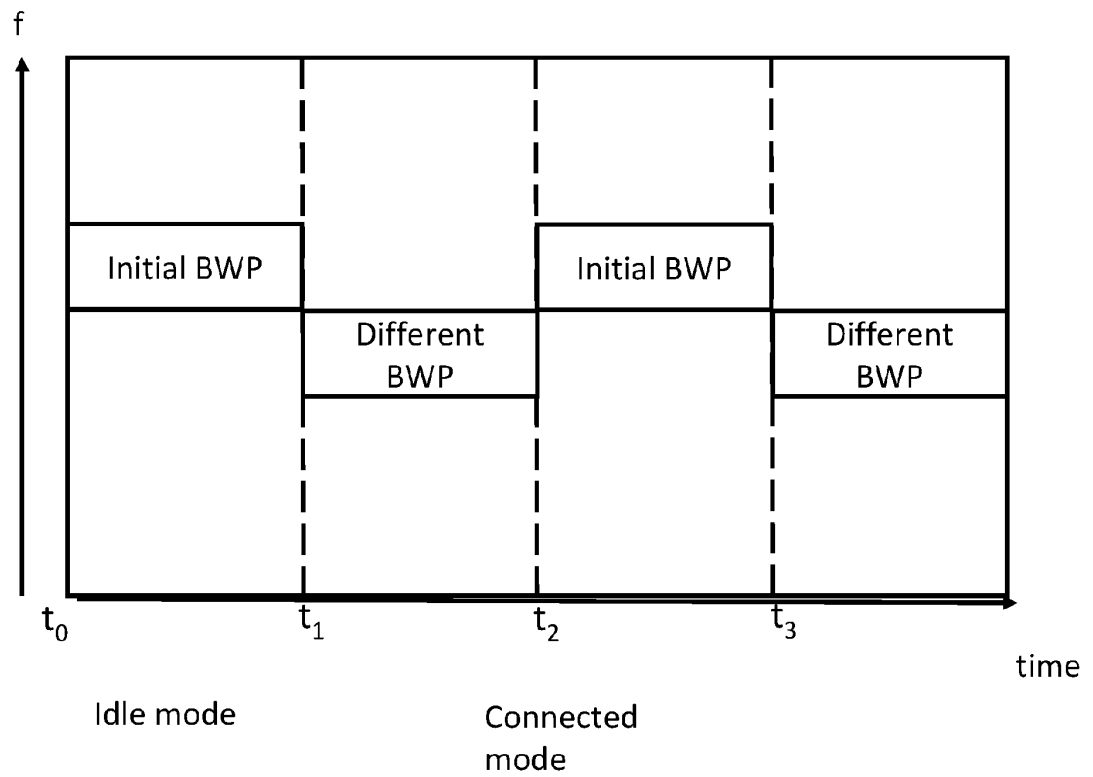
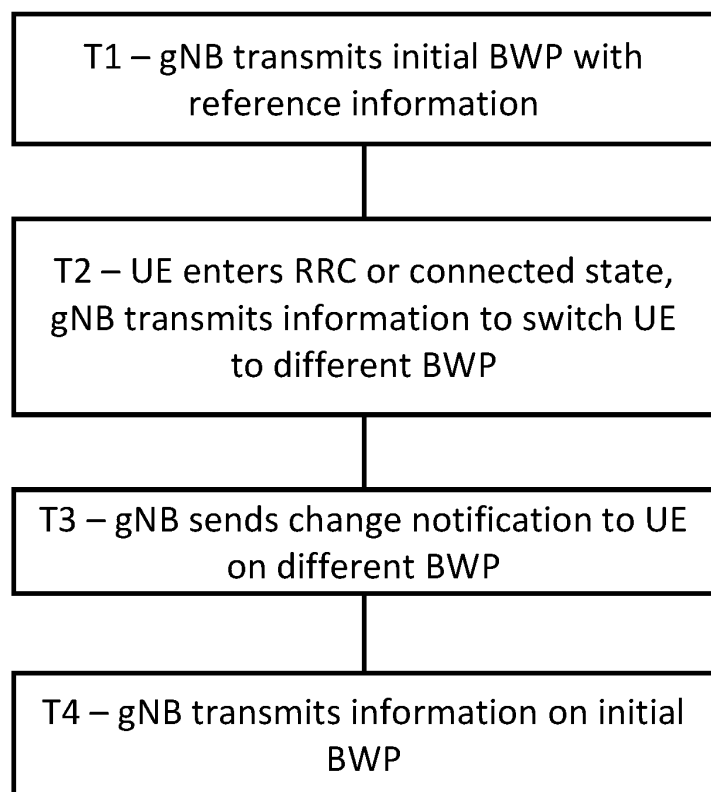


Figure 6



INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2017/105273

A. CLASSIFICATION OF SUBJECT MATTER

H04W 72/12(2009.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H04W H04L H04B

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)

WPI,EPODOC,CNPAT,CNKI:ad-hoc,MTC,D2D,bluetooth,initial bandwidth,initial bandwidth,indicat+,RRC,active,change, alert,pag+,period

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 101730248 A (SHARP KK.) 09 June 2010 (2010-06-09) description, paragraphs [0023]-[0038]	1-25
A	US 2016080206 A1 (ACELIO, INC.) 17 March 2016 (2016-03-17) the whole document	1-25
A	US 2013297819 A1 (CITRIX ONLINE LLC.) 07 November 2013 (2013-11-07) the whole document	1-25
A	US 2013315157 A1 (MOTOROLA MOBILITY LLC.) 28 November 2013 (2013-11-28) the whole document	1-25



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

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“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

05 June 2018

Date of mailing of the international search report

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Name and mailing address of the ISA/CN

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2017/105273

Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)			Publication date (day/month/year)
CN	101730248	A	09 June 2010	None			
US	2016080206	A1	17 March 2016	EP	3195540	A1	26 July 2017
				WO	2016044648	A1	24 March 2016
				CN	107113290	A	29 August 2017
				US	2016080207	A1	17 March 2016
US	2013297819	A1	07 November 2013	WO	2013165855	A2	07 November 2013
				CN	104396215	A	04 March 2015
				IN	9999DEN2014	A	14 August 2015
				EP	2856730	A2	08 April 2015
US	2013315157	A1	28 November 2013	CN	104285404	A	14 January 2015
				WO	2013176822	A2	28 November 2013
				US	2017064672	A1	02 March 2017
				EP	2856686	A2	08 April 2015

Form PCT/ISA/210 (patent family annex) (January 2015)