

(51) International Patent Classification:
H04W 76/02 (2009.01)(21) International Application Number:
PCT/EP2013/066048(22) International Filing Date:
31 July 2013 (31.07.2013)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
PCT/EP2012/069199
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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

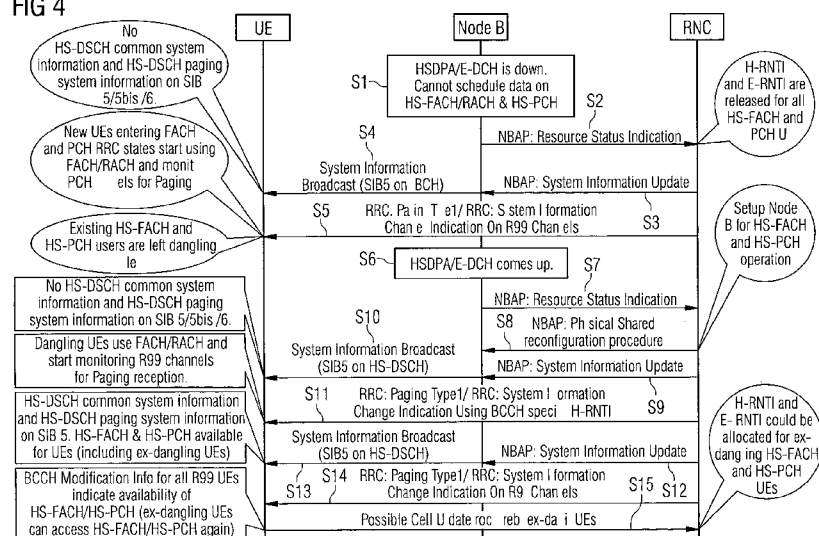
(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

- with international search report (Art. 21(3))
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))

(54) Title: METHOD AND APPARATUS FOR NOTIFYING NON-AVAILABILITY OF TRANSPORT CHANNELS

FIG 4



(57) Abstract: A method for High Speed Data Packet Access comprises receiving information relating to a non-availability of one or more transport channels, such as HS-DSCH, and monitoring one or more different transport channels for at least one of paging information and data transfer information.

METHOD AND APPARATUS FOR NOTIFYING NON-AVAILABILITY OF TRANSPORT CHANNELS

Some embodiments relate to a methods and apparatus and in particular but not exclusively to methods and apparatus usable with high speed data packet access.

5 A communication system can be seen as a facility that enables communication sessions between two or more entities such as fixed or mobile communication devices, base stations, servers and/or other communication nodes. A communication system and compatible communicating entities typically operate in accordance with a given standard or specification which sets out what the various
10 entities associated with the system are permitted to do and how that should be achieved. For example, the standards, specifications and related protocols can define the manner how various aspects of communication shall be implemented between communicating devices. A communication can be carried on wired or wireless carriers. In a wireless communication system at least a part of
15 communications between stations occurs over a wireless link.

Examples of wireless systems include public land mobile networks (PLMN) such as cellular networks, satellite based communication systems and different wireless local networks, for example wireless local area networks (WLAN). A wireless system can be divided into cells or other radio coverage or service areas. A
20 radio service area is provided by a station. Radio service areas can overlap, and thus a communication device in an area can typically send signals to and receive signals from more than one station.

A user can access the communication system by means of an appropriate communication device. A communication device of a user is often referred to as user
25 equipment (UE) or terminal. A communication device is provided with an appropriate signal receiving and transmitting arrangement for enabling communications with other parties. Typically a communication device is used for enabling receiving and transmission of communications such as speech and data. In wireless systems a communication device provides a transceiver station that can communicate with
30 another communication device such as e.g. a base station and/or another user equipment. The communication device may access a carrier provided by a station, for example a base station, and transmit and/or receive communications on the carrier.

An example of communication systems is an architecture that is being standardized by the 3rd Generation Partnership Project (3GPP). This system is often referred to as the Wideband-code division multiple access (W-CDMA) of the Universal Mobile Telecommunications System (UMTS) radio-access technology. A further development of the W-CDMA is often referred to as HSPA+ (high speed packet access). The various development stages of the 3GPP specifications are referred to as releases.

HSPA has been proposed which improves the downlink and uplink transmission (HSDPA, HSUPA).

According to an aspect, there is provided a method comprising: receiving information relating to a non-availability of one or more transport channels; and monitoring one or more different transport channels for at least one of paging information and data transfer information.

The information relating to non-availability may comprise one or more of: an indication of the unavailability of one or more transport channels and information about said one or more different transport channels to be monitored.

The method may comprise receiving said non-availability information in a plurality of messages.

The method may comprise receiving said non-availability information on a plurality of channels.

The method may comprise receiving said non-availability information in a downlink shared channel.

The method may comprise receiving said non-availability information in association with a broadcast channel identifier, said broadcast channel identifier being used prior to the non-availability of said one or more transport channels.

The broadcast channel identifier may comprise a broadcast control channel radio network temporary identifier.

The method may comprise receiving said information relating to non-availability after a recovery of at least one channel.

The said at least one recovered channel may comprise a channel on which information about at least one of said one or more transport channels is provided.

The at least one recovered channel may comprise a downlink shared channel.

The method may comprise receiving at least some of said information on the non-availability of one or more transport channels on said at least one channel.

The one or more transport channels may comprise one or more of a forward access channel, random access channel and paging channel.

5 The one or more transport channels may comprise at least one high speed data packet access channel.

The method may comprising receiving said information relating to the non-availability of one or more transport channels after a recovery of a control channel associated with said one or more transport channels and before information
10 indicating availability of said one or more transport channels .

The above methods may be performed by an apparatus. The apparatus may be provided in a user equipment.

According to another aspect, there is provided a method comprising: causing information to be sent relating to a non-availability of one or more transport channels
15 to a user equipment; and causing one or more different transport channels for at least one of paging information and data transfer information to be transmitted to said user equipment.

The information relating to non-availability may comprise one or more of: an indication of the unavailability of one or more transport channels and information
20 about said one or more different transport channels to be monitored.

The method may comprise causing said non-availability information to be sent in a plurality of messages.

The method may comprise causing said non-availability information to be sent on a plurality of channels.

25 The method may comprise causing said non-availability information to be sent in a downlink shared channel.

The method may comprise causing said non-availability information to be sent in association with a broadcast channel identifier, said broadcast channel identifier being used prior to the non-availability of said one or more transport channels.

30 The broadcast channel identifier may comprise a broadcast control channel radio network temporary identifier.

The method may comprise causing said information relating to non-availability to be sent after a recovery of at least one channel.

The at least one recovered channel may comprise a channel on which information about at least one of said one or more transport channels is provided.

The at least one recovered channel may comprise a downlink shared channel.

The method may comprise causing at least some of said information on the non-availability of one or more transport channels to be sent on said at least one channel.

The one or more transport channels may comprise one or more of a forward access channel, random access channel and paging channel.

The one or more transport channels may comprise at least one high speed data packet access channel.

The method may comprise causing said information relating to the non-availability of one or more transport channels to be sent after a recovery of a control channel associated with said one or more transport channels and before information indicating availability of said one or more transport channels.

According to an aspect, there is provided an apparatus comprising: at least one processor and at least one memory including computer program code, the at least one memory and the computer code configured to, with the at least one processor, cause the apparatus at least to: receive information relating to a non-availability of one or more transport channels; and monitor one or more different transport channels for at least one of paging information and data transfer information.

The information relating to non-availability may comprise one or more of: an indication of the unavailability of one or more transport channels and information about said one or more different transport channels to be monitored.

The at least one memory and the computer code may be configured with the at least one processor to cause the apparatus to receive said non-availability information in a plurality of messages.

The at least one memory and the computer code may be configured with the at least one processor to cause the apparatus to receive said non-availability information on a plurality of channels.

The at least one memory and the computer code may be configured with the at least one processor to cause the apparatus to receive said non-availability information in a downlink shared channel.

The at least one memory and the computer code may be configured with the at least one processor to cause the apparatus to receive said non-availability information in association with a broadcast channel identifier, said broadcast channel identifier being used prior to the non-availability of said one or more transport channels.

5 The broadcast channel identifier may comprise a broadcast control channel radio network temporary identifier.

The at least one memory and the computer code may be configured with the at least one processor to cause the apparatus to receive said information relating to non-availability after a recovery of at least one channel.

10 The at least one recovered channel may comprise a channel on which information about at least one of said one or more transport channels is provided.

The at least one recovered channel may comprise a downlink shared channel.

The at least one memory and the computer code may be configured with the at least one processor to cause the apparatus to at least some of said information on
15 the non-availability of one or more transport channels on said at least one channel.

The one or more transport channels may comprise one or more of a forward access channel, random access channel and paging channel.

The one or more transport channels may comprise at least one high speed data packet access channel.

20 The at least one memory and the computer code may be configured with the at least one processor to cause the apparatus to receive said information relating to the non-availability of one or more transport channels after a recovery of a control channel associated with said one or more transport channels and before information indicating availability of said one or more transport channels.

25 According to an aspect, there is provided an apparatus comprising: means for receiving information relating to a non-availability of one or more transport channels; and means for monitoring one or more different transport channels for at least one of paging information and data transfer information.

The information relating to non-availability may comprise one or more of: an
30 indication of the unavailability of one or more transport channels and information about said one or more different transport channels to be monitored.

The receiving means may be for receiving said non-availability information in a plurality of messages.

The receiving means may be for receiving said non-availability information on a plurality of channels.

The receiving means may be for receiving said non-availability information in a downlink shared channel.

5 The receiving means may be for receiving said non-availability information in association with a broadcast channel identifier, said broadcast channel identifier being used prior to the non-availability of said one or more transport channels.

The broadcast channel identifier may comprise a broadcast control channel radio network temporary identifier.

10 The receiving means may be for receiving said information relating to non-availability after a recovery of at least one channel.

The said at least one recovered channel may comprise a channel on which information about at least one of said one or more transport channels is provided.

The at least one recovered channel may comprise a downlink shared channel.

15 The receiving means may be for receiving at least some of said information on the non-availability of one or more transport channels on said at least one channel.

The one or more transport channels may comprise one or more of a forward access channel, random access channel and paging channel.

20 The one or more transport channels may comprise at least one high speed data packet access channel.

The receiving means may be for receiving said information relating to the non-availability of one or more transport channels after a recovery of a control channel associated with said one or more transport channels and before information
25 indicating availability of said one or more transport channels .

A user equipment may comprise any of the above mentioned apparatus.

According to an aspect, there is provided an apparatus comprising at least one processor and at least one memory including computer program code, the at least one memory and the computer code configured to, with the at least one
30 processor, cause the apparatus at least to: cause information to be sent relating to a non-availability of one or more transport channels to a user equipment; and cause one or more different transport channels for at least one of paging information and data transfer information to be transmitted to said user equipment.

The information relating to non-availability may comprise one or more of: an indication of the unavailability of one or more transport channels and information about said one or more different transport channels to be monitored.

5 The at least one memory and the computer code may be configured with the at least one processor to cause said non-availability information to be sent in a plurality of messages.

The at least one memory and the computer code may be configured with the at least one processor to cause said non-availability information to be sent on a plurality of channels.

10 The at least one memory and the computer code may be configured with the at least one processor to cause said non-availability information to be sent in a downlink shared channel.

The at least one memory and the computer code may be configured with the at least one processor to cause said non-availability information to be sent in
15 association with a broadcast channel identifier, said broadcast channel identifier being used prior to the non-availability of said one or more transport channels.

The broadcast channel identifier may comprise a broadcast control channel radio network temporary identifier.

20 The at least one memory and the computer code may be configured with the at least one processor to cause said information relating to non-availability to be sent after a recovery of at least one channel.

The at least one recovered channel may comprise a channel on which information about at least one of said one or more transport channels is provided.

25 The at least one recovered channel may comprise a downlink shared channel.

The at least one memory and the computer code may be configured with the at least one processor to cause at least some of said information on the non-availability of one or more transport channels to be sent on said at least one channel.

The one or more transport channels may comprise one or more of a forward access channel, random access channel and paging channel.

30 The one or more transport channels may comprise at least one high speed data packet access channel.

The at least one memory and the computer code may be configured with the at least one processor to cause said information relating to the non-availability of one or more transport channels to be sent after a recovery of a control channel

associated with said one or more transport channels and before information indicating availability of said one or more transport channels.

According to another aspect, there is provided an apparatus comprising: means for causing information to be sent relating to a non-availability of one or more
5 transport channels to a user equipment; and means for causing one or more different transport channels for at least one of paging information and data transfer information to be transmitted to said user equipment.

The information relating to non-availability may comprise one or more of: an indication of the unavailability of one or more transport channels and information
10 about said one or more different transport channels to be monitored.

The causing means may be for causing said non-availability information to be sent in a plurality of messages.

The causing means may be for causing said non-availability information to be sent on a plurality of channels.

15 The causing means may be for causing said non-availability information to be sent in a downlink shared channel.

The causing means may be for causing said non-availability information to be sent in association with a broadcast channel identifier, said broadcast channel identifier being used prior to the non-availability of said one or more transport
20 channels.

The broadcast channel identifier may comprise a broadcast control channel radio network temporary identifier.

The causing means may be for causing said information relating to non-availability to be sent after a recovery of at least one channel.

25 The at least one recovered channel may comprise a channel on which information about at least one of said one or more transport channels is provided.

The at least one recovered channel may comprise a downlink shared channel.

The causing means may be for causing at least some of said information on the non-availability of one or more transport channels to be sent on said at least one
30 channel.

The one or more transport channels may comprise one or more of a forward access channel, random access channel and paging channel.

The one or more transport channels may comprise at least one high speed data packet access channel.

The causing means may be for causing said information relating to the non-availability of one or more transport channels to be sent after a recovery of a control channel associated with said one or more transport channels and before information indicating availability of said one or more transport channels.

5 The above apparatus may be provided in a base station. The above apparatus may be provided in a network controller. The network controller may be a radio network controller.

Reference will now be made by way of example only to the accompanying Figures in which:

10 Figure 1a shows a schematic diagram of a network according to some embodiments;

Figure 1b shows a UMTS network;

Figure 2 shows a schematic diagram of a mobile communication device according to some embodiments;

15 Figure 3 shows a schematic diagram of a control apparatus according to some embodiments; and

Figure 4 shows a signal flow of an embodiment.

In the following certain exemplifying embodiments are explained with reference to a wireless or mobile communication system serving mobile communication devices. Before explaining in detail the exemplifying embodiments, certain general principles of a wireless communication system and mobile communication devices are briefly explained with reference to Figures 1 to 3 to assist in understanding the technology underlying the described examples.

25 In a wireless communication system mobile communication devices or user equipment (UE) 102, 103, 105 are provided wireless access via at least one base station or similar wireless transmitting and/or receiving node or point. In the Figure 1a example two overlapping access systems or radio service areas of a cellular system 100 and 110 and three smaller radio service areas 115, 117 and 119 provided by base stations 106, 107, 116, 118 and 120 are shown. Each mobile communication device and station may have one or more radio channels open at the same time and may send signals to and/or receive signals from more than one source. It is noted that the radio service area borders or edges are schematically shown for illustration purposes only in Figure 1a. It shall also be understood that the sizes and shapes of radio service areas may vary considerably from the shapes of

Figure 1a. A base station site can provide one or more cells. A base station can also provide a plurality of sectors, for example three radio sectors, each sector providing a cell or a subarea of a cell. All sectors within a cell can be served by the same base station.

5 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. In Figure 1a control apparatus 108 and 109 is shown to control the respective macro level base stations 106 and 107. The control apparatus of a base station can be interconnected with
10 other control entities. The control apparatus is typically provided with memory capacity and at least one data processor. The control apparatus and functions may be distributed between a plurality of control units. In some systems, such as discussed in relation to Figure 1b, the control apparatus may additionally or alternatively be provided in a radio network controller.

15 In Figure 1a 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 stations 116, 118 and 120 can also be connected to the network 113, for example by a separate gateway function and/or via the controllers of the
20 macro level stations. 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.

 Reference is made to Figure 1b which schematically shows a UMTS network with the entities in accordance with the terminology of that standard. The base
25 station is a node B which communicates with one or more user equipment. The node Bs are controlled by a radio network controller RNC.

 A possible mobile communication device will now be described in more detail with reference to Figure 2 showing a schematic, partially sectioned view of a
communication device 102. Such a communication device is often referred to as
30 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 include a mobile station (MS) 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, personal data assistant (PDA) 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 include 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 include downloads, television and radio programs, videos, advertisements, various alerts and other information.

The mobile device 102 may receive signals over an air 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 mobile device.

A wireless communication device can be provided with a Multiple Input / Multiple Output (MIMO) antenna system. MIMO arrangements as such are known. MIMO systems use multiple antennas at the transmitter and receiver along with advanced digital signal processing to improve link quality and capacity. Although not shown in Figures 1 and 2, multiple antennas can be provided, for example at base stations and mobile stations, and the transceiver apparatus 206 of Figure 2 can provide a plurality of antenna ports. More data can be received and/or sent where there are more antenna elements. A station may comprise an array of multiple antennas. Signalling and muting patterns can be associated with Tx antenna numbers or port numbers of MIMO arrangements.

A mobile 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

mobile 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 mobile 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.

Figure 3 shows an example of a control apparatus for a communication system, for example to be coupled to and/or for controlling a station of an access system, such as a base station. In some embodiments, base stations comprise a separate control apparatus. In other embodiments, such as shown in Figure 1b, the control apparatus can be another network element such as a radio network controller. In some embodiments, each base station may have such a control apparatus as well as a control apparatus being provided in a radio network controller. The control apparatus 109 can be arranged to provide control on communications in the service area of the system. The control apparatus 109 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 control apparatus 109 can be configured to execute an appropriate software code to provide the control functions.

The communication devices 102, 103, 105 can access the communication system based on various access techniques, such as code division multiple access (CDMA), or wideband CDMA (WCDMA). Other examples include time division multiple access (TDMA), frequency division multiple access (FDMA) and various schemes thereof such as the interleaved frequency division multiple access (IFDMA), single carrier frequency division multiple access (SC-FDMA) and orthogonal frequency division multiple access (OFDMA), space division multiple access (SDMA) and so on.

A non-limiting example of the recent developments in communication system architectures is the W-CDMA of the Universal Mobile Telecommunications System (UMTS) that is being standardized by the 3rd Generation Partnership Project (3GPP) and is schematically illustrated in Figure 1b. As explained above, further development of the W-CDMA is referred to as HSPA+. Other examples of radio access system include those provided by base stations of systems that are based on

technologies such as wireless local area network (WLAN) and/or WiMax (Worldwide Interoperability for Microwave Access).

One of the RRC (radio resource control) states of operation for user equipment is the forward access channel state (CELL_FACH). The UE may spend much more time operating in the CELL_FACH state, for example with the introduction of enhanced CELL_FACH in 3GPP release 7 and 8 and the introduction of a second discontinuous downlink reception operation in cells operating in FACH state in 3GPP release 11. Alternatively or additionally, the popularity of UE 'smart phones' and the desire to be able to operate in an 'always on' mode is expected to increase the amount of time operating in FACH mode as the 'always on' mode is typically implemented by exploiting the CELL_FACH state. The reason behind a growing number of "always on" devices (commonly referred to as "smart phones") being configured with CELL_FACH is the fact that a UE can still transmit and receive relatively small packets of data without excessively draining their battery. The lower throughput than in CELL_DCH is leveraged by the much smaller battery power consumption and thus longer battery life. The lower throughput is motivated by UE utilizing a different channel (Forward Access Channel – FACH) opposed to a Dedicated channel (DCH). For a "smart phone" type UE small but frequent data packets are enough to maintain all the "keep-alive" messages and the "always on" user experience. The characteristics of each of the states have been listed below:

CELL_FACH state may have one or more of the following characteristics:

- No dedicated physical channel is allocated to the UE.
- The UE continuously monitors a FACH in the downlink.
- The UE is assigned a default common or shared transport channel in the uplink (e.g. RACH- random access channel, Enhanced RACH) that it can use anytime according to the access procedure for that transport channel.
- The position of the UE is known by UTRAN on cell level according to the cell where the UE last made a cell update.
- In TDD (time division duplex) mode, one or several USCH (uplink shared channel) or DSCH (downlink shared channel) transport channels may have been established.

CELL_PCH state may have one or more of the following characteristics:

- No dedicated physical channel is allocated to the UE.
- The UE selects a PCH with an algorithm, and uses DRX (discontinuous reception) for monitoring the selected PCH via an associated PICH (paging indicator channel).

- No uplink activity is possible.
- The position of the UE is known by UTRAN on cell level according to the cell where the UE last made a cell update in CELL_FACH state.

It has been proposed to allow the use of HSDPA (high speed downlink packet access) and E-DCH (enhanced dedicated channel) in the cell FACH and/or cell PCH states. This is to allow high-speed access to users in those states.

User equipment accesses details about the HS-FACH (high speed forward access channel) and/or HS-RACH (high speed random access channel) and/or HS-PCH (high-speed paging channel) in system information broadcasts SIB. This broadcast information is provided on the HS-DSCH (high speed downlink shared channel).

When the HS-DSCH resources are down at the base station, the base station cannot schedule HSDPA transport to the cell FACH and/or cell PCH users. The HS-DSCH resources may be down due to a variety of different reasons. However, it is not currently possible to communicate the non-availability of the HS-DSCH resources to the user equipment if the user equipment is in the cell FACH state or the cell PCH state. Currently, the user equipment is only able to obtain that information if the user equipment attempts to contact the network when the user equipment has data to transmit in the uplink. This may cause difficulties as the user equipment may not be reached via paging procedures, e.g, for incoming circuit switched voice calls.

With current proposals, when the HSDPA resources are down at the base station, the base station will provide information about this to the RNC. This may be done using an NBAP (node B application part) message – resource status indication. The HS-FACH and HS-PCH use the same HS-DSCH resources in the base station. Hence both services are not available when HSDPA is down. The base station may set the HS-DSCH resources information element (IE) in the NBAP resource status message to “disabled”.

When the RNC receives this information from the base station, the RNC checks the cell information from its database. If the cell has HS-FACH/HS-PCH resources, the RNC initiates the NBAP system information update procedure to the base station and informs the user equipment about the non-availability of the HS-FACH and HS-PCH in the cell. This information is provided using the RRC system information update procedure and may use one or more of the following messages:

RRC: System Information Update procedure (RRC: PAGING TYPE 1, RRC: SYSTEM INFORMATION CHANGE INDICATION and RRC: SYSTEM INFORMATION messages). RRC: Paging Type 1 is for users without H-RNTI (HSDPA radio network temporary identifier) and RRC: SYSTEM INFORMATION
5 CHANGE INDICATION is for users with H-RNTI.

However, this communication is applicable only for new users entering the HS cell FACH/cell PCH state. The system information broadcast modification information will not reach existing FACH and PCH users due to the HSDPA being down. Accordingly, this means that the new HS-FACH and HS-PCH users entering
10 the respective RRC states will start using, for example, available channels such as R99 channels for paging reception. Existing HS-FACH and HS-PCH users will be left in a dangling state and will not be reachable as those user equipment will not know that the HSDPA is down. These users will be unreachable in downlink, unless the user equipment tries to contact the network for any data to be sent in uplink.
15 This is because fall back to the PRACH (physical RACH) could be used when the user equipment fails to access the HS-RACH. The user equipment in the cell PCH state cannot be reached using a paging message.

A further issue is that even after the HSPA resources come back, those dangling user equipment cannot be reached. This is because the H-RNTI and E-RNTI (E-DCH RNTI) would be cleared by both the RNC and base station when the
20 HSPA resources go down. The HS-DSCH Radio Network Transaction Identifier is allocated by a controlling RNC upon UE establishing a HS-DSCH channel. H-RNTI may be unique within a the cell carrying the HS-DSCH

In some embodiments, communication with user equipment is established so
25 that they can be informed about the non-availability of the HS-DSCH channel and the E-DCH channel, following HSDPA resources going down at Node B.

Reference is now made to figure 4 which shows the signal flow between a user equipment, base station (node B) and RNC.

In step S1, the HSDPA is down. When this occurs, data cannot be scheduled
30 on the HS-FACH and/or HS-RACH and/or HS-PCH.

In step S2, a NBAP resource status indication message is sent to the RNC from the base station. This message will indicate the status as 'disabled'. In response to this message, the RNC will release the H-RNTI and/or E-RNTI for all the HS-FACH and/or HS-PCH user equipment.

In step S3, the RNC sends an NBAP system information update message to the Node B. This indicates that the Node B is to transmit a system information broadcast SIB message that Enhanced FACH and Enhanced PCH services are not available for users.

5 Thus, in response to the NBAP message from the RNC, the base station in step S4 sends the system information broadcast message to the user equipment. This broadcast information will indicate that Enhanced FACH and Enhanced PCH services are not available for users. The SIB message will have no HS-DSCH common system information or HS-DSCH paging system information. It should be
10 appreciated that new user equipment entering the FACH and/or the PCH RRC states start using the FACH/RACH and monitor the release 99 PCH channels for paging reception. Existing HS-FACH and HS-PCH users are left dangling and unreachable.

As shown schematically, in step S5, the RNC will cause a RRC paging type I (this message is used to indicate the SIB changes to a UE in idle mode) and/or RRC
15 system information change indications (this message is used to indicate the UE that there are changes in the SIB and they have to be monitored in connected mode) to be transmitted on release 99 channels. These will be transmitted by the Radio Access Network to the user equipment. In step S6, the base station causes the HSDPA/E-DCH to come back up or the problem which causes these resources to be
20 unavailable is removed.

Once the HSDPA resources are recovered, the base station indicates in step S7 to the RNC the availability of the HSDPA resource. This will be done using an NBAP resource status indication message. Thus, when the HSDPA/E-DCH resources are recovered at Node B, the Node B informs the RNC about the
25 availability of HSDPA resource using NBAP: Resource Status Indication message.

In response to that message, the RNC will configure the base station for HS-FACH and/or HS-PCH operation. In particular the RNC configures the NodeB with the HSPA resources for HS-FACH/HS-PCH and initiates the below listed procedure

In this step S8, the RNC transmits a NBAP message to the base station. This
30 is a physical shared reconfiguration procedure. This allows the RNC to setup the base station for the HS-FACH and/or HS-PCH operation.

In step S9, the RNC sends a NBAP – system information update messaging to the base station. This is to indicate the availability of Enhanced FACH and Enhanced PCH services for users.

In step S10, system information broadcast is provided on the HS-DSCH. This is because the dangling UEs would only be monitoring HS-DSCH and such UEs should be informed about the non-availability of HS-FACH/HS-PCH on the HS-DSCH. This is transmitted from the base station to the user equipment. However, it should be appreciated that although the base station is ready to start scheduling data on the HSPA for the eligible user equipment, the RNC causes the deferment of the broadcasting of the HS-DSCH common system information and HS-PDSCH paging system information on the SIB5. This delay may be one or more DRX cycles to improve the reliability of the decoding. This delay is used in order to communicate to the dangling user equipment about the non-availability of the HS-FACH and/or HS-PCH services. Thus, the SIB broadcast in step S10 does not include any HS-PDSCH common system information nor does it include any HS-PDSCH paging information. In summary, the base station transmits BCCH (broadcast control channel) modification information (with BCCH specific H-RNTI) to indicate non-availability of HS-FACH/HS-PCH for dangling user equipment.

Thus announcing availability of HSDPA for new HS-PCH/HS-FACH users may be delayed until the SIB modification information (HSPA resource unavailable) is delivered to old dangling UEs. This is needed to ensure that all the UEs in the dangling CELL_FACH/CELL_PCH RRC states are given sufficient opportunity to read the SIB. In some embodiments, the BCCH modification information is sent for at least one or more DRX cycles to improve the reliability of decoding so that Paging occasions of the UE(s) are covered in case of UEs in a CELL_PCH RRC State and/or UEs in CELL_FACH state and DRX is enabled.

In step S11, the RNC causes an RRC paging type 1/RRC system information change indication to be sent from the RNC to the user equipment via the base station. This communication uses the BCCH specific H-RNTI. The BCCH Specific H-RNTI maybe a pre-configured value used in the network. This value is not changed even when the HSDPA resources go down and come up.

There may be UEs in Cell PCH state which do not have an allotted H-RNTI. In such cases, RRC: Paging Type 1 is used for communication.

The RRC system information change indication is used for those user equipment which have a H-RNTI. This messaging indicates to the user equipment that HS-FACH and/or HS-PCH resources are not available. This indicates to the user equipment that they should use the R99 channels for data transfer and paging

reception. This is achieved by the dangling user equipment using the BCCH specific H-RNTI. This value of the BCCH specific H-RNTI remains the same even when the HSPA resources go down and come back. This is possible by allocating the same BCCH-specific H-RNTI (using the BCCH modification information accessed by UEs
5 on the BCCH mapped to HS-DSCH) as before the HSDPA resources were lost at the NodeB. Thus the dangling UEs in the cell FACH and/ or cell PCH RRC states can be triggered to read the modified SIB information and are notified of the HSDPA resource failure. Thus, the dangling user equipment in the cell FACH and/or cell PCH state are triggered to fall back to the R99 channels. Thus once the network
10 completes the BCCH modification information communication to the old dangling user equipment, the HS-FACH and HS-PCH resources may be available to the user equipment.

In step S12, the RNC sends a NBAP – system information update messaging to the base station. This is to indicate the availability of Enhanced FACH and
15 Enhanced PCH services for users.

The base station is configured to provide system information broadcast information in step S13 to the user equipment. HS-PDSCH common system information and HS-PDSCH paging system information are provided. HS-FACH and HS-PCH states will be available for user equipment, including those user equipment
20 which were previously dangling. This HS-FACH/HS-PCH availability is announced on SIB5 (HS-DSCH common system information and HS-DSCH paging system information is broadcasted). This is available for the previously left dangling user equipment as well. Thus in step S13, HS-DSCH common system information and HS-DSCH paging system information are transmitted on SIB5.

25 In step S14, the RNC indicates to the UEs that the UEs should monitor the SIB (to read the HS-FACH/HS-PCH information).

In step S15, previously (but not longer) dangling user equipment may cause a possible cell update procedure to be sent from the UE to the RNC via the base station. H-RNTI and/or E-RNTI may be allocated for previously dangling HS-FACH
30 and HS-PCH user equipment. A UE using the R99 channels can access the availability information and perform a cell update procedure as and when required. For example this may be done when there is data to send in the uplink. The H-RNTI and E-RNTI may be allocated in dependence on availability.

In embodiments, once the dangling users are informed about the non-availability of HS-FACH and HS-PCH, they start using R99 channels for data transfer and Paging reception. Then the RNC initiates new SIB modification to inform the UE(s) about availability of HS-FACH and HS-PCH. This could be accessed by the ex-dangling users as well. In some embodiments, if such users perform Cell Update (E.g. when they have data to transmit in UL) at any point later, the user equipment should be treated like a normal HS-FACH/HS-PCH users and allocated H-RNTI/E-RNTI by the network.

Some embodiments may have one or more of the following advantages:

- The HS-FACH and HS-PCH users will no longer be left dangling after HSDPA resources are back up. These UEs may be reached by the network and allowed to continue as a normal user.
- The option of network dropping the unreachable users need not be adopted.
- The new users entering HS-FACH/HS-RACH may not be impacted.
- This option may be backward compatible. This option may be usable with for example Rel7 users.
- The RNC may not delete the user context for Cell FACH and Cell PCH state users when the HSPA resources go down. This may result in reduction of delay and/or improved signalling.

Some versions of the 3GPP standards - NBAP (25.433) and RRC (25.331) may be modified to allow deferring of the making of HS-FACH and HS-PCH available to new UEs entering Cell FACH and Cell PCH states. This is to allow any dangling UEs to be first informed of the non-availability. i.e the delay of one or more DRX cycles, which is used to inform the non-availability of Enhanced FACH and Enhanced PCH services to the dangling users may be specified. This is so that the RNC announces availability of Enhanced FACH and Enhanced PCH services only after this time has elapsed.

RLC re-establishment may be provided when the UE switches from HSPA resource to R99 resource. Some embodiments provide a change from Flexible RLC to Fixed RLC configuration.

Some embodiments have been described in relation to FACH and/or PCH states. It should be appreciated that other embodiments may be used with different states. In some embodiments, the state may be an "always on" state.

Some embodiments have been described in relation to HSPA. It should be appreciated that some embodiments may be used with different standards.

Some embodiments have been described with reference to a version of a standard. Other embodiments may be used with other versions of the standard. The
5 other versions may be latter versions.

The RNC and/or base station of figure 4 may comprise the control apparatus of Figure 3 which permits the signal flow of Figure 4 to be achieved.

Some embodiments have been described in relation to example messages such as SIB and RRC messages. It should be appreciated that these messages are
10 by way of example. Some embodiments may use one or more alternative or additional messages. In some embodiments, one or more messages may be combined.

Some embodiments have been described with reference to specific channels. It should be appreciated that some embodiments may be used with one or more
15 alternative or additional channels. For example a different channel to the R99 channels may be used. A different channel to the HS-DSCH may be used. That different channel may be one which provides the necessary channel to allow the associated state (for example an "always on" state) to be used.

In general, the various embodiments may be implemented in hardware or
20 special purpose circuits, software, logic or any combination thereof. Some aspects 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 may be illustrated and described as block diagrams, flow charts, or using
25 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.

Some embodiments may be implemented by computer software executable
30 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.

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 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.

Although the application has been described herein above with reference to specific embodiments, it is not limited to these embodiments and no doubt further alternatives will occur to the skilled person, that lie within the scope of the invention as claimed.

CLAIMS

- 5 1. A method comprising:
 receiving information relating to a non-availability of one or more transport
 channels; and
 monitoring one or more different transport channels for at least one of paging
 information and data transfer information.
- 10 2. A method as claimed in claim 1, wherein said information relating to non-
 availability comprises one or more of: an indication of the unavailability of one or
 more transport channels and information about said one or more different transport
 channels to be monitored.
- 15 3. A method as claimed in claim 1 or 2, receiving said non-availability
 information in a plurality of messages.
4. A method as claimed in any preceding claim, comprising receiving said non-
20 availability information on a plurality of channels.
5. A method as claimed in any preceding claim, comprising receiving said non-
 availability information in a downlink shared channel.
- 25 6. A method as claimed in any preceding claim, comprising receiving said non-
 availability information in association with a broadcast channel identifier, said
 broadcast channel identifier being used prior to the non availability of said one or
 more transport channels.
- 30 7. A method as claimed in claim 6, wherein said broadcast channel identifier
 comprises a broadcast control channel radio network temporary identifier.
8. A method as claimed in any preceding claim, comprising receiving said
 information relating to non-availability after a recovery of at least one channel.

9. A method as claimed in claim 8, wherein said at least one recovered channel comprises a channel on which information about at least one of said one or more transport channels is provided.

5

10. A method as claimed in claim wherein said at least one recovered channel comprises a downlink shared channel.

11. A method as claimed in any of claims 8 to 10, comprising receiving at least
10 some of said information on the non-availability of one or more transport channels on said at least one channel.

12. A method as claimed in any preceding claim, wherein said one or more
15 transport channels comprise one or more of a forward access channel, random access channel and paging channel.

13. A method as claimed in any preceding claim, wherein said one or more transport channels comprise at least one high speed data packet access channel.

20 14. A method as claimed in any preceding claim, comprising receiving said information relating to the non-availability of one or more transport channels after a recovery of a control channel associated with said one or more transport channels and before information indicating availability of said one or more transport channels.

25 15. A method comprising:
causing information to be sent relating to a non-availability of one or more transport channels to a user equipment; and
causing one or more different transport channels for at least one of paging information and data transfer information to be transmitted to said user equipment.

30

16. A method as claimed in claim 15, wherein said information relating to non-availability comprises one or more of: an indication of the unavailability of one or more transport channels and information about said one or more different transport channels to be monitored.

17. A method as claimed in claim 15 or 16, comprising causing said non-availability information to be sent in association with a broadcast channel identifier, said broadcast channel identifier being used prior to the non-availability of said one or more transport channels.

18. A method as claimed in claim 15, 16 or 17, comprising causing said information relating to non-availability to be sent after a recovery of at least one channel.

19. A method as claimed in any of claims 15 to 18, wherein said one or more transport channels comprise at least one high speed data packet access channel.

20. A method as claimed in any of claims 15 to 19, comprising causing said information relating to the non-availability of one or more transport channels to be sent after a recovery of a control channel associated with said one or more transport channels and before information indicating availability of said one or more transport channels.

21. A computer program product configured to perform the method of any preceding claim.

22. An apparatus comprising at least one processor and at least one memory including computer program code, the at least one memory and the computer code configured to, with the at least one processor, cause the apparatus at least to:

cause information to be sent relating to a non-availability of one or more transport channels to a user equipment; and

cause one or more different transport channels for at least one of paging information and data transfer information to be transmitted to said user equipment.

23. A user equipment comprising the apparatus as claimed in claim 22.

24. An apparatus comprising at least one processor and at least one memory including computer program code, the at least one memory and the computer code

configured to, with the at least one processor, cause the apparatus at least to:
receive information relating to a non-availability of one or more transport
channels; and

monitor one or more different transport channels for at least one of paging
5 information and data transfer information.

25. A base station comprising the apparatus as claimed in claim 24.

26. A radio network controller comprising the apparatus as claimed in claim 24.

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1/3

FIG 1A

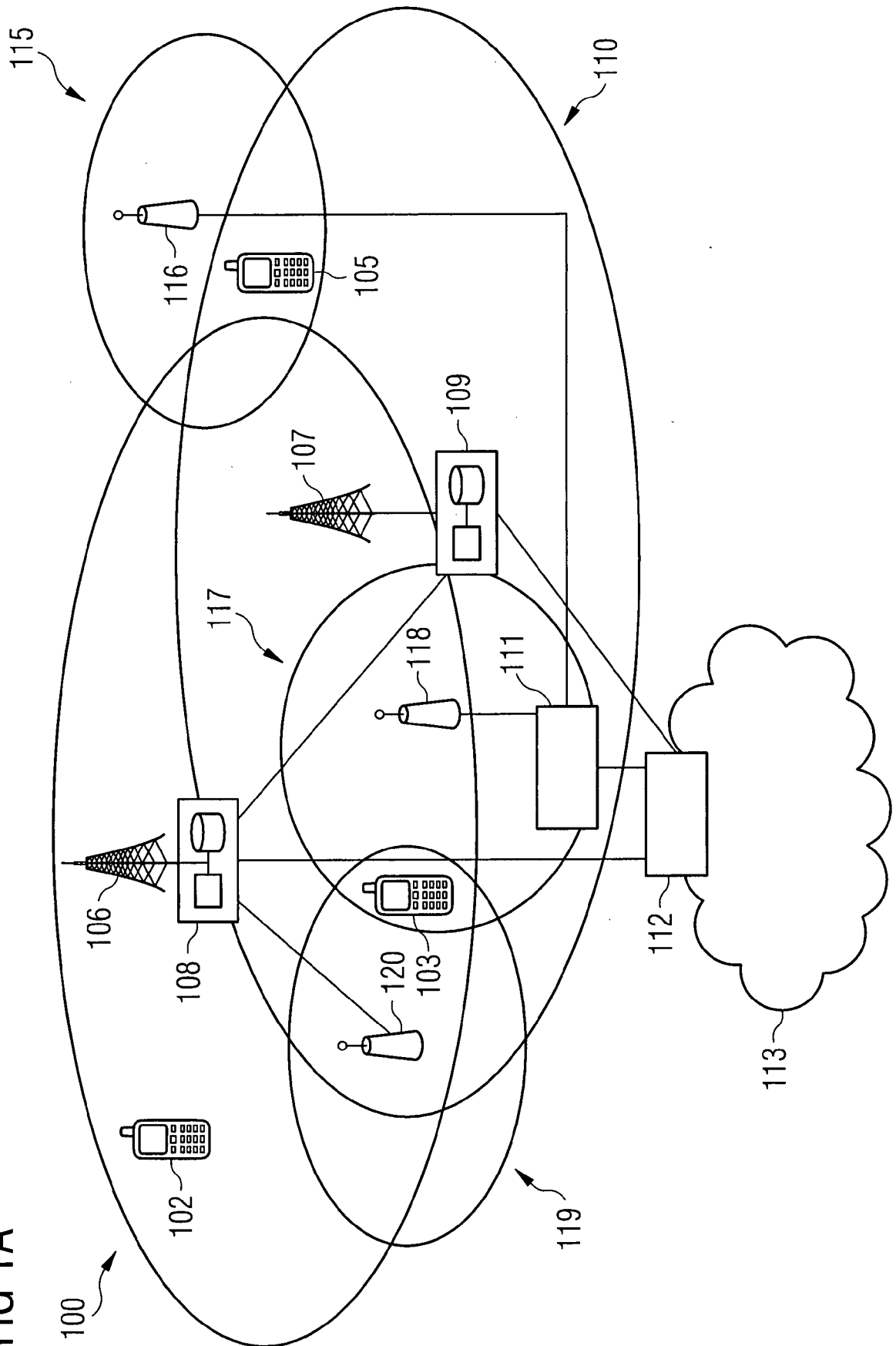


FIG 1B

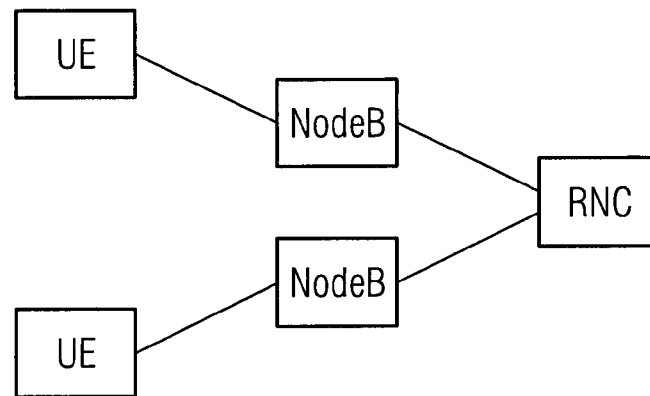


FIG 2

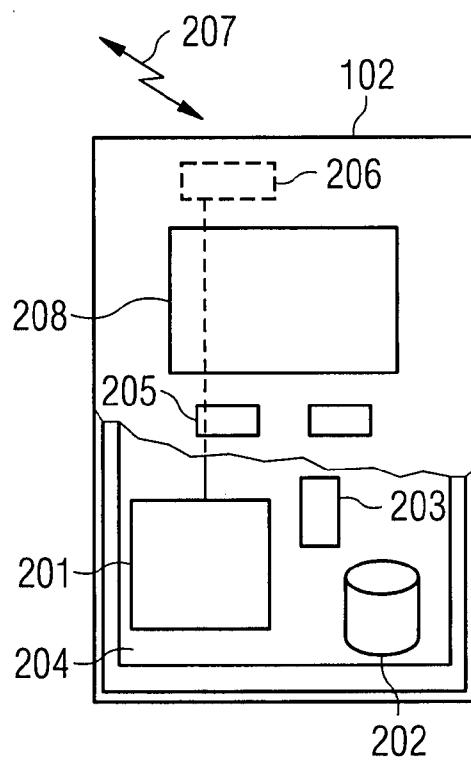
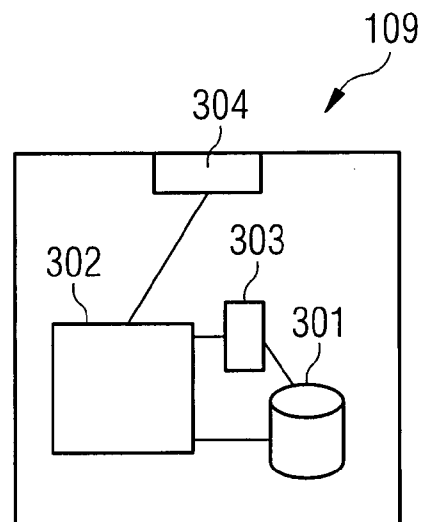
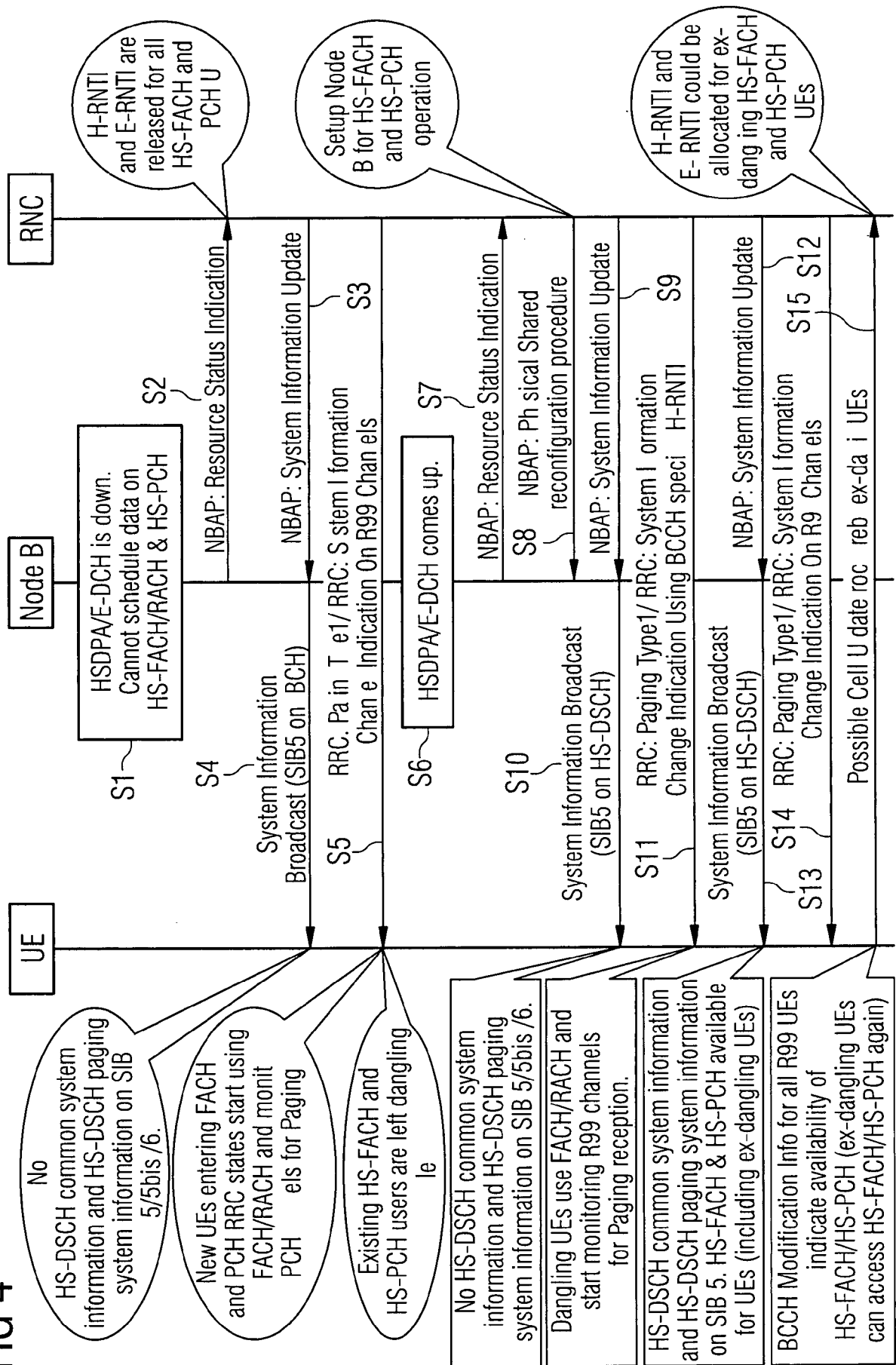


FIG 3



3/3

FIG 4



INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2013/066048

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04W76/02
ADD.

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H04W

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EP0-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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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

27 January 2014

Date of mailing of the international search report

10/02/2014

Name and mailing address of the ISA/

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Authorized officer

Straniero, Roberto

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2013/066048

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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