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(54) Title: METHOD FOR DELAYING SENDING OF MESSAGES FROM A USER EQUIPMENT ASSIGNED TO A BASE STATION WITHIN A CELL OF A MOBILE NETWORK

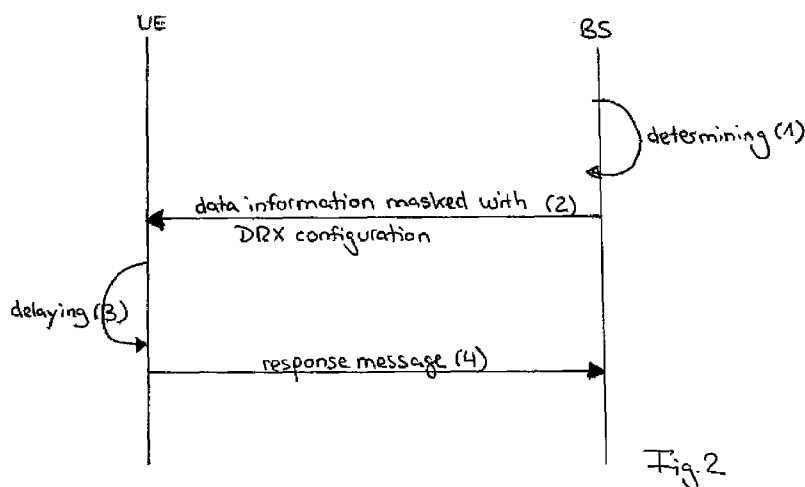


Fig. 2

(57) Abstract: It is described a method for delaying sending of messages from a user equipment assigned to a base station within a cell of a mobile network. The method comprises receiving data information in the base station, determining whether the data information is assigned to always-on applications within the cell, transmitting, in case that the data information is assigned to always-on applications, the received data information from the base station to the user equipment, wherein the received data information is masked with a DRX configuration, and delaying sending of response messages in response to the transmitted data information until the occurrence of a time interval of a DRX cycle, in which time interval the user equipment is enabled to receive and transmit data.

DESCRIPTION

Method for delaying sending of messages from a user equipment assigned to a base station within a cell of a mobile network

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Field of invention

The present invention relates to the field of delaying
10 transmission of messages within networks. In particular, the
present invention relates to a method for delaying
transmission of messages from a user equipment. Further, the
present invention relates to a user equipment. Moreover, the
invention relates to a base station. Furthermore, the
15 invention relates to a system. Further, the invention relates
to a computer program.

Art Background

20

In networks, especially in mobile wireless communications
such as 3GPP Long-Term Evolution, multiple processes have to
be performed, such as delivering text, music, video and other
multimedia content. More and more mobile radio users will
25 enjoy multimedia services thus increasing the total bandwidth
demand in mobile networks. For example, in the Release
9/Release 10 of the E-UTRA specifications, i.e. Long Term
Evolution (LTE), Scheduling Requests (SRs) from the User
Equipment (UE) to the eNodeB are triggered which is
30 standardized to support uplink packet scheduling. The SR is
transmitted on the Physical Uplink Control Channel (PUCCH)
using dedicated resources in uplink.

Among other conditions, in E-UTRA a buffer status report
35 (BSR) is triggered in the UE, if data arrives in the UE
buffer which belongs to a Logical Channel Group (LCG) with
higher priority than that of LCGs for which data is already

available for transmission, and, if new data which belongs to a Logical Channel Group (LCG) arrives in an empty UE buffer. If the UE has no allocation available on the Physical Uplink Shared Channel (PUSCH) for the Transmission Time Interval (TTI) where the BSR is triggered, a SR is then triggered. If no SR can be sent on PUCCH, for example in the case that no PUCCH resources are given to the UE, a random access procedure is triggered.

- 10 When the UE needs to send data in uplink, the network is notified through an SR sent on PUCCH or through a random access procedure if no PUCCH resources are available.

The Scheduling Request (SR) is used for requesting Uplink Shared Channel (UL-SCH) resources for new transmission. The Buffer Status reporting (BSR) procedure is used to provide the serving eNodeB, base station or extended eNodeB, with information about the amount of data available for transmission in the Uplink (UL) buffers of the user equipment (UE). Radio Resource Control (RRC) controls BSR reporting by configuring two timers and by, for each logical channel, optionally signalling logicalChannelGroup which allocates the logical channel to an LCG.

- 25 In the case of a transmission of an SR, i.e. when a BSR is triggered, the UE exits a DRX mode, and transmits an SR on PUCCH at the first occasion. Discontinuous Reception (DRX) is a method used in mobile communication to conserve the battery of the mobile device. The mobile device and the network negotiate phases in which data transfer occurs. During other times the device turns its receiver off and enters a low power state. This is usually a function designed into the protocol that allows this to happen - most notably how the transmission is structured - for example in slots with headers containing address details so that devices can listen to these headers in each slot to decide whether the transmission is relevant to them or not. In this case, the

receiver only has to be active at the beginning of each slot to receive the header, conserving battery life.

Mobile communication networks are experiencing an increasing market penetration of mobile terminals supporting so-called always-on applications. One of the main characteristics of always-on applications is that they need to send and receive small packets frequently in order to keep the IP connectivity open. This is called "Heart beat" or "Keep alive". The typical frequency of "Keep alive" messages is once per minute, or once every few minutes. Examples of always-on applications are push email, instant messaging, presence, location services, weather widgets, etc. Moreover, there may be several always-on applications simultaneously running in a terminal, each having its independent signaling events. The keeping alive messaging is typically client originated, i.e. in a mobile network those packets are sent in the uplink. This means that an SR/random access procedure is triggered for keeping alive message, as described above and that the UE leaves the sleeping mode. This way the battery is drained faster than needed, since keeping alive messages are not delay critical and thus the transmission could be delayed to the next opportunity.

There may be a need for allowing the UE to quickly notify the eNodeB of urgent data arrival while maximizing power saving by avoiding too frequent notification when non-urgent data needs to be sent.

Summary of the Invention

This need may be met by the subject matter according to the independent claims. Advantageous embodiments of the present invention are described by the dependent claims.

According to a first exemplary aspect of the invention there is provided a method for delaying sending of messages from a user equipment assigned to a base station within a cell of a mobile network, the method comprising receiving data
5 information, wherein the received data information is masked with a DRX configuration, and delaying sending of response messages in response to the received data information until the occurrence of a time interval of a DRX cycle, in which
10 time interval the user equipment is enabled to receive and transmit data.

According to a further aspect of the invention, there is provided a method for masking data information, the method comprising receiving data information in a base station
15 within a cell of a mobile network, determining whether the data information is assigned to applications with specified characteristics within the cell, transmitting, in case that the data information is assigned to applications with
specified characteristics, the received data information from
20 the base station to a user equipment assigned to the base station, wherein the received data information is masked with a DRX configuration.

According to a further aspect of the invention, there is
25 provided a method for delaying sending of messages from a user equipment assigned to a base station within a cell of a mobile network, the method comprising receiving data information in the base station, determining whether the data information is assigned to applications with specified
30 characteristics within the cell, transmitting, in case that the data information is assigned to applications with specified characteristics, the received data information from the base station to the user equipment, wherein the received data information is masked with a DRX configuration, and
35 delaying sending of response messages in response to the transmitted data information until the occurrence of a time interval of a DRX cycle, in which time interval the user equipment is enabled to receive and transmit data.

These aspects are based on the idea to provide the eNodeB or base station with a mean to "force" the terminal or user equipment to delay data transmission from for example always-on applications while keeping it in DRX mode, thus saving UE battery power and maintaining low latency for urgent applications. In this way a network operator may avoid continuous transmission of SR and only allocate resources periodically (for instance using non-contention based radio access (RA) procedure).

The term "applications with specified characteristics" may denote always-on applications, that means applications which need to send and receive small packets frequently in order to keep the IP connectivity open. This is called "Heart beat" or "Keep alive". The typical frequency of "Keep alive" messages may be once per minute, or once every few minutes. Always-on applications may be push email, instant messaging, presence, location services, weather widgets, etc. Moreover, there may be several always-on applications simultaneously running in a user equipment, each having its independent signaling events. The keeping alive messaging may be typically client originated, i.e. in a mobile network those packets are sent in the uplink. Applications with specified characteristics may also be characterized by priority or other characteristics.

The received data information may be masked with a DRX configuration. As explained above, Discontinuous Reception (DRX) is a method used in mobile communication to conserve the battery of the mobile device. The mobile device and the network may negotiate phases in which data transfer occurs. During other times the device may turn its receiver off and may enter a low power state. When the data information is masked with a DRX configuration, the data information may be seen as to be data information in DRX mode.

The term "time interval of a DRX cycle" may denote a time slot or On-duration of a DRX cycle. A DRX cycle specifies the periodic repetition of the On Duration followed by a possible period of inactivity.

5

In the following there will be described exemplary embodiments of the present invention.

According to an exemplary embodiment of the invention, the
10 response messages are scheduling requests.

The Scheduling Request (SR) may be used for requesting UL-SCH resources for new transmission. When an SR is triggered, it shall be considered as pending until it is cancelled.

15

According to an exemplary embodiment of the invention, delaying sending of response messages comprises initiating random procedures.

20 In addition or optionally to sending response messages, random procedures may be initiated.

According to an exemplary embodiment of the invention, applications with specified characteristics are always-on
25 applications.

Always-on applications may be applications which need to send and receive small packets frequently in order to keep the IP connectivity open.

30

According to an exemplary embodiment of the invention, the data information assigned to always on applications are keep-alive messages.

35 Always-on applications may need to send and receive small packets frequently in order to keep the IP connectivity open. This is called "Heart beat" or "Keep alive". The typical

frequency of "Keep alive" messages may be once per minute, or once every few minutes.

According to an exemplary embodiment of the invention, the user equipment is assigned to one of a plurality of a logical channel groups and wherein characteristics of the delaying are dependent on the one logical channel group.

For this LCG, the UE may then be instructed not to send an SR or initiate a random access procedure before the occurrence of the on-duration of the DRX cycle, effectively delaying the notification of incoming data to the eNodeB. For other LCGs of the plurality of LCGs, the normal procedure may apply, that means an SR on random access procedure may be initiated regardless of DRX.

According to an exemplary embodiment of the invention, the method comprises further using different DRX configuration dependent on a load of the cell.

The eNodeB may also use different DRX settings depending on the load, that means for example the number of active users in a cell, and possibly on the average channel conditions so that for example UE power consumption is minimized for users in poor channel conditions.

According to a further aspect of the invention, there is provided a user equipment for delaying sending of messages, wherein the user equipment is assigned to a base station within a cell of a mobile network, the user equipment comprising a first unit for receiving data information, wherein the received data information is masked with a DRX configuration, and a second unit for delaying sending of response messages in response to the received data information until the occurrence of a time interval of a DRX cycle, in which time interval the user equipment is enabled to receive and transmit data.

According to a further aspect of the invention, there is provided a base station for delaying transmission of messages from a user equipment assigned to the base station within a cell of a mobile network, the base station comprising a first
5 unit for receiving data information, a second unit for determining whether the data information is assigned to applications with specified characteristics within the cell, and a third unit for transmitting, in case that the received data information is assigned to applications with specified
10 characteristics, the data information from the base station to the user equipment, wherein the data information is masked with a DRX configuration.

According to a further aspect of the invention, there is
15 provided a system for delaying transmission of messages from a user equipment assigned to a base station within a cell of a mobile network, the system comprising a user equipment with the above mentioned features and a base station with the above mentioned features.

20 According to a further aspect of the invention, a program element (for instance a software routine, in source code or in executable code) is provided, which, when being executed by a processor, is adapted to control or carry out a method
25 having the above mentioned features.

According to yet another aspect of the invention, a computer-readable medium (for instance a CD, a DVD, a USB stick, a floppy disk or a hard disk) is provided, in which a computer
30 program is stored which, when being executed by a processor, is adapted to control or carry out a method having the above mentioned features.

Delaying sending of messages from a user equipment assigned
35 to a base station within a cell of a mobile network which may be performed according to aspects of the invention can be realized by a computer program, that is by software, or by using one or more special electronic optimization circuits,

that is in hardware, or in hybrid form, that is by means of software components and hardware components.

It has to be noted that embodiments of the invention have
5 been described with reference to different subject matters.
In particular, some embodiments have been described with
reference to method type claims whereas other embodiments
have been described with reference to apparatus type claims.
However, a person skilled in the art will gather from the
10 above and the following description that, unless other
notified, in addition to any combination of features
belonging to one type of subject matter also any combination
between features relating to different subject matters, in
particular between features of the apparatus type claims and
15 features of the method type claims is considered as to be
disclosed with this application.

The aspects defined above and further aspects of the present
invention are apparent from the examples of embodiment to be
20 described hereinafter and are explained with reference to the
examples of embodiment. The invention will be described in
more detail hereinafter with reference to examples of
embodiment but to which the invention is not limited.

25

Brief Description of the Drawings

Figure 1 shows a mobile network according to an embodiment of
the invention.

30

Figure 2 shows a transactional flow diagram according to an
embodiment of the invention.

35

Detailed Description

The illustration in the drawing is schematically. It is noted
that in different figures, similar or identical elements are

provided with reference signs, which are different from the corresponding reference signs only within the first digit.

Figure 1 shows a mobile network 100 according to an embodiment of the invention. The mobile network 100 comprises at least one cell 101. A base station or eNodeB 102 is located in and assigned to this cell. One or more user equipments 103, 104 are connected to the base station.

10 If the base station receives data information relevant for always-on applications or referring to keep-alive messages of such applications, the base station 102 masks the data information with a DRX configuration and transmits the received data information to the user equipment.

15 Subsequently, the user equipment, upon receipt of the masked data information delays sending of response messages or keep alive messages until a time interval of a DRX cycle, in which time interval the user equipment is enabled to receive and transmit data, occurs.

20

Thus, the user equipment may be kept in a kind of sleep mode as long as only not time-critical messages have to be sent like keep alive messages. If other data information occurs and is received by the user equipment, the sleep mode may be nevertheless be quit.

Figure 2 shows a transactional flow diagram according to an embodiment of the invention. In this diagram, it is shown that a base station (BS) determines (1) whether received data information is assigned to always-on applications. If this is the case, the BS masks the data information with a DRX configuration and transmits (2) the data information to a user equipment (UE). The UE then delays (3) a response to the received data information until the occurrence of a time interval of a DRX cycle, in which the UE is enabled to receive and transmit data. Once the time interval occurs, the UE sends (4) a response message or response messages to the BS.

According to common technologies, one way to reduce UE power consumption is to introduce the so-called "Fast dormancy" functionality, which releases the RRC/RAB (Radio Resource Control/Radio Access Bearer) connection when data transmission is over. However, when used in presence of always-on applications such functionality generates a lot of signaling load due to frequent release/setup of RRC/RAB connections.

A further possible way to "synchronize" transmission of "Keep alive" messages from different applications is to deploy a sort of push notification server as proposed e.g. by Apple. With a push notification server the synchronization is handled at application level. The main drawback is that all always-on applications have to go through such push notification server in order to connect to a phone, which means that this solution is not transparent to the type of application and/or to the terminal model. This concept also only works for downlink applications, but not for uplink applications, connected to different servers.

Also DRX may be used to "synchronize" transmission of "Keep alive" messages from different always-on applications. However, the majority of "Keep alive" messages are initiated by the mobile terminal and therefore transmitted in the uplink. This makes UE power saving unfeasible since the UE anyways exits DRX mode when new data arrives in its transmission buffers.

Another way would be to avoid associating the logical channel used by the application sending keep alive messages to any LCG. That would prevent BSR to be triggered and therefore SR and/or RACH procedure. One major drawback of such an approach is that no buffered data of the application will be reflected in the BSR, leaving the eNodeB possibly unaware of their existence.

In order to synchronize transmission of "Keep alive" messages from several always-on applications running over the same mobile terminal, it is proposed in the invention to introduce a method that masks the transmission of Scheduling Requests with the DRX configuration, which may also be dependent on the priority of the data. The main idea is to provide the eNodeB with a mean to "force" the terminal to delay data transmission from always-on applications while keeping it in DRX mode, thus saving UE battery power and maintaining low latency for urgent applications. In this way a network operator could avoid continuous transmission of SR and only allocate resources periodically (e.g. using non-contention based RA procedure if we need to recover synchronization).

In order to do so, first it is necessary that the eNodeB is able to distinguish between data from always-on applications and other types of traffic in order to configure the UE properly. This can be achieved at bearer setup through CQI (Channel Quality Indicator).

For those LCGs, the UE would then be instructed not to send an SR or initiate a random access procedure before the occurrence of the on-duration of the DRX cycle, effectively delaying the notification of incoming data to the eNB. For other LCGs, the normal procedure would apply: an SR on random access procedure can be initiated regardless of DRX. In order for this to be applicable, updates/modifications to the current LTE specifications are required.

The eNodeB could also use different DRX settings depending on the load (i.e. number of active users in a cell) and possibly on the average channel conditions so that e.g. UE power consumption is minimized for users in poor channel conditions.

One Release of LTE specifications distinguish between (i) regular BSR, (ii) periodic BSR and (iii) padding BSR.

In case of regular BSR, it is proposed to additionally distinguish depending on the LCG the newly arrived data in the UE buffer belongs to. For instance a regular BSR is defined as "regular BSR LCG #i" if the newly arrived data belongs to
5 LCG #i. In case data from different LCGs simultaneously arrives in the UE buffer, the LCG with higher priority is assumed when marking the corresponding regular BSR.

The eNodeB may then have the possibility to configure (for
10 each LCG) whether or not a SR which is triggered by a regular BSR marked with the corresponding LCG number has to be masked with DRX configuration. For example, a LCG bearing critical RRC signalling or VoIP may not be masked with DRX configuration, while a LCG bearing data from always-on applications
15 may.

The main advantage of the proposed idea is that it allows network operators to take control of the frequency of transmission of "Keep alive" messages without need to implement
20 non-transparent solutions at application level such as the push notification server.

It should be noted that the term "comprising" does not exclude other elements or steps and "a" or "an" does not
25 exclude a plurality. Also elements described in association with different embodiments may be combined. It should also be noted that reference signs in the claims should not be construed as limiting the scope of the claims.

CLAIMS:

1. A method for delaying sending of messages from a user equipment assigned to a base station within a cell of a mobile network, the method comprising
5 receiving data information, wherein the received data information is masked with a DRX configuration, and delaying sending of response messages in response to the received data information until the occurrence of a time
10 interval of a DRX cycle, in which time interval the user equipment is enabled to receive and transmit data.
2. A method for masking data information, the method comprising
15 receiving data information in a base station within a cell of a mobile network,
determining whether the data information is assigned to applications with specified characteristics within the cell,
transmitting, in case that the data information is assigned
20 to applications with specified characteristics, the received data information from the base station to a user equipment assigned to the base station, wherein the received data information is masked with a DRX configuration.
- 25 3. A method for delaying sending of messages from a user equipment assigned to a base station within a cell of a mobile network, the method comprising
receiving data information in the base station,
determining whether the data information is assigned to
30 applications with specified characteristics within the cell,
transmitting, in case that the data information is assigned to applications with specified characteristics, the received data information from the base station to the user equipment,
wherein the received data information is masked with a DRX
35 configuration, and
delaying sending of response messages in response to the transmitted data information until the occurrence of a time

interval of a DRX cycle, in which time interval the user equipment is enabled to receive and transmit data.

4. The method as set forth in claim 3, wherein the response
5 messages are scheduling requests.

5. The method as set forth in any one of the claims 3 to 4
claims, wherein delaying sending of response messages
comprises initiating random procedures.

10

6. The method as set forth in any one of the claims 3 to 5,
wherein the applications with specified characteristics are
always on applications.

15 7. The method as set forth in claim 6, wherein the data
information assigned to always on applications are keep-alive
messages.

8. The method as set forth in any one of the claims 3 to 7,
20 wherein the user equipment is assigned to one of a plurality
of a logical channel groups and wherein characteristics of
the delaying are dependent on the one logical channel group.

9. The method as set forth in any one of the claims 3 to 8,
25 further comprising using different DRX configuration
dependent on a load of the cell.

10. A user equipment for delaying sending of messages,
wherein the user equipment is assigned to a base station
30 within a cell of a mobile network, the user equipment
comprising
a first unit for receiving data information, wherein the
received data information is masked with a DRX configuration,
and
35 a second unit for delaying sending of response messages in
response to the received data information until the
occurrence of a time interval of a DRX cycle, in which time

interval the user equipment is enabled to receive and transmit data.

11. A base station for delaying transmission of messages from
5 a user equipment assigned to the base station within a cell
of a mobile network, the base station comprising
a first unit for receiving data information,
a second unit for determining whether the data information is
assigned to applications with specified characteristics
10 within the cell, and
a third unit for transmitting, in case that the received data
information is assigned to applications with specified
characteristics, the data information from the base station
to the user equipment, wherein the data information is masked
15 with a DRX configuration.

12. A system for delaying transmission of messages from a
user equipment assigned to a base station within a cell of a
mobile network, the system comprising
20 the user equipment as set forth in claim 10 and the base
station as set forth in claim 11.

13. A computer program for delaying sending of messages from
a user equipment assigned to a base station within a cell of
25 a mobile network, the computer program, when being executed
by a data processor, is adapted for controlling a method as
set forth in any one of the claims 1 to 9.

14. A computer-readable medium, in which a computer program
30 for delaying sending of messages from a user equipment
assigned to a base station within a cell of a mobile network
is stored, which computer program, when being executed by a
processor, is adapted to carry out or control a method as set
forth in any one of the claims 1 to 9.

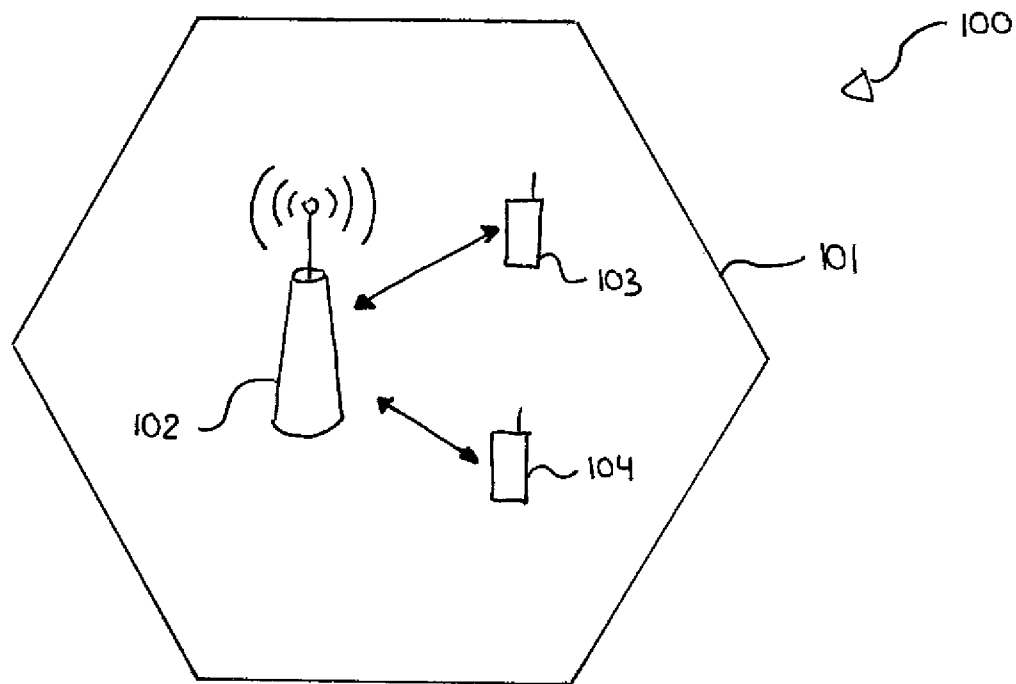


Fig. 1

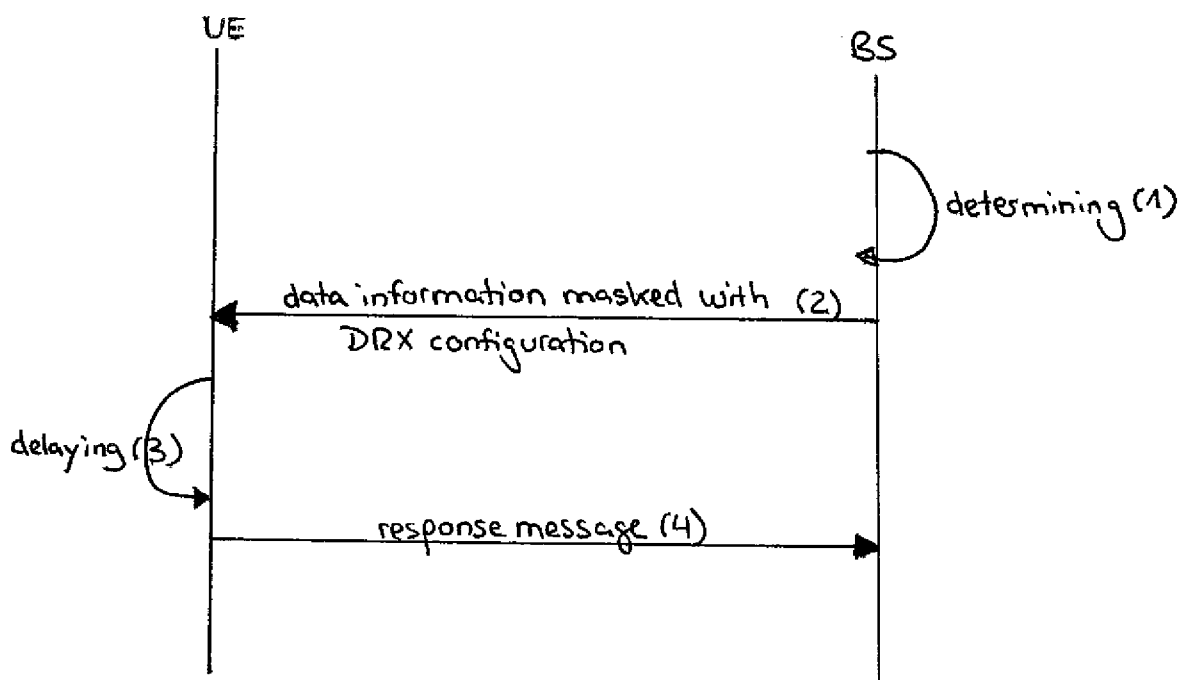


Fig. 2

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2009/062813

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04W76/04
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 practical, search terms used)

EPO-Internal, WPI Data, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2009/247203 A1 (KUO RICHARD LEE-CHEE [TW]) 1 October 2009 (2009-10-01) paragraphs [0007], [0009], [0010], [0011], [0026]	1-14
X	US 2009/161620 A1 (CAI ZHIJUN [US] ET AL) 25 June 2009 (2009-06-25) paragraphs [0028], [0039], [0043] claims 9,10,19,20 figure 8	1-14
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☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
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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

29 July 2010

Date of mailing of the international search report

06/08/2010

Name and mailing address of the ISA/

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INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2009/062813

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	RESEARCH IN MOTION: "SRS Transmission Support in DRX Mode" INTERNET CITATION 15 February 2008 (2008-02-15), XP002478324 Retrieved from the Internet: URL: http://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_61/Docs/R2-080808.zip [retrieved on 2008-04-18] page 1, lines 1-38 page 2, lines 1-9 figure 1 -----	1-14

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2009/062813

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2009247203 A1	01-10-2009	NONE	
US 2009161620 A1	25-06-2009	WO 2009085973 A2	09-07-2009