

(51) International Patent Classification:
H04W 72/04 (2009.01)(21) International Application Number:
PCT/EP2010/050383(22) International Filing Date:
14 January 2010 (14.01.2010)

(25) Filing Language: English

(26) Publication Language: English

(71) Applicant (for all designated States except US): **NOKIA SIEMENS NETWORKS OY** [FI/FI]; Karaportti 3, FIN-02610 Espoo (FI).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **FREDERIKSEN, Frank** [DK/DK]; Hornbækvej 4, DK-9270 Klarup (DK). **HWANG, Woonhee** [KR/FI]; Juhanintie 6 A, FIN-02180 Espoo (FI). **PEDERSEN, Klaus Ingemann** [DK/DK]; Laesogade 9, 3 th, DK-9000 Aalborg (DK). **ROESSEL, Sabine** [DE/DE]; Liscowstr. 1b, 81739 München (DE). **ROSA, Claudio** [IT/DK]; Krebsen 14, DK-8900 Randers (DK).(74) Common Representative: **NOKIA SIEMENS NETWORKS OY**; COO RTP IPR, Patent Administration, 80240 Munich (DE).

(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, 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, KM, 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, PE, PG, PH, PL, PT, RO, RS, RU, 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.

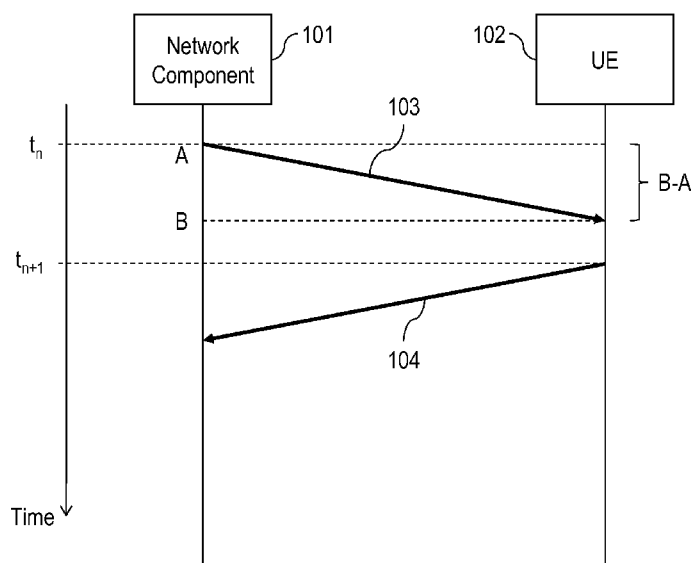
(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT,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

Published:

— with international search report (Art. 21(3))

(54) Title: SYNCHRONISATION OF CONFIGURATION CHANGE BETWEEN A NODE B AND A TERMINAL

Fig.1



(57) Abstract: A method and a device for data processing in a wireless network are provided, wherein a configuration information is transmitted to a mobile terminal via a radio resource control signaling; and wherein a configuration based on the configuration information is effected at the mobile terminal when a timing condition is met. Furthermore, a communication system is suggested comprising said device.

SYNCHRONISATION OF CONFIGURATION CHANGE BETWEEN A NODE B AND A TERMINAL

The invention relates to a method and to a device for data processing in a wireless network. Further, a communication
5 system comprising at least one such device is suggested.

The solution suggested herein relates to a network operation of long term evolution (LTE), in particular to long term evolution advanced (LTE-Advanced, LTE-A) of the UTRAN within
10 3GPP. For LTE-A, a general system configuration comprises several configuration levels. Most of the system configuration is defined via broadcast information such as "system information" elements. These system information elements contain information on the basic network configuration, e.g.,
15 system bandwidth, control channel configurations, etc. When a call is set up for a mobile terminal (user equipment, UE), the UE will receive its final (and detailed) network configuration, e.g., a UE-specific configuration. This final configuration is handled through RRC configuration messages.
20 Content and format of such messages is described in 3GPP TS 36.331.

Even if the UE is configured for a certain setup, there is no guarantee that the propagation conditions and network load is
25 such that the UE remains being configured with this specific setup. Therefore, the network may reconfigure some of the parameters via RRC signaling. However, it is a disadvantage of such RRC signaling that it is relatively slow (e.g., 50-100 ms) compared to signaling mechanisms that are closer to
30 the physical layer (8-20 ms).

For example, in recent LTE-A proposals, it was suggested allowing an activation or deactivation of component carriers using lower layer signaling. Further, UEs could be configured
35 to activate and deactivate a TTI bundling mode, which is also signaled over RRC.

However, it is a problem of re-configuring physical layer operation that RRC signaling is not time-synchronized. Hence, the base station (eNB) is not aware of the time when the UE starts operating according to the new configuration signaled by RRC. Therefore, there is no guarantee of when an RRC re-configuration will be applied at the UE.

The only option for ensuring synchronized reconfiguration is to initiate a synchronized intra-cell handover, which requires additional time and includes more extensive signaling as well as a RACH procedure for enabling the intra-cell handover. On top of this, the intra-cell handover causes all MAC and RLC procedures to reset, including any header compression schemes running. The latter means that a handover will increase a header overhead for a limited period of time until robust header compression is reconfigured. A successfully conducted intra-cell handover guarantees for a Release 8 UE that the DL and the UL are active, whereas using an intra-cell handover for a Release 10 UE that does not change its "special cell" does not commence a synchronization of the air interface with regard to additional DL and UL component carrier (CC) resources.

Hence, the lack of synchronization leads to a significant uncertainty: Firstly, the eNB does not know which of two potential states the UE actually operates in (as the configuration message may be lost). Secondly, the eNB does not know exactly when the change is supposed to occur.

The **problem** to be solved is to overcome the disadvantages mentioned above and in particular to provide an efficient mechanism that allows the eNB to identify an active state of the UE as well as a time indicating when the state change occurs.

This problem is solved according to the features of the independent claims. Further embodiments result from the depending claims.

In order to overcome this problem, a method for data processing in a wireless network, in particular an LTE-A network, is suggested,

- 5 - wherein a configuration information is transmitted to a mobile terminal;
- wherein a configuration based on the configuration information is effected at the mobile terminal when a timing condition is met.

10

Hence, advantageously, a synchronization is achieved regarding the RRC signaling conducted by the wireless network, in particular a base station (eNB) of the wireless network, towards the mobile terminal (UE). In other words, time periods
15 can be defined for changes to be effected at the mobile terminal. This leads to a synchronization of the mobile terminal that applies such changes at certain moments in time according to the time pattern defined. Hence, the network (e.g., the base station) is aware of the time the changes are conducted at the mobile terminal.
20

The configuration information may be any information that is transmitted to the mobile terminal and that can be used to configure or re-configure said mobile terminal. The configuration
25 information may optionally comprise timing information that could be used to determine whether or not the timing condition is met.

Pursuant to an embodiment, the configuration information is
30 transmitted to the mobile terminal via a signaling mechanism.

Such signaling mechanism may comprise a radio resource control (RRC) signal(ing) or any other means that allows conveying configuration information, in particular information relating to the timing condition.
35

A trigger for conducting the change, i.e. applying the configuration may be indicated explicitly or explicitly by different communication layers.

- 5 According to an embodiment, the configuration comprises a configuration or a reconfiguration of at least one physical layer parameter of the mobile terminal.

10 Hence, the solution provided allows for time-wise synchronization with a reconfiguration of physical layer parameters at the mobile terminal.

In an embodiment, the timing condition comprises limitations as to when the configuration is to be conducted.

15

Such limitation may be provided by a time pattern that is globally stored for the wireless network and the mobile terminals attached and/or it can be distributed among the components of the wireless network, e.g., base stations and/or mobile terminals to flexibly adjust the timing condition for connections with particular mobile terminals and/or (re-)configuration(s) regarding particular physical layer parameters.

- 25 Advantageously, this approach provides a high degree of flexibility as how to provide and/or adjust the timing condition.

30 In another embodiment, applying said configuration at the mobile terminal is conducted in a synchronized manner due to said timing condition.

In a further embodiment, the timing condition is met in case the following expression is true

35

$$(GC + CC_configure_phase) \bmod CC_configure_period = 0,$$

wherein

GC represents a global (e.g., on a per cell level)
counter (e.g., a system frame number);
CC_configure_period
5 represents a definition of when the reconfigura-
tion is allowed to take place;
CC_configure_phase
is used to define a time offset to control off-
sets relative to the global timing;
10 mod is the modulo operator.

It is noted that the time offset "CC_configure_phase" may be set to 0 and can be an optional parameter.

15 The parameter GC may either be a System Frame Number (SFN) or it may be a frame number (FN). The parameter CG may also be based on at least one subframe number or be a global subframe counter. The parameter CG may in particular be any global counter based on a time pattern or on resources (e.g., frames
20 or the like). The frame number (FN) may count on a 1 ms time basis.

The above condition may be true in case the term substantially reaches 0.

25 In a next embodiment, said timing condition applies for the mobile terminal and for the network element conveying the configuration information to the mobile terminal.

30 Hence, the timing condition can be defined (e.g., in advance) for both, the wireless network (e.g., the base station) and the mobile terminal.

It is also an embodiment that the timing condition comprises
35 a timer and/or timing information.

Pursuant to another embodiment, the timing condition is conveyed to the mobile terminal.

Hence, the timing condition or a portion thereof could be explicitly conveyed or signaled towards the mobile terminal in order to determine a time pattern used by the mobile terminal for conducting (re-)configurations. Such information may be transmitted via RRC signaling or otherwise.

According to an embodiment, such timing condition is conveyed from a network entity, in particular a base station, to the mobile terminal.

This allows a flexible approach of adjusting timing conditions for (each) mobile terminal.

According to another embodiment, the timing condition is globally set.

In this case, no dedicated communication regarding the timing condition itself is required.

It is noted, however, that a combination of both may be applicable as well. A globally set timing condition may be overwritten with respect to particular mobile terminals and/or base stations.

In yet another embodiment, the timing condition is set on a feature level.

Each feature may have its own timing condition. In addition, some features can be configured to have the same timing conditions. For example, timing conditions for UL CC and DL CC changes may have the same timing condition set.

Hence, the timing condition can be set for at least one feature that is associated with the configuration information.

According to a next embodiment, the network is a 3GPP wireless network, in particular an LTE-A network.

The problem stated above is also solved by a device for data processing in a wireless network, comprising or being associated with a processing unit that is arranged

- 5 - for transmitting a configuration information to a mobile terminal via a radio resource signaling;
- wherein a configuration based on the configuration information is effected at the mobile terminal when a timing condition is met.

10

It is noted that such device may be an element of the wireless network, in particular a base station (an eNB) of the wireless network. The remaining features described with regard to the method apply accordingly to such device, e.g.,

15 base station.

The problem stated above is also solved by a device for data processing in a wireless network comprising a processing unit that is arranged

- 20 - for receiving a configuration information from an element of a wireless network, in particular a base station, via a radio resource signaling;
- wherein a configuration based on the configuration information is effected when a timing condition is
- 25 met.

It is noted that such device may be a mobile terminal of the wireless network, in particular a UE. The remaining features described with regard to the method apply accordingly to such

30 device, e.g., UE.

It is noted that the steps of the method stated herein may be executable on each of these processing units as well.

35 It is further noted that each processing unit can comprise at least one, in particular several means that are arranged to execute the steps of the method described herein. The means may be logically or physically separated; in particular sev-

eral logically separate means could be combined in at least one physical unit.

Said processing unit may comprise at least one of the following: a processor, a microcontroller, a hard-wired circuit, an ASIC, an FPGA, a logic device.

The solution provided herein further comprises a computer program product directly loadable into a memory of a digital computer, comprising software code portions for performing the steps of the method as described herein.

In addition, the problem stated above is solved by a computer-readable medium, e.g., storage of any kind, having computer-executable instructions adapted to cause a computer system to perform the method as described herein.

Furthermore, the problem stated above is solved by a communication system comprising at least one device as described herein.

Embodiments of the invention are shown and illustrated in the following figures:

Fig.1 shows a schematic time diagram visualizing a time-synchronized RRC signaling scheme towards a UE;

Fig.2 shows a schematic block diagram comprising a mobile terminal and a base station eNB.

The approach provided in particular suggests introducing a timing and configuration mechanism to the signaling protocol that is used to configure and reconfigure physical layer operation.

The timing mechanism suggests limitations as to when physical layer (re-)configurations are intended and/or allowed.

In one example, the timing configuration is applied on a general level such that any physical level reconfiguration is associated with particular timing restrictions; in another example, the timing configuration may be associated with configuration parameters.

According to an exemplary scenario, a component carrier activation or deactivation event can be utilized, which relates to additional component carriers being switched on or off (both, for uplink and downlink directions).

Options for switching component carriers (on or off) comprise:

(1) RRC configuration:

In this case, the activation or deactivation message is sent via RRC signaling. An RRC acknowledged mode could be used to determine whether signaling was correctly understood (received) by the UE. However, the acknowledgment message is received with a particular delay; a total time for reconfiguration is estimated to amount to ca. 50-100 ms.

(2) MAC-c information element:

Here, a special MAC level message is sent to the UE. Such MAC-c PDU (i.e. a protocol data unit of the common MAC layer) is sent multiplexed with other downlink traffic. The control message is protected by a HARQ mechanism, thus the eNB may have some indication on whether or not the UE received the message correctly (provided that the physical layer acknowledgement is received correctly). A delay for reconfiguration using this approach is estimated to amount to ca. 16-30 ms (depending on conditions of the physical channel).

(3) Physical layer control:

In such case reconfiguration could be signaled via a physical downlink control channel (PDCCH); hence, a

theoretical delay between the event of signaling on the PDCCH and the time that the UE receives the message becomes very low. On the other hand there is no acknowledgement of whether the PDCCH has been correctly received. An expected delay for this approach is estimated to be less than 2 ms (the UE has to decode the PDCCH to obtain the information).

As these reconfigurations (1) to (3) above do not have any solution for creating a fixed time of the actual switching event, it is suggested introducing a timer approach. For example, in case of component carrier activation or deactivation a rule configured by the RRC can be provided that only allows the change to be effected in case the following condition is true:

$$(GC + CC_configure_phase) \bmod CC_configure_period = 0$$

wherein

GC represents a global (e.g., on a per cell level) counter (e.g., a system frame number);
CC_configure_period represents a definition of (time periods) when the (re-)configuration is allowed to take place;
CC_configure_phase is used to define a time offset to control offsets relative to the global timing;
mod is the modulo operator.

In case the CC_configure_period is set to 40, (with CC_configure_phase being set to 0) the reconfigurations can only be applied every 40th millisecond (or subframe or whichever time basis is used).

It is noted that a TTI in 3GPP LTE (and LTE-A) may amount to 1 ms. One TTI may cover a subframe, also lasting 1 ms. 10 subframes, numbered from 0 to 9 may be considered as a

"frame", wherein the SFN may in particular count such "frames", i.e. intervals of 10 ms.

The global counter GC may either be the SFN or it may be a frame number FN according to

$$FN = \text{subframe} + SFN * 10,$$

pursuant to the definition of the modulo operation above.

By this mechanism, it can be controlled when the physical re-configurations are to be applied and the eNB may determine when to transmit a configuration in order to meet a particular time for the reconfiguration to be conducted.

The approach presented can be applied on a per-feature basis or it can be applied at a general level such that, e.g., any reconfiguration may only happen at pre-defined time instants. As a further option, a mixture of these two approaches could be used, i.e. such that the general level applies to all features, but could be overwritten by feature level time alignment configurations.

Fig.1 shows a schematic time diagram visualizing a time-synchronized RRC signaling scheme towards a UE 102.

A network component 101, e.g., a base station (eNB), may send a configuration information 103 at a time A to the UE 102. The configuration information 103 may be a re-configuration information that is used to define at least one parameter of the UE 102 via RRC signaling. The configuration information 103 arrives at a time B at the UE 102, hence the UE 102 can process said configuration information 103 at time B at the earliest. Without time synchronization, the network component 101 cannot be aware of the time when the new or changed configuration conveyed via said configuration information 103 will be effected.

The approach provided herein allows the network component 101 to be aware of a synchronization scheme that only allows changes to be effected at certain points in time t_n . Sending the configuration information 103 at a time t_n , the network component 101 knows that the next time for changes to take place at the UE 102 is t_{n+1} . If the transmission time B-A can be expected to be below the time difference $t_{n-1}-t_n$, the configuration information 103 conveyed will be utilized by the UE 102 at the time t_{n+1} .

In addition, the UE may provide an acknowledgment information 104 stating that the configuration information 103 has been received and optionally further (successfully) utilized.

Fig.2 shows a schematic block diagram comprising a mobile terminal 201 and a base station eNB 202. The mobile terminal 201 and the base station eNB 202 each comprises a processing unit 203, 204 in particular with an antenna, which may be part or associated with a transceiver unit for exchanging information over a wireless interface.

The base station eNB 202 may exchange information 205 with the mobile terminal. This information 205 may comprise configuration information transmitted via a radio resource control (RRC) signaling. A configuration based on the configuration information is effected at the mobile terminal when a timing condition is met. The timing condition may be set globally for several components of the wireless network or it may be set, e.g., for each mobile terminal 201 and/or each base station 202.

It is noted that the block structure shown in Fig.2 could be implemented by a person skilled in the art as various physical units, wherein the mobile terminal 201 or the base station eNB 202 could be realized each as at least one logical entity that may be deployed as hardware, program code, e.g., software and/or firmware, running on a processing unit, e.g.,

a computer, microcontroller, ASIC, FPGA and/or any other logic device.

The functionality described herein may be based on an existing component of a (wireless) network, which is extended by means of software and/or hardware. The eNB mentioned herein could also be referred to as any base station pursuant to any communication standard.

10 The base stations each comprise at least one physical or logical processing unit that is arranged for providing and/or utilizing a timing condition such that a (re-)configuration is conducted at the mobile terminal at certain points in time. This allows for an efficient synchronization of configuration changes at the mobile terminal.

List of Abbreviations:

	3GPP	3rd generation partnership project
	CC	Component Carrier
5	DL	Downlink
	eNB	LTE Base Station
	eNode-B	LTE Base Station
	FN	Frame Number
	GC	Global Counter
10	HARQ	Hybrid Automatic Repeat Request
	LTE	Long term evolution
	MAC	Media Access Control
	PDCCH	Physical Downlink Control Channel
	PDU	Protocol Data Unit
15	RACH	Random Access Channel
	RLC	Radio Link Control
	RRC	Radio Resource Control
	SFN	System Frame Number
	TTI	Transmission Time Interval
20	UE	User Equipment (also referred to as mobile terminal)
	UL	Uplink
	UMTS	Universal Mobile Telecommunications System
	UTRAN	UMTS Terrestrial Radio Access Network

Claims:

1. A method for data processing in a wireless network,
 - wherein a configuration information is transmitted to a mobile terminal;
 - 5 - wherein a configuration based on the configuration information is effected at the mobile terminal when a timing condition is met.
2. The method according to claim 1, wherein the configuration information is transmitted to the mobile terminal
10 via a signaling mechanism, in particular via a resource control signaling.
3. The method according to any of the preceding claims, wherein the configuration comprises a configuration or a reconfiguration of at least one physical layer parameter
15 of the mobile terminal.
4. The method according to any of the preceding claims, wherein the timing condition comprises limitations as to when the configuration is to be conducted.
5. The method according to any of the preceding claims,
20 wherein applying said configuration at the mobile terminal is conducted in a synchronized manner due to said timing condition.
6. The method according to any of the preceding claims, wherein the timing condition is met in case the following expression is true
25

$$(GC + CC_configure_phase) \bmod CC_configure_period = 0,$$

wherein

GC represents a counter;

CC_configure_period

represents a definition of when the reconfiguration is allowed to take place;

CC_configure_phase

is used to define a time offset to control offsets relative to the global timing;

mod is the modulo operator.

- 5 7. The method according to any of the preceding claims,
wherein said timing condition applies for the mobile
terminal and for the network element conveying the con-
figuration information to the mobile terminal.
- 10 8. The method according to any of the preceding claims,
wherein the timing condition comprises a timer and/or
timing information.
9. The method according to any of the preceding claims,
wherein such timing condition is conveyed to the mobile
terminal.
- 15 10. The method according to any of the preceding claims,
wherein such timing condition is conveyed from a network
entity, in particular a base station, to the mobile ter-
minal.
- 20 11. The method according to any of the preceding claims,
wherein the timing condition is globally set.
12. The method according to any of the preceding claims,
wherein the timing condition is set on a feature level.
13. The method according to any of the preceding claims,
wherein the network is a 3GPP wireless network, in par-
25 ticular an LTE-A network.
14. A device for data processing in a wireless network com-
prising a processing unit that is arranged
- 30 - for transmitting a configuration information to a mo-
bile terminal via a radio resource signaling;
- wherein a configuration based on the configuration
information is effected at the mobile terminal when a
timing condition is met.

15. A communication system comprising at least one device according to claim 14.

Fig.1

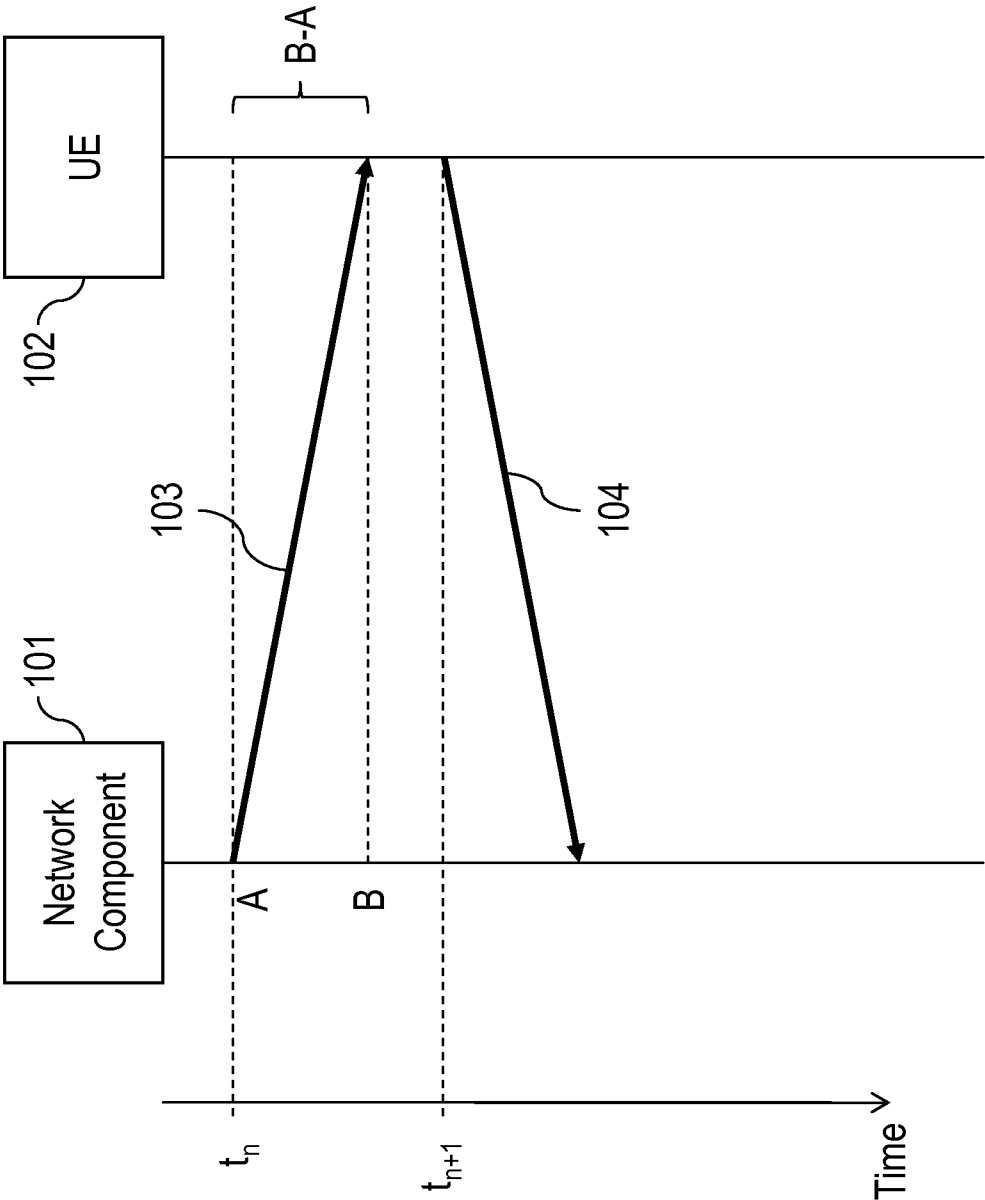
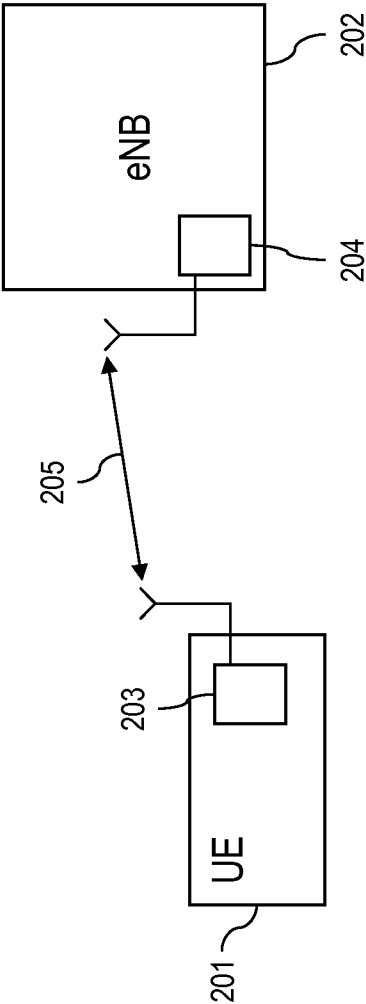


Fig.2



INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2010/050383

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04W72/04
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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	Anonymous: "The start time for TTI bundling" 3GPP TSG-RAN WG2 R2-085564 3 October 2008 (2008-10-03), pages 1-4, XP002602697 Prague, Czech Retrieved from the Internet: URL: http://ftp.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_63bis/Docs/R2-085564.zip [retrieved on 2010-09-29]	1-5, 7, 12-15
Y	the whole document ----- -/--	6, 8-11

☒ 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

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

29 September 2010

Date of mailing of the international search report

09/11/2010

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040.
Fax: (+31-70) 340-3016

Authorized officer

Wolf, William

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2010/050383

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	ANONYMOUS: "RB Setup Procedure with More Accurate Activation Time" ZTE - 3GPP RAN WG2 DRAFT R2-062518, 4 September 2006 (2006-09-04), XP050132088 Tallinn the whole document -----	8-10
Y	Anonymous: "Report of E-UTRA control plane session" 3GPP TSG RAN WG2 R2-075369 9 November 2007 (2007-11-09), page 1-11, XP002602698 Jeju, South Korea Retrieved from the Internet: URL: http://ftp.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_60/Docs/R2-075369.zip [retrieved on 2010-09-29] 5.2.1.1 System information -----	6,11
Y	HUAWEI ET AL: "proposal on Activation Time in RB Setup message" 3GPP DRAFT RAN WG2 R2-062237, 23 August 2006 (2006-08-23), XP050131844 Tallinn 2.2 Current procedure and related difficulties -----	6