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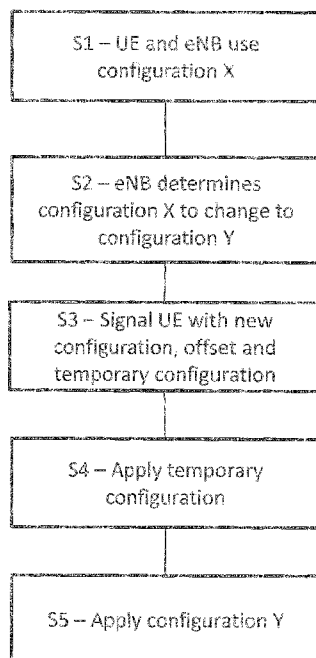
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[Continued on next page]

- (54) **Title:** METHOD AND APPARATUS

Figure 11



- (57) **Abstract:** A method comprises using a first time divi-
sion duplex uplink/downlink configuration; selecting a
second time division duplex uplink/downlink configuration;
and changing to a third time division duplex uplink/downlink
configuration and then changing to said second time division
uplink/downlink configuration.



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METHOD AND APPARATUS

This disclosure relates to a method and apparatus and in particular but not exclusively to methods and apparatus for use with time division duplexing.

A communication system can be seen as a facility that enables communication sessions between two or more nodes such as fixed or mobile devices, machine-type terminals, access nodes such as base stations, servers and so on. A communication system and compatible communicating entities typically operate in accordance with a given standard or specification which sets out what the various entities associated with the system are permitted to do and how that should be achieved. For example, the standards, specifications and related protocols can define the manner how devices shall communicate, how various aspects of communications shall be implemented and how devices for use in the system shall be configured.

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 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 device such as a user equipment is used for enabling receiving and transmission of communications such as speech and content data.

Communications can be carried on wireless carriers. 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). In wireless systems a communication device provides a transceiver station that can communicate with another communication device such as e.g. a base station of an access network and/or another user equipment. The two directions of communications between a base station and communication devices of users have been conventionally referred to as downlink and uplink. Downlink (DL) can be understood as the direction from the base station to the communication device and uplink (UL) the direction from the communication device to the base station.

Some systems use FDD (frequency division duplexing) and other systems use TDD (time division duplexing). With FDD, different frequencies are used for UL and DL communications with a UE. With TDD, the same frequency is used for UL and DL communications but different time slots are allocated for UL and DL communication.

Control information may be communicated for example on a physical uplink control channel (PUCCH). For example, signalling for the purposes of error detection and/or correction may be provided by means of such signalling. Requests for retransmission of any information that the recipient node did not successfully receive are possible. For example, hybrid automatic repeat request (HARQ) error control mechanism may be used for this purpose. The error control mechanism can be implemented such that a transmitting device shall receive either a positive or a negative acknowledgement (ACK/NACK; A/N) or other indication regarding its transmission from a receiving device.

UL control information may be communicated on a physical uplink shared channel (PUSCH) if the PUSCH is scheduled for UL data transmission.

According to an aspect there is provided a method comprising; using a first time division duplex uplink/downlink configuration; selecting a second time division duplex uplink/downlink configuration; and changing to a third time division duplex uplink/downlink configuration and then changing to said second time division duplex uplink/downlink configuration.

The third time division duplex uplink/downlink configuration may comprise a default time division duplex uplink/downlink configuration.

The method may comprise changing to said third time division duplex uplink/downlink configuration for a defined length of time.

The defined time may comprise a frame or an integer number of frames.

The method may comprise causing information to be provided to a user equipment indicating that said second time division duplex uplink/down link configuration is to be used.

The method may comprise causing timing information to be provided to a user equipment about timing of at least one of a start of said third time division duplex uplink/downlink configuration and said second time division uplink/downlink configuration.

The timing information may comprise at least one of frame offset information and system frame number.

The third uplink/downlink configuration may comprise a configuration in which a number of uplink subframes is higher or the same as for said first and second uplink/down link configurations.

The method may comprise causing information to be provided to a user equipment about said second time division duplex uplink/downlink configuration and timing information about said second time division duplex uplink/downlink configuration.

5 The user equipment may receive information indicating which configuration is the second configuration and timing information. This may be provided in configuration signalling. The user equipment may use the timing information of the second configuration in for example the indicated frame number.

10 According to another aspect there is provided a method comprising: using a first time division duplex uplink/downlink configuration; selecting a second time division duplex uplink/downlink configuration; causing information to be provided to a user equipment about said second time division duplex uplink/downlink configuration and timing information about said second time division duplex uplink/downlink configuration; and starting to use said second time division duplex uplink/downlink configuration at a time defined by said timing information.

15 It should be appreciated that in some embodiments, one or more of the features associated with the previous aspect may be used with this aspect.

20 According to an aspect there is provided an apparatus comprising at least one processor and at least one memory including computer code for one or more programs, the at least one memory and the computer code configured, with the at least one processor, to cause the apparatus at least to: use a first time division duplex uplink/downlink configuration; select a second time division duplex uplink/downlink configuration; and change to a third time division duplex uplink/downlink configuration and then change to said second time division duplex uplink/downlink configuration.

The third time division duplex uplink/downlink configuration may comprise a default time division duplex uplink/downlink configuration.

25 The at least one memory and the computer code may be configured with the at least one processor to cause the apparatus to change to said third time division duplex uplink/downlink configuration for a defined length of time.

The defined time may comprise a frame or an integer number of frames.

30 The at least one memory and the computer code may be configured with the at least one processor to cause the apparatus to cause information to be provided to a user equipment indicating that said second time division duplex uplink/down link configuration is to be used.

The at least one memory and the computer code may be configured with the at least one processor to cause the apparatus to cause timing information to be provided to a user equipment about timing of at least one of a start of said third time division duplex uplink/downlink configuration and said second time division uplink/downlink configuration.

- 5 The timing information may comprise at least one of frame offset information and system frame number.

The third uplink/downlink configuration may comprise a configuration in which a number of uplink subframes is higher or the same as for said first and second uplink/down link configurations.

- 10 The at least one memory and the computer code may be configured with the at least one processor to cause the apparatus to cause information to be provided to a user equipment about said second time division duplex uplink/downlink configuration and timing information about said second time division uplink/downlink configuration.

- 15 According to an aspect there is provided an apparatus comprising at least one processor and at least one memory including computer code for one or more programs, the at least one memory and the computer code configured, with the at least one processor, to cause the apparatus at least to: use a first time division duplex uplink/downlink configuration; select a second time division duplex uplink/downlink configuration; cause information to be provided to a user equipment about said second time division duplex uplink/downlink configuration and timing information about said second time division duplex uplink/downlink configuration; and start to use said second time
20 division duplex uplink/downlink configuration at a time defined by said timing information.

It should be appreciated that in some embodiments, one or more of the features associated with the previous aspect may be used with this aspect.

- 25 According to an aspect there is provided an apparatus comprising; means for using a first time division duplex uplink/downlink configuration; means for selecting a second time division duplex uplink/downlink configuration; and means for changing to a third time division duplex uplink/downlink configuration and then changing to said second time division duplex uplink/downlink configuration.

The third time division duplex uplink/downlink configuration may comprise a default time division duplex uplink/downlink configuration.

- 30 The changing means may be for changing to said third time division duplex uplink/downlink configuration for a defined length of time.

The defined time may comprise a frame or an integer number of frames.

The apparatus may comprise means for causing information to be provided to a user equipment indicating that said second time division duplex uplink/down link configuration is to be used.

5 The apparatus may comprise means for causing timing information to be provided to a user equipment about timing of at least one of a start of said third time division duplex uplink/downlink configuration and said second time division uplink/downlink configuration.

The timing information may comprise at least one of frame offset information and system frame number.

10 The third uplink/downlink configuration may comprise a configuration in which a number of uplink subframes is higher or the same as for said first and second uplink/down link configurations.

The apparatus may comprise means for causing information to be provided to a user equipment about said second time division duplex uplink/downlink configuration and timing information about said second time division uplink/downlink configuration.

15 According to another aspect there is provided an apparatus comprising: means for using a first time division duplex uplink/downlink configuration; means for selecting a second time division duplex uplink/downlink configuration; causing information to be provided to a user equipment about said second time division duplex uplink/downlink configuration and timing information about said second time division duplex uplink/downlink configuration; and starting to use said second time division duplex uplink/downlink configuration at a time defined by said timing information.

20 It should be appreciated that in some embodiments, one or more of the features associated with the previous aspect may be used with this aspect.

A base station may comprise any of the above apparatus

25 According to another aspect, there is provided a method comprising; using a first time division duplex uplink/downlink configuration; receiving information that a second time division duplex uplink/downlink configuration is to be used; and changing to a third time division duplex uplink/downlink configuration and then changing to said second time division uplink/downlink configuration.

The third time division duplex uplink/downlink configuration may comprise a default time division duplex uplink/downlink configuration.

The method may comprise changing to said third time division duplex uplink/downlink configuration for a defined length of time.

The defined time may comprise a frame.

5 The method may comprise receiving timing information about timing of at least one of a start of said third time division duplex uplink/downlink configuration and said second time division uplink/downlink configuration.

The timing information may comprise at least one of frame offset information and system frame number.

10 The third uplink/downlink configuration may comprise a configuration in which a number of uplink subframes is higher or the same as for said first and second uplink/downlink configurations.

The method may comprise receiving timing information about timing of at least one of a start of said second time division duplex uplink/downlink configuration and said second time division uplink/downlink configuration.

15 According to another aspect, there is provided a method comprising: using a first time division duplex uplink/downlink configuration; receiving information about a second time division duplex uplink/downlink configuration and timing information about said second time division duplex uplink/downlink configuration; and starting to use said second time division duplex uplink/downlink configuration at a time defined by said timing information.

20 It should be appreciated that in some embodiments, one or more of the features associated with the previous aspect may be used with this aspect.

According to an aspect there is provided an apparatus comprising at least one processor and at least one memory including computer code for one or more programs, the at least one memory and the computer code configured, with the at least one processor, to cause the apparatus at least to: use a first time division duplex uplink/downlink configuration; receive information that a second time
25 division duplex uplink/downlink configuration is to be used; and change to a third time division duplex uplink/downlink configuration and then change to said second time division uplink/downlink configuration.

The third time division duplex uplink/downlink configuration may comprise a default time division duplex uplink/downlink configuration.

The at least one memory and the computer code may be configured with the at least one processor to cause the apparatus to change to said third time division duplex uplink/downlink configuration for a defined length of time.

The defined time may comprise a frame.

- 5 The at least one memory and the computer code may be configured with the at least one processor to cause the apparatus to receive timing information about timing of at least one of a start of said third time division duplex uplink/downlink configuration and said second time division uplink/downlink configuration.

10 The timing information may comprise at least one of frame offset information and system frame number.

The third uplink/downlink configuration may comprise a configuration in which a number of uplink subframes is higher or the same as for said first and second uplink/downlink configurations.

15 The at least one memory and the computer code may be configured with the at least one processor to cause the apparatus to receive timing information about timing of at least one of a start of said second time division duplex uplink/downlink configuration and said second time division uplink/downlink configuration.

20 According to an aspect there is provided an apparatus comprising at least one processor and at least one memory including computer code for one or more programs, the at least one memory and the computer code configured, with the at least one processor, to cause the apparatus at least to: use a first time division duplex uplink/downlink configuration; receive information about a second time division duplex uplink/downlink configuration and timing information about said second time division duplex uplink/downlink configuration; and start to use said second time division duplex uplink/downlink configuration at a time defined by said timing information.

25 It should be appreciated that in some embodiments, one or more of the features associated with the previous aspect may be used with this aspect.

30 According to another aspect, there is provided an apparatus comprising; means for using a first time division duplex uplink/downlink configuration; means for receiving information that a second time division duplex uplink/downlink configuration is to be used; and means for changing to a third time division duplex uplink/downlink configuration and then changing to said second time division uplink/downlink configuration.

The third time division duplex uplink/downlink configuration may comprise a default time division duplex uplink/downlink configuration.

The changing means may be for changing to said third time division duplex uplink/downlink configuration for a defined length of time.

- 5 The defined time may comprise a frame.

The receiving means may be for receiving timing information about timing of at least one of a start of said third time division duplex uplink/downlink configuration and said second time division uplink/downlink configuration.

- 10 The timing information may comprise at least one of frame offset information and system frame number.

The third uplink/downlink configuration may comprise a configuration in which a number of uplink subframes is higher or the same as for said first and second uplink/downlink configurations.

- 15 The receiving means may be for receiving timing information about timing of at least one of a start of said second time division duplex uplink/downlink configuration and said second time division uplink/downlink configuration.

- 20 According to another aspect, there is provided an apparatus comprising: means for using a first time division duplex uplink/downlink configuration; means for receiving information about a second time division duplex uplink/downlink configuration and timing information about said second time division duplex uplink/downlink configuration; and means for starting to use said second time division duplex uplink/downlink configuration at a time defined by said timing information.

It should be appreciated that in some embodiments, one or more of the features associated with the previous aspect may be used with this aspect.

A user equipment may comprise any of the above apparatus

- 25 A computer program comprising program code means adapted to perform the method may also be provided. The computer program may be stored and/or otherwise embodied by means of a carrier medium.

It should be appreciated that any feature of any aspect may be combined with any other feature of any other aspect.

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

Figure 1 shows a schematic diagram of a communication system comprising a base station and a plurality of communication devices;

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

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

Figure 4 shows a table of uplink and downlink configuration options for LTE TDD;

10 Figure 5 shows a table for the report of HARQ feedback for each of the configuration options of Figure 4;

Figure 6 illustrates HARQ timing problems with dynamic TDD UL/DL reconfiguration;

Figure 7 shows a possible PUCCH resource collision in the case of dynamic TDD UL/DL reconfiguration;

Figure 8 shows a table with "k" values for the TDD configurations of Figure 4;

15 Figure 9 shows a k_{PHICH} for TDD;

Figure 10 shows a TDD UL/DL configuration change according to an embodiment; and

Figure 11 shows a method of an embodiment.

20 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, access systems thereof, 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 An example of wireless communication systems are architectures standardized by the 3rd Generation Partnership Project (3GPP). A latest 3GPP based development is often referred to as the long-term evolution (LTE) of the Universal Mobile Telecommunications System (UMTS) radio-access technology. The various development stages of the 3GPP LTE specifications are referred to as releases. More recent developments of the LTE are often referred to as LTE Advanced (LTE-A). The LTE employs a mobile architecture known as the Evolved Universal Terrestrial Radio Access Network

(E-UTRAN). Base stations of such systems are known as evolved or enhanced Node Bs (eNBs) and may provide E-UTRAN features such as user plane Radio Link Control/Medium Access Control/Physical layer protocol (RLC/MAC/PHY) and control plane Radio Resource Control (RRC) protocol terminations towards the communication devices. Other examples of radio access system
5 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).

A device capable of wireless communications can communicate via at least one base station or similar wireless transmitter and/or receiver node. In figure 1 a base station 10 is shown to be serving various mobile devices 20 and a machine-like terminal 22. Base stations are typically controlled by at
10 least one appropriate controller apparatus so as to enable operation thereof and management of mobile communication devices in communication with the base stations. The base station can be connected further to a broader communications system 12. It shall be understood that a number of neighbouring and/or overlapping access systems or radio service areas provided by a number of base stations may exist. A base station site can provide one or more cells or sectors, each sector
15 providing a cell or a subarea of a cell. Each device and base station may have one or more radio channels open at the same time and may send signals to and/or receive signals from one or more sources. As a plurality of devices can use the same wireless resource, transmissions thereof need to be scheduled to avoid collisions and/or interference.

A possible mobile communication device for transmitting in uplink and receiving in downlink will
20 now be described in more detail with reference to Figure 2 showing a schematic, partially sectioned view of a communication device 20. Such a communication device is often referred to as user equipment (UE) or terminal. An appropriate communication device may be provided by any device capable of sending radio signals to and/or 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 portable
25 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-
30 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. Non-limiting examples of content data include downloads, television and radio programs, videos, advertisements, various alerts and other information.

The device 20 is configured to receive signals in the downlink 29 over an air interface via appropriate apparatus for receiving and to transmit signals in the uplink 28 via appropriate apparatus for transmitting radio signals. In Figure 2 the transceiver apparatus is designated schematically by block 26. The transceiver apparatus 26 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 mobile communication device is also provided with at least one data processing entity 21, at least one memory 22 and other possible components 23 for use in software and hardware aided execution of tasks the device is designed to perform, including control of access to and communications with base stations and/or other communication devices. The data processing, storage and other relevant apparatus can be provided on an appropriate circuit board and/or in chipsets. This apparatus is denoted by reference 24.

The user may control the operation of the mobile device by means of a suitable user interface such as key pad 25, voice commands, touch sensitive screen or pad, combinations thereof or the like. A display 27, a speaker and a microphone can be also provided. Furthermore, a 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 30 for a communication system, for example to be coupled to and/or for controlling a base station. In some embodiments a base station may comprise an integrated control apparatus and some other embodiments the control apparatus can be provided by a separate network element. The control apparatus can be interconnected with other control entities. The control apparatus and functions may be distributed between a plurality of control units. In some embodiments each base station can comprise a control apparatus. In alternative embodiments, two or more base stations may share a control apparatus. The arrangement of the control depends on the standard, and for example in accordance with the current LTE specifications no separate radio network controller is provided. Regardless of the location, the control apparatus 30 can be understood as providing control on communications in the service area of at least one base station. The control apparatus 30 can be configured to provide control functions in accordance with embodiments described below. For this purpose the control apparatus can comprise at least one memory 31, at least one data processing unit 32, 33 and an input/output interface 34. Via the interface the control apparatus can be coupled to a base station or other parts of the base station to cause operation of the base station in accordance with the

below described embodiments. The control apparatus can be configured to execute an appropriate software code to provide the control functions.

A wireless communication device, such as a mobile device, machine-like terminal or a base station, 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. For example, the transceiver apparatus 26 of Figure 2 can provide a plurality of antenna ports. More data can be received and/or sent where there are more antennae elements.

Some embodiments may be used in relation to 3GPP LTE-Advanced technology. It should of course be appreciated that some embodiments may be used with later releases or in relation to different standards.

Some embodiments may be used with traffic adaptation and UL-DL interference management.

LTE TDD allows for asymmetric uplink/downlink allocation by providing seven different TDD uplink/down link configurations. This is shown in the table of figure 4. D are downlink subframes, U are uplink subframes and S are special subframes. These configurations may provide for example between 40 to 90% downlink subframes. There are Configurations 0-6. Each configuration specifies which of ten subframes 0-9 are uplink subframes and which are downlink subframes or special subframes. In some embodiments, subframes 0 and 5 contain a synchronization signal and broadcast information which allows the UE to perform synchronization and obtain relevant system information. These subframes are downlink subframes. Subframe 1 is a subframe which serves as a switching point between downlink to uplink transmissions. This has a downlink pilot time slot and an uplink pilot time slot separated by a guard period. Depending on the switching point periodicity, in some UL/DL configurations subframe 6 may also serve as a switching point. In configuration number 0 (#0), subframes 2, 3, 4, 7, 8 and 9 are uplink subframes.

LTE TDD may be operated as a DL heavy system, which results in a UL subframe often used to transmit HARQ-ACKs corresponding to multiple DL subframes. As for example specified in TS 36.213, the set of DL subframes whose HARQ-ACKs are reported in the same UL subframe is listed in the Table of Figure 5. The table of Figure 5 shows which uplink subframes handling ACK/NACK feedback for certain downlink subframe(s) for each of the different UL/DL configurations of Figure 4. For example, in UL/DL configuration #4, uplink subframe #2 handles feedback for downlink subframes which are 12, 8, 7, and 11 subframes earlier than uplink subframe 2, i.e. downlink subframes 0, 4, 5,

and 1. Depending on the uplink-downlink configuration one uplink subframe may be responsible for ACK/NACK feedback for one or multiple downlink subframes.

Various evaluations have been performed dynamic TDD UL/DL configuration in an isolated pico cell scenario, a multiple outdoor pico cell scenario and a macro-outdoor pico cell scenario with activated co-channel interference. Generally a performance gain in term of cell average packet throughput when dynamic TDD UL/DL reconfiguration is adopted is observed compared to fixed TDD UL/DL configuration. A faster TDD UL/DL reconfiguration may provide better performance for example in the case of relatively low or medium cell traffic load.

Different methods to indicate a TDD UL/DL configuration change have been considered. For example the following have been considered for TDD UL-DL reconfiguration: SIB (system information block) signalling, RRC (radio resource control) signalling, MAC (medium access control) signalling and physical layer signalling.

SIB signalling may support TDD UL/DL reconfiguration using a system information (SI) change where the TDD UL/DL configuration is indicated by SIB. This may for example use the procedure as outlined in Rel-8, With the Rel-8 system information change procedure, the supported time scale for TDD UL/DL reconfiguration is every 640ms or larger. However, with this method, ambiguity exists between the eNB and UE on the TDD UL/DL configuration. The eNB does not know the exact time at which the UE correctly decodes the updated SI. Accordingly the eNB may apply a scheduling restriction during this uncertain period, in order to properly maintain the communications between the eNB and the UE. This ambiguity may cause problems. When the ambiguity exists, the PDSCH (physical downlink shared channel)/PUSCH (physical uplink shared channel) HARQ during the reconfiguration process may be impacted.

For the RRC signalling solution, a typical time scale is on the order of 200ms. This method requires one RRC message informing about the TDD UL/DL configuration per active UE, unless a broadcast or a multicast approach is specified. However, ambiguity will exists between the eNB and the UE on the TDD UL/DL configuration, if the eNB does not know the exact time at which the UE applies the updated TDD UL/DL configuration during reconfiguration. Similar to SIB, the PDSCH/PUSCH HARQ during reconfiguration will be impacted

The MAC signalling solution provides TDD UL/DL reconfiguration with an adaptation time scale of the order of a few tens of ms. Ambiguity may exist between the eNB and UE on the TDD UL/DL configuration, if the eNB does not know the exact time at which the UE applies the updated TDD UL/DL configuration during reconfiguration. This may be a particular problem considering MAC CE

(control element) signalling does not have its own error recovery process and the HARQ-ACK corresponding to the PDSCH containing the MAC CE signalling may be received incorrectly. Similarly to SIB and RRC, the PDSCH/PUSCH HARQ during reconfiguration may be impacted.

5 The physical layer signalling solution can support the TDD UL/DL reconfiguration with 10ms switching scale. The TDD UL/DL configuration can be explicitly indicated by a downlink physical signal or implicitly derived by UE. This solution may have an impact on CSI (channel state information) measurement due to the variation of interference on flexible subframes (i.e. the subframe that can be flexibly configured as a DL or a UL sub-frame). Considering the resulting UL-DL interference due to individual reconfiguration in each cell, the traffic adaptation capability in the time scale of 10ms may not be fully exploited in combination with interference mitigation schemes requiring coordination
10 among cells. Furthermore, the PDSCH/PUSCH HARQ timing during reconfiguration period also needs to be addressed.

Besides the ambiguity problem, PDSCH/PUSCH HARQ timing during reconfiguration period may also be impacted, which may lead to intra-cell interference or PUCCH resource collision.

15 Reference is made to Figure 6 which schematically shows a potential problem. In the case of TDD UL/DL configuration 1, if the UE receives PDSCH in DL subframe 9, it shall transmit a corresponding A/N on the PUCCH in UL subframe 3 in the next radio frame according to currently specified LTE HARQ timing rules. However, if the current TDD UL/DL configuration is switched to TDD UL/DL configuration 2 to adapt to the traffic fluctuation, then subframe 3 in the next radio frame will be a
20 DL subframe. The UE then cannot feedback A/N in subframe 3 and needs to find other uplink subframe to transmit A/N. The resulting HARQ timing is changed. If UE does not know the new TDD UL/DL configuration or know in which frame the new TDD UL/DL configuration will be switched, then the UE shall still transmit the A/N in subframe 3. This will result in intra-cell interference due to simultaneous transmissions in same subframe by the UE and the eNB.

25 Another potential problem is shown in Figure 7. In the case of TDD UL/DL configuration 2, if the UE receives a PDSCH in DL subframe 9, it shall transmit a corresponding A/N on the PUCCH in UL subframe 7 in the next radio frame according to currently specified LTE HARQ timing rules. However, if the current TDD UL/DL configuration is switched to TDD UL/DL configuration 1 to respond the traffic fluctuation, although subframe 7 in the next radio frame is a UL subframe, A/N to DL
30 subframe 0 and 1 in next radio frame shall also be transmitted in subframe 7 (as shown by the arrow). This may result in a PUCCH resource collision. Therefore, the UE needs to find other uplink subframe to transmit the A/N. The resulting HARQ timing is also changed.

Some embodiments address this problem to solve the ambiguity and handle HARQ process properly during reconfiguration. One of the SIB, RRC or MAC signalling solutions may be used to indicate TDD UL/DL configuration. It should be appreciated that in other embodiments, a different signalling method may be used to indicate the TDD UL/DL configuration.

- 5 In some embodiments a pre-determined TDD UL/DL configuration is temporarily used to resolve the ambiguity and handle the HARQ process properly during TDD UL/DL reconfiguration.

In some embodiments, to handle the HARQ process mismatching problem during reconfiguration, a pre-determined TDD configuration, TDD UL/DL configuration 0, is proposed to be a temporary configuration during reconfiguration.

- 10 After the signalling is transmitted to indicate the TDD UL/DL configuration to be used, the eNB shall change the TDD UL/DL configuration to Configuration 0 at the beginning of a predetermined frame.

In the period of the temporary TDD UL/DL configuration, the DL/UL HARQ timing and PUSCH (re)transmission timing shall follow the TDD UL/DL configuration 0 so that the HARQ timing and PUSCH timing can be guaranteed properly.

- 15 The temporary TDD UL/DL configuration may only be applied only in one radio frame during each TDD UL/DL reconfiguration and then switched to the target TDD UL/DL configuration indicated by the eNB in the immediately following radio frame.

- To handle the reconfiguration ambiguity problem, a timer or frame offset is contained in the high layer signalling to indicate the timing when the temporary TDD UL/DL configuration is applied. The
20 actual value of this timer or frame offset may be dependent on the time scale of the signalling carrying the TDD UL/DL configuration or be a typical value based on the TDD UL/DL configuration indication method.

- Alternatively or additionally, a SFN (system frame number) value can be contained in the high layer signalling to indicate the SFN number of the frame when the temporary TDD UL/DL configuration is
25 applied. The actual SFN value may be dependent on the time scale of the signalling carrying the TDD UL/DL configuration or be a typical value based on the TDD UL/DL configuration indication method.

The radio frame immediately following the frame with the temporary TDD UL/DL configuration is switched to the new TDD UL/DL configuration, indicated by the eNB. The eNB and UE will then follow the timing relationship of the new TDD UL/DL configuration.

Alternatively or additionally, to handle the reconfiguration ambiguity problem, a SFN value may be contained in the high layer signalling to indicate the timing when the new TDD UL/DL configuration is to be applied. The actual value of this SFN value may be dependent on the time scale of the signalling carrying the TDD UL/DL configuration or be a typical value based on the used TDD UL/DL configuration indication method. In this alternative, the eNB shall switch to the new TDD UL/DL configuration.

Hence, the ambiguity during reconfiguration may be solved by the temporary TDD UL/DL configuration and time/RF (radio frame) offset. Furthermore, the DL/UL HARQ timing and PUSCH (re)transmission timing may be correct so that there is no timing problem caused during reconfiguration period.

Some embodiments do not require a new TDD timing or new TDD UL/DL configuration. In some embodiments the benefit of dynamic TDD reconfiguration can be achieved with minor changes.

Currently, one option is to dynamically change TDD UL/DL configuration within all of the seven configurations of Figure 4 to match to the traffic variations in uplink and downlink. So subframe 0, 1, 5 and 6 are generally used for DL transmission and subframe 2 is generally used for UL transmission. Other subframes, subframe 3, 4, 7, 8 and 9, may be used for uplink or downlink which is dependent on the practical TDD UL/DL configuration.

The DL HARQ timing during reconfiguration will now be explained. The DL HARQ timing and A/N generation are currently specified in LTE TS36.213 and is as shown in Figure 5.

For TDD, the UE shall upon detection of a PDSCH transmission or a PDCCH indicating downlink SPS (semi-persistent service) release within subframe(s) $n-k$, where $k \in K$ and K is defined in the table of Figure 5 and intended for that UE and for which an ACK/NACK response shall be provided, transmit the ACK/NACK response in UL subframe n .

As mentioned above, in a dynamic TDD UL/DL reconfiguration mode, only subframe 2 is always used for UL transmission. So subframe 2 of the table of Figure 5 has no HARQ timing problem since the DL subframe set shall feedback A/N on this fixed UL subframe.

An analysis of the DL HARQ timing problems now follows.

Analysis of TDD UL/DL configuration 0: UL subframe 4, 7 and 9 are used to feedback A/N corresponding to DL subframes 0, 1 and 5, respectively, which are not across the frame border. In other words the A/N feedback is within the same frame. So there is no HARQ timing problem for

configuration 0 even if in the next radio frame eNB dynamic changes the TDD UL/DL configuration to another configurations.

Analysis of TDD UL/DL configuration 1: UL subframe 7 is used to feedback A/N corresponding to DL subframe 0 and 1, which is not across the frame border. Similar case for UL subframe 8 used to feedback A/N corresponding to DL subframe 4. So there is no HARQ timing problem for these DL subframes. However, A/N feedback corresponding to DL subframe 9 is transmitted in the subframe 3 in next radio frame. Since subframe 3 is a flexible subframe, when it is configured as a DL subframe, A/N feedback corresponding to DL subframe 9 cannot be transmitted in subframe 3. For example subframe 3 is a DL subframe in case of TDD UL/DL configuration 2 and 5. It may cause a HARQ timing problem when TDD UL/DL configuration 1 is changed to configuration 2 or 5.

Analysis of TDD UL/DL configuration 2, 3, 4, 5 and 6: The problematic subframes are as follows:

UL-DL configuration	DL subframe	Corresponding UL subframe for A/N feedback
2	9	7
3	7,8,9	3, 4
4	6,7,8,9	3
6	6,9	3,4

In summary, there is no HARQ timing problem for TDD UL/DL configuration 0 when the eNB changes the TDD UL/DL configuration to any other configuration. There is also no HARQ timing problem for TDD UL/DL configuration 0 when eNB changes any other TDD UL/DL configuration to Configuration 0. Although there is no problem when configuration 5 is changed to any other configuration, a timing problem will be caused when another configuration is changed to configuration 5.

The PUSCH timing (an uplink channel) during reconfiguration will now be considered. For TDD UL/DL configurations 1-6 and normal HARQ operation, the UE shall upon detection of a PDCCH with DCI format 0/4 and/or a PHICH transmission in subframe n intended for the UE, adjust the corresponding PUSCH transmission to subframe $n+k$, with k given in Figure 8, according to the PDCCH and PHICH information. For example in configuration 1, subframe 1 (i.e. $n=1$), the PUSCH transmission would be in the $1+6=7$ subframe (where $k=6$). This is an uplink frame within the same frame so there would be no problem. For TDD UL/DL configuration 0 and normal HARQ operation, multi-TTI (transmission time interval) scheduling may be used. Since subframe 3 is a flexible subframe (in other words, depending on the configuration, the subframe may be an uplink or a downlink subframe) when multi-TTI scheduling is adopted in DL subframe 6 and the subframe is used for DL, PUSCH scheduled

in DL subframe 6 is not transmitted in subframe 3 (for example in configuration 2). However, multi-TTI scheduling can be used in DL 0, 1 or 5 to schedule all the UL subframes. In some embodiments the problematic subframe 3 can be avoided without any drawbacks. Configuration 0 is a configuration with more UL subframes than DL. For this reason multi-TTI scheduling is supported only for configuration 0. In multi-TTI scheduling, UL subframe $n+k$ and $n+7$ are scheduled in same DL subframe n . For $n+k$ (here, $k=6$ for configuration 0), UL SF2 is always for UL transmission and no PUSCH timing problem; for $n+7$, SF3 is flexible subframe. When it is configured for DL, it will cause PUSCH timing problem.

The TDD UL/DL configuration 1 is analysed: Since subframe 3 is a flexible subframe, when it is used for DL, PUSCH scheduled in DL subframe 9 is not transmitted in subframe 3 of the following radio frame. Subframe 3 is a DL subframe in case of TDD UL/DL configuration 2 and 5. So it may cause the PUSCH timing problem when TDD UL/DL configuration 1 is changed to configuration 2 or 5.

Analysis of TDD UL/DL configuration 2, 3, 4, 5, 6: The problematic subframes in the table below have the same problem as explained in the analysis of TDD UL/DL configuration 1.

Configuration	Downlink subframe	Corresponding uplink subframe (of next radio frame) for PUSCH transmission
3	9	3
4	9	3
6	6,9	3,4

Thus there is no PUSCH timing problem for TDD UL/DL configuration 0 when eNB changes the TDD UL/DL configuration to any other configuration. There is also no PUSCH timing problem for TDD UL/DL configuration 0 when eNB changes any other TDD UL/DL configuration to Configuration 0.

PHICH timing during reconfiguration will now be discussed. PHICH is transmitted in the downlink.

For PUSCH transmissions scheduled in subframe n , a UE shall determine the corresponding PHICH resource in subframe $n + k_{PHICH}$, where k_{PHICH} is given in Figure 9 for TDD.

Analysis of TDD UL/DL configuration 0: Since all PHICHs are mapped to DL subframe 0, 1, 5 and 6, there is no PHICH timing problem for TDD UL/DL configuration 0. This is because these subframes are always downlink frames.

Analysis of TDD UL/DL configuration 1: Since subframe 4 is a flexible subframe, when it is used for UL or no PHICH is mapped in this subframe according to currently specified PHICH timing, PUSCH transmitted in UL subframe 8 cannot receive PHICH in subframe 4 of the next radio frame if it is an UL frame. As can be seen from Figure 4, subframe 4 is for DL and PHICH is mapped to this subframe only in case of TDD UL/DL configuration 1. This may cause a PHICH timing problem when TDD UL/DL configuration 1 is changed to any other configuration. This may be either because the corresponding subframe is UL or the corresponding subframe is DL but not used for PHICH transmission.

Analysis of TDD UL/DL configuration 2: There is a problem with the PHICH mapping from subframe 7 to subframe 3 of the next radio frame. This may cause a PHICH timing problem when the configuration 2 is changed to one where subframe 3 is an uplink subframe

To sum up, there is no PHICH timing problem for TDD UL/DL configuration 0 when eNB changes the TDD UL/DL configuration 0 to any other configuration. There is also no PHICH timing problem for TDD UL/DL configuration 0 when eNB changes TDD UL/DL configuration 3, 4, 5 or 6 to TDD UL/DL configuration 0. When TDD UL/DL configuration 1 or 2 is changed to Configuration 0, a PHICH timing problem may happen for subframe 8 or 7, respectively. In that sense, UE receives the PHICH in an UL subframe and cause an "NACK" to be received. So the UE will trigger the PUSCH retransmission in subframe 8 or 7 in the current radio frame. eNB just reserves the resource for UE retransmission.

In a summary, TDD UL/DL configuration 0 may be an appropriate TDD UL/DL configuration during reconfiguration ambiguity period.

Reference is made to Figure 11 which illustrates a method used in an embodiment.

In step S1, the eNB and UE are initially in TDD UL/DL configuration X.

In step S2, the eNB determines that due to the traffic fluctuation in UL and DL, a new TDD UL/DL configuration Y is to be used for to adapt to the traffic variation.

In step S3, at frame N, eNB signals to the UE to indicate the new determined TDD UL/DL configuration, Configuration Y, to UE. This TDD configuration indication may be sent to the UE with a frame offset indicating which frame a temporary TDD UL/DL configuration will be applied after the current frame. The temporary TDD UL/DL configuration can be predetermined as TDD UL/DL configuration 0 or indicated as this in the high layer signalling. The UE and eNB will use TDD UL/DL configuration 0 as the temporary configuration during the TDD reconfiguration period. The value of the frame offset may be dependent on the signalling carrying the TDD UL/DL configuration or a

typical value based on the used TDD UL/DL configuration indication method. In this way, no ambiguity on TDD UL/DL configuration between eNB and UE is caused. This is illustrated in Figure 10. At frame N, the UE and eNB will be using configuration X.

5 In step S4, at frame N+offset, the temporary TDD UL/DL configuration is applied as can be seen in Figure 11. The UE and eNB use this temporary configuration's timing relationships. In that way, DL/UL HARQ and PUSCH will work without ambiguity.

In step S5, at frame N+offset+1, the indicated TDD UL/DL configuration Y shall be applied. The UE and eNB shall follow the timing relationships of TDD UL/DL configuration Y. This can be seen in Figure 10.

10 It is noted that the proposed temporary TDD UL/DL configuration can also be extended to physical layer signalling method to indicate TDD UL/DL configuration. In that case, the frame offset is not necessary or the offset can be set to zero. The temporary TDD UL/DL configuration can be applied during the change between TDD UL/DL configuration X and Y. In this way, DL/UL HARQ and PUSCH timing without ambiguity during TDD reconfiguration period.

15 Some embodiments may provide one or more advantages. The benefits of dynamic TDD UL/DL reconfiguration may be achieved. The ambiguity problem during reconfiguration is addressed. Some embodiments may ensure that the DL/UL HARQ and PUSCH processes are handled correctly.

In the described embodiments, the default configuration is configuration 0. It should be appreciated that in other embodiments, the default configuration may be any other suitable configuration.

20 In some embodiments, the default configuration will depend on the current configuration and the selected next configuration. The intermediate or temporary configuration may be selected as one which is compatible with the currently used configuration.

In some embodiments, a determination is made as to whether there is any ambiguity in changing from the current used time division duplex uplink/downlink configuration to the new time division duplex uplink/downlink configuration. If there is a potential problem, then an intermediate uplink/downlink configuration is used. If there is no conflict, then the changes is made between the first time division duplex uplink/down link configuration and the new time division uplink/down link configuration, without going via an intermediate configuration.

25 It should be appreciated that in some embodiments, where the intermediate configuration is not used, a frame offset or other time information (i.e. SFN) may be used to control the timing when the new time division uplink/down link configuration is started to be used.

In some embodiments, the offset is described as being one frame. It should be appreciated that in some embodiments, the offset may be more than one frame.

In some embodiments, the intermediate configuration is used for one frame. In some embodiments the intermediate configuration may be used for more than one frame.

- 5 Embodiments have been described in relation to the particular uplink/downlink configurations associated with a particular LTE standard. It should be appreciated that other embodiments can be extended to any other standard or versions of the uplink/downlink configurations.

10 It is noted that whilst embodiments have been described in relation to LTE, similar principles can be applied to any other communication system or to further developments with LTE. Thus, although the embodiments are described with references to uplink and downlink, this disclosure is not limited by these directions between a base station and a user terminal. Instead, the invention is applicable to any system with transmissions between two or more communicating entities. For example, a communication system may be provided by means of a plurality of user equipment, for example in ad-hoc networks. Therefore, although certain embodiments were described above by way of
15 example with reference to certain exemplifying architectures for wireless networks, technologies and standards, embodiments may be applied to any other suitable forms of communication systems than those illustrated and described herein.

The required data processing apparatus and functions of a base station apparatus, a communication device and any other appropriate apparatus may be provided by means of one or more data
20 processors. The described functions at each end may be provided by separate processors or by an integrated processor. The data processors may be of any type suitable to the local technical environment, and may include one or more of general purpose computers, special purpose computers, microprocessors, digital signal processors (DSPs), application specific integrated circuits (ASIC), gate level circuits and processors based on multi core processor architecture, as non-limiting
25 examples. The data processing may be distributed across several data processing modules. A data processor may be provided by means of, for example, at least one chip. Appropriate memory capacity can also be provided in the relevant devices. The memory or memories 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,
30 optical memory devices and systems, fixed memory and removable memory.

In general, the various embodiments may be implemented in hardware or special purpose circuits, software, logic or any combination thereof. Some aspects of the invention may be implemented in

hardware, while other aspects may be implemented in firmware or software which may be executed by a controller, microprocessor or other computing device, although the invention is not limited thereto. While various aspects of the invention may be illustrated and described as block diagrams, flow charts, or using some other pictorial representation, it is well understood that these blocks, apparatus, systems, techniques or methods described herein may be implemented in, as non-limiting examples, hardware, software, firmware, special purpose circuits or logic, general purpose hardware or controller or other computing devices, or some combination thereof. The 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 foregoing description has provided by way of exemplary and non-limiting examples a full and informative description of the exemplary embodiment of this invention. However, various modifications and adaptations may become apparent to those skilled in the relevant arts in view of the foregoing description, when read in conjunction with the accompanying drawings and the appended claims. However, all such and similar modifications of the teachings of this invention will still fall within the scope of this invention as defined in the appended claims. Indeed there is a further embodiment comprising a combination of one or more of any of the other embodiments previously discussed.

WHAT IS CLAIMED IS:

1. A method comprising;
5 Using a first time division duplex uplink/downlink configuration;

 Selecting a second time division duplex uplink/downlink configuration; and

 Changing to a third time division duplex uplink/downlink configuration and then
changing to said second time division duplex uplink/downlink configuration.
2. A method as claimed in claim1, wherein said third time division duplex uplink/downlink
10 configuration comprises a default time division duplex uplink/downlink configuration.
3. A method as claimed in claim 1 or 2, comprising changing to said third time division duplex
uplink/downlink configuration for a defined length of time.
4. A method as claimed in claim 3, wherein said defined time comprises a frame.
5. A method as claimed in any preceding claim, comprising causing information to be provided
15 to a user equipment indicating that said second time division duplex uplink/down link configuration
is to be used.
6. A method as claimed in any preceding claim, comprising causing timing information to be
provided to a user equipment about timing of at least one of a start of said third time division duplex
uplink/downlink configuration and said second time division uplink/downlink configuration.
- 20 7. A method as claimed in claim 6, wherein said timing information comprises at least one of
frame offset information and system frame number.
8. A method as claimed in any preceding claim, where in the said third uplink/downlink
configuration comprises a configuration in which a number of is uplink subframes is higher or the
same as said first and second uplink/down link configurations.
- 25 9. A method comprising:

using a first time division duplex uplink/downlink configuration;

selecting a second time division duplex uplink/downlink configuration;

causing information to be provided to a user equipment about said second time division duplex uplink/downlink configuration and timing information about said second time division duplex uplink/downlink configuration; and

starting to use said second time division duplex uplink/downlink configuration at a time defined by said timing information.

10. A method comprising;

Using a first time division duplex uplink/downlink configuration;

Receiving information that a second time division duplex uplink/downlink configuration is to be used; and

10 Changing to a third time division duplex uplink/downlink configuration and then changing to said second time division uplink/downlink configuration.

11. A method as claimed in claim 10, wherein said third time division duplex uplink/downlink configuration comprises a default time division duplex uplink/downlink configuration.

12. A method as claimed in claim 10 or 11, comprising changing to said third time division duplex uplink/downlink configuration for a defined length of time.

13. A method as claimed in claim 12, wherein said defined time comprises a frame.

14. A method as claimed in any of claims 10 to 13, comprising receiving timing information about timing of at least one of a start of said third time division duplex uplink/downlink configuration and said second time division uplink/downlink configuration.

15. A method as claimed in claim 14, wherein said timing information comprises at least one of frame offset information and system frame number.

16. A method as claimed in any of claims 10 to 15, where in the said third uplink/downlink configuration comprises a configuration in which a number of uplink subframes is higher or the same as for said first and second uplink/downlink configurations.

17 An apparatus comprising at least one processor and at least one memory including computer code for one or more programs, the at least one memory and the computer code configured, with the at least one processor, to cause the apparatus at least to: use a first time division duplex uplink/downlink configuration; select a second time division duplex uplink/downlink

configuration; and change to a third time division duplex uplink/downlink configuration and then change to said second time division duplex uplink/downlink configuration.

18. Apparatus as claimed in claim 17, wherein the third time division duplex uplink/downlink configuration comprises a default time division duplex uplink/downlink configuration.

5 19. Apparatus as claimed in claim 17 or 18, wherein the at least one memory and the computer code are configured with the at least one processor to cause the apparatus to cause timing information to be provided to a user equipment about timing of at least one of a start of said third time division duplex uplink/downlink configuration and said second time division uplink/downlink configuration.

10 20. Apparatus as claimed in claim 19, wherein the timing information comprises at least one of frame offset information and system frame number.

21. Apparatus as claimed in any of claims 17 to 20, wherein the third uplink/downlink configuration comprises a configuration in which a number of uplink subframes is higher or the same as for said first and second uplink/down link configurations.

15 22. An apparatus comprising at least one processor and at least one memory including computer code for one or more programs, the at least one memory and the computer code configured, with the at least one processor, to cause the apparatus at least to: use a first time division duplex uplink/downlink configuration; receive information that a second time division duplex uplink/downlink configuration is to be used; and change to a third time division duplex
20 uplink/downlink configuration and then change to said second time division uplink/downlink configuration.

23. An apparatus as claimed in claim 22, wherein the third time division duplex uplink/downlink configuration comprises a default time division duplex uplink/downlink configuration.

24. An apparatus as claimed in claim 22 or 23, wherein the at least one memory and the
25 computer code may be configured with the at least one processor to cause the apparatus to receive timing information about timing of at least one of a start of said third time division duplex uplink/downlink configuration and said second time division.

25. A method comprising:

using a first time division duplex uplink/downlink configuration;

receiving information about a second time division duplex uplink/downlink configuration and timing information about said second time division duplex uplink/downlink configuration; and

starting to use said second time division duplex uplink/downlink configuration at a time defined by said timing information.

- 5 26. A computer program comprising computer executable code which when run causes the method of any of claims 1 to 16 or 25 to be performed.

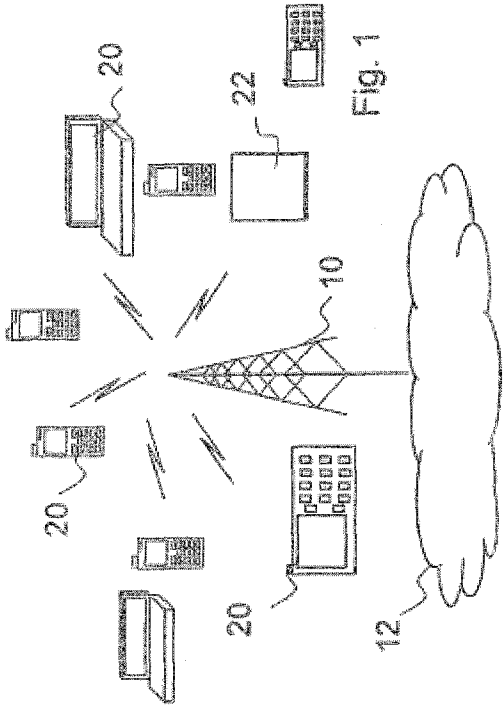


Fig. 1

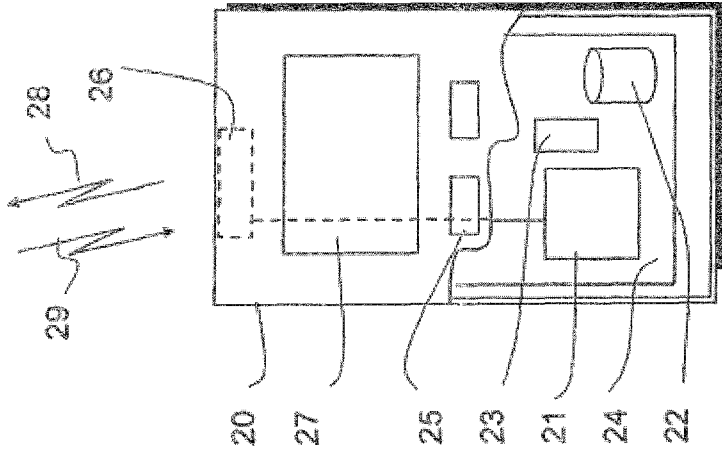


Fig. 2

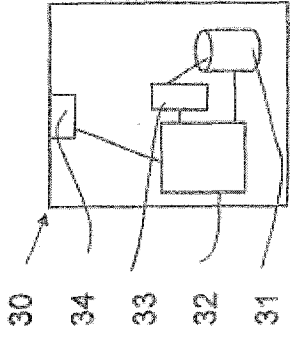


Fig. 3

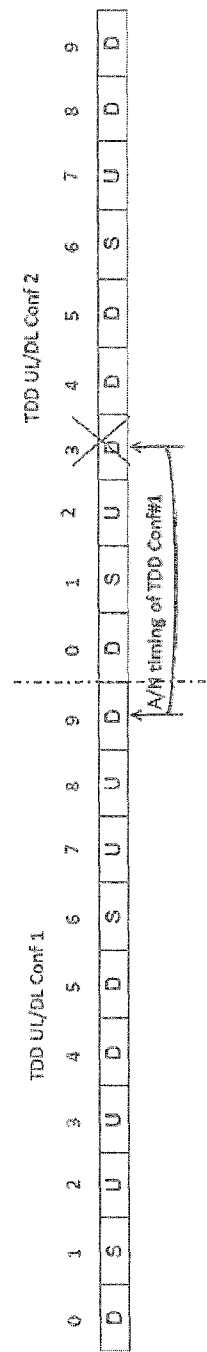
Figure 4

UL/DL configuration	Switching-point periodicity	Subframe number									
		0	1	2	3	4	5	6	7	8	9
0	5 ms	D	S	U	U	U	D	S	U	U	U
1	5 ms	D	S	U	U	D	D	S	U	U	D
2	5 ms	D	S	U	D	D	D	S	U	D	D
3	10 ms	D	S	U	U	U	D	D	D	D	D
4	10 ms	D	S	U	U	D	D	D	D	D	D
5	10 ms	D	S	U	D	D	D	D	D	D	D
6	5 ms	D	S	U	U	U	D	S	U	U	D

Figure 5

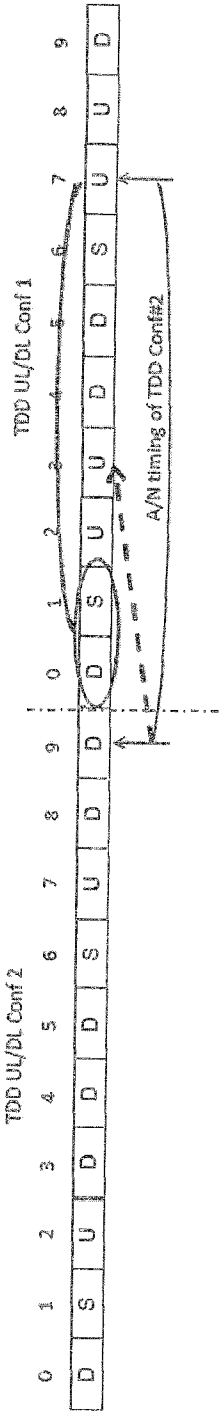
UL-DL Configuration	Subframe <i>n</i>									
	0	1	2	3	4	5	6	7	8	9
0	-	-	6	-	4	-	-	6	-	4
1	-	-	7, 6	4	-	-	-	7, 6	4	-
2	-	-	8, 7, 4, 6	-	-	-	-	8, 7, 4, 6	-	-
3	-	-	7, 6, 11	6, 5	5, 4	-	-	-	-	-
4	-	-	12, 8, 7, 11	6, 5, 4, 7	-	-	-	-	-	-
5	-	-	13, 12, 9, 8, 7, 5, 4, 11, 6	-	-	-	-	-	-	-
6	-	-	7	7	5	-	-	7	7	-

Figure 6



HARQ timing problem in case of dynamic TDD UL/DL reconfiguration

Figure 7



PUCCH resource collision in case of dynamic TDD
UL/DL reconfiguration

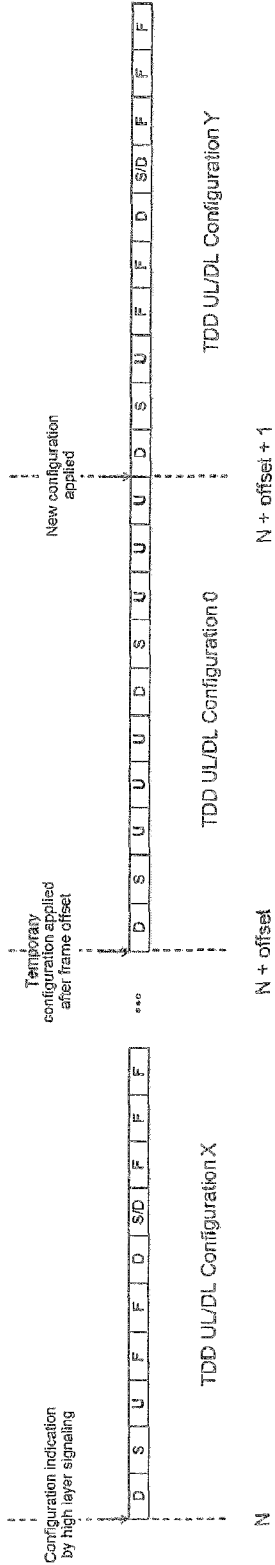
Figure 8

TDD UL/DL Configuration	DL subframe number <i>n</i>									
	0	1	2	3	4	5	6	7	8	9
0	4	6					6			
1		6			4		6			4
2				4					4	
3	4								4	4
4									4	4
5									4	
6	7	7				7	7			5

Figure 9

TDD UL/DL Configuration	subframe index n									
	0	1	2	3	4	5	6	7	8	9
0			4	7	6			4	7	6
1			4	6				4	6	
2			6					6		
3			6	6	6					
4			6	6						
5			6							
6			4	6	6			4	7	

Figure 10



The whole procedure during reconfiguration

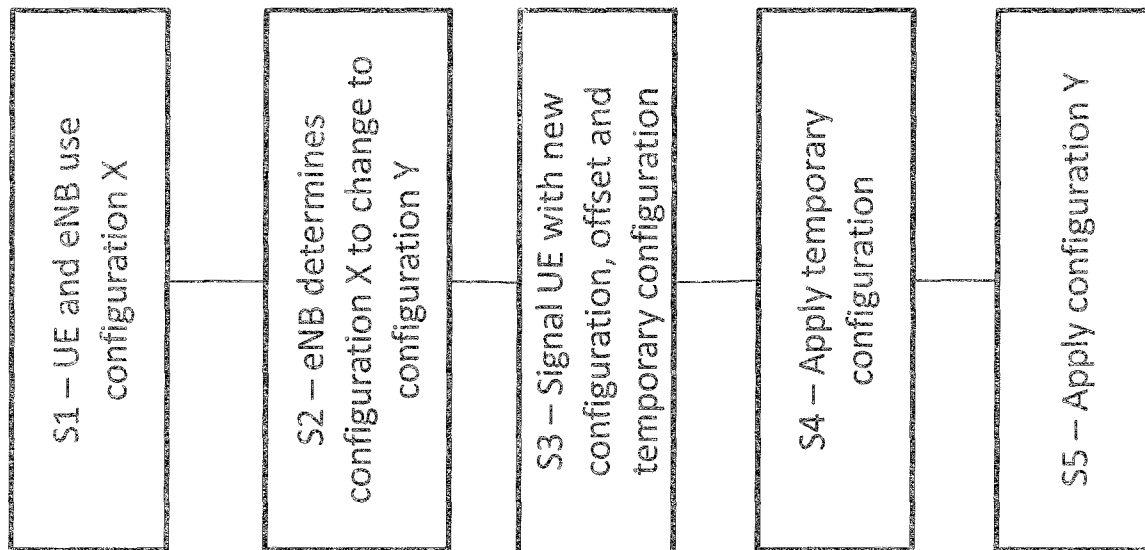


Figure 11

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2012/084850

A. CLASSIFICATION OF SUBJECT MATTER

See the extra sheet

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)

IPC: H04L, 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)

CNABS, CNTXT, CNKI, VEN: time division duplex, TDD, uplink/downlink, UL/DL, uplink, downlink, upstream, downstream, sub frame+, sub carrier+, dynamic, adjust, configuration, reconfiguration, temporary

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 102035594 A (ZTE CORP) 27 April 2011 (27.04.2011) description, paragraphs [0033] to [0039], [0090] to [0101] and figures 1-3	1-7, 9-15, 17-20, 22-26
A	the same as above	8, 16, 21
A	CN 102685872 A (HUAWEI TECHNOLOGIES CO LTD) 19 September 2012 (19.09.2012) the whole document	1-26
A	US 2011149813 A1 (TELEFONAKTIEBOLAGET ERICSSON L M) 23 June 2011 (23.06.2011) the whole document	1-26

☐ 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 application or patent but published on or after the international filing date

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Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/CN2012/084850

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2012/084850

A. CLASSIFICATION OF SUBJECT MATTER

H04L 1/18 (2006.01) i
H04W 72/04 (2009.01) i
H04W 72/12 (2009.01) i