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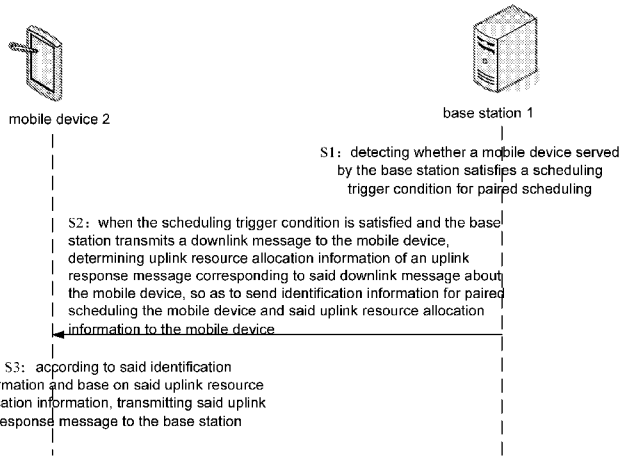
(54) Title: METHOD AND APPARATUS FOR TRANSMITTING AN UPLINK RESPONSE MESSAGE

Fig. 6



(57) Abstract: An objective of this invention is to provide a method and apparatus for transmitting an uplink response message. Specifically, detecting, by a base station serving a mobile device, whether the mobile device satisfies a scheduling trigger condition for paired scheduling; when the scheduling trigger condition is satisfied and the base station transmits a downlink message to the mobile device, determining, by the base station, uplink resource allocation information of an uplink response message corresponding to said downlink message about the mobile device, so as to send identification information for paired scheduling the mobile device and said uplink resource allocation information to the mobile device; transmitting, by the mobile device, said uplink response message according to said identification information and base on said uplink resource allocation information. Compared with the prior art, in the present invention, the base station transmits identification information to the mobile device which satisfies a scheduling trigger condition for paired scheduling, and uplink resource allocation information of an uplink response message corresponding to the downlink message, such that the base station can allocate UL and DL resource in the same resource allocation message. Thereby, signaling overhead is reduced, and the coverage of the mobile device is enhanced.

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Method and Apparatus for Transmitting an Uplink Response Message

FIELD OF THE INVENTION

[0001] The invention relates to the field of communication technology, and more particularly, a technology of transmitting an Uplink Response Message.

BACKGROUND OF THE INVENTION

[0002] Machine Type Communication (MTC) device is a UE that is used by a machine for specific application. An example of such MTC device is smart meter. Some of these smart meters are located in basement, which suffer from high penetration loss and therefore it is difficult for the MTC device to communicate with the network. Therefore, in 3GPP a new Work Item for Low Cost MTC UE and coverage enhancement is approved. The coverage enhancement aspect aims at extending the coverage of such MTC UE by 15 dB. We refer to these UEs as CE-MTC UE (Coverage Enhanced MTC UE).

[0003] In order to achieve the 15dB coverage enhancement, tens to hundreds of repetitions are expected for PRACH(Physical Random Access Channel) and PUSCH(Physical Uplink Shared Channel), which reduce the system spectral efficiency to its 1/100. Hence, techiques are desired to improve the efficiency. One important aspect of efficiency issue is the signaling overhead. Because the transmission is still dynamically scheduled in PDCCH(Physical Downlink Control Channel). One hundred repetitions mean that both PDSCH (Physical Downlink Shared Channel) / PUSCH and PDCCH need so many repetitions. Furthermore, the typical application is meter like which features small data transmsision, so the signaling overhead is more than other traffic such as web browsing. A useful method to reduce the signaling overhead, especially when CSI (Channel State Information) is not avaialble, is persistent scheduling. However, this does not help much, as the major transmission of a session is for signaling, such as Figure 1 shows the corresponding signaling flow in the process of a UE random accessing an eNB (evolved Node B). A typical application of metering, would only send a few data packets, and this makes it difficult to apply the persistent scheduling. Next, another possibility is to use persistent scheduling for signaling transmission, and this method does not work well either, as the signaling flow is more complexity than data transmission and sometime unpredicable, and this sometime is modeld as an state machine. Hence, the coventional persistent scheduling may waste resoruces when there is data to transmit. Next, the current signaling flow has excessive delay as each signaling may have to be repeated by 100 times. The delay means the UE needs more power to decode and/or transmit the more messages, so consumes more power.

SUMMARY OF THE INVENTION

[0004] An objective of this invention is to provide a method and apparatus for transmitting an Uplink Response Message.

[0005] According to one aspect of this invention, there provides a method for transmitting an uplink response message, comprising steps of:

[0006] a. detecting, by a base station serving a mobile device, whether the mobile device satisfies a scheduling trigger condition for paired scheduling;

[0007] b. when the scheduling trigger condition is satisfied and the base station transmits a downlink message to the mobile device, determining, by the base station, uplink resource allocation information of an uplink response message corresponding to said downlink message about the mobile device, so as to send identification information for paired scheduling the mobile device and said uplink resource allocation information to the mobile device;

[0008] c. transmitting, by the mobile device, said uplink response message according to said identification information and base on said uplink resource allocation information.

[0009] According to another aspect of this invention, there also provides a base station for transmitting an uplink response message, wherein the base station comprises:

[00010] a detecting module configured to detect whether a mobile device served by the base station satisfies a scheduling trigger condition for paired scheduling;

[00011] a sending module configured to, when the scheduling trigger condition is satisfied and the base station transmits a downlink message to the mobile device, determine uplink resource allocation information of an uplink response message corresponding to said downlink message about the mobile device, so as to send identification information for paired scheduling the mobile device and said uplink resource allocation information to the mobile device.

[00012] According to a further aspect of this invention, there also provides a mobile station for transmitting an uplink response message, wherein the mobile station comprises:

[00013] a receiving module configured to receive identification information for paired scheduling the mobile device sent by a base station serving the mobile device, and uplink resource allocation information of an uplink response message corresponding to the downlink message about the mobile device, which is determined when the base station sends the uplink message to the mobile device;

[00014] a response sending module configured to, according to said identification information and base on said uplink resource allocation information, transmit said uplink response message to the base station.

[00015] According to another aspect of this invention, there also provides a base station for transmitting an uplink response message, wherein the base station comprises the aforementioned base station according to another aspect of the invention.

[00016] According to another aspect of this invention, there also provides a mobile device for transmitting an uplink response message, wherein the mobile device comprises the aforementioned mobile device according to a further aspect of the invention.

[00017] According to another aspect of this invention, there also provides a system for transmitting an uplink response message, wherein the system comprises the aforementioned base station according to another aspect of the invention and the aforementioned mobile device according to a further aspect of the invention.

[00018] Compared with the prior art, in the present invention, the base station transmits identification information to the mobile device which satisfies a scheduling trigger condition for paired scheduling, and uplink resource allocation information of an uplink response message corresponding to the downlink message about the mobile device, which is determined by the base station when sending the uplink message to the mobile device, such that the base station can allocate UL and DL resource in the same resource allocation message. Thereby, the invention not only can reduce signaling overhead, save the resource required in scheduling the mobile device, but also can save the batter of the mobile device, and in hence, the coverage of the mobile device is enhanced at the same time. Moreover, when sending identification information for paired scheduling the mobile device and said uplink resource allocation information to the mobile device in the invention, it can generate corresponding system information firstly, wherein the system information includes identifying information for paired scheduling the mobile device and said uplink resource allocation information; then broadcast the system information to the mobile device, so as to send said identification information and said uplink resource allocation information to the mobile device, so the invention can further reduce signaling overhead and save the batter of the mobile device through sending said identification information and said uplink resource allocation information to the mobile device in the system information.

BRIEF DESCRIPTION OF THE DRAWINGS

[00019] Other features, aims and advantages of this invention will become

more apparent through reading the detailed statement of the non-restrictive embodiments made with reference to the following accompanying drawings:

[00020] Fig.1 shows a schematic diagram illustrating the corresponding signaling flow in the process of a UE random accessing an eNB in prior arts;

[00021] Fig.2 shows a schematic diagram illustrating a mobile device and a base station for transmitting an uplink response message according to one aspect of the present invention;

[00022] Fig.3 shows the signaling that satisfies paired scheduling in the signaling flow of Fig.1;

[00023] Fig.4 shows the resource allocation for UL;

[00024] Fig.5 shows a schematic diagram illustrating a base station for transmitting an uplink response message according to one preferred embodiment of the present invention;

[00025] Fig.6 shows a flowchart of a method for transmitting an uplink response message with cooperation between a mobile device and a base station according to another aspect of the present invention;

[00026] Fig.7 shows a flowchart of a method for transmitting an uplink response message according to one preferred embodiment of the present invention.

[00027] The same or similar reference signs in the drawings represent the same or similar component parts.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[00028] Details of the invention will be further provided below in combination with the accompanying drawings.

[00029] Fig. 2 shows a mobile device 2 and a base station 1, for transmitting an uplink response message according to one aspect of the present invention, wherein the base station 1 comprises a detecting module 11 and a sending module 12; the mobile device 2 comprises a receiving module 21 and a response sending module 22. Specifically, the detecting module 11 of the base station 1 detects whether the mobile device 2 served by the base station 1 satisfies a scheduling trigger condition for paired scheduling; when the scheduling trigger condition is satisfied and the base station 1 transmits a downlink message to the mobile device 2, the sending module 12 determines uplink resource allocation information of an uplink response message corresponding to said downlink message about the mobile device 2, so as to

send identification information for paired scheduling the mobile device 2 and said uplink resource allocation information to the mobile device 2; correspondingly, the receiving module 21 of the mobile device 2 receives identification information for paired scheduling the mobile device sent by the base station 1 serving the mobile device 2, as well as uplink resource allocation information of an uplink response message corresponding to the downlink message about the mobile device 2, which is determined when the base station 1 sends the uplink message to the mobile device 2; the response sending module 22 according to said identification information and base on said uplink resource allocation information, transmits said uplink response message to the base station 1.

[00030] Here, the mobile device refers to the part in mobile communication device, which terminates wireless transmission from or to the network and adapts the capability of a terminal device to the wireless transmission, i.e., the device for a user to access to the mobile network, which includes, but not limited to, any electronic product that performs human-machine interaction with the user through a keyboard, a touch pad, or a voice-control device, and implements transmission of mobile communication signals through mutual transmission and reception of signals between a mobile network and a base station, for example, a tablet, a smart mobile phone, a PDA, a vehicle mount computer, a UE for converage enhancement, a MTC device, a CE-MTC UE, a CE-MTC device, etc.. Here, the base station refers to the device in mobile communication, which connects the fixed part and the wireless part and be connected to the mobile station through wireless transmission in the air, which includes, but not limited to, such as eNB, etc.. Here, the mobile network includes, but not limited to, GSM, 3G, LTE, Wi-Fi, WiMax, WCDMA, CDMA2000, TD-SCDMA, HSPA, LTD, etc. Those skilled in the art should understand that the aforesaid mobile devices, base stations, and mobile networks are only exemplary, other existing mobile devices, base stations, and mobile networks or those that may possibly come out later should also be covered in the protection scope of the invention and included here in a way of quotation, if they are adaptable to this invention.

[00031] Specifically, the detecting module 11 of the base station 1 detects whether the mobile device served by the base station satisfies the scheduling trigger condition for paired scheduling.

[00032] Here, the paired scheduling means simultaneously scheduling a potential RRC (Radio Resource Control) uplink feedback message in a signaling of scheduling a downlink RRC message. For example, based on a mechanism in which messages are organized in pairs (e.g., in the signaling flow as shown in Fig. 1, the uplink message “RRC connection reconfiguration” is immediately followed a corresponding downlink response message “RRC connection reconfiguration complete” (the “RRC connection reconfiguration” and the “RRC connection reconfiguration complete” forms paired messages)),

when the base station eNB transmits a downlink message to the mobile device UE, it may know the uplink response message to be transmitted by the mobile device UE in response to the downlink message and estimate the size of the uplink response message, thereby, it can transmit uplink resource allocation corresponding to the uplink response message while transmitting the downlink message, and allocating the resources for UL and DL in the same resource allocation message is realized. Fig. 3 shows signaling satisfying paired scheduling as shown in Fig. 1, wherein the signaling in the bold dotted line "_ _ _" blocks are paired signaling. It can be seen from Fig. 3 that the paired scheduling in the present invention can be used for most of the signaling transmissions. 12 out 18 signaling shown in Fig. 3 can use paired scheduling, and hence, approximately 30% of the signaling can be saved and as another consequence the mobile device batter is also saved.

[00033] Here, the scheduling trigger condition includes, but not limited to, any one of the following: 1) a preamble sequence adopted by the mobile device randomly accessing the base station satisfies a predetermined sequence number, e.g., the sequence of the preamble signals transmitted on PRACH (Physical Random Access Channel) when the mobile device randomly accesses the base station is 31-56, while the sequence of the preamble signals employed by a normal UE accessing the base station is 1-30; II. The subframe transmitting PRACH when the mobile device accesses the base station satisfies a predetermined subframe number, i.e., the PRACH when the mobile device accesses the base station and the PRACH when the normal UE accesses the base station are transmitted on different subframes. For example, if the normal UE performs transmission in subframe 0, then the mobile device may perform transmission in a remaining subframe. Those skilled in the art should understand that the above trigger condition is only exemplary, and other existing or future possibly developed scheduling trigger conditions, if applicable to the present invention, should also be included within the protection scope of the present invention, and is incorporated here by reference.

[00034] For example, suppose the mobile device 2 has already searched a cell covered by the base station 1 when being powered on and initially accessing the network, and has been synchronized with the cell; then, the mobile device 2 applies for a possibility of establishing a network connection with the base station 1, i.e., realizing random access with the base station 1, so as to establish uplink synchronization; suppose the preamble signal sequence transmitted on PRACH when the mobile device 2 randomly accesses the base station 1 is 50, it satisfies the above scheduling trigger condition I, and the detecting module 11 can determine that the mobile device 2 satisfies the scheduling trigger condition for performing paired scheduling. For another example, suppose the PRACH is transmitted on subframe 0 when the mobile device 2 randomly accesses the base station 1, it will not satisfy the scheduling trigger condition II, then the detecting module 11 may determine that the mobile device 2 does not satisfy the scheduling trigger condition for paired scheduling.

[00035] Those skilled in the art should understand that the aforesaid manner of detecting whether the mobile device satisfies a scheduling trigger condition for paired scheduling is only exemplary, other existing manner of detecting whether the mobile device satisfies a scheduling trigger condition for paired scheduling, or those that may possibly come out later should also be covered in the protection scope of the invention and included here in a way of quotation, if they are adaptable to this invention.

[00036] When the scheduling trigger condition is satisfied and the base station transmits a downlink message to the mobile device, the sending module 12 determines uplink resource allocation information of an uplink response message corresponding to said downlink message about the mobile device, so as to send identification information for paired scheduling the mobile device and said uplink resource allocation information to the mobile device.

[00037] Here, the identification information is for indicating whether the paired scheduling is used, which can be defined in the DCI (DOWNLINK CONTROL INFORMATION) of downlink scheduling, or defined in a system message such as SIB (System Information Block).

[00038] Here, the uplink resource allocation information includes, but not limited to, at least any one of the following: i) uplink resource block assignment information corresponding to the uplink response message; ii) resource block initiation location information and resource block amount information corresponding to the uplink response message; iii) offset information between the first physical resource block corresponding to the uplink response message and the first physical resource block corresponding to the downlink message; iv) timing interval information between the uplink response message and the downlink message. Here, the uplink resource allocation information may be defined in the DCI of downlink scheduling, or defined in a system message such as SIB. Preferably, the offset information may be indicated in the SIB, and the timing interval information may also be indicated in the SIB.

[00039] Here, the illustration is only made with the identification information and the uplink resource allocation information illustrated in the DCI as an example, to improve the existing DCI format 1A, DCI format 1, and DCI format 1C, respectively, e.g., a bit of the identification information and a bit of the uplink resource allocation information are newly added, to illustrate the identification information and the uplink resource allocation information:

[00040] 1) by improving the DCI format 1A, derive a DCI format 1A', and the information included therein, as well as bits seized by respective information are specified below:

- carrier indication – 0 or 3 bits
- flag for format 0/ format 1 differentiation – 1 bit
- localized/ distributed VRB (Virtual Resource Block) assignment flag –1 bit

- resource block assignment
- modulation and coding scheme – 2 bits
- HARQ (Hybrid Automatic Repeat Request) process number – 3bits
- new data indicator – 1 bit
- redundancy version – 2 bits
- TPC command for PUCCH – 2 bits
- paired scheduling is used-1 bit
- uplink resource block assignment-3 bits

[00041] 2) by improving the DCQ format 1, derive DCI format 1', and the information included therein, as well as the bits seized by respective information, is specified below:

- carrier indication – 0 or 3 bits
- resource block assignment
- modulation and coding scheme – 2 bits
- HARQ (Hybrid Automatic Repeat Request) process number – 3bits (FDD Frequency Division Duplexing), 4 bits (TDD, Time Division Duplexing)
- new data indicator – 1 bit
- redundancy version – 2 bits
- downlink assignment index (for FDD) – 2 bits
- paired scheduling is used-1 bit
- uplink resource block assignment-3 bits

[00042] 3) by improving the DCI format 1C, derive the DCI format 1C', and the information included therein, as well as bits seized by respective information, is specified below:

- 1bit indication gap value
- resource block assignment
- modulation and coding scheme – 2 bits
- paired scheduling is used-1 bit
- uplink resource block assignment-3 bits

Here, the "paired scheduling is used" bit in the DCI format 1A', the DCI format 1', and the DCI format 1C' is for indicating whether the paired scheduling is used, i.e., reflecting the identification information; the "uplink resource block assignment" bit in the DCI format 1A', the DCI format 1', and the DCI format 1C' shows the uplink resource allocation information. Here, to those skilled in the art, through comparison between the above DCI format 1A', DCI format 1', and DCI format 1C' with the DCI format 1A, DCI format 1, and the DCI format 1C in the prior art, it can be seen that some information in the DCI format 1A, DCI format 1, and the DCI format 1C in the prior art are not needed in the above DCI format 1A', DCI format 1', and DCI format 1C', and the number of bits of some information can be reduced. Here, only take the DCI format 1A as an example. The "SRS (sounding reference signal) request – 0 or 1 bit" in the DCI format 1A in the prior art is unnecessary for the DCI format 1A'; the "modulation and coding scheme" seizes 5 bits in the DCI format 1A, while it

only seizes 3 bits in the DCI format 1A", therefore, the total number of bits of the DCI format 1A' is identical to that of the DCI format 1A; for another example, the maximum resources to be assigned to the mobile device 2 are 6 PRBs (Physical Resource Blocks); hence, the bits for the resources allocation are fewer, which is sufficient to take uplink resource allocate in the same message.

[00043] Specifically, when the scheduling trigger condition is satisfied and the base station transmits a downlink message to the mobile device, the sending module 12 can first determine uplink resource allocation information of an uplink response message corresponding to said downlink message about the mobile device. For example, determining the uplink resource allocation information based on historical uplink resource allocation information of the mobile device, so as to send the uplink resource allocation information to the mobile device; then, sends identification information for paired scheduling the mobile device and said uplink resource allocation information to the mobile device.

[00044] For example, for the mobile device 2, suppose the detecting module 11 determines that the mobile device 2 satisfies the scheduling trigger condition. Then, when the base station 1 receives a new downlink message from a higher layer, e.g., RRC, if the base station 1 transmits a downlink message as shown in Fig. 1, e.g., "RRC connection setup", because the uplink response message "RRC connection complete" and "RRC connection setup" shown in Fig. 1 are paired messages, the base station 1 can estimate the uplink resource allocation information when the mobile device 2 responds to the downlink message "RRC connection setup", i.e., transmitting "RRC connection complete" to the base station 1. Suppose the mobile device 2 transmitted "RRC connection complete" to the base station 1 in history, the historical uplink resource allocation information of the uplink response message assigned by the base station 1 to the mobile device 2 is 3PRBs. When the base station 1 performs paired scheduling to the mobile device 2 and the base station 1 transmits a downlink message "RRC connection setup" to the mobile device 2, the sending module 12 can determine uplink resource allocation information of an uplink response message corresponding to said downlink message about the mobile device 2 is " UL resource allocation=3PRBs".

[00045] Next, the sending module 12 sends identification information for paired scheduling the mobile device 2 and said uplink resource allocation information to the mobile device 2. For example, continue the above example, suppose the base station 1 selects the DCI format 1A' to transmit the identification information and the uplink resource allocation information to the mobile device 2, then the sending module 12 may first generate corresponding scheduling information (e.g., scheduling-DCI1A'), wherein the scheduling information "scheduling-DCI1A' " includes the identification information and the uplink resource allocation information, such as the bit value corresponding to "paired scheduling is used" in scheduling-DCI1A' is 1 (here, the value of the bit illustrates the identification information, e.g., it may be predetermined that "1" or "0" indicates whether the paired scheduling is used); the bit value in the "uplink resource block assignment" in scheduling-DCI1A' is "011" (here, the

value of bits illustrates the number of PRBs in the uplink resource allocation information; because "uplink resource block assignment" in the scheduling-DCI1A' seizes 3bits, while the uplink resource allocation information first determined by the sending module 12 is 3PRBs, so the bit number here is "011"); then, the sending module 12 transmits the scheduling information scheduling-DCI1A' to the mobile device 2 via a mobile network such as LTE (Long Term Evolution), so as to send the identification information and the uplink resource allocation information to the mobile device 2. Here, the manner of illustrating the identification information and the uplink resource allocation information in DCI information is only exemplary, other existing manner of illustrating the identification information and the uplink resource allocation information in DCI information, or those that may possibly come out later should also be covered in the protection scope of the invention and included here in a way of quotation, if they are adaptable to this invention.

[00046] Here, through sending identification information for paired scheduling the mobile device and uplink resource allocation information of an uplink response message corresponding to said downlink message, such that in the present invention, the base station can allocate UL and DL resource in the same resource allocation message. Thereby, the benefit result of reducing signaling overhead is realized, so as to save approximately 50% signaling overhead.

[00047] Preferably, when the scheduling trigger condition is satisfied and the base station transmits a downlink message to the mobile device, the sending module 12 may first determine uplink resource allocation information of an uplink response message corresponding to said downlink message about the mobile device, so as to send said uplink resource allocation information to the mobile device; or, when the scheduling trigger condition is satisfied and the base station transmits a downlink message to the mobile device, the sending module 12 may first generate corresponding second scheduling information, wherein the second scheduling information includes identification information for paired scheduling the mobile device; then, sends the second scheduling information to the mobile device, so as to send said identification information to the mobile device.

[00048] Specifically, when the scheduling trigger condition is satisfied and the base station transmits a downlink message to the mobile device, the sending module 12 may first determine uplink resource allocation information of an uplink response message corresponding to said downlink message about the mobile device. Here, the manner in which the sending module 12 determines the uplink resource allocation information is identical or substantially identical to the manner in which the abovementioned sending module 12 determines the uplink resource allocation information. For the sake of simplicity, it will not be detailed here, but is incorporated here by reference.

[00049] Then, the sending module 12 sends said uplink resource allocation information to the mobile device, e.g., generating corresponding system

information based on the uplink resource allocation information, wherein the system information comprises the uplink resource allocation information; next, broadcasts the system information to the mobile device so as to send the uplink resource allocation information to the mobile device. For example, for mobile device 2, suppose the detecting module 11 determines that the mobile device 2 satisfies the scheduling trigger condition, then when the base station 1 receives a new downlink message from a higher layer (e.g., RRC), the sending module 12 first determine that uplink resource allocation information of an uplink response message corresponding to said downlink message about the mobile device is "UL resource allocation=3PRBs", then the sending module 12 may generate a corresponding system message (e.g., SIB) based on the uplink resource allocation information, the system information SIB includes the uplink resource allocation information "UL resource allocation=3PRBs"; next, the sending module 12 periodically broadcasts the system message SIB to the mobile device 2 through a mobile network (e.g., LTE).

[00050] Or, when the scheduling trigger condition is satisfied and the base station transmits a downlink message to the mobile device, the sending module 12 may first generate corresponding second scheduling information, wherein the second scheduling information includes identification information for paired scheduling the mobile device; then, sending the second scheduling information to the mobile device, so as to send said identification information to the mobile device. For example, still continue the above example, the detecting module 11 determines that the mobile device 2 satisfies the scheduling trigger condition, suppose the base station 1 selects the DCI format 1' to send the identification information and the uplink resource allocation information to the mobile device 2, then the sending module 12 may first generate corresponding second scheduling information, e.g., scheduling-DCI1', wherein the second scheduling information (e.g., scheduling-DCI1') includes the identification information, e.g., the bit value corresponding to "paired scheduling is used" in the scheduling-DCI1' is "1"; then, the sending module 12 sends the second scheduling information (e.g., scheduling-DCI1') to the mobile device 2 through a mobile network (e.g., LTE), so as to send the identification information to the mobile device 2.

[00051] Here, the present invention sends the identification information only in the scheduling information (i.e, only in DCI information), and sends the uplink resource allocation information in a system message (e.g., SIB), so that the bits for uplink resource allocation in DCI information can be minimized, that is, reducing the number of bits of DCI information. The benefit result of further reducing signaling overhead is realized.

[00052] Here, those skilled in the art should understand that the present invention can sends the uplink resource allocation information only in the

scheduling information (i.e, only in DCI information), and sends the identification information in a system message (e.g., SIB).

[00053] Preferably, the paired scheduling in the present invention can be used together with dynamic scheduling and/or persistence scheduling for data. The mobile device 2 can use SR (Scheduling Request) to request additional resources for UL transmission and the the base station 1 can also schedule the mobile device 2 in one direction UL or DL when it is needed.

[00054] Preferably, the paired scheduling for a mobile device in the present invention can be predetermined, or configured by a higher layer; the signaling message employed by paired scheduling can be defined in a standard, or be indicated, together with the number of resources assigned for a corresponding uplink response message in a system message (e.g., SIB).

[00055] Correspondingly, the receiving module 21 of the mobile device 2 receives the identification information sent by the base station 1 serving the mobile device 2 for paired scheduling the mobile device 2 through a mobile network (e.g., LTE), as we as the uplink resource allocation information of an uplink response message corresponding to the downlink message about the mobile device 2, which is determined when the base station 1 sends the uplink message to the mobile device 2.

[00056] A response sending module 22 according to said identification information and base on said uplink resource allocation information, transmits said uplink response message to the base station. For example, for the mobile device 2, suppose the receiving module 21 receives the identification information for paired scheduling the mobile device 2 sent by the base station 1 serving the mobile device 2. If the bit value corresponding to “paired scheduling is used” indicating the identification information in the scheduling information “scheduling-DCI1A’ ” transmitted by the sending module 12 of the base station 1 is “1” , as well as the uplink resource allocation information of an uplink response message corresponding to the downlink message about the mobile device 2, which is determined when the base station 1 transmits the downlink message to the mobile device 2, e.g., the uplink resource allocation information of the uplink response message “RRC connection complete” corresponding to the downlink message “RRC connection set up” about the mobile device 2, which is determined when the base station 1 transmits a downlink message “RRC connection set up” and indicated in the scheduling information “scheduling-DCI1A’ ” transmitted by the sending module 12 of the base station 1, e.g., the bit value in the “uplink resource block assignment” in scheduling-DCI1A’ is “011,” then the response sending module 22 transmits the uplink response message “RRC connection complete” on 3 PRBs continuously assigned in the spectral domain based on the identification

information, or after a predetermined delay time, the uplink response message "RRC connection complete" is transmitted on 3 PRBs continuously assigned in the spectrum domain.

[00057] For another example, suppose the receiving module 21 of the mobile device 2 receives the identification information for paired scheduling the mobile device sent by the base station 1 serving the mobile device 2, e.g., the bit value corresponding to the "paired scheduling is used" indicating the identification information in the scheduling information "scheduling-DCI1A' " transmitted by the sending module 12 of the base station 1 is "1," as well as the uplink resource allocation information of the uplink response message "RRC connection complete" corresponding to the downlink message "RRC connection setup" about the mobile device 2 as determined when the base station 1 transmits the downlink message "RRC connection setup", the uplink resource allocation information is shown in Fig. 4, wherein the uplink resource allocation information includes: 1) offset information between the first physical resource block corresponding to the uplink response message "RRC connection complete" and the first physical resource block corresponding to the downlink message "RRC connection setup"; 2) timing interval information between the uplink response message "RRC connection complete" and the downlink message "RRC connection setup"; 3) the resource block number information corresponding to the uplink response message "RRC connection complete", e.g., 3PRBs, then the response sending module 22 can determine a PRB initial location for transmitting the uplink response message "RRC connection complete" based on the offset information; and after a timing interval, the uplink response message "RRC connection complete" on continuously assigned PRBs in 3 frequency domains starting from the initial location.

[00058] The various modules of the base station 1 and the mobile device 2 works continuously between each other. Specifically, the detecting module 11 of the base station 1 continuously detects whether the mobile device 2 served by the base station 1 satisfies a scheduling trigger condition for paired scheduling; when the scheduling trigger condition is satisfied and the base station 1 transmits a downlink message to the mobile device 2, the sending module 12 continuously determines uplink resource allocation information of an uplink response message corresponding to said downlink message about the mobile device 2, so as to send identification information for paired scheduling the mobile device 2 and said uplink resource allocation information to the mobile device 2; correspondingly, the receiving module 21 of the mobile device 2 continuously receives identification information for paired scheduling the mobile device sent by the base station 1 serving the mobile device 2, as well as uplink resource allocation information of an uplink response message corresponding to the downlink message about the mobile device 2, which is

determined when the base station 1 sends the uplink message to the mobile device 2; the response sending module 22 continuously according to said identification information and base on said uplink resource allocation information, transmits said uplink response message to the base station 1. Here, those skilled in the art should understand that "continuously" means the various modules of the base station 1 and the mobile device 2 continuously detect whether a scheduling trigger condition for paired scheduling is satisfied , send and receive identification information for paired scheduling and the uplink resource allocation information, and send the uplink response message, till the base station 1 stops detecting whether a scheduling trigger condition for paired scheduling is satisfied.

[00059] Fig. 5 shows a base station 1 for transmitting an uplink response message according to one preferred embodiment of the present invention, wherein the base station 1 comprises a detecting module 11' and a sending module 12', wherein the sending module 12' comprises a determination unit 121' and a sending unit 122'. Specifically, the detecting module 11' of the base station 1 detects whether a mobile device 2 served by the base station 1 satisfies a scheduling trigger condition for paired scheduling; when the scheduling trigger condition is satisfied and the base station transmits a downlink message to the mobile device, the determination unit 121' determines uplink resource allocation information of an uplink response message corresponding to the downlink message about the mobile device; the sending unit 122' sends the identification information for paired scheduling the mobile device and the uplink resource allocation information to the mobile device. Here, the content of the detecting module 11' is identical or substantially identical to the corresponding module in the specific embodiment of Fig. 2. For the sake of simplicity, it will not be detailed here, and is incorporated here by reference.

[00060] Specifically, when the scheduling trigger condition is satisfied and the base station transmits a downlink message to the mobile device, the determination unit 121' determines uplink resource allocation information of an uplink response message corresponding to said downlink message about the mobile device. Here, the manner in which the determination unit 121' determines the uplink resource allocation information includes, but not limited to, any one of the following:

[00061] 1) determining uplink resource allocation information about the uplink response message of the mobile device corresponding to the downlink message based on device type information of the mobile device. Here, the device type information includes, but not limited to, a low-cost type device, a high-cost type device, etc. For example, for the mobile device 2, suppose the detecting module 11' determines that the mobile device 2 satisfies the

scheduling trigger condition, then when the base station 1 receives a new downlink message from a higher layer (e.g., RRC), e.g., when the base station 1 transmits a downlink message such as "RRC connection setup" as shown in Fig. 1 to the mobile device 2, because the uplink response message "RRC connection complete" as shown in Fig. 1 and the "RRC connection setup" are paired messages, the base station 1 can estimate the uplink resource allocation information when the mobile device 2 responds to the downlink message "RRC connection setup," i.e., transmitting "RRC connection complete" to the base station 1, e.g., based on the capacity of the mobile device 2 and the stored information, estimates which parameters in the uplink response message "RRC connection complete" that it will transmit are usable, while which parameters are not used, thereby estimating the bits of the uplink response message "RRC connection complete", thereby further calculating the required uplink resource allocation information, i.e., the needed PRBs; suppose the mobile device is a low-cost type device, for the uplink response message "RRC connection complete," registeredMME is an optional item; if the system only has one MME (Mobility Management Entity) or all mobile devices accessing the base station 1 use a certain MME, then for the uplink response message "RRC connection complete," the registeredMME parameter can not be transmitted; then the determination unit 121' may first determine the bits of the uplink response message "RRC connection complete" is those that minus bits seized by the registeredMME parameter, i.e., needing 17+fixed MAC and RLC heads; then determines the MCS (Module and Coding Scheme) based on the performance of bit-error-rate (BER), and next, further determines the needed PRBs (e.g., 2PRBs) based on the bits those can be transmitted by each PRB, i.e., the determination unit 121' determines that the uplink resource allocation information is 2PRBs.

[00062] 2) determining the uplink resource allocation information of an uplink response message corresponding to said downlink message about the mobile device based on history uplink resource allocation information of the mobile device. For example, suppose the detecting module 11' determines that the mobile device 2 satisfies the scheduling trigger condition, then when the base station 1 receives a new downlink message from a higher layer (e.g., RRC), e.g., when the base station 1 transmits the downlink message such as "RRC connection setup" as shown in Fig. 2 to the mobile device 2, because the uplink response message "RRC connection complete" and the "RRC connection setup" as shown in Fig 1 are paired messages, the base station 1 estimates the uplink resource allocation information when the mobile device 2 responds to the downlink message "RRC connection setup," that is when the base station transmits "RRC connection complete" to the base station 1, and the history uplink resource allocation information of the uplink response message assigned by the base station 1 to the mobile device 2 is 3PRBs, then when the base station 1 performs paired scheduling for the mobile device 2

and the base station 1 transmits the downlink message "RRC connection setup" to the mobile device 2, the determination unit 121' may determine that the uplink resource allocation information about the uplink response message of the mobile device 2 corresponding to the downlink message is "UL resource allocation=3PRBs".

[00063] Those skilled in the art should understand that the aforesaid manner of determining uplink resource allocation information is only exemplary, other existing manner of determining uplink resource allocation information, or those that may possibly come out later should also be covered in the protection scope of the invention and included here in a way of quotation, if they are adaptable to this invention.

[00064] The sending unit 122' sends the identification information for paired scheduling the mobile device and the uplink resource allocation information to the mobile device. Here, the manner in which the sending unit 122'sends the identification information and the uplink resource allocation information includes, but not limited to, any one of the following:

[00065] 1) First, generating corresponding system information, wherein the system information includes identification information for paired scheduling the mobile device and the uplink resource allocation information; then, broadcasting the system information to the mobile device so as to send the identification information and the uplink resource allocation information to the mobile device. For example, continue the above example, the determination unit 121' determines that the uplink resource allocation information of an uplink response message corresponding to said downlink message about the mobile device is "UL resource allocation=3PRBs", then the sending unit 122' may improve the system information SIB in the prior art based on the corresponding message (e.g., SIB') firstly generated, the system information SIB' includes identification information for paired scheduling the mobile device 2, thereby obtaining the system message SIB' suitable for the present invention, e.g., first adding information "paired scheduling is used – 1 bit" in the SIB to obtain SIB', wherein the "paired scheduling is used" bit is for indicating whether the paired scheduling is used, i.e., reflecting the identification information, e.g., "1" or "0" may be predetermined to identify whether the paired scheduling is used; meanwhile, the uplink resource allocation information "UL resource allocation=3PRBs" is added into the SIB; next, the sending unit 122' periodically broadcasts the system message SIB' to the mobile device 2 through a mobile network such as LTE (Long Term Evolution).

[00066] 2) First generating corresponding first scheduling information, wherein the first scheduling information includes identification information for paired scheduling the mobile device, and the uplink resource allocation information; then sending the first scheduling information to the mobile device so as to send

the identification information and the uplink resource allocation information to the mobile device. For example, continue the above example, suppose the base station 1 selects the DCI format 1C' to transmit the identification information and the uplink resource allocation information to the mobile device 2; then the sending unit 122' can first generate corresponding first scheduling information, e.g., scheduling-DCI1C', wherein the first scheduling information "scheduling-DCI1C' " includes the identification information and the uplink resource allocation information, e.g., the bits corresponding to "paired scheduling is used" in the scheduling-DCI1C' is "1" (here, the bit value illustrates the identification information, e.g., "1" or "0" can be predetermined to identify whether the paired scheduling is used), and the bit value in the "uplink resource block assignment" in the "scheduling-DCI1C' " is "011" (here, the bit value illustrates the number of PRBs in the uplink resource assignment information; because "uplink resource block assignment" in the DCI1C' seizes 3bits, while the uplink resource allocation information first determined by the determination unit 121' is 3PRBs, so the bit value here is "011"); then, the sending unit 122' sends the first scheduling information "scheduling-DCI1C' " to the mobile device 2 via a mobile network such as LTE (Long Term Evolution), so as to send the identification information and the uplink resource allocation information to the mobile device 2.

[00067] Those skilled in the art should understand that the aforesaid manner of sending the identification information and the uplink resource allocation information is only exemplary, other existing manner of sending the identification information and the uplink resource allocation information, or those that may possibly come out later should also be covered in the protection scope of the invention and included here in a way of quotation, if they are adaptable to this invention.

[00068] Fig.6 shows a flowchart of a method for transmitting an uplink response message with cooperation between a mobile device and a base station according to another aspect of the present invention.

[00069] Specifically, in the step S1, the base station 1 detects whether the mobile device 2 served by the base station 1 satisfies a scheduling trigger condition for paired scheduling; when the scheduling trigger condition is satisfied and the base station 1 transmits a downlink message to the mobile device 2, in the step S2, the base station 1 determines uplink resource allocation information of an uplink response message corresponding to said downlink message about the mobile device 2, so as to send identification information for paired scheduling the mobile device 2 and said uplink resource allocation information to the mobile device 2; correspondingly, the mobile device 2 receives identification information for paired scheduling the mobile device sent by the base station 1 serving the mobile device 2, as well as uplink resource allocation information of an uplink response message corresponding to the downlink message about the mobile device 2, which is determined when the base station 1 sends the uplink message to the mobile device 2; in the step S3, the mobile device 2 according to said identification information and base on said uplink resource allocation information, transmits said uplink response message to the base station 1.

[00070] Here, the mobile device refers to the part in mobile communication device, which terminates wireless transmission from or to the network and adapts the capability of a terminal device to the wireless transmission, i.e., the device for a user to access to the mobile network, which includes, but not limited to, any electronic product that performs human-machine interaction with the user through a keyboard, a touch pad, or a voice-control device, and implements transmission of mobile communication signals through mutual transmission and reception of signals between a mobile network and a base station, for example, a tablet, a smart mobile phone, a PDA, a vehicle mount computer, a UE for converage enhancement, a MTC device, a CE-MTC UE, a CE-MTC device, etc.. Here, the base station refers to the device in mobile communication, which connects the fixed part and the wireless part and be connected to the mobile station through wireless transmission in the air, which includes, but not limited to, such as eNB, etc.. Here, the mobile network includes, but not limited to, GSM, 3G, LTE, Wi-Fi, WiMax, WCDMA, CDMA2000, TD-SCDMA, HSPA, LTD, etc. Those skilled in the art should understand that the aforesaid mobile devices, base stations, and mobile networks are only exemplary, other existing mobile devices, base stations, and mobile networks or those that may possibly come out later should also be covered in the protection scope of the invention and included here in a way of quotation, if they are adaptable to this invention.

[00071] Specifically, in the step S1, the base station 1 detects whether the mobile device served by the base station satisfies the scheduling trigger condition for paired scheduling.

[00072] Here, the paired scheduling means simultaneously scheduling a potential RRC (Radio Resource Control) uplink feedback message in a signaling of scheduling a downlink RRC message. For example, based on a mechanism in which messages are organized in pairs (e.g., in the signaling flow as shown in Fig. 1, the uplink message “RRC connection reconfiguration” is immediately followed a corresponding downlink response message “RRC connection reconfiguration complete” (the “RRC connection reconfiguration” and the “RRC connection reconfiguration complete” forms paired messages)), when the base station eNB transmits a downlink message to the mobile device UE, it may know the uplink response message to be transmitted by the mobile device UE in response to the downlink message and estimate the size of the uplink response message, thereby, it can transmit uplink resource allocation corresponding to the uplink response message while transmitting the downlink message, and allocating the resources for UL and DL in the same resource allocation message is realized. Fig. 3 shows signaling satisfying paired scheduling as shown in Fig. 1, wherein the signaling in the bold dotted line “_ _ _” blocks are paired signaling. It can be seen from Fig. 3 that the paired scheduling in the present invention can be used for most of the signaling

transmissions. 12 out 18 signaling shown in Fig. 3 can use paired scheduling, and hence, approximately 30% of the signaling can be saved and as another consequence the mobile device batter is also saved.

[00073] Here, the scheduling trigger condition includes, but not limited to, any one of the following: 1) a preamble sequence adopted by the mobile device randomly accessing the base station satisfies a predetermined sequence number, e.g., the sequence of the preamble signals transmitted on PRACH (Physical Random Access Channel) when the mobile device randomly accesses the base station is 31-56, while the sequence of the preamble signals employed by a normal UE accessing the base station is 1-30; II. The subframe transmitting PRACH when the mobile device accesses the base station satisfies a predetermined subframe number, i.e., the PRACH when the mobile device accesses the base station and the PRACH when the normal UE accesses the base station are transmitted on different subframes. For example, if the normal UE performs transmission in subframe 0, then the mobile device may perform transmission in a remaining subframe. Those skilled in the art should understand that the above trigger condition is only exemplary, and other existing or future possibly developed scheduling trigger conditions, if applicable to the present invention, should also be included within the protection scope of the present invention, and is incorporated here by reference.

[00074] For example, suppose the mobile device 2 has already searched a cell covered by the base station 1 when being powered on and initially accessing the network, and has been synchronized with the cell; then, the mobile device 2 applies for a possibility of establishing a network connection with the base station 1, i.e., realizing random access with the base station 1, so as to establish uplink synchronization; suppose the preamble signal sequence transmitted on PRACH when the mobile device 2 randomly accesses the base station 1 is 50, it satisfies the above scheduling trigger condition I, and in the step S1, the base station 1 can determine that the mobile device 2 satisfies the scheduling trigger condition for performing paired scheduling. For another example, suppose the PRACH is transmitted on subframe 0 when the mobile device 2 randomly accesses the base station 1, it will not satisfy the scheduling trigger condition II, then in the step S1, the base station 1 may determine that the mobile device 2 does not satisfy the scheduling trigger condition for paired scheduling.

[00075] Those skilled in the art should understand that the aforesaid manner of detecting whether the mobile device satisfies a scheduling trigger condition for paired scheduling is only exemplary, other existing manner of detecting whether the mobile device satisfies a scheduling trigger condition for paired scheduling, or those that may possibly come out later should also be covered in the protection scope of the invention and included here in a way of quotation, if they are adaptable to this invention.

[00076] When the scheduling trigger condition is satisfied and the base station transmits a downlink message to the mobile device, in the step S2, the base station 1 determines uplink resource allocation information of an uplink

response message corresponding to said downlink message about the mobile device, so as to send identification information for paired scheduling the mobile device and said uplink resource allocation information to the mobile device.

[00077] Here, the identification information is for indicating whether the paired scheduling is used, which can be defined in the DCI (DOWNLINK CONTROL INFORMATION) of downlink scheduling, or defined in a system message such as SIB (System Information Block).

[00078] Here, the uplink resource allocation information includes, but not limited to, at least any one of the following: i) uplink resource block assignment information corresponding to the uplink response message; ii) resource block initiation location information and resource block amount information corresponding to the uplink response message; iii) offset information between the first physical resource block corresponding to the uplink response message and the first physical resource block corresponding to the downlink message; iv) timing interval information between the uplink response message and the downlink message. Here, the uplink resource allocation information may be defined in the DCI of downlink scheduling, or defined in a system message such as SIB. Preferably, the offset information may be indicated in the SIB, and the timing interval information may also be indicated in the SIB.

[00079] Here, the illustration is only made with the identification information and the uplink resource allocation information illustrated in the DCI as an example, to improve the existing DCI format 1A, DCI format 1, and DCI format 1C, respectively, e.g., a bit of the identification information and a bit of the uplink resource allocation information are newly added, to illustrate the identification information and the uplink resource allocation information:

[00080] 1) by improving the DCI format 1A, derive a DCI format 1A', and the information included therein, as well as bits seized by respective information are specified below:

- carrier indication – 0 or 3 bits
- flag for format 0/ format 1 differentiation – 1 bit
- localized/ distributed VRB (Virtual Resource Block) assignment flag –1 bit
- resource block assignment
- modulation and coding scheme – 2 bits
- HARQ (Hybrid Automatic Repeat Request) process number – 3bits
- new data indicator – 1 bit
- redundancy version – 2 bits
- TPC command for PUCCH – 2 bits
- paired scheduling is used-1 bit
- uplink resource block assignment-3 bits

[00081] 2) by improving the DCQ format 1, derive DCI format 1', and the information included therein, as well as the bits seized by respective

information, is specified below:

- carrier indication – 0 or 3 bits
- resource block assignment
- modulation and coding scheme – 2 bits
- HARQ (Hybrid Automatic Repeat Request) process number – 3bits (FDD Frequency Division Duplexing), 4 bits (TDD, Time Division Duplexing)
- new data indicator – 1 bit
- redundancy version – 2 bits
- downlink assignment index (for FDD) – 2 bits
- paired scheduling is used-1 bit
- uplink resource block assignment-3 bits

[00082] 3) by improving the DCI format 1C, derive the DCI format 1C', and the information included therein, as well as bits seized by respective information, is specified below:

- 1bit indication gap value
- resource block assignment
- modulation and coding scheme – 2 bits
- paired scheduling is used-1 bit
- uplink resource block assignment-3 bits

Here, the "paired scheduling is used" bit in the DCI format 1A', the DCI format 1', and the DCI format 1C' is for indicating whether the paired scheduling is used, i.e., reflecting the identification information; the "uplink resource block assignment" bit in the DCI format 1A', the DCI format 1', and the DCI format 1C' shows the uplink resource allocation information. Here, to those skilled in the art, through comparison between the above DCI format 1A', DCI format 1', and DCI format 1C' with the DCI format 1A, DCI format 1, and the DCI format 1C in the prior art, it can be seen that some information in the DCI format 1A, DCI format 1, and the DCI format 1C in the prior art are not needed in the above DCI format 1A', DCI format 1', and DCI format 1C', and the number of bits of some information can be reduced. Here, only take the DCI format 1A as an example. The "SRS (sounding reference signal) request – 0 or 1 bit" in the DCI format 1A in the prior art is unnecessary for the DCI format 1A'; the "modulation and coding scheme" seizes 5 bits in the DCI format 1A, while it only seizes 3 bits in the DCI format 1A", therefore, the total number of bits of the DCI format 1A' is identical to that of the DCI format 1A; for another example, the maximum resources to be assigned to the mobile device 2 are 6 PRBs (Physical Resource Blocks); hence, the bits for the resources allocation are fewer, which is sufficient to take uplink resource allocate in the same message.

[00083] Specifically, when the scheduling trigger condition is satisfied and the base station transmits a downlink message to the mobile device, in the step S2, the base station 1 can first determine uplink resource allocation information of an uplink response message corresponding to said downlink message about the mobile device. For example, determining the uplink resource allocation information based on historical uplink resource allocation information of the

mobile device, so as to send the uplink resource allocation information to the mobile device; then, sends identification information for paired scheduling the mobile device and said uplink resource allocation information to the mobile device.

[00084] For example, for the mobile device 2, suppose in the step S1, the base station 1 determines that the mobile device 2 satisfies the scheduling trigger condition. Then, when the base station 1 receives a new downlink message from a higher layer, e.g., RRC, if the base station 1 transmits a downlink message as shown in Fig. 1, e.g., "RRC connection setup", because the uplink response message "RRC connection complete" and "RRC connection setup" shown in Fig. 1 are paired messages, the base station 1 can estimate the uplink resource allocation information when the mobile device 2 responds to the downlink message "RRC connection setup", i.e., transmitting "RRC connection complete" to the base station 1. Suppose the mobile device 2 transmitted "RRC connection complete" to the base station 1 in history, the historical uplink resource allocation information of the uplink response message assigned by the base station 1 to the mobile device 2 is 3PRBs. When the base station 1 performs paired scheduling to the mobile device 2 and the base station 1 transmits a downlink message "RRC connection setup" to the mobile device 2, in the step S2, the base station 1 can determine uplink resource allocation information of an uplink response message corresponding to said downlink message about the mobile device 2 is " UL resource allocation=3PRBs".

[00085] Next, in the step S2, the base station 1 sends identification information for paired scheduling the mobile device 2 and said uplink resource allocation information to the mobile device 2. For example, continue the above example, suppose the base station 1 selects the DCI format 1A' to transmit the identification information and the uplink resource allocation information to the mobile device 2, then in the step S2, the base station 1 may first generate corresponding scheduling information (e.g., scheduling-DCI1A'), wherein the scheduling information "scheduling-DCI1A' " includes the identification information and the uplink resource allocation information, such as the bit value corresponding to "paired scheduling is used" in scheduling-DCI1A' is 1 (here, the value of the bit illustrates the identification information, e.g., it may be predetermined that "1" or "0" indicates whether the paired scheduling is used); the bit value in the "uplink resource block assignment" in scheduling-DCI1A' is "011" (here, the value of bits illustrates the number of PRBs in the uplink resource allocation information; because "uplink resource block assignment" in the scheduling-DCI1A' seizes 3bits, while the uplink resource allocation information first determined by the base station 1 in the step S2 is 3PRBs, so the bit number here is "011"); then, in the step S2, the base station 1 transmits the scheduling information scheduling-DCI1A' to the mobile device 2 via a mobile network such as LTE (Long Term Evolution), so as to send the identification information and the uplink resource allocation information to the mobile device 2. Here, the manner of illustrating the identification information and the uplink resource allocation information in DCI information is only exemplary, other existing manner of illustrating the identification information and the uplink resource allocation information in

DCI information, or those that may possibly come out later should also be covered in the protection scope of the invention and included here in a way of quotation, if they are adaptable to this invention.

[00086] Here, through sending identification information for paired scheduling the mobile device and uplink resource allocation information of an uplink response message corresponding to said downlink message, such that in the present invention, the base station can allocate UL and DL resource in the same resource allocation message. Thereby, the benefit result of reducing signaling overhead is realized, so as to save approximately 50% signaling overhead.

[00087] Preferably, when the scheduling trigger condition is satisfied and the base station transmits a downlink message to the mobile device, in the step S2, the base station 1 may first determine uplink resource allocation information of an uplink response message corresponding to said downlink message about the mobile device, so as to send said uplink resource allocation information to the mobile device; or, when the scheduling trigger condition is satisfied and the base station transmits a downlink message to the mobile device, in the step S2, the base station 1 may first generate corresponding second scheduling information, wherein the second scheduling information includes identification information for paired scheduling the mobile device; then, sends the second scheduling information to the mobile device, so as to send said identification information to the mobile device.

[00088] Specifically, when the scheduling trigger condition is satisfied and the base station transmits a downlink message to the mobile device, in the step S2, the base station 1 may first determine uplink resource allocation information of an uplink response message corresponding to said downlink message about the mobile device. Here, the manner in which the base station 1 in the step S2 determines the uplink resource allocation information is identical or substantially identical to the manner in which the abovementioned sending module 12 determines the uplink resource allocation information. For the sake of simplicity, it will not be detailed here, but is incorporated here by reference.

[00089] Then, in the step S2, the base station 1 sends said uplink resource allocation information to the mobile device, e.g., generating corresponding system information based on the uplink resource allocation information, wherein the system information comprises the uplink resource allocation information; next, broadcasts the system information to the mobile device so as to send the uplink resource allocation information to the mobile device. For example, for mobile device 2, suppose in the step S1, the base station 1 determines that the mobile device 2 satisfies the scheduling trigger condition, then when the base station 1 receives a new downlink message from a higher layer (e.g., RRC), in the step S2, the base station 1 first determine that uplink resource allocation information of an uplink response message corresponding to said downlink message about the mobile device is “UL resource

allocation=3PRBs", then in the step S2, the base station 1 may generate a corresponding system message (e.g., SIB) based on the uplink resource allocation information, the system information SIB includes the uplink resource allocation information "UL resource allocation=3PRBs"; next, in the step S2, the base station 1 periodically broadcasts the system message SIB to the mobile device 2 through a mobile network (e.g., LTE).

[00090] Or, when the scheduling trigger condition is satisfied and the base station transmits a downlink message to the mobile device, in the step S2, the base station 1 may first generate corresponding second scheduling information, wherein the second scheduling information includes identification information for paired scheduling the mobile device; then, sending the second scheduling information to the mobile device, so as to send said identification information to the mobile device. For example, still continue the above example, in the step S1, the base station 1 determines that the mobile device 2 satisfies the scheduling trigger condition, suppose the base station 1 selects the DCI format 1' to send the identification information and the uplink resource allocation information to the mobile device 2, then in the step S2, the base station 1 may first generate corresponding second scheduling information, e.g., scheduling-DCI1', wherein the second scheduling information (e.g., scheduling-DCI1') includes the identification information, e.g., the bit value corresponding to "paired scheduling is used" in the scheduling-DCI1' is "1"; then, in the step S2, the base station 1 sends the second scheduling information (e.g., scheduling-DCI1') to the mobile device 2 through a mobile network (e.g., LTE), so as to send the identification information to the mobile device 2.

[00091] Here, the present invention sends the identification information only in the scheduling information (i.e, only in DCI information), and sends the uplink resource allocation information in a system message (e.g., SIB), so that the bits for uplink resource allocation in DCI information can be minimized, that is, reducing the number of bits of DCI information. The benefit result of further reducing signaling overhead is realized.

[00092] Here, those skilled in the art should understand that the present invention can sends the uplink resource allocation information only in the scheduling information (i.e, only in DCI information), and sends the identification information in a system message (e.g., SIB).

[00093] Preferably, the paired scheduling in the present invention can be used together with dynamic scheduling and/or persistence scheduling for data. The mobile device 2 can use SR (Scheduling Request) to request additional resources for UL transmission and the base station 1 can also schedule the mobile device 2 in one direction UL or DL when it is needed.

[00094] Preferably, the paired scheduling for a mobile device in the present invention can be predetermined, or configured by a higher layer; the signaling message employed by paired scheduling can be defined in a standard, or be indicated, together with the number of resources assigned for a corresponding uplink response message in a system message (e.g., SIB).

[00095] Correspondingly, in the step S2, the mobile device 2 of the mobile device 2 receives the identification information sent by the base station 1 serving the mobile device 2 for paired scheduling the mobile device 2 through a mobile network (e.g., LTE), as we as the uplink resource allocation information of an uplink response message corresponding to the downlink message about the mobile device 2, which is determined when the base station 1 sends the uplink message to the mobile device 2.

[00096] In the step S3, the mobile device 2 according to said identification information and base on said uplink resource allocation information, transmits said uplink response message to the base station. For example, for the mobile device 2, suppose in the step S2, the mobile device 2 receives the identification information for paired scheduling the mobile device 2 sent by the base station 1 serving the mobile device 2. If the bit value corresponding to "paired scheduling is used" indicating the identification information in the scheduling information "scheduling-DCI1A' " transmitted by the base station 1 in the step S2 of the base station 1 is "1" , as well as the uplink resource allocation information of an uplink response message corresponding to the downlink message about the mobile device 2, which is determined when the base station 1 transmits the downlink message to the mobile device 2, e.g., the uplink resource allocation information of the uplink response message "RRC connection complete" corresponding to the downlink message "RRC connection set up" about the mobile device 2, which is determined when the base station 1 transmits a downlink message "RRC connection set up" and indicated in the scheduling information "scheduling-DCI1A' " transmitted by in the base station 1 in the step S2 of the base station 1, e.g., the bit value in the "uplink resource block assignment" in scheduling-DCI1A' is "011," then in the step S3, the mobile device 2 transmits the uplink response message "RRC connection complete" on 3 PRBs continuously assigned in the spectral domain based on the identification information, or after a predetermined delay time, the uplink response message "RRC connection complete" is transmitted on 3 PRBs continuously assigned in the spectrum domain.

[00097] For another example, suppose in the step S2, the mobile device 2 of the mobile device 2 receives the identification information for paired scheduling the mobile device sent by the base station 1 serving the mobile device 2, e.g., the bit value corresponding to the "paired scheduling is used" indicating the

identification information in the scheduling information "scheduling-DCI1A' " transmitted by in the step S2, the base station 1 of the base station 1 is "1," as well as the uplink resource allocation information of the uplink response message "RRC connection complete" corresponding to the downlink message "RRC connection setup" about the mobile device 2 as determined when the base station 1 transmits the downlink message "RRC connection setup", the uplink resource allocation information is shown in Fig. 4, wherein the uplink resource allocation information includes: 1) offset information between the first physical resource block corresponding to the uplink response message "RRC connection complete" and the first physical resource block corresponding to the downlink message "RRC connection setup"; 2) timing interval information between the uplink response message "RRC connection complete" and the downlink message "RRC connection setup"; 3) the resource block number information corresponding to the uplink response message "RRC connection complete", e.g., 3PRBs, then in the step S3, the mobile device 2 can determine a PRB initial location for transmitting the uplink response message "RRC connection complete" based on the offset information; and after a timing interval, the uplink response message "RRC connection complete" on continuously assigned PRBs in 3 frequency domains starting from the initial location.

[00098] The various steps of the base station 1 and the mobile device 2 works continuously between each other. Specifically, in the step S1, the base station 1 of the base station 1 continuously detects whether the mobile device 2 served by the base station 1 satisfies a scheduling trigger condition for paired scheduling; when the scheduling trigger condition is satisfied and the base station 1 transmits a downlink message to the mobile device 2, in the step S2, the base station 1 continuously determines uplink resource allocation information of an uplink response message corresponding to said downlink message about the mobile device 2, so as to send identification information for paired scheduling the mobile device 2 and said uplink resource allocation information to the mobile device 2; correspondingly, in the step S2, the mobile device 2 of the mobile device 2 continuously receives identification information for paired scheduling the mobile device sent by the base station 1 serving the mobile device 2, as well as uplink resource allocation information of an uplink response message corresponding to the downlink message about the mobile device 2, which is determined when the base station 1 sends the uplink message to the mobile device 2; in the step S3, the mobile device 2 continuously according to said identification information and base on said uplink resource allocation information, transmits said uplink response message to the base station 1. Here, those skilled in the art should understand that "continuously" means the various steps of the base station 1 and the mobile device 2 continuously detect whether a scheduling trigger condition for paired scheduling is satisfied , send and receive identification information for paired

scheduling and the uplink resource allocation information, and send the uplink response message, till the base station 1 stops detecting whether a scheduling trigger condition for paired scheduling is satisfied.

[00099] Fig.7 shows a flowchart of a method for transmitting an uplink response message according to one preferred embodiment of the present invention.

[000100] Wherein, the method comprises the step S1' and the step S2', here, the step S2' comprise the step S21' and the step S22'. Specifically, the in the step S1', the base station 1 detects whether a mobile device 2 served by the base station 1 satisfies a scheduling trigger condition for paired scheduling; when the scheduling trigger condition is satisfied and the base station transmits a downlink message to the mobile device, in the step S21', the base station 1determines uplink resource allocation information of an uplink response message corresponding to the downlink message about the mobile device; in the step S22', the base station 1 sends the identification information for paired scheduling the mobile device and the uplink resource allocation information to the mobile device. Here, the content of the base station 1 in the step S1' is identical or substantially identical to the corresponding module in the specific embodiment of Fig. 2. For the sake of simplicity, it will not be detailed here, and is incorporated here by reference.

[000101] Specifically, when the scheduling trigger condition is satisfied and the base station transmits a downlink message to the mobile device, in the step S21', the base station 1 determines uplink resource allocation information of an uplink response message corresponding to said downlink message about the mobile device. Here, the manner in which the base station 1 in the step S21' determines the uplink resource allocation information includes, but not limited to, any one of the following:

[000102] 1) determining uplink resource allocation information about the uplink response message of the mobile device corresponding to the downlink message based on device type information of the mobile device. Here, the device type information includes, but not limited to, a low-cost type device, a high-cost type device, etc. For example, for the mobile device 2, suppose the in the step S1', the base station 1 determines that the mobile device 2 satisfies the scheduling trigger condition, then when the base station 1 receives a new downlink message from a higher layer (e.g., RRC), e.g., when the base station 1 transmits a downlink message such as "RRC connection setup" as shown in Fig. 1 to the mobile device 2, because the uplink response message "RRC connection complete" as shown in Fig. 1 and the "RRC connection setup" are paired messages, the base station 1 can estimate the uplink resource allocation information when the mobile device 2 responds to the downlink

message "RRC connection setup," i.e., transmitting "RRC connection complete" to the base station 1, e.g., based on the capacity of the mobile device 2 and the stored information, estimates which parameters in the uplink response message "RRC connection complete" that it will transmit are usable, while which parameters are not used, thereby estimating the bits of the uplink response message "RRC connection complete", thereby further calculating the required uplink resource allocation information, i.e., the needed PRBs; suppose the mobile device is a low-cost type device, for the uplink response message "RRC connection complete," registeredMME is an optional item; if the system only has one MME (Mobility Management Entity) or all mobile devices accessing the base station 1 use a certain MME, then for the uplink response message "RRC connection complete," the registeredMME parameter can not be transmitted; then in the step S21', the base station 1 may first determine the bits of the uplink response message "RRC connection complete" is those that minus bits seized by the registeredMME parameter, i.e., needing 17+fixed MAC and RLC heads; then determines the MCS (Module and Coding Scheme) based on the performance of bit-error-rate (BER), and next, further determines the needed PRBs (e.g., 2PRBs) based on the bits those can be transmitted by each PRB, i.e., in the step S21', the base station 1 determines that the uplink resource allocation information is 2PRBs.

[000103] 2) determining the uplink resource allocation information of an uplink response message corresponding to said downlink message about the mobile device based on history uplink resource allocation information of the mobile device. For example, suppose the in the step S1', the base station 1 determines that the mobile device 2 satisfies the scheduling trigger condition, then when the base station 1 receives a new downlink message from a higher layer (e.g., RRC), e.g., when the base station 1 transmits the downlink message such as "RRC connection setup" as shown in Fig. 2 to the mobile device 2, because the uplink response message "RRC connection complete" and the "RRC connection setup" as shown in Fig 1 are paired messages, the base station 1 estimates the uplink resource allocation information when the mobile device 2 responds to the downlink message "RRC connection setup," that is when the base station transmits "RRC connection complete" to the base station 1, and the history uplink resource allocation information of the uplink response message assigned by the base station 1 to the mobile device 2 is 3PRBs, then when the base station 1 performs paired scheduling for the mobile device 2 and the base station 1 transmits the downlink message "RRC connection setup" to the mobile device 2, in the step S21', the base station 1 may determine that the uplink resource allocation information about the uplink response message of the mobile device 2 corresponding to the downlink message is "UL resource allocation=3PRBs".

[000104] Those skilled in the art should understand that the aforesaid manner

of determining uplink resource allocation information is only exemplary, other existing manner of determining uplink resource allocation information, or those that may possibly come out later should also be covered in the protection scope of the invention and included here in a way of quotation, if they are adaptable to this invention.

[000105] In the step S22', the base station 1 sends the identification information for paired scheduling the mobile device and the uplink resource allocation information to the mobile device. Here, the manner in which in the step S22', the base station 1 sends the identification information and the uplink resource allocation information includes, but not limited to, any one of the following:

[000106] 1) First, generating corresponding system information, wherein the system information includes identification information for paired scheduling the mobile device and the uplink resource allocation information; then, broadcasting the system information to the mobile device so as to send the identification information and the uplink resource allocation information to the mobile device. For example, continue the above example, in the step S21', the base station 1 determines that the uplink resource allocation information of an uplink response message corresponding to said downlink message about the mobile device is "UL resource allocation=3PRBs", then in the step S22', the base station 1 may improve the system information SIB in the prior art based on the corresponding message (e.g., SIB') firstly generated, the system information SIB' includes identification information for paired scheduling the mobile device 2, thereby obtaining the system message SIB' suitable for the present invention, e.g., first adding information "paired scheduling is used – 1 bit" in the SIB to obtain SIB', wherein the "paired scheduling is used" bit is for indicating whether the paired scheduling is used, i.e., reflecting the identification information, e.g., "1" or "0" may be predetermined to identify whether the paired scheduling is used; meanwhile, the uplink resource allocation information "UL resource allocation=3PRBs" is added into the SIB; next, in the step S22', the base station 1 periodically broadcasts the system message SIB' to the mobile device 2 through a mobile network such as LTE (Long Term Evolution).

[000107] 2) First generating corresponding first scheduling information, wherein the first scheduling information includes identification information for paired scheduling the mobile device, and the uplink resource allocation information; then sending the first scheduling information to the mobile device so as to send the identification information and the uplink resource allocation information to the mobile device. For example, continue the above example, suppose the base station 1 selects the DCI format 1C' to transmit the identification information and the uplink resource allocation information to the mobile device 2; then in the step S22', the base station 1 can first generate

corresponding first scheduling information, e.g., scheduling-DCI1C', wherein the first scheduling information "scheduling-DCI1C' " includes the identification information and the uplink resource allocation information, e.g., the bits corresponding to "paired scheduling is used" in the scheduling-DCI1C' is "1" (here, the bit value illustrates the identification information, e.g., "1" or "0" can be predetermined to identify whether the paired scheduling is used), and the bit value in the "uplink resource block assignment" in the "scheduling-DCI1C' " is "011" (here, the bit value illustrates the number of PRBs in the uplink resource assignment information; because "uplink resource block assignment" in the DCI1C' seizes 3bits, while the uplink resource allocation information first determined by the base station 1 in the step S21' is 3PRBs, so the bit value here is "011"); then, in the step S22', the base station 1 sends the first scheduling information "scheduling-DCI1C' " to the mobile device 2 via a mobile network such as LTE (Long Term Evolution), so as to send the identification information and the uplink resource allocation information to the mobile device 2.

[000108] Those skilled in the art should understand that the aforesaid manner of sending the identification information and the uplink resource allocation information is only exemplary, other existing manner of sending the identification information and the uplink resource allocation information, or those that may possibly come out later should also be covered in the protection scope of the invention and included here in a way of quotation, if they are adaptable to this invention.

[000109] It needs to note that the invention can be implemented in software and/or a combination of software and hardware, for example, the invention can be implemented by using an Application Specific Integrated Circuit (ASIC), a general purpose computer or any other similar hardware equipment. In one embodiment, the software program of this invention can be executed by a processor to accomplish the aforesaid steps or functions. Likewise, the software program (including the relevant data structure) of the invention can be stored in a computer readable recording medium, for example, RAM memory, magneto-optical drive or floppy disk and similar devices. In addition, some steps or functions of the invention can be realized by using hardware, for example, a circuit that cooperates with the processor to perform various steps or functions.

[000110] In addition, part of the invention can be applied as a computer program product, such as a computer program instruction. When the instruction is executed by the computer, the method and/or technical solution according to this invention may be called or provided through an operation of the computer. However, the program instruction for calling the method of the invention may possibly be stored in a fixed or movable recording medium, and/or be transmitted via broadcasting or other signal carrier mediums, and/or be stored in the operation memory of a computer device that is running

according to said program instruction. Here, there is one device included according to an embodiment of the invention. Said device comprises a memory for storing computer program instructions and a processor for executing program instructions. This device is triggered to operate the methods and/or technical solutions based on the aforesaid embodiments of the invention when the computer program instructions are executed by said processor.

[000111] To those skilled in the art, apparently the invention is not limited to the details of the aforementioned exemplary embodiments. Moreover, under the premise of not deviating from the spirit or fundamental characteristics of the invention, this invention can be accomplished in other specific forms. Therefore, the embodiments should be considered exemplary and non-restrictive no matter from which point. The scope of the invention is defined by the appended claims instead of the above description, and aims at covering the meanings of the equivalent components falling into the claims and all changes within the scope in this invention. Any reference sign in the claims shall not be deemed as limiting the concerned claims. Besides, apparently the word “comprise/include” does not exclude other components or steps, singular numbers does not exclude complex numbers, the plurality of components or means mentioned in device claims may also be accomplished by one component or means through software or hardware, the wording like first and second are only used to represent names rather than any specific order.

We claim:

1. A method for transmitting an uplink response message, comprising steps of:

a. detecting, by a base station serving a mobile device, whether the mobile device satisfies a scheduling trigger condition for paired scheduling;

b. when the scheduling trigger condition is satisfied and the base station transmits a downlink message to the mobile device, determining, by the base station, uplink resource allocation information of an uplink response message corresponding to said downlink message about the mobile device, so as to send identification information for paired scheduling the mobile device and said uplink resource allocation information to the mobile device;

c. transmitting, by the mobile device, said uplink response message according to said identification information and base on said uplink resource allocation information.

2. The method according to claim 1, wherein the step b comprises:

b1 when the scheduling trigger condition is satisfied and the base station transmits a downlink message to the mobile device, determining, by the base station, uplink resource allocation information of an uplink response message corresponding to said downlink message about the mobile device;

b2 sending, by the base station, identification information for paired scheduling the mobile device and said uplink resource allocation information to the mobile device.

3. The method according to claim 2, wherein the step b1 comprises:

- when the scheduling trigger condition is satisfied and the base station transmits a downlink message to the mobile device, determining, by the base station, uplink resource allocation information of an uplink response message corresponding to said downlink message about the mobile device, based on device type information of the mobile device.

4. The method according to claim 2 or 3, wherein the step b2 comprises:

- generating, by the base station, corresponding system information, wherein the system information includes identifying information for paired scheduling the mobile device and said uplink resource allocation information;

- broadcasting, by the base station, the system information to the mobile device, so as to send said identification information and said uplink resource allocation information to the mobile device.

5. The method according to claim 2 or 3, wherein the step b2 comprises:

- generating, by the base station, corresponding first scheduling information, wherein the first scheduling information includes identification information for paired scheduling the mobile device and said uplink resource

allocation information;

- sending, by the base station, the first scheduling information to the mobile device, so as to send said identification information and said uplink resource allocation information to the mobile device.

6. The method according to claim 1, wherein the step b comprises:

- when the scheduling trigger condition is satisfied and the base station transmits a downlink message to the mobile device, determining, by the base station, uplink resource allocation information of an uplink response message corresponding to said downlink message about the mobile device, so as to send said uplink resource allocation information to the mobile device;

- when the scheduling trigger condition is satisfied and the base station transmits a downlink message to the mobile device, generating, by the base station, corresponding second scheduling information, wherein the second scheduling information includes identification information for paired scheduling the mobile device;

- sending, by the base station, the second scheduling information to the mobile device, so as to send said identification information to the mobile device.

7. A base station for transmitting an uplink response message, wherein the base station comprises:

a detecting module configured to detect whether a mobile device served by the base station satisfies a scheduling trigger condition for paired scheduling;

a sending module configured to, when the scheduling trigger condition is satisfied and the base station transmits a downlink message to the mobile device, determine uplink resource allocation information of an uplink response message corresponding to said downlink message about the mobile device, so as to send identification information for paired scheduling the mobile device and said uplink resource allocation information to the mobile device.

8. The base station according to claim 7, wherein the sending module comprises:

a determination unit configured to, when the scheduling trigger condition is satisfied and the base station transmits a downlink message to the mobile device, determine uplink resource allocation information of an uplink response message corresponding to said downlink message about the mobile device;

a sending unit configured to send identification information for paired scheduling the mobile device and said uplink resource allocation information to the mobile device.

9. The base station according to claim 8, wherein the determination unit

configured to:

- when the scheduling trigger condition is satisfied and the base station transmits a downlink message to the mobile device, determine uplink resource allocation information of an uplink response message corresponding to said downlink message, about the mobile device, based on device type information of the mobile device.

10. The base station according to claim 8 or 9, wherein the sending unit configured to:

- generate corresponding system information, wherein the system information includes identifying information for paired scheduling the mobile device and said uplink resource allocation information;

- broadcast the system information to the mobile device, so as to send said identification information and said uplink resource allocation information to the mobile device.

11. The base station according to claim 8 or 9, wherein the sending unit configured to:

- generate corresponding first scheduling information, wherein the first scheduling information includes identification information for paired scheduling the mobile device and said uplink resource allocation information;

- send the first scheduling information to the mobile device, so as to send said identification information and said uplink resource allocation information to the mobile device.

12. The base station according to claim 7, wherein the sending module configured to:

- when the scheduling trigger condition is satisfied and the base station transmits a downlink message to the mobile device, determine uplink resource allocation information of an uplink response message corresponding to said downlink message about the mobile device, so as to send said uplink resource allocation information to the mobile device;

- when the scheduling trigger condition is satisfied and the base station transmits a downlink message to the mobile device, generate corresponding second scheduling information, wherein the second scheduling information includes identification information for paired scheduling the mobile device;

- send the second scheduling information to the mobile device, so as to send said identification information to the mobile device.

13. A mobile station for transmitting an uplink response message, wherein the mobile station comprises:

a receiving module configured to receive identification information for paired scheduling the mobile device sent by a base station serving the mobile device, as well as uplink resource allocation information of an uplink response

message corresponding to the downlink message about the mobile device, which is determined when the base station sends the uplink message to the mobile device;

a response sending module configured to, according to said identification information and base on said uplink resource allocation information, transmit said uplink response message to the base station.

14. A system for transmitting an uplink response message, wherein the system comprises the base station according to any one of claims 7-12, the mobile device according to claim 13.

Drawings:

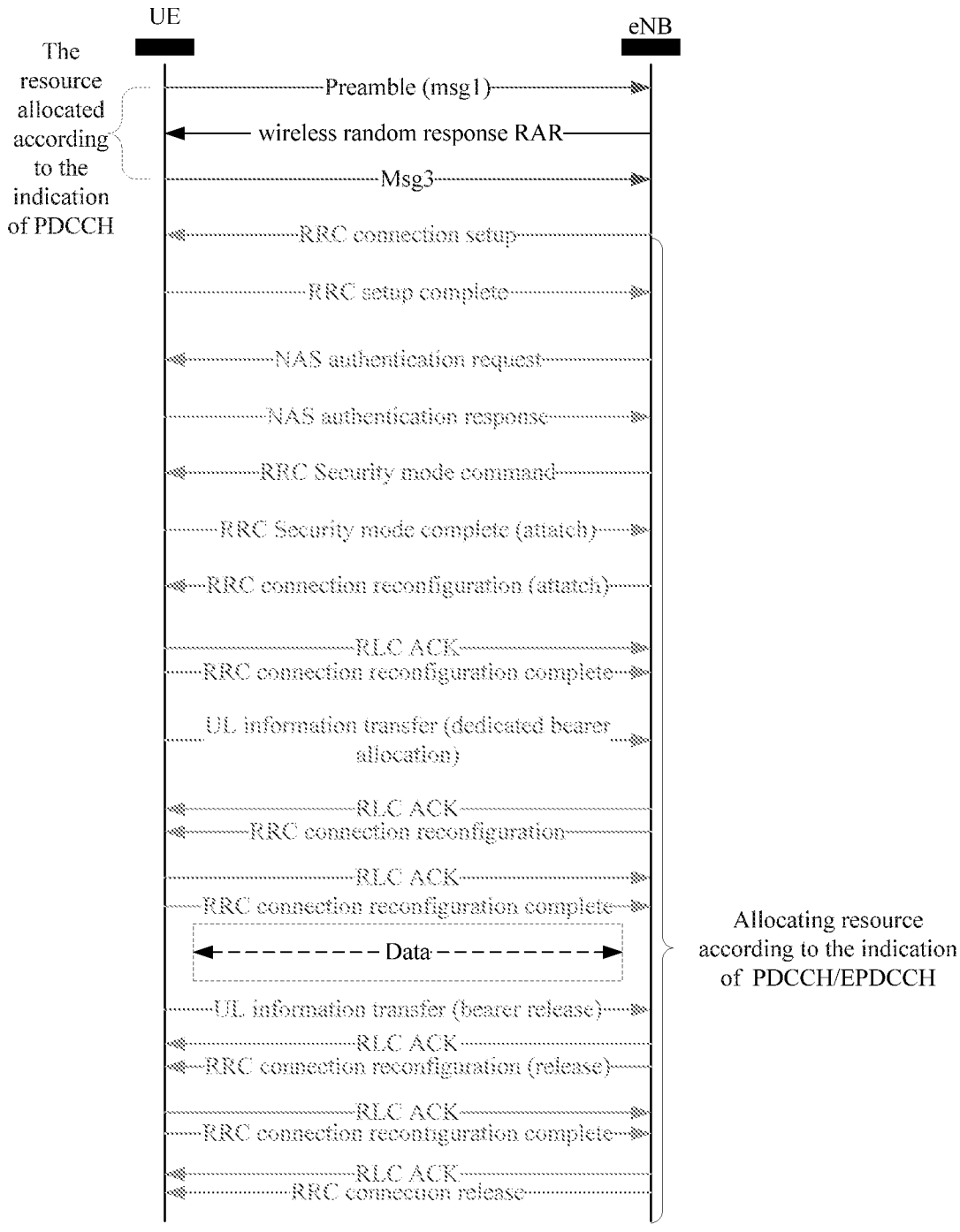

Fig. 1

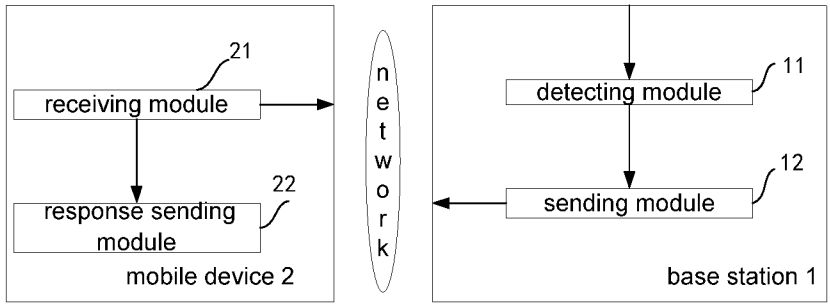
21
receiving module
22
response sending module
mobile device 2
network
11
detecting module
12
sending module
base station 1

Fig. 2

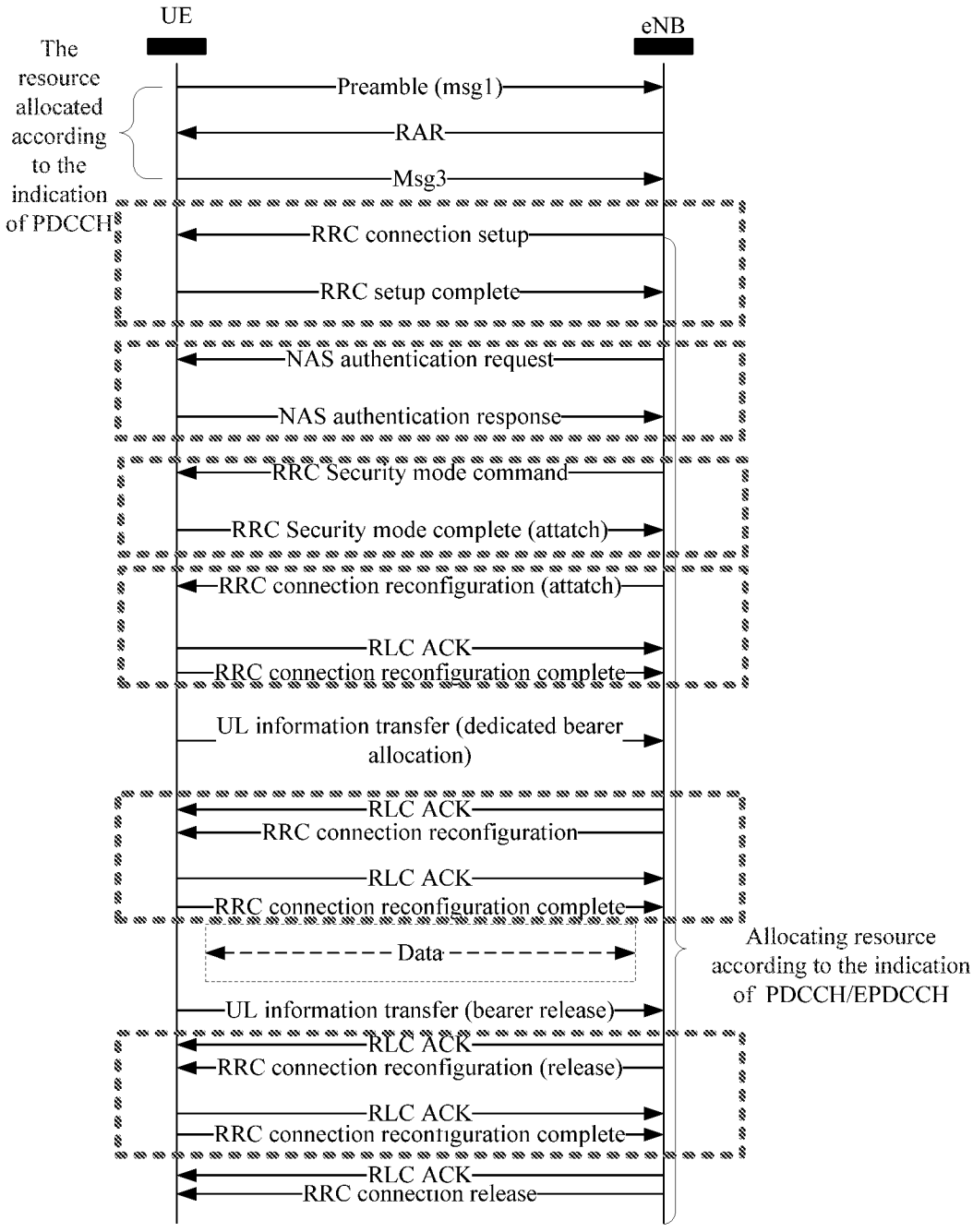
UE
eNB
The resource allocated according to the indication of PDCCH
Preamble (msg1)
RAR
Msg3
RRC connection setup
RRC setup complete
NAS authentication request
NAS authentication response
RRC Security mode command
RRC Security mode complete (attatch)
RRC connection reconfiguration (attatch)
RLC ACK
RRC connection reconfiguration complete
UL information transfer (dedicated bearer allocation)
RLC ACK
RRC connection reconfiguration
RLC ACK
RRC connection reconfiguration complete
Data
UL information transfer (bearer release)
RLC ACK
RRC connection reconfiguration (release)
RLC ACK
RRC connection reconfiguration complete
RLC ACK
RRC connection release
Allocating resource according to the indication of PDCCH/EPDCCH

Fig. 3

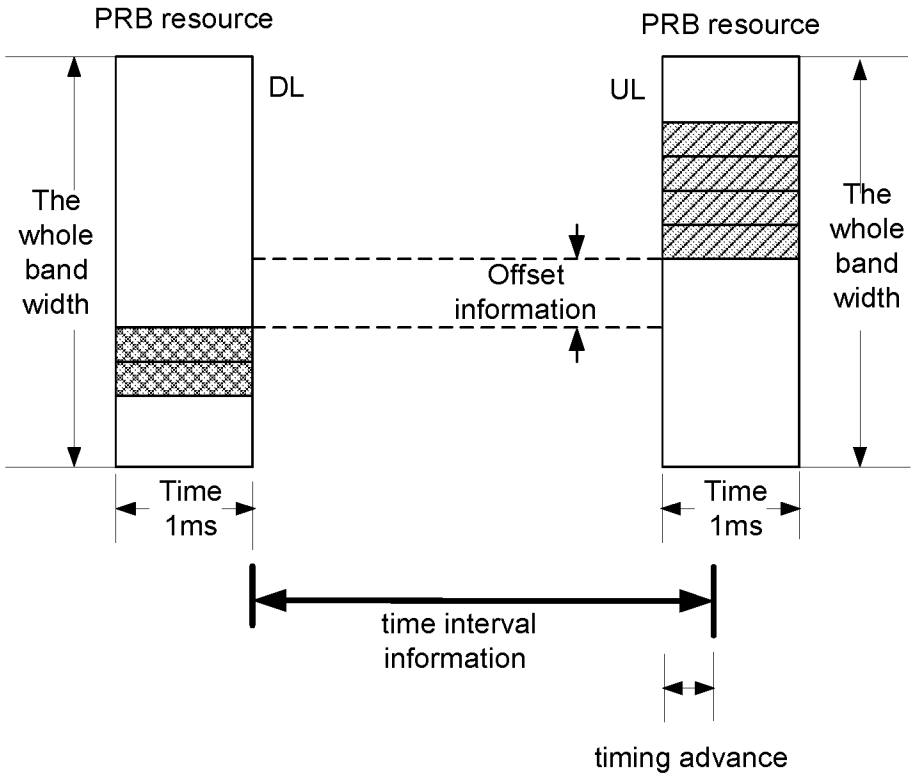
PRB resource
PRB resource
DL
UL
The whole band width
The whole band width
Offset information
Time 1ms
Time 1ms
time interval information
timing advance

Fig. 4

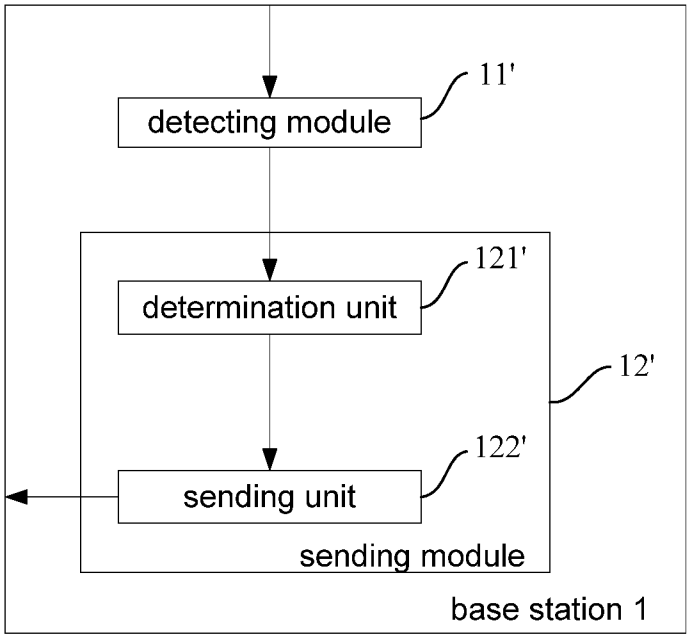
11'
detecting module
121'
determination unit
12'
122'
sending unit
sending module
base station 1

Fig. 5

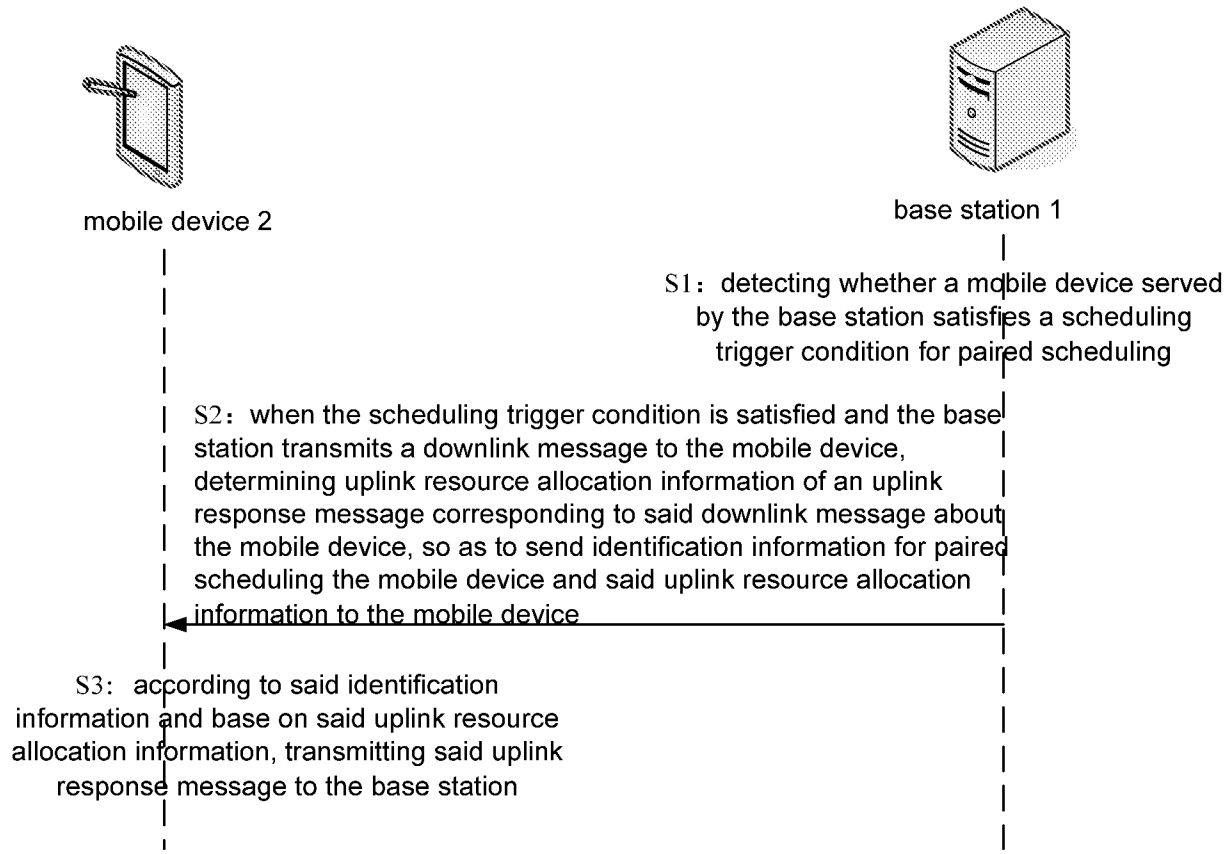
mobile device 2
base station 1
S1：detecting whether a mobile device served by the base station satisfies a scheduling trigger condition for paired scheduling
S2：when the scheduling trigger condition is satisfied and the base station transmits a downlink message to the mobile device, determining uplink resource allocation information of an uplink response message corresponding to said downlink message about the mobile device, so as to send identification information for paired scheduling the mobile device and said uplink resource allocation information to the mobile device
S3：according to said identification information and base on said uplink resource allocation information, transmitting said uplink response message to the base station

Fig. 6

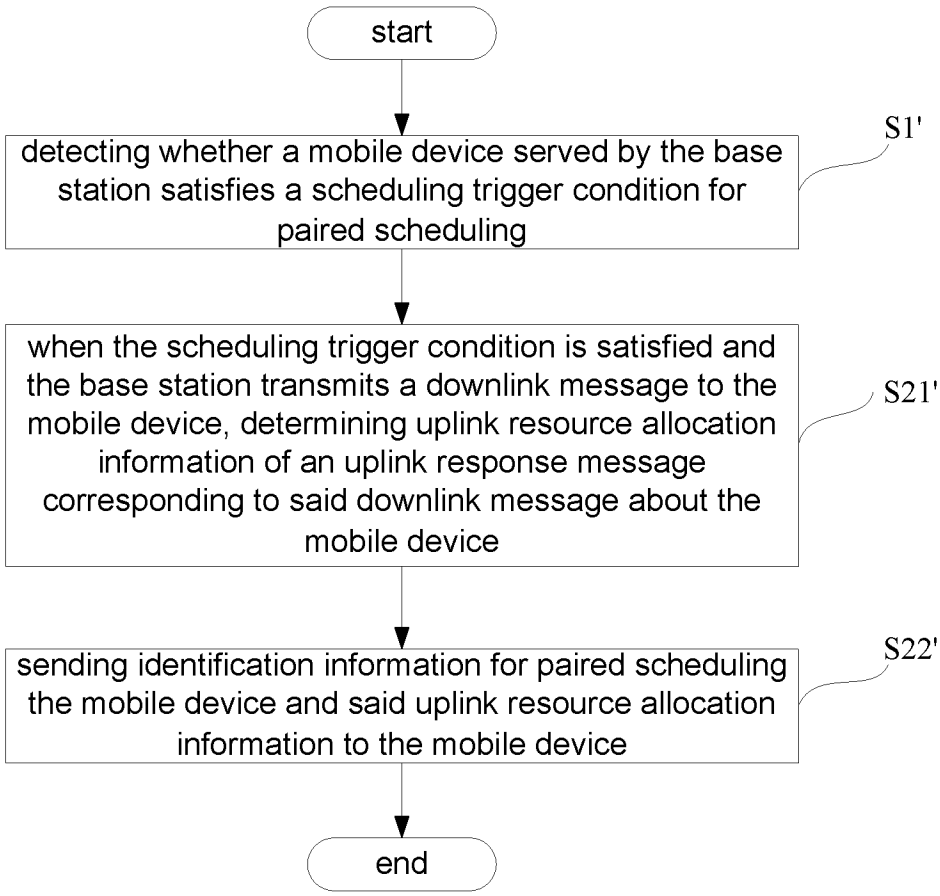
start
detecting whether a mobile device served by the base station satisfies a scheduling trigger condition for paired scheduling
S1'
when the scheduling trigger condition is satisfied and the base station transmits a downlink message to the mobile device, determining uplink resource allocation information of an uplink response message corresponding to said downlink message about the mobile device
S21'
sending identification information for paired scheduling the mobile device and said uplink resource allocation information to the mobile device
S22'
end

Fig. 7