

(51) International Patent Classification:
H04L 5/00 (2006.01)(21) International Application Number:
PCT/IB2014/002009(22) International Filing Date:
8 August 2014 (08.08.2014)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
201310347851.9 9 August 2013 (09.08.2013) CN(71) Applicant: **ALCATEL LUCENT** [FR/FR]; 148/152
Route de la Reine, F-92100 Boulogne-billancourt (FR).(72) Inventors: **LIU, Jin**; 388# Ningqiao RD, Shanghai,
Shanghai 201206 (CN). **YANG, Tao**; 388# Ningqiao RD,
Shanghai, Shanghai 201206 (CN). **SUN, Fanglei**; 388#
Ningqiao RD, Shanghai, Shanghai 201206 (CN). **LIU, Ji-
anguo**; 388# Ningqiao RD, Shanghai, Shanghai 201206
(CN).(74) Agent: **THERIAS, Philippe**; Alcatel-lucent International,
148/152 Route de la Reine, 32 avenue Kléber, F-92100
Boulogne-billancourt (FR).(81) Designated States (unless otherwise indicated, for every
kind of national protection available): AE, AG, AL, AM,
AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY,
BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM,
DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT,
HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR,
KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME,
MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ,
OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA,
SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM,
TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM,
ZW.(84) Designated States (unless otherwise indicated, for every
kind of regional protection available): ARIPO (BW, GH,
GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ,
UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ,
TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK,
EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV,
MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM,
TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW,
KM, ML, MR, NE, SN, TD, TG).**Published:**— without international search report and to be republished
upon receipt of that report (Rule 48.2(g))

(54) Title: METHOD AND APPARATUS FOR TRANSMITTING UPLINK CONTROL INFORMATION

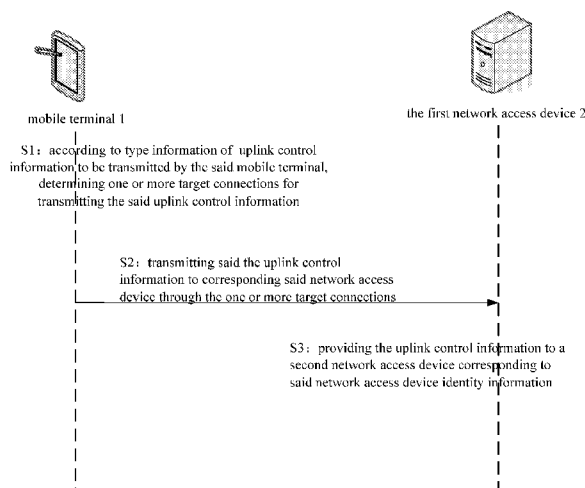


Fig. 3

(57) **Abstract:** An objective of the invention is to provide a method and apparatus for transmitting uplink control information. Specifically, wherein mobile terminal is simultaneously connected to at least two network access devices through carrier components of respective network access device, according to type information of uplink control information to be transmitted by mobile terminal, determining target connections for transmitting uplink control information; transmitting said uplink control information to corresponding network access device through the target connections. Compared with the prior art, the invention determines one or more target connections for transmitting uplink control information according to type information of the uplink control information to be transmitted by a mobile terminal, transmitting said uplink control information to the corresponding network access device through the target connections, thereby a UCI-specific resource allocation mechanism is implemented, so that the determination of the target connection for the uplink control information is implemented in CA-based dual-connectivity, and the scheduling efficiency and system performance are enhanced.

Method and Apparatus for Transmitting Uplink Control Information

FIELD OF THE INVENTION

- 5 [0001] The invention relates to the field of communication technology, and more particularly, a technology of transmitting uplink control information.

BACKGROUND OF THE INVENTION

- 10 [0002] In heterogeneous networks, the introduction of low power nodes has many challenges, such as the UL/DL (uplink/downlink) power imbalance, mobility robustness, frequent handovers as well as the incurred signaling overload, and inefficient inter-node resource utilization due to non-ideal backhaul, which limit the network performance remarkably.

- 15 [0003] In 3GPP RAN2, dual-connectivity was identified as a promising solution to solve these challenges. In Dual-connectivity, the UE can have simultaneous connectivity to at least two network points, which could operate on the same or separate frequency. Dual-connectivity is typically applicable to the eNBs (evolved-NodeB) which are connected with each other by non-ideal backhaul, such as
20 the backhaul with loose latency and capacity requirements.

- [0004] Carrier aggregation (CA) can be used to realize dual-connectivity, where one radio connection could operate on a part of component carriers (CCs) and another radio connection operates on another part of CCs, as illustrated in Fig. 2, wherein, UE has simultaneous connectivity to the macro-cell eNB and the small-cell eNB, the
25 macro-cell eNB and the small-cell eNB are connected by non-ideal backhaul, the macro-cell eNB configures one set of component carriers such as CC1 and CC2 for UE, the small-cell eNB configures one set of component carriers such as CC3 and CC4 for UE.

- [0005] However, in 3GPP LTE-Advanced Release 10/11, the multiple serving cells aggregated by CA all have to be controlled by the same eNB. The uplink control information (UCI) reporting has some rules, such as at most one PUCCH (Physical Uplink Control Channel) or PUSCH (Physical Uplink Shared Channel) could convey UCI, as well as PUCCH and PUSCH carrying UCI cannot be transmitted in the same subframe.

- 35 [0006] To realize dual-connectivity with CA, those aggregated serving cells needs to be controlled by separate eNBs. Thus the traditional CA strategies should to be enhanced, such as the UCI are transmitted on multiple CCs, rather than only the CC corresponding to the primary cell (PCC). It leads to simultaneous transmission of multiple PUSCHs carrying UCI in parallel on different CCs, simultaneous
40 transmission of multiple PUCCHs as well as simultaneous transmission of PUCCH and PUSCH carrying UCI.

[0007] Therefore, new UCI multiplexing rules for CA are required and the resource allocation for different UCI should be re-considered to support CA-based dual-connectivity.

- 45 [0008] In the current LTE-Advanced Release-10/11, with the introduction of CA,

multiple PUSCHs may be transmitted in parallel on different CCs and it is also possible that PUSCH and PUCCH are transmitted simultaneously on the same or different CCs.

5 [0009] Each CC appears as a separate cell with its own Cell ID from the higher-layer perspective. The Primary Serving Cell (PCell) is defined as the cell that is initially configured during connection establishment; it plays an essential role with respect to security, NAS (Non-Access Stratum) mobility information, SI (System Information) for configured cells, and some lower-layer functions. A Secondary Serving Cell (SCell) is a cell that may be configured after connection establishment, merely to provide
10 additional radio resources.

[00010] For CA, the UCI (which includes HARQ ACK/NACK (Hybird Automatic Repeat reQuest ACKnowledgement/Non ACKnowledgement) signaling, scheduling request (SR) and Channel State Information (CSI) feedback) can support up to five DL CCs. In Release-10/11, UCI is time multiplexed on one UL CC only – that is, UCI
15 cannot be split across multiple UL CCs.

[00011] The basic principle of UCI multiplexing is that apart from the aperiodic CSI reports in existing technology, all UCI is multiplexed onto the UL primary CC (PCC) of the PCell if scheduled in the same subframe; otherwise one of the secondary CC (SCC) is used. Some existing strategies for realizing UCI multiplexing are
20 summarized as follows:

1. All UCI multiplexed onto PUCCH is transmitted on the UL PCC of the PCell only;
2. Aperiodic CSI report is transmitted on a PUSCH of the UL CC corresponding to the DL CC that triggered the report;
- 25 3. If simultaneous PUCCH and PUSCH transmission is not enabled, and there is at least one PUSCH transmission, all UCI is multiplexed onto a PUSCH:
 - Any periodic CSI feedback and/or HARQ-ACK reports are normally transmitted on the PCC PUSCH if it is transmitted;
 - 30 -- If the PCC PUSCH is not transmitted, the UCI is multiplexed onto an SCC PUSCH if one is transmitted;
 - If more than one SCC PUSCH transmission occurs in the same subframe, the periodic CSI and/or HARQ-ACK reports are transmitted on the SCC PUSCH of the serving cell with the lowest
35 cell index.
4. If simultaneous PUCCH and PUSCH transmission is enabled, and there is at least one PUSCH transmission:
 - HARQ-ACK is transmitted on PUCCH;
 - Periodic CSI feedback is normally transmitted on the PCC PUSCH if it
40 is transmitted;
 - If the PCC PUSCH is not transmitted, the periodic CSI is multiplexed onto an SCC PUSCH if one is transmitted;

-- If more than one SCC PUSCH transmission occurs in the same subframe, the periodic CSI is transmitted on the SCC PUSCH of the serving cell with the lowest cell index.

- 5 5. In the case of a collision between periodic CSI and aperiodic CSI for the same or different DL CCs, the periodic CSI is dropped and only the aperiodic CSI feedback is transmitted.

[00012] With the current UCI multiplexing strategy, all UCI even for different DL CCs should be transmitted via one of the CCs, which may be connected to macro-cell eNB or small-cell eNB. Due to non-ideal backhaul of dual-connectivity, the periodic
10 CSI or HARQ-ACK feedback may have a remarkable delay, which impacts the scheduling efficiency and system performance significantly.

SUMMARY OF THE INVENTION

15 [00013] An objective of this invention is to provide a method and apparatus for transmitting uplink control information.

[00014] According to one aspect of this invention, there provides a method for transmitting uplink control information in a mobile terminal, wherein said mobile terminal is simultaneously connected to at least two network access devices through
20 carrier components of respective network access device, wherein the method comprises the following steps of:

[00015] a. according to type information of uplink control information to be transmitted by said mobile terminal, determining one or more target connections for transmitting said uplink control information, wherein the target connection
25 corresponds to one of said at least two network access devices;

[00016] b. transmitting said uplink control information to corresponding said network access device through the one or more target connections, wherein said uplink control information further comprises network access device identity information corresponding to said uplink control information.

30 [00017] According to another aspect of this invention, there also provides a method for assisting transmitting uplink control information of a mobile terminal in a first network access device, wherein the method comprises the following steps of:

[00018] A. receiving uplink control information sent from a mobile terminal, wherein the uplink control information further comprises network access device identity
35 information corresponding to the uplink control information, said mobile terminal is connected to the first network access device through carrier components corresponding to the first network access device;

[00019] B. providing the uplink control information to a second network access device corresponding to said network access device identity information, wherein said
40 mobile terminal is simultaneously connected to the second network access device through carrier components corresponding to the second network access device.

[00020] According to one aspect of this invention, there also provides a mobile terminal for transmitting uplink control information, wherein said mobile terminal is simultaneously connected to at least two network access devices through carrier
45 components of respective network access device, wherein the mobile terminal

comprises:

[00021] a target connection determination apparatus configured to, according to type information of uplink control information to be transmitted by said mobile terminal, determine one or more target connections for transmitting said uplink control information, wherein the target connection corresponds to one of said at least two network access devices;

[00022] a transmission apparatus configured to, transmit said uplink control information to corresponding said network access device through the one or more target connections, wherein said uplink control information further comprises network access device identity information corresponding to said uplink control information.

[00023] According to another aspect of this invention, there also provides a first network access device for assisting transmitting uplink control information of a mobile terminal, wherein the first network access device comprises:

[00024] a receiving apparatus configured to, receive uplink control information sent from a mobile terminal, wherein the uplink control information further comprises network access device identity information corresponding to the uplink control information, said mobile terminal is connected to the first network access device through carrier components corresponding to the first network access device;

[00025] a providing apparatus configured to, provide the uplink control information to a second network access device corresponding to the network access device identity information, wherein said mobile terminal is simultaneously connected to the second network access device through carrier components corresponding to the second network access device.

[00026] According to a further aspect of this invention, there also provides a system for transmitting uplink control information, wherein the system comprises the aforementioned the mobile terminal according to one aspect of the invention, and the aforementioned the first network access device according to another aspect of the invention.

[00027] Compared with the prior art, the invention determines one or more target connections for transmitting said uplink control information according to type information of the uplink control information to be transmitted by a mobile terminal, transmitting said uplink control information to the corresponding said network access device through the one or more target connections, thereby a UCI-specific resource allocation mechanism is implemented, so that the determination of the target connection for the uplink control information is implemented in CA-based dual-connectivity, thereby this invention enhances the scheduling efficiency and system performance compared to the current physical channel assignment strategies about the uplink control information. Moreover, when the type information of the uplink control information comprises automatic repeat acknowledgement, the present invention may use PUCCH or PUSCH of one or more carrier components connected to respective network access devices corresponding to the said uplink control information as a target connection for transmitting said uplink control information, respectively, thereby reducing the transmission delay of automatic repeat acknowledgement, which further enhances the scheduling efficiency and system performance. Besides, when type information of the uplink control information includes aperiodic channel state information, the present invention may use uplink carrier components corresponding to downlink carrier components that triggered said uplink control information respectively as one or more target connections for

transmitting said uplink control information, by splitting the aperiodic channel state information so as to be multiplexed to carrier components corresponding to different network access devices for transmission, a stricter sensitivity requirement can be satisfied, which further enhances the scheduling efficiency and system performance.

5

BRIEF DESCRIPTION OF THE DRAWINGS

[00028] 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:

10

[00029] Fig.1 shows a schematic diagram illustrating a mobile terminal and a first network access device for transmitting uplink control information according to one aspect of the present invention;

[00030] Fig.2 shows a connectivity schematic diagram of a CA-based dual connectivity;

15

[00031] Fig.3 shows a flowchart illustrating a method for transmitting uplink control information by cooperation between a mobile terminal and a first network access device according to another aspect of the present invention.

[00032] The same or similar reference signs in the drawings represent the same or similar component parts.

20

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[00033] Details of the invention will be further provided below in combination with the accompanying drawings.

25

[00034] Fig.1 shows a schematic diagram illustrating a mobile terminal 1 and a first network access device 2 for transmitting uplink control information according to one aspect of the present invention, wherein mobile terminal 1 is simultaneously connected to at least two network access devices through carrier components of respective network access device, wherein, mobile terminal 1 comprises a target connection determination apparatus 11 and a transmission apparatus 12, the first network access device 2 comprises a receiving apparatus 21 and a providing apparatus 22. Specifically, the target connection determination apparatus 11 of mobile terminal 1, according to type information of uplink control information to be transmitted by said mobile terminal, determines one or more target connections for transmitting said uplink control information, wherein the target connection corresponds to one of said at least two network access devices; the transmission apparatus 12 transmits said uplink control information to corresponding said network access device through the one or more target connections, wherein said uplink control information further comprises network access device identity information corresponding to said uplink control information; correspondingly, the receiving apparatus 21 of the first network access device 2 receives uplink control information sent from the mobile terminal 1, wherein the uplink control information further comprises network access device identity information corresponding to the uplink control information, said mobile terminal is connected to the first network access device through carrier components corresponding to the first network access device; the providing apparatus 22 provides the uplink control information to a second network access device corresponding to the network access device identity information, wherein said mobile terminal is simultaneously connected to the second network access device through carrier

30

35

40

45

components corresponding to the second network access device.

[00035] Here, the mobile terminal 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, etc.. Here, the network access device includes, but not limited to, a base station, eNB, etc. Here, the mobile network includes, but not limited to, GSM, 3G, TD-LTE, Wi-Fi, WiMax, WCDMA, CDMA2000, TD-SCDMA, HSPA, LTE, LTE-Advanced, etc. Those skilled in the art should understand that the aforesaid mobile terminals, network access devices, and mobile networks are only exemplary, other existing mobile terminals or network access devices or 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.

[00036] Specifically, the target connection determination apparatus 11 of the mobile terminal 1 obtains uplink control information to be transmitted by the mobile terminal through invoking an application program interface (API) for providing the uplink control information of the mobile terminal 1 itself; then, according to type information of the uplink control information, determines one or more target connections for transmitting the uplink control information, wherein the target connection corresponds to one of said at least two network access devices. Here, the type of the uplink control information includes, for example, 1) automatic repeat acknowledgement, e.g. HARQ ACK/NACK; 2) channel state information, e.g., CSI, wherein the channel state information comprises aperiodic channel state information and periodical channel state information. Here, said target connection is one through which the mobile terminal transmits uplink control information to a corresponding network access device, including, but not limited to, carrier component CC, PUCCH, PUSCH, etc., configured for the mobile terminal. Those skilled in the art should understand that the aforesaid channel state information and target connections are only examples, and other existing channel state information or target connections, or those that can 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.

[00037] For example, suppose the mobile terminal (e.g., UE) is simultaneously connected to at least two network access devices through carrier components of respective network devices, e.g., connected to a macro-cell eNB and a small-cell eNB, the macro-cell eNB and the small-cell eNB are connected through a non-ideal backhaul connection. Suppose the macro-cell eNB configures a set of carrier components such as CC1 and CC2 for the UE, the small-cell eNB configures a set of carrier components such as CC3 and CC4 for the UE. The uplink carrier components of the UE correspond to its downlink carrier components. Suppose the network access device (e.g., macro-cell eNB) sends uplink traffic data transmission to the UE, if the UE correctly receives it and demodulates the sent data blocks, the UE will feed back an ACK message to the network access device (e.g., macro-cell eNB) through uplink

control signaling; otherwise, the UE will feed back a NACK message, then the target connection determination apparatus 11 may obtain the uplink control information to be transmitted by the UE, e.g., HARQ-ACK/NACK, through invoking an application program interface (API) for providing uplink control information of the UE itself.

5 [00038] Those skilled in the art should understand that the aforesaid manner of obtaining uplink control information to be transmitted by the mobile terminal is only exemplary, and other existing manner of obtaining uplink control information to be transmitted by the mobile terminal, or those that can 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.

10 [00039] Next, the target connection determination apparatus 11 according to type information of uplink control information to be transmitted by said mobile terminal, determines one or more target connections for transmitting said uplink control information, wherein the target connection corresponds to one of said at least two network access devices. Here, the manner in which the target connection determination apparatus 11 determines the target connection includes, but not limited to, at least any one of the following:

15 [00040] 1) when the type information of the uplink control information includes automatic repeat acknowledgement, use PUCCH or PUSCH of one or more carrier components connected to respective network access devices corresponding to said uplink control information as a target connection for transmitting said uplink control information, respectively, wherein the target connection corresponds to one of said at least two network access devices.

20 [00041] For, example, continue the above example, the target connection determination apparatus 11 gets uplink control information HARQ-ACK1 to be transmitted by the mobile terminal UE, while the network access device corresponding to the uplink control information is macro-cell eNB; then the target connection determination apparatus 11 can use PUCCH or PUSCH of one or more carrier components corresponding to the macro-cell eNB, e.g., the PUCCH or PUSCH of a primary carrier component corresponding to the macro-cell eNB, as a target connection for transmitting the HARQ-ACK1, e.g., multiplexing HARQ-ACK1 onto the PUCCH or PUSCH of the primary carrier component corresponding to the macro-cell eNB. For another example, suppose the target connection determination apparatus 11 also gets uplink control information HARQ-ACK2 to be transmitted by the mobile terminal UE in the meanwhile, while the network access device corresponding to the uplink control information is the small-cell eNB, then the target connection determination apparatus 11 can use the PUCCH or PUSCH of one or more carrier components corresponding to the small-cell eNB, e.g., the PUCCH or PUSCH of a primary carrier component corresponding to the small-cell eNB, as the target connection for transmitting the HARQ-ACK2, e.g., multiplexing the HARQ-ACK2 onto the PUCCH or PUSCH of one or more carrier components corresponding to the small-cell eNB.

30 [00042] Preferably, when the PUCCH or PUSCH cannot transmit said uplink control information simultaneously, and there is at least one PUSCH transmission for each network access device, the target connection determination apparatus 11 can use the PUSCH of one or more carrier components of the network access device corresponding to said uplink control information as the target connection for transmitting said uplink control information, wherein the target connection corresponds to one of said at least two network access devices. For example, suppose the target connection determination apparatus 11 gets the uplink control information

HARQ-ACK1 to be transmitted by the mobile terminal UE, while the network access device corresponding to the uplink control information is macro-cell eNB, for the macro-cell eNB, the PUCCH and the PUSCH cannot transmit the uplink control information simultaneously, but there is at least one PUSCH transmission, then the target connection determination apparatus 11 can use the PUSCH of one or more carrier components corresponding to the macro-cell eNB, e.g., the PUSCH of the primary carrier component corresponding to the macro-cell eNB, as the target connection for transmitting HARQ-ACK1, e.g., multiplexing the HARQ-ACK1 onto the PUSCH of the primary carrier component corresponding to the macro-cell eNB.

[00043] Preferably, when the PUCCH and the PUSCH cannot transmit said uplink control information simultaneously, and there is at least one PUSCH transmission for each network access device, but the PUSCH of one or more carrier components of the at least one network access device of the at least two network access devices corresponding to the uplink control information is not allowed to transmit the uplink control information, the target connection determination apparatus 11 can use the PUSCH of a secondary carrier component with the lowest cell index of the network access device as the target connection for transmitting said uplink control information. For example, for the UE, the uplink control information to be transmitted includes HARQ-ACK1 corresponding to the macro-cell eNB, and HARQ-ACK2 corresponding to the small-cell eNB, suppose the PUSCH of one or more carrier components of the macro-cell eNB is not allowed to transmit the uplink control information, while for the small-cell eNB, there is at least one PUSCH transmission, then the target connection determination apparatus 11 can use the PUSCH of the secondary carrier component with the lowest cell index of the macro-cell eNB as the target connection for transmitting the HARQ-ACK1, and use the PUSCH of one or more carrier components corresponding to the small-cell eNB, e.g., the PUSCH of the primary carrier component corresponding to the small-cell eNB, as the target connection for transmitting the HARQ-ACK2.

[00044] Here, since the HARQ-ACK feedback has high sensitivity to feedback delay, therefore, the HARQ-ACKs of the DL CCs belonging to different network access devices may be transmitted through the UL CCs of the corresponding network access devices, that is at least two parallel PUCCHs carrying UCI or at least two parallel PUSCHs carrying UCI are supported. The present invention realizes an advantageous effect of splitting the HARQ-ACK to multiplex transmission for different eNBs.

[00045] 2) When type information of said uplink control information includes automatic repeat acknowledgement, use PUCCH or PUSCH of one or more carrier components connected to one network access device of at least two network access devices corresponding to all said uplink control information as a target connection for transmitting said uplink control information, wherein the target connection corresponds to one of said at least two network access devices.

[00046] For example, for the UE, the uplink control information transmitted includes HARQ-ACK1 corresponding to the macro-cell eNB, and HARQ-ACK2 corresponding to the small-cell eNB, then the target connection determination apparatus 11 can multiplex the HARQ-ACK1 and the HARQ-ACK2 onto the PUCCH or PUSCH of one or more carrier components connected to the macro-cell eNB or the small-cell eNB, to use which as the target connection for the HARQ-ACK1 and HARQ-ACK2, e.g., multiplex the HARQ-ACK1 and HARQ-ACK2 onto the PUCCH or PUSCH of the primary carrier connected to the macro-cell eNB, for PUCCH, the current PUCCH format 3 can be used.

[00047] Preferably, when the PUCCH and PUSCH cannot transmit the uplink control

information simultaneously, and for one network access device of the at least two network access devices corresponding to the uplink control information, there is at least one PUSCH transmission, the PUSCH of one or more carrier components connected to this network access device is used as one or more target connections for transmitting the uplink control information, wherein the target connection corresponds to one of the at least two network access devices. For example, continue the above example, suppose the PUCCH and the PUSCH cannot transmit the uplink control information simultaneously, the macro-cell eNB has at least one PUSCH transmission, then the target connection determination apparatus 11 can multiplex the HARQ-ACK1 and the HARQ-ACK2 onto the PUSCH of the one or more carrier components connected to the macro-cell eNB, to use which as the target connection for HARQ-ACK1 and HARQ-ACK2.

[00048] Preferably, when the PUCCH and the PUSCH cannot transmit the uplink control information simultaneously, and for one network access device of the at least two network access devices corresponding to the uplink control information, there is at least one PUSCH transmission, and the PUSCH of the one or more carrier components connected to this network access device is not allowed to transmit the uplink control information, the target connection determination apparatus 11 can use the PUSCH of the secondary carrier component with the lowest cell index of this network access device as the target connection for transmitting the uplink control information. For example, continue the above example, suppose the PUSCH of one or more carrier components connected to the macro-cell eNB is not allowed to transmit the uplink control information, e.g., the PUSCH of the primary carrier component of the macro-cell eNB is not allowed to transmit HARQ-ACK1 and HARQ-ACK2, then the target connection determination apparatus 11 can use the PUSCH of the secondary carrier cell with the lowest cell index of the macro-cell eNB as the target connection for transmitting the uplink control information.

[00049] Here, according to the present invention, by multiplexing all HARQ-ACKs to the uplink carrier component of one network access device of the at least two network access devices to which the mobile device is connected simultaneously through carrier components of respective network access devices, for example, for the connection of the UE with the macro-cell eNB and the small-cell eNB, the carrier component connected to the macro-cell eNB can be configured as PCC, therefore, the current physical channel assignment strategies about HARQ-ACK can be used, and meanwhile the signaling overheads of the small-cell eNB is also reduced.

[00050] 3) when type information of said uplink control information includes periodical channel state information, use uplink carrier components of a network access device corresponding to said uplink control information as one or more target connections for transmitting said uplink control information, wherein the target connection corresponds to one of said at least two network access devices.

[00051] For example, suppose the target connection determination apparatus 11 obtains the uplink control information, such as CSI1 corresponding to the macro-cell eNB and CSI2 corresponding to the small-cell eNB, to be transmitted by the mobile terminal UE and these uplink control information are periodical channel state information, then the target connection determination apparatus 11 can use the uplink carrier component of the network access device (i.e., macro-cell eNB) corresponding to the CSI1 as the target connection for transmitting the CSI1, and use the uplink carrier component of the network access device (i.e., small-cell eNB) corresponding to the CSI2 as the target connection for transmitting the CSI2.

[00052] Preferably, when type information of said uplink control information

comprises periodical channel state information, the target connection determination apparatus 11 also can use carrier components of one network access device of the at least two network access devices corresponding to all said uplink control information as one or more target connections for transmitting all said uplink control information, wherein the target connection corresponds to one of said at least two network access devices. For example, continue the above example, the target connection determination apparatus 11 can multiplex the CSI1 and CSI2 to be transmitted by the UE onto the CC of the macro-cell eNB, thereby achieving a beneficial effect of reducing the signaling overheads of the small-cell eNB. For example, for the simultaneous transmission of periodical channel state information, PUCCH format 2 can be used.

[00053] Those skilled in the art should understand that the aforesaid the manner of determining target connections for transmitting said uplink control information are only examples, and other existing manner of determining target connections for transmitting said uplink control information, or those that can 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.

[00054] The transmission apparatus 12 transmits said uplink control information to corresponding said network access device through the one or more target connections, wherein said uplink control information further comprises network access device identity information corresponding to said uplink control information. Here, said network access device identity information includes, but not limited to, for example, the ID of the network access device, the index information of its corresponding carrier components, etc. Those skilled in the art should understand that the aforesaid network access device identity information is only exemplary, and other existing network access device identity information, or those that can 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.

[00055] Correspondingly, the receiving apparatus 21 of the first network access device 2 receives uplink control information sent from a mobile terminal, wherein the uplink control information further comprises network access device identity information corresponding to the uplink control information, said mobile terminal is connected to the first network access device through carrier components corresponding to the first network access device.

[00056] The providing apparatus 22 provides the uplink control information to a second network access device corresponding to the network access device identity information through such as a non-ideal backhaul connection between the first network access device 1 and the second network access device 2, wherein the mobile terminal 1 is simultaneously connected to the second network access device through carrier components corresponding to the second network access device. For example, as shown in Fig. 2, suppose the mobile terminal UE is connected to the first network device 1 (e.g., macro-cell eNB) through carrier components CC1 and CC2 corresponding to the first network device 1, and is connected to the second network access device (e.g., small-cell eNB) through the carrier components CC3 and CC4 corresponding to the second network access device, suppose the receiving apparatus 21 of the first network device 1 (e.g., macro-cell eNB) receives the uplink control information sent from the UE, such as the automatic repeat acknowledgements, e.g., HARQ-ASK1 and HARQ-ASK2, wherein the uplink control information further comprises network access device identity information corresponding to the uplink control information, e.g., HARQ-ASK1 corresponds to the identification information

(e.g., ID-macro-cell eNB) of the macro-cell eNB, HARQ-ASK2 corresponds to the identification information (e.g., ID-small-cell eNB) of the small-cell eNB, then the providing apparatus 22 can provide the HARQ-ASK2 corresponding to the small-cell eNB to the small-cell eNB.

5 [00057] Here, the second network access device includes, but not limited to, a base station, eNB, etc., the second network access device and the first network access device belong to different network access device. Those skilled in the art should understand that the aforesaid the second network access device are only examples, and other existing the second network access device, or those that can possibly come
10 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.

[00058] The various apparatus of the mobile terminal 1 and the first network access device 2 works continuously between each other. Specifically, the target connection determination apparatus 11 of mobile terminal 1, continuously according to type
15 information of uplink control information to be transmitted by said mobile terminal, determines one or more target connections for transmitting said uplink control information, wherein the target connection corresponds to one of said at least two network access devices; the transmission apparatus 12 continuously transmits said uplink control information to corresponding said network access device through the
20 one or more target connections, wherein said uplink control information further comprises network access device identity information corresponding to said uplink control information; correspondingly, the receiving apparatus 21 of the first network access device 2 continuously receives uplink control information sent from the mobile terminal 1, wherein the uplink control information further comprises network access
25 device identity information corresponding to the uplink control information, said mobile terminal is connected to the first network access device 1 through carrier components corresponding to the first network access device 1; the providing apparatus 22 continuously provides the uplink control information to a second network access device corresponding to the network access device identity
30 information, wherein said mobile terminal is simultaneously connected to the second network access device through carrier components corresponding to the second network access device. Here, those skilled in the art should understand that “continuously” means the various apparatus of the mobile terminal 1 and the first network access device 2 continuously determines target connections, transmits uplink
35 control information, receives uplink control information and provides uplink control information, till the mobile terminal 1 stops determining target connections within a relatively long time.

[00059] Preferably, when type information of said uplink control information comprises aperiodic channel state information, the target connection determination
40 apparatus 11 can use uplink carrier components corresponding to downlink carrier components that triggered said uplink control information as one or more target connections for transmitting said uplink control information, wherein the target connection corresponds to one of said at least two network access devices. For example, suppose the network access device (e.g., macro-cell eNB) connected to the
45 mobile terminal UE sends a signaling of transmitting the aperiodic channel state information to the UE through DL CC1, while UE correspondingly reports the aperiodic channel state information (e.g., aperiodic CSI1) to the macro-cell eNB, then

the target connection determination apparatus 11 can use the uplink carrier component (e.g., UP CC1) corresponding to the downlink carrier component which triggered aperiodic CSI1 as the target connection for transmitting the aperiodic CSI1.

[00060] More preferably, when type information of said uplink control information comprises aperiodic channel state information, the target connection determination apparatus 11 can use uplink carrier components corresponding to downlink carrier components that triggered said uplink control information respectively as one or more target connections for transmitting said uplink control information, wherein the target connection corresponds to one of said at least two network access devices. For example, continue the above example, suppose the mobile terminal UE also receives that the network access device (e.g., small-cell eNB) to which it is connected sends a signaling of transmitting aperiodic channel state information to the UE through the corresponding DL CC3, while the aperiodic channel state information notified by the UE to the small-cell eNB is aperiodic CSI2, then the target connection determination apparatus 11 can use the uplink carrier component (e.g., UP CC) corresponding to the downlink carrier component that triggered the aperiodic CSI1 as the target connection for transmitting the aperiodic CSI1, and use the uplink carrier component (e.g., UP CC3) corresponding to the downlink carrier component triggering the aperiodic CSI2 as the target connection for transmitting the aperiodic CSI2.

[00061] Here, the present invention achieves an advantageous effect of satisfying stricter sensitivity requirement by splitting the aperiodic channel state information so as to multiplex it onto carrier components corresponding to different network access devices for transmitting.

[00062] Fig.3 shows a flowchart illustrating a method for transmitting uplink control information by cooperation between a mobile terminal and a first network access device according to another aspect of the present invention. Wherein mobile terminal 1 is simultaneously connected to at least two network access devices through carrier components of respective network access device. Specifically, in the step S1, the mobile terminal 1, according to type information of uplink control information to be transmitted by said mobile terminal, determines one or more target connections for transmitting said uplink control information, wherein the target connection corresponds to one of said at least two network access devices; in the step S2, the mobile terminal 1 transmits said uplink control information to corresponding said network access device through the one or more target connections, wherein said uplink control information further comprises network access device identity information corresponding to said uplink control information; correspondingly, the first network access device 2 receives uplink control information sent from the mobile terminal 1, wherein the uplink control information further comprises network access device identity information corresponding to the uplink control information, said mobile terminal is connected to the first network access device through carrier components corresponding to the first network access device; in the step S3, the first network access device 2 provides the uplink control information to a second network access device corresponding to the network access device identity information, wherein said mobile terminal is simultaneously connected to the second network access device through carrier components corresponding to the second network access device.

[00063] Here, the mobile terminal 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, etc.. Here, the network access device includes, but not limited to, a base station, eNB, etc. Here, the mobile network includes, but not limited to, GSM, 3G, TD-LTE, Wi-Fi, WiMax, WCDMA, CDMA2000, TD-SCDMA, HSPA, LTE, LTE-Advanced, etc. Those skilled in the art should understand that the aforesaid mobile terminals, network access devices, and mobile networks are only exemplary, other existing mobile terminals or network access devices or 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.

[00064] Specifically, in the step S1, the mobile terminal 1 obtains uplink control information to be transmitted by the mobile terminal through invoking an application program interface (API) for providing the uplink control information of the mobile terminal 1 itself; then, according to type information of the uplink control information, determines one or more target connections for transmitting the uplink control information, wherein the target connection corresponds to one of said at least two network access devices. Here, the type of the uplink control information includes, for example, 1) automatic repeat acknowledgement, e.g. HARQ ACK/NACK; 2) channel state information, e.g., CSI, wherein the channel state information comprises aperiodic channel state information and periodical channel state information. Here, said target connection is one through which the mobile terminal transmits uplink control information to a corresponding network access device, including, but not limited to, carrier component CC, PUCCH, PUSCH, etc., configured for the mobile terminal. Those skilled in the art should understand that the aforesaid channel state information and target connections are only examples, and other existing channel state information or target connections, or those that can 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.

[00065] For example, suppose the mobile terminal (e.g., UE) is simultaneously connected to at least two network access devices through carrier components of respective network devices, e.g., connected to a macro-cell eNB and a small-cell eNB, the macro-cell eNB and the small-cell eNB are connected through a non-ideal backhaul connection. Suppose the macro-cell eNB configures a set of carrier components such as CC1 and CC2 for the UE, the small-cell eNB configures a set of carrier components such as CC3 and CC4 for the UE. The uplink carrier components of the UE correspond to its downlink carrier components. Suppose the network access device (e.g., macro-cell eNB) sends uplink traffic data transmission to the UE, if the UE correctly receives it and demodulates the sent data blocks, the UE will feed back an ACK message to the network access device (e.g., macro-cell eNB) through uplink control signaling; otherwise, the UE will feed back a NACK message, then the target connection determination apparatus 11 may obtain the uplink control information to be transmitted by the UE, e.g., HARQ-ACK/NACK, through invoking an application program interface (API) for providing uplink control information of the UE itself.

[00066] Those skilled in the art should understand that the aforesaid manner of obtaining uplink control information to be transmitted by the mobile terminal is only

exemplary, and other existing manner of obtaining uplink control information to be transmitted by the mobile terminal, or those that can 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.

5 [00067] Next, in the step S1, the mobile terminal 1 according to type information of uplink control information to be transmitted by said mobile terminal, determines one or more target connections for transmitting said uplink control information, wherein the target connection corresponds to one of said at least two network access devices. Here, the manner in which in the step S1, the mobile terminal 1 determines the target connection includes, but not limited to, at least any one of the following:

10 [00068] 1) when the type information of the uplink control information includes automatic repeat acknowledgement, use PUCCH or PUSCH of one or more carrier components connected to respective network access devices corresponding to said uplink control information as a target connection for transmitting said uplink control information, respectively, wherein the target connection corresponds to one of said at least two network access devices.

[00069] For, example, continue the above example, in the step S1, the mobile terminal 1 gets uplink control information HARQ-ACK1 to be transmitted by the mobile terminal UE, while the network access device corresponding to the uplink control information is macro-cell eNB; then in the step S1, the mobile terminal 1 can use PUCCH or PUSCH of one or more carrier components corresponding to the macro-cell eNB, e.g., the PUCCH or PUSCH of a primary carrier component corresponding to the macro-cell eNB, as a target connection for transmitting the HARQ-ACK1, e.g., multiplexing HARQ-ACK1 onto the PUCCH or PUSCH of the primary carrier component corresponding to the macro-cell eNB. For another example, suppose in the step S1, the mobile terminal 1 also gets uplink control information HARQ-ACK2 to be transmitted by the mobile terminal UE in the meanwhile, while the network access device corresponding to the uplink control information is the small-cell eNB, then in the step S1, the mobile terminal 1 can use the PUCCH or PUSCH of one or more carrier components corresponding to the small-cell eNB, e.g., the PUCCH or PUSCH of a primary carrier component corresponding to the small-cell eNB, as the target connection for transmitting the HARQ-ACK2, e.g., multiplexing the HARQ-ACK2 onto the PUCCH or PUSCH of one or more carrier components corresponding to the small-cell eNB.

35 [00070] Preferably, when the PUCCH or PUSCH cannot transmit said uplink control information simultaneously, and there is at least one PUSCH transmission for each network access device, in the step S1, the mobile terminal 1 can use the PUSCH of one or more carrier components of the network access device corresponding to said uplink control information as the target connection for transmitting said uplink control information, wherein the target connection corresponds to one of said at least two network access devices. For example, suppose in the step S1, the mobile terminal 1 gets the uplink control information HARQ-ACK1 to be transmitted by the mobile terminal UE, while the network access device corresponding to the uplink control information is macro-cell eNB, for the macro-cell eNB, the PUCCH and the PUSCH cannot transmit the uplink control information simultaneously, but there is at least one PUSCH transmission, then in the step S1, the mobile terminal 1 can use the PUSCH of one or more carrier components corresponding to the macro-cell eNB, e.g., the PUSCH of the primary carrier component corresponding to the macro-cell eNB, as the target connection for transmitting HARQ-ACK1, e.g., multiplexing the HARQ-ACK1 onto the PUSCH of the primary carrier component corresponding to the macro-cell

eNB.

[00071] Preferably, when the PUCCH and the PUSCH cannot transmit said uplink control information simultaneously, and there is at least one PUSCH transmission for each network access device, but the PUSCH of one or more carrier components of the at least one network access device of the at least two network access devices corresponding to the uplink control information is not allowed to transmit the uplink control information, in the step S1, the mobile terminal 1 can use the PUSCH of a secondary carrier component with the lowest cell index of the network access device as the target connection for transmitting said uplink control information. For example, for the UE, the uplink control information to be transmitted includes HARQ-ACK1 corresponding to the macro-cell eNB, and HARQ-ACK2 corresponding to the small-cell eNB, suppose the PUSCH of one or more carrier components of the macro-cell eNB is not allowed to transmit the uplink control information, while for the small-cell eNB, there is at least one PUSCH transmission, then in the step S1, the mobile terminal 1 can use the PUSCH of the secondary carrier component with the lowest cell index of the macro-cell eNB as the target connection for transmitting the HARQ-ACK1, and use the PUSCH of one or more carrier components corresponding to the small-cell eNB, e.g., the PUSCH of the primary carrier component corresponding to the small-cell eNB, as the target connection for transmitting the HARQ-ACK2.

[00072] Here, since the HARQ-ACK feedback has high sensitivity to feedback delay, therefore, the HARQ-ACKs of the DL CCs belonging to different network access devices may be transmitted through the UL CCs of the corresponding network access devices, that is at least two parallel PUCCHs carrying UCI or at least two parallel PUSCHs carrying UCI are supported. The present invention realizes an advantageous effect of splitting the HARQ-ACK to multiplex transmission for different eNBs.

[00073] 2) When type information of said uplink control information includes automatic repeat acknowledgement, use PUCCH or PUSCH of one or more carrier components connected to one network access device of at least two network access devices corresponding to all said uplink control information as a target connection for transmitting said uplink control information, wherein the target connection corresponds to one of said at least two network access devices.

[00074] For example, for the UE, the uplink control information transmitted includes HARQ-ACK1 corresponding to the macro-cell eNB, and HARQ-ACK2 corresponding to the small-cell eNB, then in the step S1, the mobile terminal 1 can multiplex the HARQ-ACK1 and the HARQ-ACK2 onto the PUCCH or PUSCH of one or more carrier components connected to the macro-cell eNB or the small-cell eNB, to use which as the target connection for the HARQ-ACK1 and HARQ-ACK2, e.g., multiplex the HARQ-ACK1 and HARQ-ACK2 onto the PUCCH or PUSCH of the primary carrier connected to the macro-cell eNB, for PUCCH, the current PUCCH format 3 can be used.

[00075] Preferably, when the PUCCH and PUSCH cannot transmit the uplink control information simultaneously, and for one network access device of the at least two network access devices corresponding to the uplink control information, there is at least one PUSCH transmission, the PUSCH of one or more carrier components connected to this network access device is used as one or more target connections for transmitting the uplink control information, wherein the target connection corresponds to one of the at least two network access devices. For example, continue the above example, suppose the PUCCH and the PUSCH cannot transmit the uplink control information simultaneously, the macro-cell eNB has at least one PUSCH transmission,

then in the step S1, the mobile terminal 1 can multiplex the HARQ-ACK1 and the HARQ-ACK2 onto the PUSCH of the one or more carrier components connected to the macro-cell eNB, to use which as the target connection for HARQ-ACK1 and HARQ-ACK2.

5 [00076] Preferably, when the PUCCH and the PUSCH cannot transmit the uplink control information simultaneously, and for one network access device of the at least two network access devices corresponding to the uplink control information, there is at least one PUSCH transmission, and the PUSCH of the one or more carrier components connected to this network access device is not allowed to transmit the
10 uplink control information, in the step S1, the mobile terminal 1 can use the PUSCH of the secondary carrier component with the lowest cell index of this network access device as the target connection for transmitting the uplink control information. For example, continue the above example, suppose the PUSCH of one or more carrier components connected to the macro-cell eNB is not allowed to transmit the uplink control information, e.g., the PUSCH of the primary carrier component of the
15 macro-cell eNB is not allowed to transmit HARQ-ACK1 and HARQ-ACK2, then in the step S1, the mobile terminal 1 can use the PUSCH of the secondary carrier cell with the lowest cell index of the macro-cell eNB as the target connection for transmitting the uplink control information.

20 [00077] Here, according to the present invention, by multiplexing all HARQ-ACKs to the uplink carrier component of one network access device of the at least two network access devices to which the mobile device is connected simultaneously through carrier components of respective network access devices, for example, for the connection of the UE with the macro-cell eNB and the small-cell eNB, the carrier component
25 connected to the macro-cell eNB can be configured as PCC, therefore, the current physical channel assignment strategies about HARQ-ACK can be used, and meanwhile the signaling overheads of the small-cell eNB is also reduced.

[00078] 3) when type information of said uplink control information includes periodical channel state information, use uplink carrier components of a network
30 access device corresponding to said uplink control information as one or more target connections for transmitting said uplink control information, wherein the target connection corresponds to one of said at least two network access devices.

[00079] For example, suppose in the step S1, the mobile terminal 1 obtains the uplink control information, such as CSI1 corresponding to the macro-cell eNB and CSI2
35 corresponding to the small-cell eNB, to be transmitted by the mobile terminal UE and these uplink control information are periodical channel state information, then the target connection determination apparatus11 can use the uplink carrier component of the network access device (i.e., macro-cell eNB) corresponding to the CSI1 as the target connection for transmitting the CSI1, and use the uplink carrier component of
40 the network access device (i.e., small-cell eNB) corresponding to the CSI2 as the target connection for transmitting the CSI2.

[00080] Preferably, when type information of said uplink control information comprises periodical channel state information, in the step S1, the mobile terminal 1
45 also can use carrier components of one network access device of the at least two network access devices corresponding to all said uplink control information as one or more target connections for transmitting all said uplink control information, wherein the target connection corresponds to one of said at least two network access devices. For example, continue the above example, in the step S1, the mobile terminal 1 can multiplex the CSI1 and CSI2 to be transmitted by the UE onto the CC of the
50 macro-cell eNB, thereby achieving a beneficial effect of reducing the signaling

overheads of the small-cell eNB. For example, for the simultaneous transmission of periodical channel state information, PUCCH format 2 can be used.

[00081] Those skilled in the art should understand that the aforesaid the manner of determining target connections for transmitting said uplink control information are only examples, and other existing manner of determining target connections for transmitting said uplink control information, or those that can 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.

[00082] In the step S2, the mobile terminal 1 transmits said uplink control information to corresponding said network access device through the one or more target connections, wherein said uplink control information further comprises network access device identity information corresponding to said uplink control information. Here, said network access device identity information includes, but not limited to, for example, the ID of the network access device, the index information of its corresponding carrier components, etc. Those skilled in the art should understand that the aforesaid network access device identity information is only exemplary, and other existing network access device identity information, or those that can 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.

[00083] Correspondingly, in the step S2, the first network access device 2 receives uplink control information sent from a mobile terminal, wherein the uplink control information further comprises network access device identity information corresponding to the uplink control information, said mobile terminal is connected to the first network access device through carrier components corresponding to the first network access device.

[00084] In the step S3, the first network access device 2 provides the uplink control information to a second network access device corresponding to the network access device identity information through such as a non-ideal backhaul connection between the first network access device 1 and the second network access device 2, wherein the mobile terminal 1 is simultaneously connected to the second network access device through carrier components corresponding to the second network access device. For example, as shown in Fig. 2, suppose the mobile terminal UE is connected to the first network device 1 (e.g., macro-cell eNB) through carrier components CC1 and CC2 corresponding to the first network device 1, and is connected to the second network access device (e.g., small-cell eNB) through the carrier components CC3 and CC4 corresponding to the second network access device, suppose in the step S2, the first network access device 2 of the first network device 1 (e.g., macro-cell eNB) receives the uplink control information sent from the UE, such as the automatic repeat acknowledgements, e.g., HARQ-ASK1 and HARQ-ASK2, wherein the uplink control information further comprises network access device identity information corresponding to the uplink control information, e.g., HARQ-ASK1 corresponds to the identification information (e.g., ID-macro-cell eNB) of the macro-cell eNB, HARQ-ASK2 corresponds to the identification information (e.g., ID-small-cell eNB) of the small-cell eNB, then in the step S3, the first network access device 2 can provide the HARQ-ASK2 corresponding to the small-cell eNB to the small-cell eNB.

[00085] Here, the second network access device includes, but not limited to, a base station, eNB, etc., the second network access device and the first network access device belong to different network access device. Those skilled in the art should understand that the aforesaid the second network access device are only examples, and other existing the second network access device, or those that can 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] The various steps of the mobile terminal 1 and the first network access device 2 works continuously between each other. Specifically, in the step S1, the mobile terminal 1, continuously according to type information of uplink control information to be transmitted by said mobile terminal, determines one or more target connections for transmitting said uplink control information, wherein the target connection corresponds to one of said at least two network access devices; in the step S2, the mobile terminal 1 continuously transmits said uplink control information to corresponding said network access device through the one or more target connections, wherein said uplink control information further comprises network access device identity information corresponding to said uplink control information; correspondingly, the first network access device 2 continuously receives uplink control information sent from the mobile terminal 1, wherein the uplink control information further comprises network access device identity information corresponding to the uplink control information, said mobile terminal is connected to the first network access device 1 through carrier components corresponding to the first network access device 1; in the step S3, the first network access device 2 continuously provides the uplink control information to a second network access device corresponding to the network access device identity information, wherein said mobile terminal is simultaneously connected to the second network access device through carrier components corresponding to the second network access device. Here, those skilled in the art should understand that “continuously” means the various steps of the mobile terminal 1 and the first network access device 2 continuously determines target connections, transmits uplink control information, receives uplink control information and provides uplink control information, till the mobile terminal 1 stops determining target connections within a relatively long time.

[00087] Preferably, when type information of said uplink control information comprises aperiodic channel state information, in the step S1, the mobile terminal 1 can use uplink carrier components corresponding to downlink carrier components that triggered said uplink control information as one or more target connections for transmitting said uplink control information, wherein the target connection corresponds to one of said at least two network access devices. For example, suppose the network access device (e.g., macro-cell eNB) connected to the mobile terminal UE sends a signaling of transmitting the aperiodic channel state information to the UE through DL CC1, while UE correspondingly reports the aperiodic channel state information (e.g., aperiodic CSI1) to the macro-cell eNB, then in the step S1, the mobile terminal 1 can use the uplink carrier component (e.g., UP CC1) corresponding to the downlink carrier component which triggered aperiodic CSI1 as the target connection for transmitting the aperiodic CSI1.

[00088] More preferably, when type information of said uplink control information comprises aperiodic channel state information, in the step S1, the mobile terminal 1 can use uplink carrier components corresponding to downlink carrier components that triggered said uplink control information respectively as one or more target connections for transmitting said uplink control information, wherein the target connection corresponds to one of said at least two network access devices. For example, continue the above example, suppose the mobile terminal UE also receives

that the network access device (e.g., small-cell eNB) to which it is connected sends a signaling of transmitting aperiodic channel state information to the UE through the corresponding DL CC3, while the aperiodic channel state information notified by the UE to the small-cell eNB is aperiodic CSI2, then in the step S1, the mobile terminal 1
5 can use the uplink carrier component (e.g., UP CC) corresponding to the downlink carrier component that triggered the aperiodic CSI1 as the target connection for transmitting the aperiodic CSI1, and use the uplink carrier component (e.g., UP CC3) corresponding to the downlink carrier component triggering the aperiodic CSI2 as the target connection for transmitting the aperiodic CSI2.

10 [00089] Here, the present invention achieves an advantageous effect of satisfying stricter sensitivity requirement by splitting the aperiodic channel state information so as to multiplex it onto carrier components corresponding to different network access devices for transmitting.

[00090] It needs to note that the invention can be implemented in software and/or a
15 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
20 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.

25 [00091] 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
30 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
35 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.

[00092] 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
40 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
45 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.

10

15

20

25

30

35

40

We claim:

1. A method for transmitting uplink control information in a mobile terminal, wherein said mobile terminal is simultaneously connected to at least two network access devices through carrier components of respective network access device, wherein the method comprises the following steps of:

a. according to type information of uplink control information to be transmitted by said mobile terminal, determining one or more target connections for transmitting said uplink control information, wherein the target connection corresponds to one of said at least two network access devices;

b. transmitting said uplink control information to corresponding said network access device through the one or more target connections, wherein said uplink control information further comprises network access device identity information corresponding to said uplink control information.

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

- when type information of said uplink control information includes automatic repeat acknowledgement, using PUCCH or PUSCH of one or more carrier components connected to respective network access devices corresponding to said uplink control information as a target connection for transmitting said uplink control information, respectively, wherein the target connection corresponds to one of said at least two network access devices.

3. The method according to claim 1, wherein the step a further comprises:

- when type information of said uplink control information includes automatic repeat acknowledgement, using PUCCH or PUSCH of one or more carrier components connected to one network access device of at least two network access devices corresponding to all said uplink control information as a target connection for transmitting said uplink control information, wherein the target connection corresponds to one of said at least two network access devices.

4. The method according to claim 1, wherein the step a further comprises:

- when type information of said uplink control information comprises aperiodic channel state information, using uplink carrier components corresponding to downlink carrier components that triggered said uplink control information as one or more target connections for transmitting said uplink control information, wherein the target connection corresponds to one of said at least two network access devices.

5. The method according to claim 4, wherein the step a comprises:

- when type information of said uplink control information comprises aperiodic channel state information, using uplink carrier components corresponding to downlink carrier components that triggered said uplink control information respectively as one or more target connections for transmitting said uplink control information, wherein the target connection corresponds to one of said at least two network access devices.

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

- when type information of said uplink control information includes periodical channel state information, using uplink carrier components of a network access device corresponding to said uplink control information as one or more target connections for transmitting said uplink control information, wherein the target connection corresponds to one of said at least two network access devices.

7. A method for assisting transmitting uplink control information of a mobile terminal in a first network access device, wherein the method comprises the following steps of:

A. receiving uplink control information sent from a mobile terminal, wherein the uplink control information further comprises network access device identity information corresponding to the uplink control information, said mobile terminal is connected to the first network access device through carrier components corresponding to the first network access device;

B. providing the uplink control information to a second network access device corresponding to said network access device identity information, wherein said mobile terminal is simultaneously connected to the second network access device through carrier components corresponding to the second network access device.

8. A mobile terminal for transmitting uplink control information, wherein said mobile terminal is simultaneously connected to at least two network access devices through carrier components of respective network access device, wherein the mobile terminal comprises:

a target connection determination apparatus configured to, according to type information of uplink control information to be transmitted by said mobile terminal, determine one or more target connections for transmitting said uplink control information, wherein the target connection corresponds to one of said at least two network access devices;

a transmission apparatus configured to, transmit said uplink control information to corresponding said network access device through the one or more target connections, wherein said uplink control information further comprises network access device identity information corresponding to said uplink control information.

9. The mobile terminal according to claim 8, wherein the target connection determination apparatus further configured to:

- when type information of said uplink control information includes automatic repeat acknowledgement, use PUCCH or PUSCH of one or more carrier components connected to respective network access devices corresponding to said uplink control information as a target connection for transmitting said uplink control information, respectively, wherein the target connection corresponds to one of said at least two network access devices.

10. The mobile terminal according to claim 8, wherein target connection

determination apparatus further configured to:

- when type information of said uplink control information includes automatic repeat acknowledgement, use PUCCH or PUSCH of one or more carrier components connected to one network access device of at least two network access devices corresponding to all said uplink control information as a target connection for transmitting said uplink control information, wherein the target connection corresponds to one of said at least two network access devices.

11. The mobile terminal according to claim 8, wherein target connection determination apparatus further configured to:

- when type information of said uplink control information comprises aperiodic channel state information, use uplink carrier components corresponding to downlink carrier components that triggered said uplink control information as one or more target connections for transmitting said uplink control information, wherein the target connection corresponds to one of said at least two network access devices.

12. The mobile terminal according to claim 11, wherein target connection determination apparatus configured to:

- when type information of said uplink control information comprises aperiodic channel state information, use uplink carrier components corresponding to downlink carrier components that triggered said uplink control information respectively as one or more target connections for transmitting said uplink control information, wherein the target connection corresponds to one of said at least two network access devices.

13. The mobile terminal according to claim 8, wherein target connection determination apparatus further configured to:

- when type information of said uplink control information includes periodical channel state information, use uplink carrier components of a network access device corresponding to said uplink control information as one or more target connections for transmitting said uplink control information, wherein the target connection corresponds to one of said at least two network access devices.

14. A first network access device for assisting transmitting uplink control information of a mobile terminal, wherein the first network access device comprises:

- a receiving apparatus configured to, receive uplink control information sent from a mobile terminal, wherein the uplink control information further comprises network access device identity information corresponding to the uplink control information, said mobile terminal is connected to the first network access device through carrier components corresponding to the first network access device;

- a providing apparatus configured to, provide the uplink control information to a second network access device corresponding to the network access device identity information, wherein said mobile terminal is simultaneously connected to the second network access device through carrier components corresponding to the second network access device.

15. A system for transmitting uplink control information, wherein the system comprises the mobile terminal according to any one of claims 8-13, and the first network access device according to claim 14.

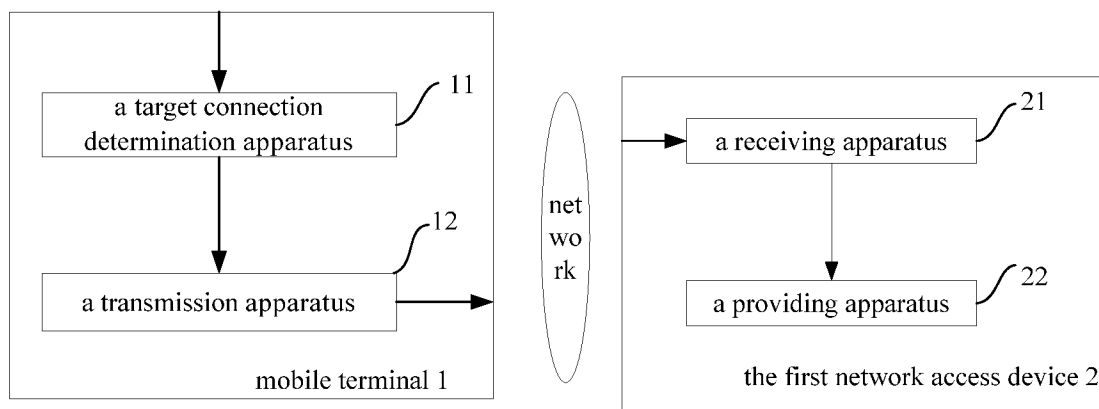


Fig. 1

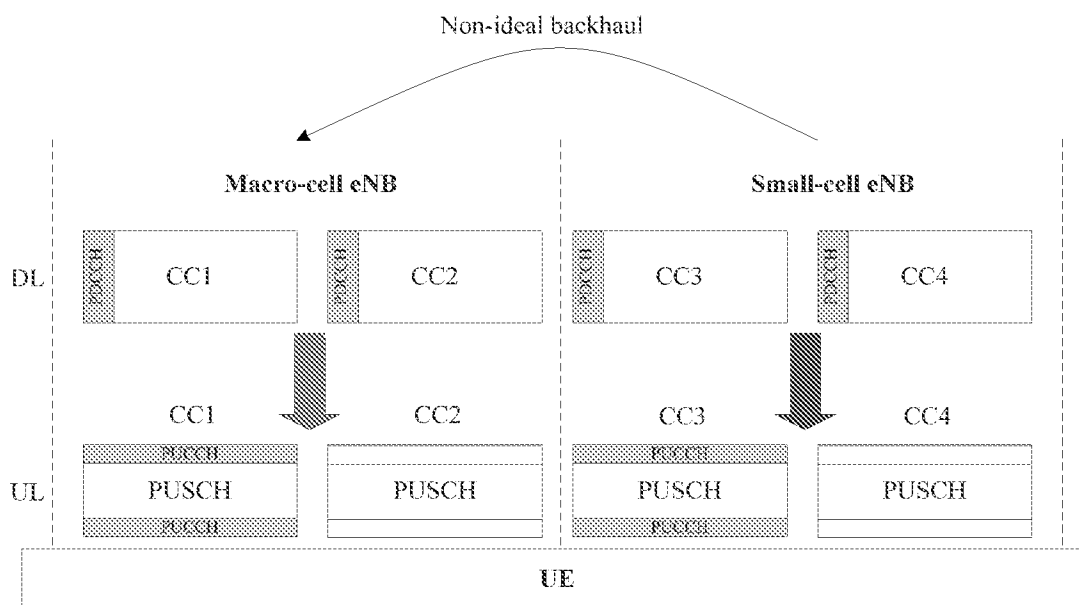


Fig. 2

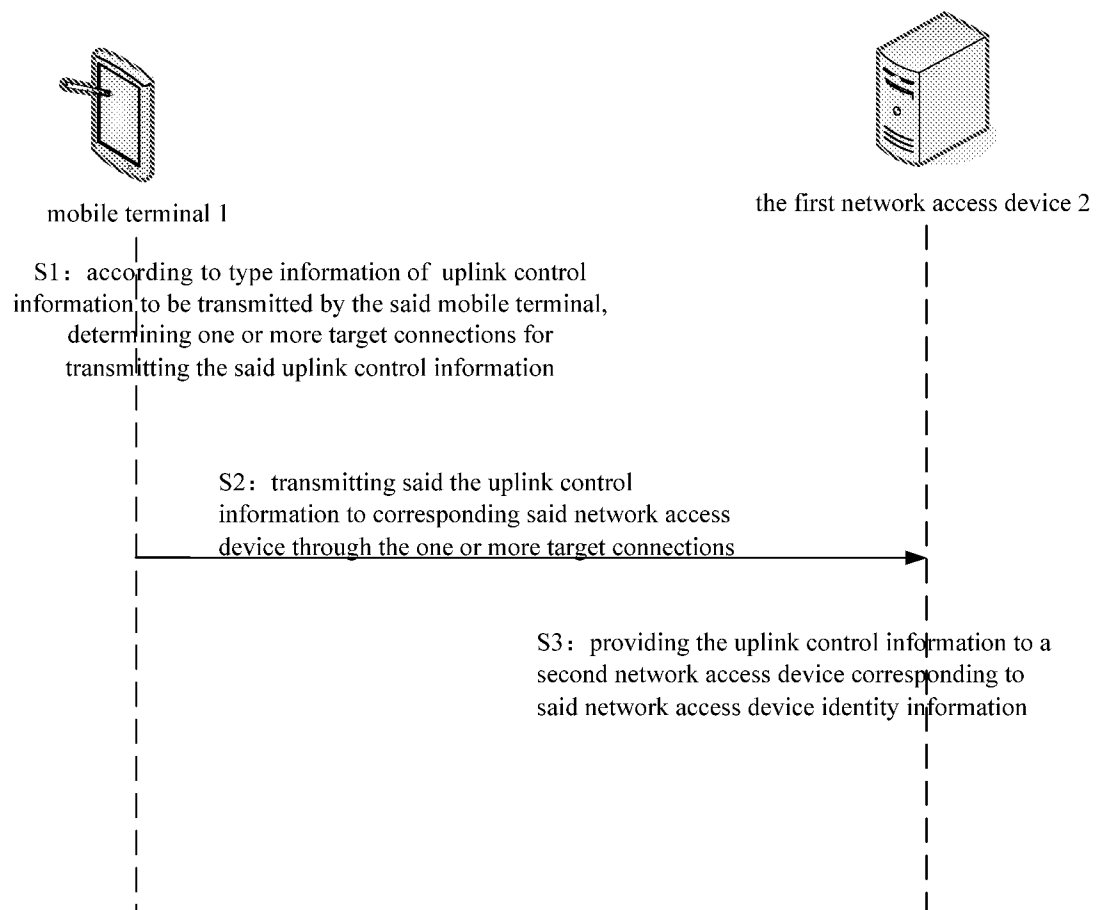


Fig. 3