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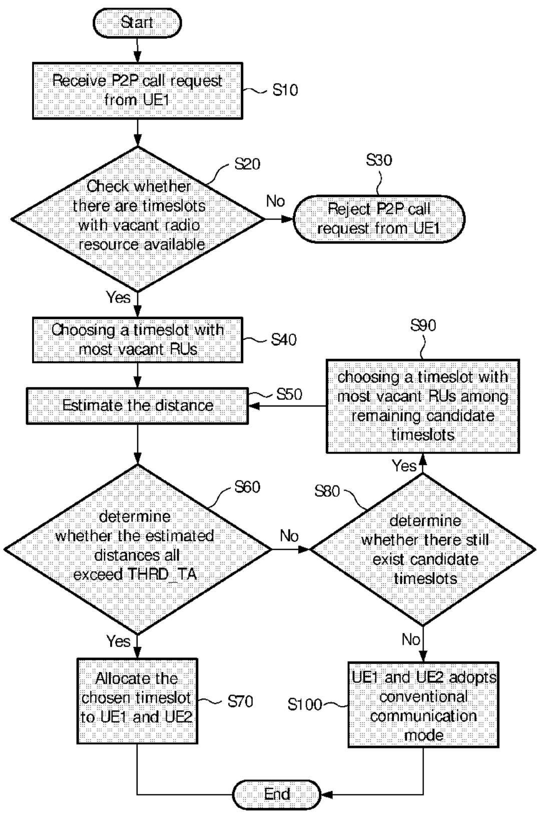
[Continued on next page]

(54) Title: METHOD AND APPARATUS FOR ELIMINATING P2P INTERFERENCE IN P2P-ENABLED COMMUNICATION SYSTEMS



(57) Abstract: A radio resource allocation method to be executed by a network system, comprising the steps of: receiving a call request from a UE for setting up P2P communication with another UE; choosing a timeslot with most vacant resource units among multiple candidate timeslots with vacant radio resource according to the call request; estimating distances between each of multiple UEs previously allocated in the chosen timeslot and any one of the pair of UEs attempting to set up P2P communication respectively; allocating the chosen timeslot to the UE to set up P2P communication if the estimated distances all exceed a predefined value.

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METHOD AND APPARATUS FOR ELIMINATING P2P INTERFERENCE IN P2P-ENABLED COMMUNICATION SYSTEMS

FIELD OF THE INVENTION

The present invention relates generally to a communication method and apparatus, and more particularly, to a method and apparatus for eliminating P2P interference in P2P-enabled communication systems.

BACKGROUND OF THE INVENTION

In conventional cellular mobile communication systems, one User Equipment (UE) has to communicate with another UE through the relaying of base stations. Fig.1 illustrates this conventional communication mode used in TD-SCDMA system, in which UE1 and UE2 exchange information through UTRAN consisting of a base station transceiver (Node B) and a radio network controller (RNC). This conventional communication mode is also called UP-UTRAN-DOWN mode. However, in some cases where two UEs camping in a cell are very close to each other, it can be a more reasonable way for them to communicate directly rather than through the relaying/forwarding of base stations, and this is the so-called peer-to-peer communication, abbreviated as P2P.

Fig.2 shows a P2P communication mode used in TD-SCDMA system. As shown in Fig.2, there only exist control links for transferring signaling between UTRAN and UE1 and UE2 (represented by the dashed line), while there only exist P2P direct links for transferring traffic data between the communicating UE1 and UE2 (represented by the solid line). Compared with conventional communication mode, P2P communication can save up to 50% radio resource, and meanwhile UTRAN still keeps control over the P2P communication, especially over the use of radio resource, thus network operators can easily solve the billing issue for the radio resource used by P2P communication.

The P2P communication mode monitored by UTRAN is also called “online P2P communication mode”. The methods for realizing the online P2P communication mode are disclosed in detail in the patent applications filed by KONINKLIJKE PHILIPS ELECTRONICS N.V. on March 7, 2003, Application Serial No. 03119892.9 and 03119894.5, and incorporated herein as reference.

It is commonly accepted that the Time Division Duplex (TDD) air interface is a communication standard that can offer a flexible adaptation to different uplink and downlink traffic requirements. Among existing 3G systems based on TDD communication mode, TD-SCDMA (Time Division – Synchronization Code Division Multiple Access) system is an ideal system more suitable for the combination of P2P communication with conventional communication mode, because the fact that the same carrier frequency is applied in both uplink and downlink communications can simplify the RF (Radio Frequency) module of the UE.

However, due to the introduction of P2P communication, it changes the conventional UP-UTRAN-DOWN communication mode in TD-SCDMA communication systems. When a conventional link shares the same timeslot with a P2P link, the conventional uplink and/or downlink communications will unavoidably produce interference on the P2P link communication, which will severely degrade the performance of the P2P-enabled TDD CDMA communication systems.

Fig.3 shows the various possible interferences caused by introducing P2P communication into TD-SCDMA communication systems. As shown in figure, assuming that signal S2 sent from UE A to UE B shares the same uplink timeslot with signal S1 sent from UE C to the base station, then if UE B falls within the radio coverage of UE C, UE B can receive P2P signals from UE A as well as the radio signals from UE C , and at this time, signal S1 sent by UE C becomes interference signal I1 for UE B, while signal S2 sent by UE A becomes interference signal I2 for the base station. Similarly, if UE C falls within the P2P radio coverage of UE B, signal S4 sent from UE B to UE A shares the same downlink timeslot with signal S3 sent from the base station to UE C, and in this case, signal S4 becomes interference signal I4 for UE C while signal S3 becomes interference signal I3 for UE A. Moreover, when the radio interference occurs between a pair of P2P communicating UE A and/or UE B and another pair of P2P communicating UE D and/or UE E by sharing the same timeslots, there are still interference signals I5 and I6.

It is, therefore, necessary to provide a new communication method and apparatus suitable for the P2P-enabled communication systems, to avoid the above-stated potential impacts of interference signals on the performance of the communication systems.

OBJECT AND SUMMARY OF THE INVENTION

An object of the present invention is to provide a new radio resource allocation method and apparatus in P2P-enabled communication systems, with which the interference caused by introducing P2P communication mode into communication systems can be decreased effectively.

A radio resource allocation method to be executed by a network system according to the present invention, comprising the steps of: receiving a call request from a UE for setting up P2P communication with another UE; choosing a timeslot with most vacant resource units among multiple candidate timeslots with vacant radio resource, according to the call request; estimating distances between each of multiple UEs previously allocated in the chosen timeslot and any one of said pair of UEs setting up P2P communication respectively; allocating the chosen timeslot to the UE to set up P2P communication if the estimated distances all exceed a predefined value.

A radio resource allocation method to be executed by a network system is provided according to the present invention, comprising the steps of: receiving a call request from a UE for setting up conventional communication; choosing a timeslot with most vacant resource units among the multiple candidate timeslots with vacant radio resource, according to the call request for conventional communication; estimating the distances between each of the multiple pairs of P2P UEs previously allocated in the chosen timeslot and said UE respectively; allocating the chosen timeslot to said UE to perform conventional communication if said estimated distances all exceed a predefined value.

A network system according to the present invention, comprising: receiving means for receiving a call request from a UE for setting up P2P communication with another UE; choosing means for choosing a timeslot with most vacant resource units among multiple candidate timeslots with vacant radio resource, according to the call request; estimating means for estimating distances between each of multiple UEs previously allocated in the chosen timeslot and any one of the pair of UEs setting up P2P communication respectively; allocating means for allocating the chosen timeslot to the UE to set up P2P communication if the estimated distances all exceed a predefined value.

A network system according to the present invention, comprising: receiving means for receiving a call request from a UE for setting up conventional communication; choosing means for choosing a timeslot with most vacant resource units among multiple candidate timeslots with vacant radio resource, according to the call request for conventional communication; estimating means for estimating distances between multiple pairs of P2P UEs previously allocated in the chosen timeslot and the UE respectively;

allocating means for allocating the chosen timeslot to the UE to set up conventional communication if the estimated distances all exceed a predefined value.

Other objects and attainments together with a more comprehensive understanding of the invention will become more clear and appreciated by referring to the following description and claims taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Detailed descriptions will be given below to the present invention in conjunction with specific embodiments and accompanying drawings, in which:

Fig.1 is a schematic diagram illustrating two UEs communicating through the relaying of base stations in conventional communication mode;

Fig.2 is a schematic diagram illustrating two UEs communicating in P2P communication mode;

Fig.3 is a schematic diagram illustrating various interference signals caused by introducing P2P communication mode into TD-SCDMA system;

Fig.4 is a flowchart illustrating the timeslot allocation for a P2P call request according to an embodiment of the present invention;

Fig.5 is a flowchart illustrating the timeslot allocation for a conventional call request according to another embodiment of the present invention;

Fig.6A is a block diagram illustrating the network system for executing the radio resource allocation method according to an embodiment of the present invention; and

Fig.6B is a block diagram illustrating the configuration of the network system for executing the radio resource allocation method according to another embodiment of the present invention.

Throughout the drawing figures, like reference numerals will be understood to refer to like parts and components.

DETAILED DESCRIPTION OF THE INVENTION

According to the radio resource allocation method for use in P2P-enabled communication systems provided in the present invention, when allocating communication timeslot to a UE originating a call request, considerations should be given not only to the condition of vacant radio resource of each available timeslot to balance the traffic load of each timeslot, but also to the radio range of P2P communication, so that the UE originating the P2P call request won't produce P2P interference to other communicating UEs previously allocated in the timeslot when setting up P2P communication in the allocated timeslot; and also, the UE originating the conventional call request won't produce interference to other P2P communicating UEs previously allocated in the timeslot when setting up conventional communication in the allocated timeslot.

TD-SCDMA system will be taken as an example below to describe the specific timeslot allocation procedures respectively for P2P call request and conventional call request according to an embodiment of the present invention, in conjunction with Fig.4 and Fig.5.

As shown in Fig.4, first, UTRAN receives a call request from UE1 for setting up P2P communication with UE2 (step S10). Based on this call request, UTRAN checks the current utilization of radio resource, especially the current utilization of each timeslot (step S20).

The radio resource managed by UTRAN generally relates to physical characters identifying the characteristics of a physical channel, such as carrier frequency, timeslot, spreading code and etc. The radio resource consists of several RUs (Resource Units). Each RU is a basic unit of radio resource, that is, a spreading code in a timeslot at a carrier frequency is a RU.

For instance, if the available carrier frequency is two frequencies and the SF (Spreading Factor) adopted is 16 (or namely 16 spreading codes), the total radio resources managed by UTRAN are 224 (2X16X7=224) RUs for a TD-SCDMA system in which a subframe consists of 7 timeslots. Specifically, each timeslot should have 32 (2X16=32) vacant RUs.

For conventional communication, since the relaying of base stations is necessary, the uplink and the downlink between each UE and base station need a respective RU. Thus, for conventional communication, 2 pairs (4) of RUs are needed to maintain the traffic transmission between two UEs, whereas, for P2P communication, only 1 pair (2) of RUs are needed to maintain the direct traffic communication between two UEs. Therefore, the P2P communication can save almost half radio resource.

At the above step S20, UTRAN checks the current utilization of radio resource, mainly checks whether there is a timeslot with vacant radio resource, so as to take the timeslot with vacant RU as the candidate timeslot to be allocated to the UE for setting up P2P communication.

If there is no timeslot with vacant radio resource, then reject the P2P call request from UE1 (step S30), that is, in the current, there is no sufficient RUs available for UE1 and UE2 to set up P2P communication.

If there exist timeslots with vacant radio resource, the timeslot with most vacant RUs is chosen among these candidate timeslots as the one to be allocated to UE1 and UE2 for setting up P2P communication (step S40).

Next, UTRAN estimates the distances between UE1/UE2 and each of the UEs previously allocated in the chosen timeslot, respectively (step S50).

Many approaches can apply in TD-SCDMA system to estimate the distance between two UEs. For example, UTRAN can estimate the Direction of Arrival (DOA) by using the recovered midamble data; UTRAN can estimate the distance between the UE and the base station by the arrival time from the UE to the base station, which is computed with uplink synchronization; UTRAN can estimate the location of the UE according to the DOA of the UE and the distance between the UE and the base station; and then UTRAN can determine the distance between two UEs according to the computed location of each UE. Alternatively, the distance between two UEs can be determined by using GPS (Global Positioning System).

At step S50, judge whether the estimated distances between UE1/UE2 and each of the UEs previously allocated in the chosen timeslot are all above a predefined value, such as THRD_TA, the value of which can be set according to the allowable radio range for P2P communication (step S60).

If the estimated distances all exceed the predefined value, the chosen timeslot can be allocated to UE1 and UE2 to set up P2P communication (step S70).

If not all of the estimated distances are above the predefined value, judge whether there is a candidate timeslot with vacant radio resource currently (step S80).

If there still exist candidate timeslots with vacant radio resource, a timeslot with most vacant RUs is chosen among the remaining candidate timeslots as the one to be allocated to UE1 and UE2 for setting up P2P communication (step S90). Then, steps S50 to S90 are iterated so as to find a suitable timeslot for P2P communication between UE1 and UE2.

If there is no candidate timeslot with vacant radio resource, UE1 and UE2 attempting to setting up P2P communication should change to adopt conventional communication mode (step S100), that is, regard the P2P call request from UE1 as a call request for conventional communication and allocate it the corresponding radio resource for conventional communication with the following procedures described in conjunction with Fig.5.

As shown in Fig.5, first, UTRAN receives a call request from UE1 for setting up conventional communication with UE2 (step S210). According to the call request, UTRAN checks the current utilization of radio resource, especially the current utilization of each timeslot (step S220), that is, whether there is a timeslot with vacant radio resource so as to take the timeslot with vacant RUs as the candidate timeslot to be allocated to UE1 to set up conventional communication.

If there is no such timeslot with vacant radio resource currently, that is, no sufficient RUs are available for UE1 to set up conventional communication, reject the call request for conventional communication from UE1 (step S230).

If there are timeslots with vacant radio resource currently, the timeslot with most vacant RUs is chosen among these candidate timeslots as the one to be allocated to UE1 to set up conventional communication (step S240).

Next, UTRAN estimates the distances between each of the pair of P2P communicating UEs previously allocated in the chosen timeslot and UE1 respectively (step S250).

To judge whether the estimated distances all exceed a predefined value, such as THRD_TA, the value of which can be set according to the allowable radio range for P2P communication (step S260).

If the estimated distances all exceed the predefined value, the chosen timeslot can be allocated to UE1 to set up conventional communication (step S270).

If not all of the estimated distances exceed the predefined value, determine whether there is a timeslot for relevant P2P UEs to set up conventional communication (step S265). For example, if the distance between UE1 and UE3 that belongs to a pair of P2P communicating UEs (UE3 and UE 4) in the timeslot is not above the predefined value THRD_TA, UTRAN will judge whether there is a suitable timeslot for P2P UEs (UE3 and UE4) to set up conventional communication, according to the current utilization of radio resource.

If there exist timeslots available for the pair of P2P UEs to set up conventional communication, these timeslots are reallocated to UE3 and UE4 so that UE3 and UE4 can switch respectively to conventional mode to proceed with communication (step S268). At the same time, UTRAN allocates the said timeslot chosen at step S240 to UE1 to set up conventional communication (step S270).

If there is no suitable timeslot for the pair of P2P UEs to set up conventional communication, judge whether there still exists a candidate timeslot with vacant radio resource (step S280).

If there still exist candidate timeslots with vacant radio resource, a timeslot with most vacant RUs is chosen among the remaining candidate timeslots as the one to be allocated to UE1 to set up conventional communication (step S290). And then, steps S250 to S280 are iterated so as to find a suitable timeslot for conventional communication for UE1.

If there is no candidate timeslot with vacant radio resource, reject the call request to perform conventional communication from UE1 (step S230).

With the above radio resource allocation method for use in P2P-enabled TD-SCDMA communication systems provided in the present invention, it can be implemented in software or hardware, or in combination of both.

Fig.6A is a block diagram illustrating the configuration of the network system according to an embodiment of the present invention when the above radio resource allocation method for use in P2P-enabled TD-SCDMA communication systems is implemented in hardware, wherein the components same as those in conventional network system are not given herein.

As shown in Fig.6A, in the network system: receiving unit 10 receives a call request from UE1 for setting up P2P communication with UE2; choosing unit 20 chooses a timeslot with most vacant resource units among the multiple candidate timeslots with vacant radio resource, according to the call request; estimating unit 30 estimates the distances between each of the multiple UEs previously allocated in the chosen timeslot and any one of the pair of UEs (UE1 and UE2) attempting to set up P2P communication, respectively; allocating unit 40 allocates the chosen timeslot to UE1 and UE2 to set up P2P communication if the estimated distances all exceed a predefined value.

Wherein, the vacant RU includes the carrier frequency and/or spreading code available in each timeslot, as defined in the above radio resource allocation method for use in P2P-enable TD-SCDMA communication systems.

When not all of the estimated distances are above the predefined value, choosing unit 20 chooses a timeslot with most vacant RUs among the remaining candidate timeslots. And then, estimating unit 30 re-estimates the distance between each of the multiple UEs previously allocated in the chosen timeslot and any one of the pair of UEs (UE1 and UE2)respectively, so as to find a suitable timeslot for them to set up P2P communication.

If no suitable timeslot for P2P communication is found, allocating unit 40 allocates the radio resource for conventional communication mode to UE1 and UE2 to set up communication.

Fig.6B is a block diagram illustrating the configuration of the network system according to another embodiment of the present invention, wherein, receiving unit 10 receives a call request from UE1 for setting up conventional communication; choosing unit 20 chooses a timeslot with most vacant resource units among the multiple candidate timeslots with vacant radio resource, according to the call request for conventional communication; estimating unit 30 estimates the distances between each of the multiple pairs of P2P UEs previously allocated in the chosen timeslot and UE1 respectively; allocating unit 40 allocates the chosen timeslot to UE1 to set up conventional communication if the estimated distances all exceed a predefined value.

The network system further comprises a judging unit 50, for judging whether there is a suitable timeslot for relevant P2P UEs (such as UE3 and UE4) to set up conventional communication in case that not all of the estimated distance are above the predefined value.

If there exists the suitable timeslot for relevant P2P UEs to set up conventional communication, allocating unit 40 reallocates the timeslot to the relevant P2P UEs to switch to conventional communication mode, and also allocates the chosen timeslot to UE1 to set up conventional communication.

If there exists no suitable timeslot for relevant P2P UEs to set up conventional communication, choosing unit 20 chooses a timeslot with most vacant RUs among the remaining candidate timeslots. And then, estimating unit 30 re-estimates the distances between each of the multiple pairs of P2P UEs previously allocated in the chosen timeslot and UE1 respectively, so as to find a suitable timeslot for UE1 to set up conventional communication.

Advantages of the Invention

As described above, according to the radio resource allocation method provided in the present invention, whether allocating timeslot to a UE originating P2P call request or to a UE attempting to set up conventional communication, since considering the balance of traffic load in each timeslot while considering the radio range for P2P communication, therefore, the P2P UEs setting up P2P communication in the allocated timeslot won't cause interference to other UEs sharing the same timeslot, and meanwhile, the UEs setting up conventional communication won't cause interference to the UEs setting up P2P communication within the same timeslot , . Thus, this approach can effectively avoid the possible interferences caused by introducing P2P communication into the system.

It is to be understood by those skilled in the art that the radio resource allocation method as disclosed in this invention is equally applicable to the timeslot allocation in a multicast communication system between a transmitting terminal and multiple receiving terminals, and the resource allocation of two UEs in any hop of a multi-hop communication system.

It is to be understood by those skilled in the art that the radio resource allocation method and apparatus as disclosed in this invention can be made of various modifications without departing from the spirit and scope of the invention as defined by the appended claims.

CLAIMS:

1. A radio resource allocation method to be executed by a network system, comprising the steps of:

(a) receiving a call request from a UE for setting up P2P communication with another UE;

(b) choosing a timeslot with most vacant resource units among multiple candidate timeslots with vacant radio resource, according to the call request;

(c) estimating distances between each of multiple UEs previously allocated in the chosen timeslot and any one of said pair of UEs setting up P2P communication respectively;

(d) allocating the chosen timeslot to the UE to set up P2P communication if the estimated distances all exceed a predefined value.

2. The radio resource allocation method according to claim 1, further comprising the steps of:

choosing a timeslot with most vacant resource units among the remaining candidate timeslots if not all of the estimated distances are above the predefined value;

executing step (c) and (d) so as to find a suitable timeslot for P2P communication for the UE.

3. The radio resource allocation method according to claim 2, further comprising the step of:

adopting conventional communication mode for the pair of UEs setting up P2P communication communicate; and allocating relevant radio resource to them if the suitable timeslot for P2P communication is not found.

4. The radio resource allocation method according to any one of claims 1 to 3, wherein the vacant resource unit includes carrier frequency and/or spreading code available in each timeslot.

5. A radio resource allocation method to be executed by a network system, comprising the steps of:

(i) receiving a call request from a UE for setting up conventional communication;

(ii) choosing a timeslot with most vacant resource units among multiple candidate timeslots with vacant radio resource, according to the call request for conventional communication;

(iii) estimating distances between each of multiple pairs of P2P UEs previously allocated in the chosen timeslot and said UE respectively;

(iv) allocating the chosen timeslot to the UE to set up conventional communication if the estimated distances all exceed a predefined value.

6. The radio resource allocation method according to claim 5, further comprising the steps of:

(v) judging whether there exists a suitable timeslot for relevant P2P UEs to set up conventional communication if not all of the estimated distances are above the predefined value;

(vi) reallocating the relevant P2P UEs in the timeslot to switch to conventional communication mode if there exists the suitable timeslot for relevant P2P UEs to set up conventional communication;

(vii) allocating the chosen timeslot to the UE originating the call request for conventional communication to set up conventional communication.

7. The radio resource allocation method according to claim 6, further comprising the steps of:

choosing a timeslot with most vacant resource units among the remaining candidate timeslots if there doesn't exist the suitable timeslot for relevant P2P UEs to set up conventional communication;

executing steps (iii) to (vii) so as to find a suitable timeslot for the UE to set up conventional communication.

8. The radio resource allocation method according to claim 7, further comprising the step of:

rejecting the call request for conventional communication sent from the UE if the suitable timeslot for conventional communication is not found.

9. A network system, comprising:

receiving means for receiving a call request from a UE for setting up P2P communication with another UE;

choosing means for choosing a timeslot with most vacant resource units among multiple candidate timeslots with vacant radio resource, according to the call request;

estimating means for estimating distances between each of multiple UEs previously allocated in the chosen timeslot and any one of the pair of UEs setting up P2P communication respectively;

allocating means for allocating the chosen timeslot to the UE to set up P2P communication if the estimated distances all exceed a predefined value.

10. The network system according to claim 9, wherein the choosing means chooses a timeslot with most vacant resource units among the remaining candidate timeslots so as to find a suitable timeslot for P2P communication for the UE when not all of the estimated distances exceed the predefined value.

11. The network system according to claim 10, wherein the allocating means allocates radio resource for conventional communication mode to the UE so that the pair of UEs setting up P2P communication can communicate by adopting conventional communication mode when the suitable timeslot for P2P communication is not found.

12. The network system according to any one of claims 9 to 10, wherein the vacant resource unit includes carrier frequency and/or spreading code available in each timeslot.

13. A network system, comprising:

receiving means for receiving a call request from a UE for setting up conventional communication;

choosing means for choosing a timeslot with most vacant resource units among multiple candidate timeslots with vacant radio resource, according to the call request for conventional communication;

estimating means for estimating distances between multiple pairs of P2P UEs previously allocated in the chosen timeslot and the UE respectively;

allocating means for allocating the chosen timeslot to the UE to set up conventional communication if the estimated distances all exceed a predefined value.

14. The network system according to claim 13, further comprising:

judging means for judging whether there exists a suitable timeslot for relevant P2P UEs to set up conventional communication when not all of the estimated distances are above the predefined value;

allocating means re-allocates the relevant P2P UEs in the timeslot to switch to conventional communication mode and allocates the chosen timeslot to the UE originating the call request for conventional communication to set up conventional communication when there exists the suitable timeslot for relevant P2P UEs to set up conventional communication.

15. The network system according to claim 14, further comprising:

choosing means chooses a timeslot with most vacant resource units among the remaining candidate timeslots so as to find a suitable timeslot for the UEs to set up conventional communication when there doesn’t exist the suitable timeslot for relevant P2P UEs to set up conventional communication.

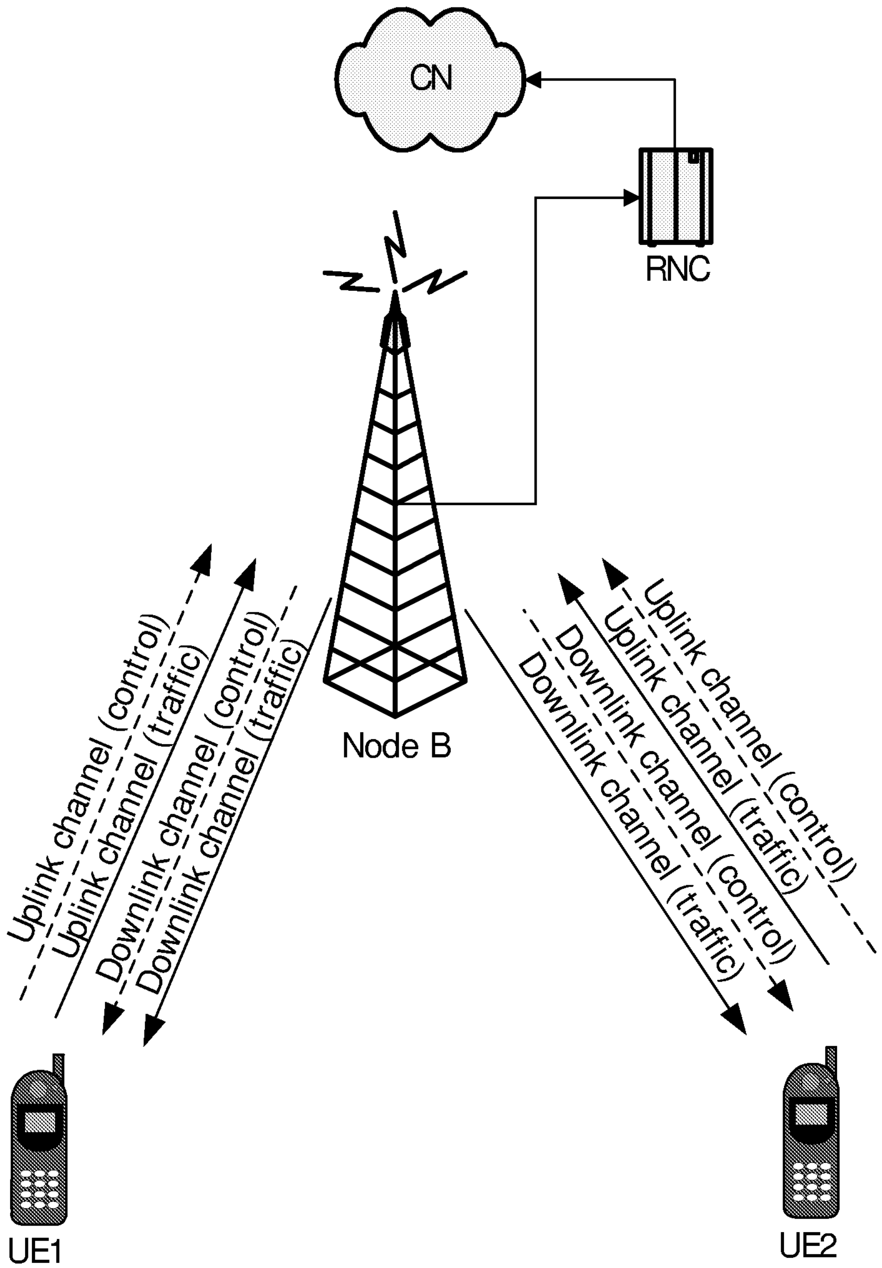
CN
RNC
Node B
Uplink channel (control)
Uplink channel (traffic)
Downlink channel (control)
Downlink channel (traffic)
Uplink channel (control)
Uplink channel (traffic)
Downlink channel (control)
Downlink channel (traffic)
UE1
UE2

FIG. 1

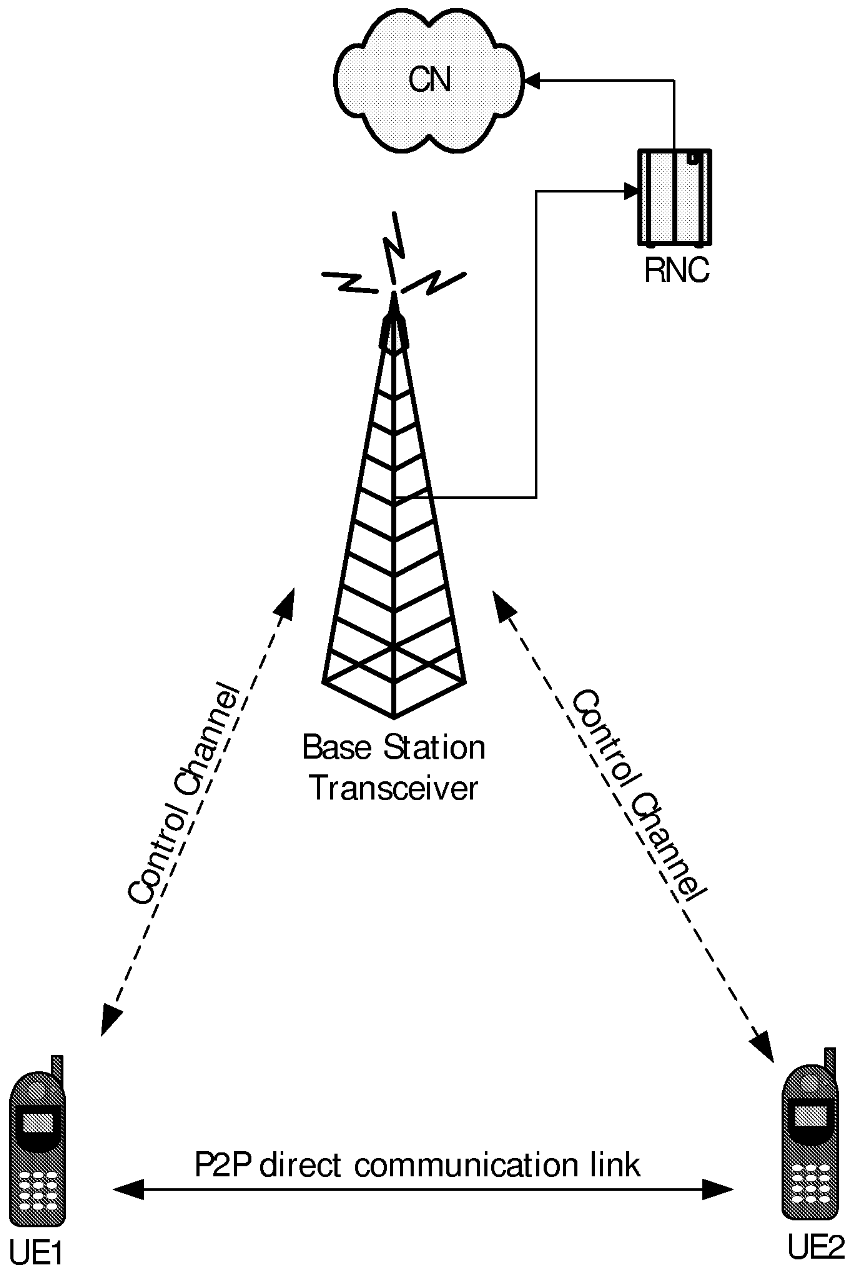
CN
RNC
Base Station
Transceiver
Control Channel
Control Channel
P2P direct communication link
UE1
UE2

FIG. 2

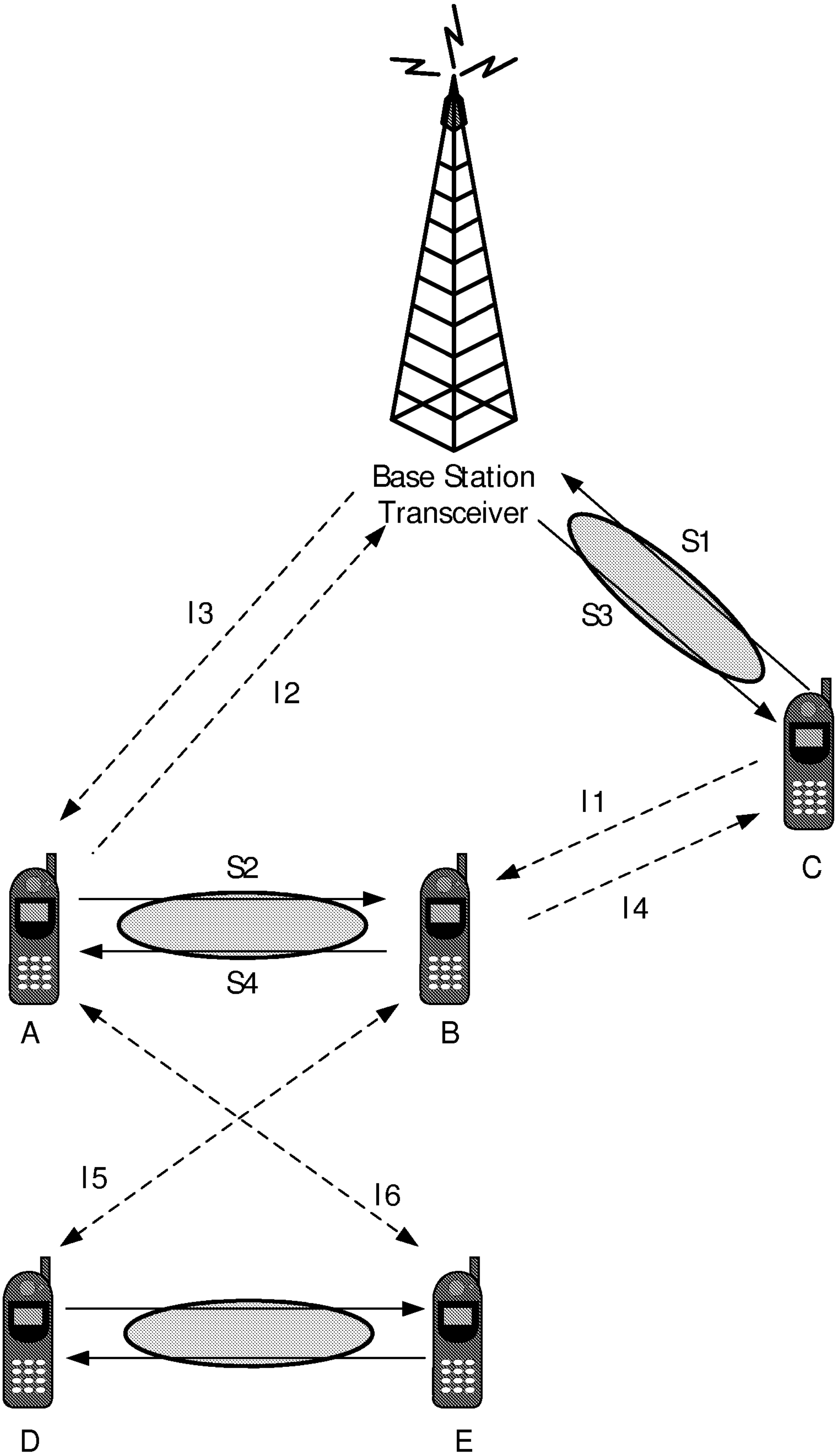

FIG. 3

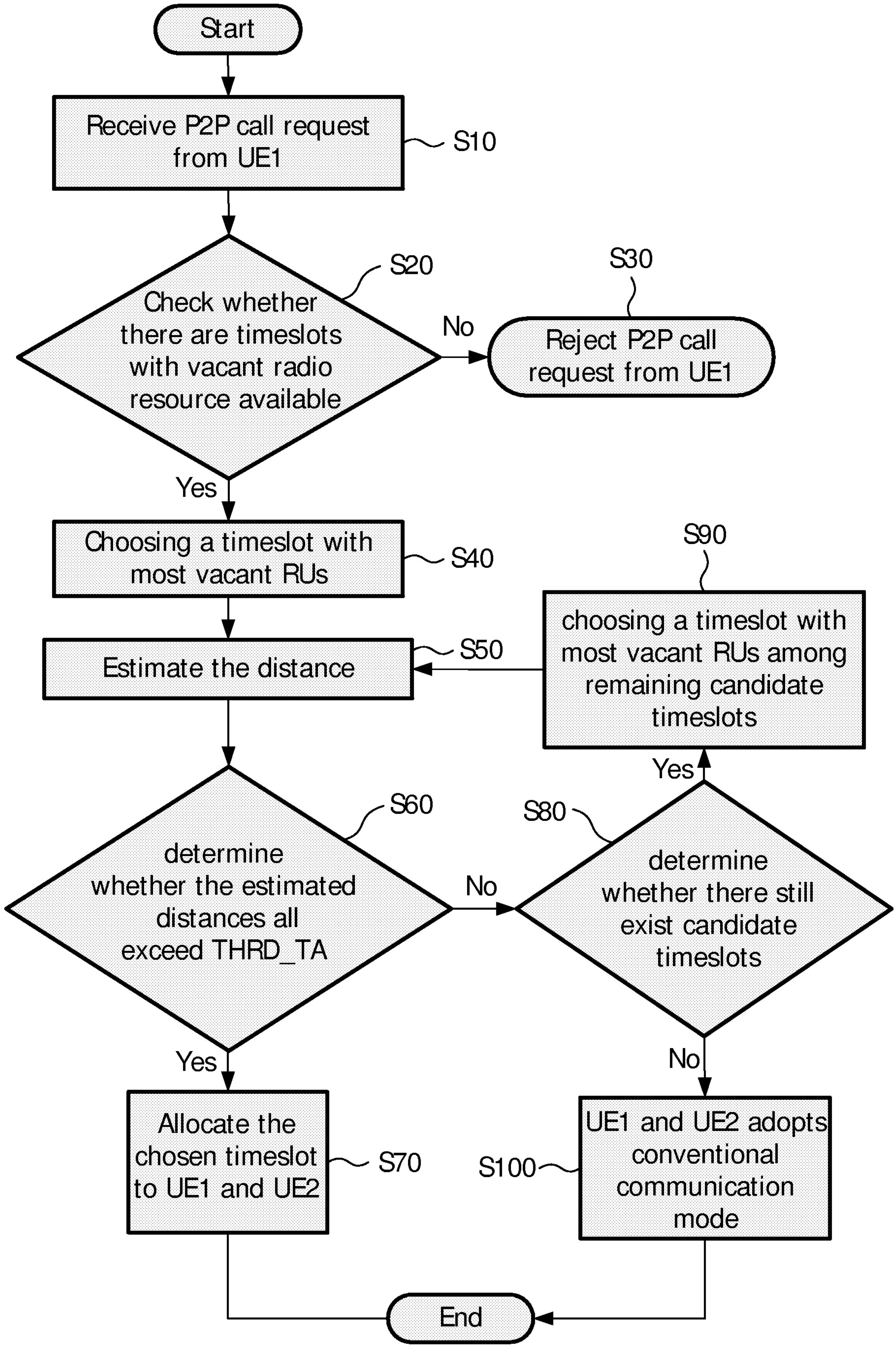
Start
Receive P2P call request from UE1
S10
S20
Check whether there are timeslots with vacant radio resource available
No
S30
Reject P2P call request from UE1
Yes
Choosing a timeslot with most vacant RUs
S40
S90
choosing a timeslot with most vacant RUs among remaining candidate timeslots
Estimate the distance
S50
Yes
S60
S80
determine whether the estimated distances all exceed THRD_TA
No
determine whether there still exist candidate timeslots
Yes
No
Allocate the chosen timeslot to UE1 and UE2
S70
S100
UE1 and UE2 adopts conventional communication mode
End

FIG. 4

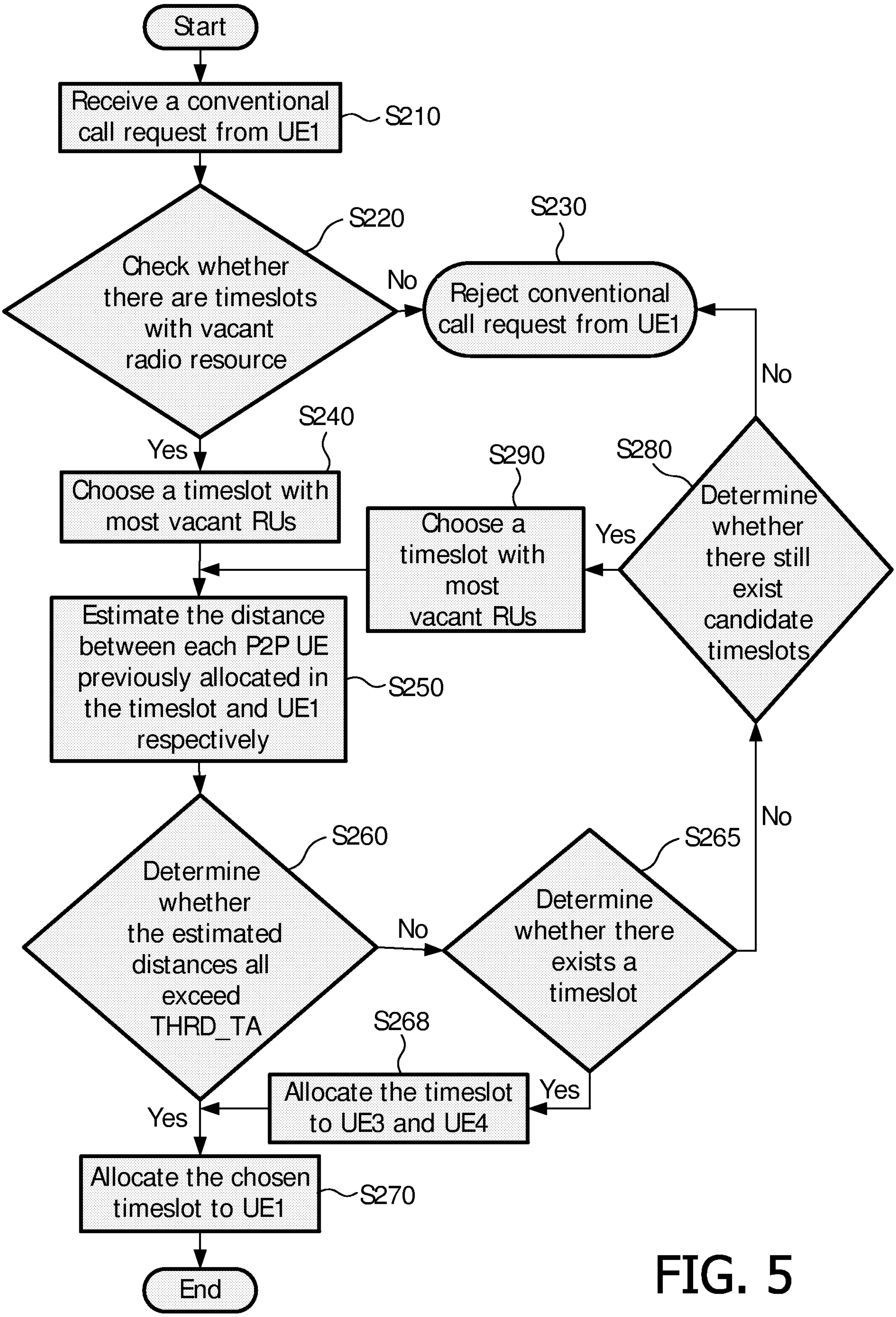
Start
Receive a conventional call request from UE1
S210
Check whether there are timeslots with vacant radio resource
S220
No
Reject conventional call request from UE1
S230
Yes
Choose a timeslot with most vacant RUs
S240
Estimate the distance between each P2P UE previously allocated in the timeslot and UE1 respectively
S250
Choose a timeslot with most vacant RUs
S290
Yes
Determine whether there still exist candidate timeslots
S280
No
Determine whether the estimated distances all exceed THRD_TA
S260
No
Determine whether there exists a timeslot
S265
No
Allocate the timeslot to UE3 and UE4
S268
Yes
Yes
Allocate the chosen timeslot to UE1
S270
End

FIG. 5

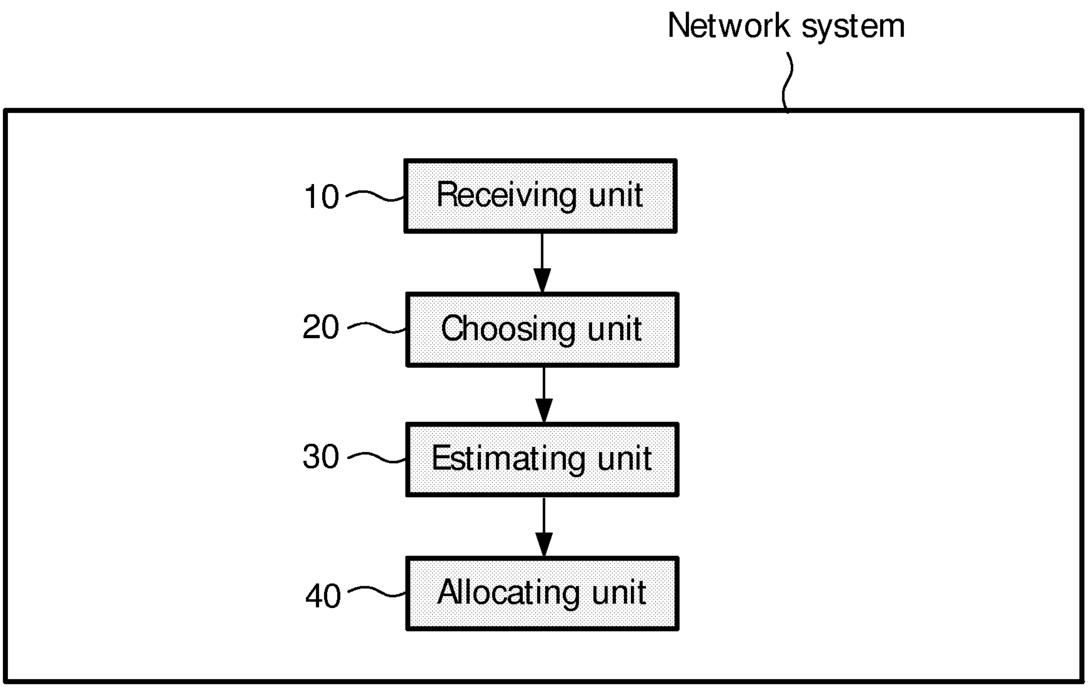
Network system
10
Receiving unit
20
Choosing unit
30
Estimating unit
40
Allocating unit

FIG. 6A

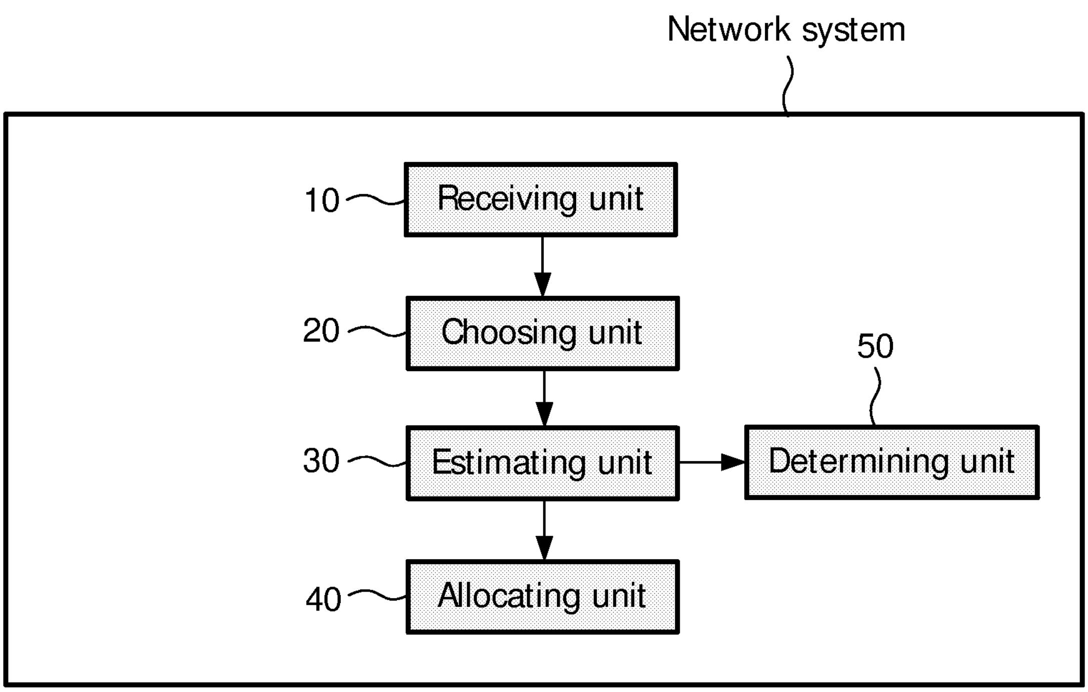
Network system
10
Receiving unit
20
Choosing unit
50
30
Estimating unit
Determining unit
40
Allocating unit

FIG. 6B