

RESOURCE SCHEDULING METHOD, BASE STATION, AND USER EQUIPMENT

~~[0001] This application claims priority to Chinese Patent Application No. 201410380567.6, filed with the Chinese Patent Office on August 4, 2014 and entitled "RESOURCE SCHEDULING METHOD, BASE STATION, AND USER EQUIPMENT", which is incorporated herein by reference in its entirety.~~

TECHNICAL FIELD

[0002] Embodiments of the present invention relate to the field of wireless communications, and more specifically, to a resource scheduling method, a base station, and user equipment.

BACKGROUND

[0003] Key technologies such as orthogonal frequency division multiplexing (Orthogonal Frequency Division Multiplexing, OFDM) and multiple-input multiple-output (Multi-Input & Multi-Output, MIMO) are introduced into a Long Term Evolution (Long Term Evolution, LTE) system, so that spectrum efficiency and a data transmission rate are obviously increased, and a system capacity and coverage are also obviously expanded.

[0004] As LTE users increase, a demand for the system capacity becomes higher. The system capacity may be expanded by increasing bandwidth, but due to limited spectrum resources, how to expand the system capacity as much as possible with limited spectrum resources has become a focus of attention.

[0005] In an LTE uplink, a virtual multiple-input multiple-output (Virtual Multi-Input & Multi-Output, VMIMO) technology may be used to pair multiple users and transmit data of the multiple users on one time-frequency resource, thereby obviously improving a cell throughput without increasing bandwidth.

[0006] However, after the VMIMO technology is used, powers for the paired users are superimposed, which obviously increases inter-cell interference, and as a quantity of paired layers increases, a quantity of interference sources increases, which finally reduce an interference suppression effect of a receiver. As a result, a throughput and performance of edge user equipment (User Equipment, UE) in a VMIMO system decline significantly, and as the quantity of paired

[0050] FIG. 9 is a schematic block diagram of a base station according to another embodiment of the present invention; and

[0051] FIG. 10 is a schematic block diagram of user equipment according to another embodiment of the present invention.

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DESCRIPTION OF EMBODIMENTS

[0052] The following clearly and completely describes the technical solutions in the embodiments of the present invention with reference to the accompanying drawings in the embodiments of the present invention. Apparently, the described embodiments are a part rather than all of the embodiments of the present invention. All other embodiments obtained by a person of ordinary skill in the art based on the embodiments of the present invention without creative efforts shall fall within the protection scope of the present invention.

[0053] The technical solutions of the present invention may be applied to various communications systems, such as: a Global System for Mobile Communications (GSM, Global System of Mobile Communication) system, a Code Division Multiple Access (CDMA, Code Division Multiple Access) system, a Wideband Code Division Multiple Access (WCDMA, Wideband Code Division Multiple Access-Wireless) system, a general packet radio service (GPRS, General Packet Radio Service) system, and a Long Term Evolution (LTE, Long Term Evolution) system.

[0054] User equipment (UE, User Equipment), which may also be referred to as a mobile terminal (Mobile Terminal), mobile user equipment, or the like, may communicate with one or more core networks by using a radio access network (~~for example, RAN~~, Radio Access Network). The user equipment may be a mobile terminal such as a mobile phone (or referred to as a "cellular" phone), or a computer embedded with a mobile terminal; for example, the user equipment may be a portable, pocket-sized, handheld, computer built-in, or in-vehicle mobile apparatus, which exchanges voice and/or data with the radio access network.

[0055] A base station may be a base station (BTS, Base Transceiver Station) in GSM or CDMA, may be a base station (NodeB) in WCDMA, or may be an evolved NodeB (eNB, or e-NodeB, evolutionary Node B) in LTE, which is not limited in the present invention.

[0056] As a key technology for implementing LTE, a MIMO technology can obviously improve a system capacity and spectrum efficiency, and can well resolve a situation of radio resource shortage. In an actual mobile communications system, relatively few limitations are imposed on a base station side, multiple transmit and receive antennas may be used, and isolation between the antennas is relatively good. Therefore, an advantage of the MIMO technology can be fully exploited

VMIMO pairing is not performed on the edge UE scheduled on the dedicated frequency resource, thereby improving a throughput and performance of the edge UE while a throughput of an entire VMIMO system is ensured.

[0064] First, the UE may send the scheduling request to the base station, to request the base station to allocate an uplink time-frequency resource to the UE, so that the UE sends uplink data to the base station by using the allocated uplink time-frequency resource. Specifically, the scheduling request may be from using a physical uplink control channel (~~PhysielPhysical~~ Uplink Control Channel, PUCCH), a physical uplink shared channel (~~PhysielPhysical~~ Uplink Schared Channel, PUSCH), or another uplink channel. The scheduling request may carry a message field used to instruct the base station to allocate a time-frequency resource to the UE. For example, the scheduling request may be an uplink scheduling request (Schduling Request, SR), a radio access request message of the UE, or another uplink message from the UE to the base station, which is not limited in the present invention.

[0065] After receiving the scheduling request from the UE, the base station may determine the scheduling type of the UE, that is, determine that the UE is edge UE or non-edge UE. It should be understood that, in a mobile communications network, one cell may provide communications services to multiple UEs at the same time, which may be understood as that a serving cell may control multiple UEs. A criterion for determining edge UE may be based on a geographical location of the UE, for example, UE at a cell edge is regarded as edge UE. Alternatively, a criterion for determining edge UE may be based on a throughput, for example, some UEs with a lowest throughput are regarded as edge UEs. There may be a constant percentage of UEs having the lowest throughput, for example, 5%, and a specific value may be determined based on a network requirement.

[0066] In addition, the base station may also determine edge UE by measuring a signal to interference plus noise ratio (~~Singal to Interference Noise Ratio~~, SINR) on a channel between the UE and the base station, or by using a reference signal received power (~~Reference Signal Receeiving Power~~, RSRP) reported by the UE, or by using an RSRP difference or an SINR difference, reported by the UE, between the serving cell of the UE and a neighboring cell of the serving cell.

[0067] The frequency resource configuration of the serving cell of the UE is used to indicate that a frequency resource of the serving cell includes a dedicated frequency resource and a public frequency resource. The frequency resource configuration may be pre-configured by the base station or an upper-layer network element, and takes effect in a control unit of each cell after the base station or the cell starts working and joins in a network or after settings are adjusted. The frequency resource configuration may also be set by network maintenance personnel for the entire

communication quality, such as an RSRP, RSRQ, an RSSI, and a distance between the UE and the base station. Correspondingly, the setting of the second threshold, and settings of a magnitude relationship and a determining result vary with a parameter type. For example, when a measurement parameter is an RSRP, and when a measurement result is less than the second threshold, it is determined that the UE is a user that needs to be protected; or when a measurement result is greater than the second threshold, it is determined that the UE is a user that does not need to be protected. As for a case in which the measurement result is equal to the second threshold, that the UE is a user that needs to be protected or a user that does not need to be protected may be preset. In addition, the parameter for determining whether the UE is a user that needs to be protected may also be any combination of the foregoing several parameters, which is not limited in the present invention. In addition, the type of the parameter for determining whether the UE is edge UE may be the same as or different from that of the parameter for determining whether the UE is a user that needs to be protected.

[0104] The base station sends the scheduling information to the UE, where the scheduling information is used to indicate the frequency resource scheduled by the base station for the UE. Specifically, the scheduling information may carry a message field that indicates a time-frequency resource allocated by the base station to the UE, and is used to indicate the frequency resource scheduled by the base station for the UE in the foregoing embodiments. The scheduling information may be from using a physical downlink control channel (~~Physical~~Physical Downlink Control Channel, PDCCH), a physical downlink shared channel (~~Physical~~Physical Downlink Shared Channel, PDSCH), or another downlink channel, which is not limited in the present invention.

[0105] According to this embodiment of the present invention, frequency band configuration is performed on an entire frequency resource of a cell, so that a user at a cell edge is preferentially scheduled on a configured dedicated frequency resource, and VMIMO pairing is not performed on edge UE scheduled on the dedicated frequency resource; therefore, while a throughput of an entire VMIMO system is ensured, interference from VMIMO paired users in this cell and a neighboring cell on the edge UE is reduced, thereby improving a throughput and performance of the edge UE. Moreover, the dedicated frequency resource may be configured at one side of an entire frequency band in a centralized manner, to reduce frequency borders with a public frequency resource, and further improve isolation between the edge UE on the dedicated frequency resource and a user scheduled on the public frequency resource, so that the interference on the edge UE may be reduced as much as possible. Alternatively, different frequency band configuration manners are used in neighboring cells, so that locations of dedicated frequency resources can be staggered on the entire frequency band, and interference between edge UEs of the neighboring cells is further reduced;

embodiment of the present invention. Similar to FIG. 5, three hexagons combined together may represent three cellular cells or three sectors controlled by a base station, and numbers 0, 1, and 2 in each cell may correspond to the three frequency band configurations in FIG. 4. As can be seen, frequency band configurations of every two neighboring cells are different, that is, dedicated frequency resources of all cells are staggered; in this way, interference between edge UEs of the neighboring cells is reduced; therefore, a throughput and performance of the edge UE can be further improved.

[0135] FIG. 7 is a schematic block diagram of a base station according to an embodiment of the present invention. The base station 60 in FIG. 6-7 includes a receiving unit 61, a processing unit 62, and a sending unit 63.

[0136] The receiving unit 61 receives a scheduling request from user equipment UE. The processing unit 62 determines a scheduling type of the UE, where the scheduling type is edge UE or non-edge UE. The processing unit 62 schedules a frequency resource for the UE according to the scheduling type of the UE and a frequency resource configuration of a serving cell of the UE, where the frequency resource configuration of the serving cell of the UE includes a public frequency resource and a dedicated frequency resource; virtual multiple-input multiple-output VMIMO pairing is allowed on the public frequency resource, and the public frequency resource is capable of being used to schedule edge UE and non-edge UE; and VMIMO pairing is not allowed on the dedicated frequency resource, and the dedicated frequency resource is capable of being used to schedule only edge UE. The sending unit 63 sends scheduling information to the UE, where the scheduling information is used to indicate a frequency resource scheduled by the base station for the UE.

[0137] The base station 60 in this embodiment of the present invention determines that a scheduling type of UE is edge UE or non-edge UE, and schedules a resource for the UE according to the scheduling type of the UE and a frequency resource configuration of a serving cell of the UE; therefore, edge UE is preferentially scheduled on a configured dedicated frequency resource, and VMIMO pairing is not performed on the edge UE scheduled on the dedicated frequency resource, thereby improving a throughput and performance of the edge UE while a throughput of an entire VMIMO system is ensured.

[0138] First, the UE may send the scheduling request to the base station 60, to request the base station 60 to allocate an uplink time-frequency resource to the UE, so that the UE sends uplink data to the base station 60 by using the allocated uplink time-frequency resource. Specifically, the scheduling request may be from using a physical uplink control channel (~~Physical~~Physical Uplink Control Channel, PUCCH), a physical uplink shared channel (~~Physical~~Physical Uplink Schared Channel, PUSCH), or

CLAIMS

What is claimed is:

1. A resource scheduling method, comprising:

receiving (101, S301), by a base station, a scheduling request from user equipment, UE;

determining (102, S302), by the base station, a scheduling type of the UE, wherein the scheduling type is edge UE or non-edge UE;

scheduling (103, S303), by the base station, a frequency resource for the UE according to the scheduling type of the UE and a frequency resource configuration of a serving cell of the UE; and

sending (104, S304), by the base station, scheduling information to the UE, wherein the scheduling information is used to indicate the frequency resource scheduled ~~by the base station~~ for the UE, wherein

the frequency resource configuration of the serving cell of the UE comprises a public frequency resource and a dedicated frequency resource; virtual multiple-input multiple-output, VMIMO, pairing is allowed on the public frequency resource, and the public frequency resource is capable of being used to schedule edge UE and non-edge UE; and VMIMO pairing is not allowed on the dedicated frequency resource, and the dedicated frequency resource is capable of being used to schedule only edge UE.

2. The method according to claim 1, wherein the scheduling, by the base station, a frequency resource for the UE according to the scheduling type of the UE and a frequency resource configuration of a serving cell of the UE comprises:

when the UE is non-edge UE, scheduling the frequency resource for the UE only on the public frequency resource.

3. The method according to claim 1 or 2, wherein the scheduling, by the base station, a frequency resource for the UE according to the scheduling type of the UE and a frequency resource configuration of a serving cell of the UE comprises:

when the UE is edge UE, between the dedicated frequency resource and the public frequency resource, scheduling the frequency resource for the UE preferentially on the dedicated frequency resource.

4. The method according to claim 3, wherein the scheduling the frequency resource for the UE preferentially on the dedicated frequency resource comprises:

preferentially selecting, from unscheduled frequency resources of the dedicated frequency resource, a frequency resource with a largest frequency spacing from the public frequency resource.

5 5. The method according to claim 1 or 2, wherein the scheduling, by the base station, a frequency resource for the UE according to the scheduling type of the UE and a frequency resource configuration of a serving cell of the UE comprises:

when the UE is edge UE, preferentially selecting a frequency resource with a maximum signal to interference plus noise ratio, $SINR_s$, from unscheduled resources of the public frequency resource and the dedicated frequency resource.

10 6. The method according to any one of claims 1 to 5, wherein the determining, by the base station, a scheduling type of the UE comprises:

receiving an uplink signal from the UE, and determining a signal to interference plus noise ratio, $SINR_s$, of the UE; and

15 when the SINR of the UE is less than a first preset threshold, determining that the UE is edge UE; or

when the SINR of the ~~target~~-UE is greater than a first preset threshold, determining that the UE is non-edge UE.

20 7. The method according to any one of claims 1 to 5, wherein the determining, by the base station, a scheduling type of the UE comprises:

receiving a reference signal received power, $RSRP_s$, difference from the UE, wherein the $RSRP$ difference comprises a difference between a receive power of a downlink reference signal in the serving cell of the UE and a receive power of a downlink reference signal in a neighboring cell of the serving cell of the UE; and

25 when an absolute value of the $RSRP$ difference is less than a first preset threshold, determining that the UE is edge UE; or

when an absolute value of the $RSRP$ difference is greater than a first preset threshold, determining that the UE is non-edge UE.

30 8. The method according to any one of claims 1 to 7, wherein

the dedicated frequency resource is a continuous frequency segment pre-configured in a frequency resource of the serving cell of the UE, and the pre-configured continuous frequency segment comprises a highest frequency or a lowest frequency in the frequency resource of the

serving cell of the UE.

9. A resource scheduling method, comprising:

5 sending, by user equipment UE, a scheduling request to a base station, wherein the base station is a control base station of a serving cell of the UE, and a scheduling type, determined by the base station, of the UE is edge UE or non-edge UE, wherein

10 a frequency resource configuration of the serving cell of the UE comprises a public frequency resource and a dedicated frequency resource; virtual multiple input multiple output VMIMO pairing is allowed on the public frequency resource, and the public frequency resource is capable of being used to schedule edge UE and non-edge UE; and VMIMO pairing is not allowed on the dedicated frequency resource, and the dedicated frequency resource is capable of being used to schedule only edge UE; and

15 receiving, by the UE, scheduling information from the base station, wherein the scheduling information is used to indicate a frequency resource scheduled by the base station for the UE.

10. The method according to claim 9, wherein

20 when the scheduling type, determined by the base station, of the UE is non-edge UE, the frequency resource indicated by the scheduling information comprises only some or all unscheduled resources of the public frequency resource.

11. The method according to claim 9 or 10, wherein

25 when the scheduling type, determined by the base station, of the UE is edge UE, the frequency resource indicated by the scheduling information comprises only some or all unscheduled resources of the dedicated frequency resource; or

30 the frequency resource indicated by the scheduling information comprises all unscheduled resources of the dedicated frequency resource and some or all unscheduled resources of the public frequency resource.

12. The method according to claim 11, wherein

when the frequency resource indicated by the scheduling information comprises only some unscheduled resources of the dedicated frequency resource, the frequency resource indicated by the scheduling information comprises: a frequency resource, in the unscheduled frequency resources of the dedicated frequency resource, with a largest frequency spacing from the public frequency resource.

13. The method according to claim 9 or 10, wherein

when the scheduling type, determined by the base station, of the UE is edge UE, the frequency resource indicated by the scheduling information comprises: a frequency resource with a maximum signal to interference plus noise ratio SINR in unscheduled resources of the public frequency resource and the dedicated frequency resource.

14. The method according to any one of claims 9 to 13, further comprising:

sending an uplink reference signal to the base station, wherein the uplink reference signal is used by the base station to determine a signal to interference plus noise ratio SINR of the UE; or

sending a reference signal received power RSRP difference to the base station, wherein the RSRP difference comprises a difference between a receive power of a downlink reference signal in the serving cell of the UE and a receive power of a downlink reference signal in a neighboring cell of the serving cell of the UE, wherein

the signal to interference plus noise ratio SINR of the UE or the RSRP difference is used by the base station to determine that the UE is edge UE or non-edge UE.

15. The method according to any one of claims 9 to 14, wherein

the dedicated frequency resource is a continuous frequency segment pre-configured in a frequency resource of the serving cell of the UE, and the pre-configured continuous frequency segment comprises a highest frequency or a lowest frequency in the frequency resource of the serving cell of the UE.

169. A base station, comprising:

a receiving unit (61), configured to receive a scheduling request from user equipment, UE;
a processing unit (62), configured to determine a scheduling type of the UE, wherein the scheduling type is edge UE or non-edge UE, and the processing unit schedules a frequency resource for the UE according to the scheduling type of the UE and a frequency resource configuration of a serving cell of the UE; and

a sending unit (63), configured to send scheduling information to the UE, wherein the scheduling information is used to indicate the frequency resource scheduled by the base station for the UE, wherein

the frequency resource configuration of the serving cell of the UE comprises a public frequency resource and a dedicated frequency resource; virtual multiple-input multiple-output,

VMIMO₁ pairing is allowed on the public frequency resource, and the public frequency resource is capable of being used to schedule edge UE and non-edge UE; and VMIMO pairing is not allowed on the dedicated frequency resource, and the dedicated frequency resource is capable of being used to schedule only edge UE.

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1710. The base station according to claim 169, wherein the processing unit is specifically configured to: when the UE is non-edge UE, schedule the frequency resource for the UE only on the public frequency resource.

10 1811. The base station according to claim 169 or 1710, wherein the processing unit is specifically configured to: when the UE is edge UE, between the dedicated frequency resource and the public frequency resource, schedule the frequency resource for the UE preferentially on the dedicated frequency resource.

15 1912. The base station according to claim 1811, wherein the processing unit is specifically configured to: preferentially select, from unscheduled frequency resources of the dedicated frequency resource, a frequency resource with a largest frequency spacing from the public frequency resource.

20 2013. The base station according to claim 169 or 1710, wherein the processing unit is specifically configured to: when the UE is edge UE, preferentially select a frequency resource with a maximum signal to interference plus noise ratio, SINR₁, from unscheduled resources of the public frequency resource and the dedicated frequency resource.

25 2114. The base station according to any one of claims 169 to 2013, wherein the processing unit is specifically configured to:

receive, by using the receiving unit, an uplink signal from the UE, and determine a signal to interference plus noise ratio, SINR₁, of the UE; and

when the SINR of the UE is less than a first preset threshold, determine that the UE is edge UE;

30 or

when the SINR of the target UE is greater than a first preset threshold, determine that the UE is non-edge UE.

2215. The base station according to any one of claims 16-9 to 2014, wherein the processing unit is specifically configured to:

receive, by using the receiving unit, a reference signal received power, RSRP, difference from the UE, wherein the RSRP difference comprises a difference between a receive power of a downlink reference signal in the serving cell of the UE and a receive power of a downlink reference signal in a neighboring cell of the serving cell of the UE; and

when an absolute value of the RSRP difference is less than a first preset threshold, determine that the UE is edge UE; or

when an absolute value of the RSRP difference is greater than a first preset threshold, determine that the UE is non-edge UE.

2316. The base station according to any one of claims 16-9 to 2215, wherein

the dedicated frequency resource is a continuous frequency segment pre-configured in a frequency resource of the serving cell of the UE, and the pre-configured continuous frequency segment comprises a highest frequency or a lowest frequency in the frequency resource of the serving cell of the UE.

24. User equipment, comprising:

a sending unit, configured to send a scheduling request to a base station, wherein the base station is a control base station of a serving cell of the UE, and a scheduling type, determined by the base station, of the UE is edge UE or non-edge UE, wherein

a frequency resource configuration of the serving cell of the UE comprises a public frequency resource and a dedicated frequency resource; virtual multiple-input multiple-output VMIMO pairing is allowed on the public frequency resource, and the public frequency resource is capable of being used to schedule edge UE and non-edge UE; and VMIMO pairing is not allowed on the dedicated frequency resource, and the dedicated frequency resource is capable of being used to schedule only edge UE; and

a receiving unit, configured to receive scheduling information from the base station, wherein the scheduling information is used to indicate a frequency resource scheduled by the base station for the UE.

25. The user equipment according to claim 24, wherein

when the scheduling type, determined by the base station, of the UE is non-edge UE, the frequency resource indicated by the scheduling information comprises only some or all unscheduled

resources of the public frequency resource.

26. The user equipment according to claim 24 or 25, wherein
when the scheduling type, determined by the base station, of the UE is edge UE, the frequency
resource indicated by the scheduling information comprises only some or all unscheduled resources
of the dedicated frequency resource; or

the frequency resource indicated by the scheduling information comprises all unscheduled
resources of the dedicated frequency resource and some or all unscheduled resources of the public
frequency resource.

27. The user equipment according to claim 26, wherein
when the frequency resource indicated by the scheduling information comprises only some
unscheduled resources of the dedicated frequency resource, the frequency resource indicated by the
scheduling information comprises: a frequency resource, in the unscheduled frequency resources of
the dedicated frequency resource, with a largest frequency spacing from the public frequency
resource.

28. The user equipment according to claim 24 or 25, wherein
when the scheduling type, determined by the base station, of the UE is edge UE, the frequency
resource indicated by the scheduling information comprises: a frequency resource with a maximum
signal to interference plus noise ratio SINR in unscheduled resources of the public frequency
resource and the dedicated frequency resource.

29. The user equipment according to any one of claims 24 to 28, wherein the sending unit is
further configured to:

send an uplink reference signal to the base station, wherein the uplink reference signal is used
by the base station to determine a signal to interference plus noise ratio SINR of the UE; or

send a reference signal received power RSRP difference to the base station, wherein the RSRP
difference comprises a difference between a receive power of a downlink reference signal in the
serving cell of the UE and a receive power of a downlink reference signal in a neighboring cell of
the serving cell of the UE, wherein

the signal to interference plus noise ratio SINR of the UE or the RSRP difference is used by
the base station to determine that the UE is edge UE or non-edge UE.

30. ~~The user equipment according to any one of claims 24 to 29, wherein~~
~~the dedicated frequency resource is a continuous frequency segment pre-configured in a~~
~~frequency resource of the serving cell of the UE, and the pre-configured continuous frequency~~
~~segment comprises a highest frequency or a lowest frequency in the frequency resource of the~~
~~serving cell of the UE.~~

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