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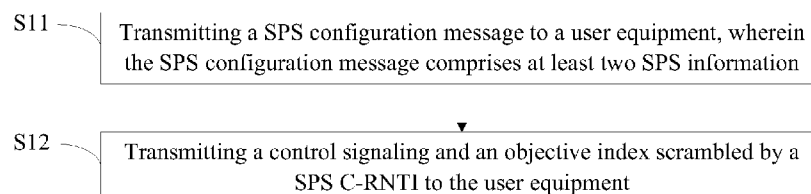


FIG. 1

(57) Abstract: Methods for semi-persistent scheduling are disclosed. A method includes: transmitting a SPS (semi-persistent scheduling) configuration message for a SPS to a user equipment, wherein the SPS configuration message comprises at least two SPS information, each of the SPS information at least comprises a SPS C-RNTI (cell radio network temporary identity) of the SPS; transmitting a control signaling and an objective index scrambled by the SPS C-RNTI to the user equipment, wherein the objective index comprises at least an identification of one user equipment, such that the user equipment corresponding to the identification executes one or more operations for the SPS corresponding to the SPS C-RNTI in accordance with the control signaling. Associated base stations and UEs are also disclosed.

# **METHOD, BASE STATION, AND USER EQUIPMENT FOR SEMI-PERSISTENT SCHEDULING**

## **TECHNICAL FIELD**

[0001] Embodiments of the present disclosure generally relate to communication technologies, and in particular relate to a semi-persistent scheduling method, a base station, and a user equipment (UE).

## **BACKGROUND**

[0002] In LTE/LTE-A, dynamic shared resource scheduling technique is adopted. In a data upload process. Since a user equipment has to use time frequency resources to transmit data, the user equipment has to apply for resources toward a base station in advance, and then the data can be transmitted after obtaining authority from the base station.

[0003] Although dynamic shared resource scheduling technique largely optimizes resource allocation, it has control signaling overheads. In order to reduce the control signaling overheads, semi-persistent scheduling (SPS) technique is adopted in the applications which have more fixed data packet sizes and more regular intervals between data packets.

[0004] For instance, in UL (uplink) SPS, a base station transmits a SPS configuration message comprising a SPS C-RNTI (cell radio network temporary identity) and a SPS period to a user equipment, and then transmits an SPS activation message comprising a SPS resource allocation information. After activated, the user equipment use allocated resources to transmit upload data in accordance with the SPS period, while scheduling is not need.

[0005] However, in some systems such as vehicle-to-everything (V2X) which have to transmit various data regularly, the control signaling overheads caused by scheduling is too many and even possible to limit system capacity. Although multiple SPSs is an effective method to reduce the control signaling overheads, since

the existed techniques merely support one SPS in a time, which is not able to satisfy the demand for multiple SPSs.

## SUMMARY

[0006] In view of the above, embodiments of the present disclosure provide methods, base station, and user equipments for semi-persistent scheduling, aiming at supporting multiple SPSs.

[0007] There is provided a method for semi-persistent scheduling that comprises: transmitting a SPS (semi-persistent scheduling) configuration message for a SPS to a user equipment, wherein the SPS configuration message comprises at least two SPS information, each of the SPS information at least comprises a SPS C-RNTI (cell radio network temporary identity) of the SPS; transmitting a control signaling and an objective index scrambled by the SPS C-RNTI to the user equipment, wherein the objective index comprises at least an identification of one user equipment, such that the user equipment corresponding to the identification executes one or more operations for the SPS corresponding to the SPS C-RNTI in accordance with the control signaling.

[0008] The step of transmitting a control signaling scrambled by the SPS C-RNTI to the user equipment may comprise at least: transmitting an activation signaling scrambled by the SPS C-RNTI to the user equipment through a PDCCH (physical downlink control channel); or transmitting a release signaling scrambled by the SPS C-RNTI to the user equipment through the PDCCH or using a RRC (radio resource control) message.

[0009] The step of transmitting a control signaling scrambled by the SPS C-RNTI to the user equipment may comprise: transmitting the control signaling corresponding to an operation request for the SPS to the user equipment in response to the operation request from the user equipment, wherein the operation request comprises at least activation request or a release request.

[0010] The step of transmitting the control signaling corresponding to a release

request for the SPS to the user equipment in response to the release request transmitted by the user equipment may comprise: transmitting the control signaling corresponding to the release request to the user equipment if the continuous times of not yet receiving the data transmitted by the user equipment using a corresponding SPS resource is larger than a predetermined threshold.

[0011] The step of transmitting a control signaling scrambled by the SPS C-RNTI to the user equipment may comprise: transmitting the control signaling to a plurality of the user equipment through multicast or broadcast.

[0012] The method may further comprise, before the step of transmitting the control signaling to a plurality of the user equipment through multicast or broadcast: obtaining an operation request from the user equipment, wherein the amount of the operation request obtained from the user equipment in a predetermined period is larger than a predetermined threshold.

[0013] The control signaling may comprise the objective index, and the step of transmitting the control signaling to a plurality of the user equipment through multicast may comprise: transmitting the control signaling to at least the user equipment informing of the operation request for the SPS through multicast in a plurality of times, wherein the sum of the times to transmit the control signaling and the largest amount of the identification comprised in the objective index is smallest

[0014] The control signaling may include the objective index.

[0015] The method may further comprise, before the step of transmitting a control signaling and an objective index scrambled by the SPS C-RNTI to the user equipment: allocating the identification to the user equipment.

[0016] The identification may comprise: a group identification and a user equipment identification.

[0017] When transmitting the control signaling to at least the user equipment informing of an operation request for the SPS through multicast in response to the operation request from the user equipment, the identification in the objective index may be the group identification if the transmission objectives have a same group

identification and all informed of the operation request.

[0018] The SPS information may further comprise a period and a resource allocation of the SPS.

[0019] The SPS information may further comprise a release instruction of the SPS.

[0020] There is also provided a method for semi-persistent scheduling that comprises: receiving a SPS (semi-persistent scheduling) configuration message transmitted by a base station, wherein the SPS configuration message comprises at least two SPS information, each of the SPS information at least comprises a SPS C-RNTI (cell radio network temporary identity) of the SPS; receiving a control signaling and an objective index scrambled by the SPS C-RNTI transmitted by the base station; executing one or more operations for the SPS corresponding to the SPS C-RNTI in accordance with the control signaling if the objective index comprises a self identification, wherein the operation comprises at least activation or release.

[0021] The step of receiving a control signaling scrambled by the SPS C-RNTI from the base station comprises at least: receiving an activation signaling scrambled by the SPS C-RNTI through a PDCCH (physical downlink control channel); or receiving a release signaling scrambled by the SPS C-RNTI through the PDCCH or using a RRC message.

[0022] The method may further comprise, before the step of receiving a control signaling and an objective index scrambled by the SPS C-RNTI transmitted by the base station: informing the base station of an operation request corresponding to the SPS, wherein the operation request comprises at least an activation request or a release request.

[0023] The step of informing the base station of an operation request corresponding to the SPS may comprise: transmitting the operation request corresponding to the SPS to the base station.

[0024] The step of informing the base station of a release request corresponding to the SPS may comprise: suspending using a corresponding SPS resource to transmit data to the base station for continuous N times, wherein N is larger than a

predetermined threshold.

[0025] The control signaling may comprise the objective index, and after the step of receiving a control signaling and an objective index scrambled by the SPS C-RNTI transmitted by the base station the method may further comprise: trying to use the SPS C-RNTI in the SPS configuration message to decode the control signaling; determining whether the objective index comprises the self identification if the decode is successful.

[0026] The control signaling may not comprise the objective index, and after the step of receiving a control signaling and an objective index scrambled by the SPS C-RNTI transmitted by the base station the method may further comprise: determining whether the objective index comprises the self identification; using the SPS C-RNTI in the SPS configuration message to decode the control signaling, if the objective index comprises the self identification.

[0027] The method may further comprise, before the step of receiving a control signaling and an objective index scrambled by the SPS C-RNTI transmitted by the base station: receiving an identification allocated by the base station.

[0028] The identification may comprise a group identification and a user equipment identification.

[0029] There is also provided a base station that comprises: a first transmitting module configured to transmit a SPS (semi-persistent scheduling) configuration message for a SPS to a user equipment, wherein the SPS configuration message comprises at least two SPS information, each of the SPS information at least comprises a SPS C-RNTI (cell radio network temporary identity) of the SPS; a second transmitting module configured to transmit a control signaling and an objective index scrambled by the SPS C-RNTI to the user equipment, wherein the objective index comprises at least an identification of one user equipment, such that the user equipment corresponding to the identification executes one or more operations for the SPS corresponding to the SPS C-RNTI in accordance with the control signaling.

[0030] The second transmitting module may be configured to transmit the control

signaling corresponding to an operation request for the SPS to the user equipment in response to the operation request from the user equipment, wherein the operation request comprises at least an activation request or a release request.

[0031] The second transmitting module may be configured to transmit the control signaling corresponding to the release request to the user equipment when the continuous times of not yet receiving the data transmitted by the user equipment using a corresponding SPS resource is larger than a predetermined threshold

[0032] The second transmitting module may be configured to transmit the control signaling to a plurality of the user equipment through multicast or broadcast.

[0033] The base station may further comprise an allocation module configured to allocate an identification to the user equipment.

[0034] There is also provided a user equipment that comprises: a first receiving module configured to receive a SPS (semi-persistent scheduling) configuration message transmitted by a base station, wherein the SPS configuration message comprises at least two SPS information, each of the SPS information at least comprises a SPS C-RNTI (cell radio network temporary identity) of the SPS; a second receiving module configured to receive a control signaling and an objective index scrambled by the SPS C-RNTI transmitted by the base station; an execution module configured to execute one or more operations for the SPS corresponding to the SPS C-RNTI in accordance with the control signaling if the objective index comprises a self identification of the user equipment, wherein the operation comprises at least activation or release.

[0035] The second receiving module may be configured to at least receive an activation signaling scrambled by the SPS C-RNTI through a PDCCH (physical downlink control channel); or receive a release signaling scrambled by the SPS C-RNTI through the PDCCH or using a RRC message.

[0036] The control signaling may comprise the objective index, and the user equipment may further comprise: a decoder module configured to try to use the SPS C-RNTI in the SPS configuration message to decode the control signaling; a

determination module configured to determine whether the objective index comprises the self identification.

[0037] The control signaling may not comprise the objective index, the user equipment may further comprise: a determination module configured to determine whether the objective index comprises the self identification; a decoder module configured to use the SPS C-RNTI in the SPS configuration message to decode the control signaling, if the objective index comprises the self identification.

[0038] There is also provided a base station that comprises a processor and a transceiver coupled to the processor. The processor may be configured to transmit via the transceiver a SPS (semi-persistent scheduling) configuration message for a SPS to a user equipment, wherein the SPS configuration message comprises at least two SPS information, each of the SPS information at least comprises a SPS C-RNTI (cell radio network temporary identity) of the SPS; transmit via the transceiver a control signaling and an objective index scrambled by the SPS C-RNTI to the user equipment, the objective index comprises at least an identification of one user equipment, such that the user equipment corresponding to the identification executes one or more operations for the SPS corresponding to the SPS C-RNTI in accordance with the control signaling.

[0039] The processor may be configured to at least transmit via the transceiver an activation signaling scrambled by the SPS C-RNTI to the user equipment through a PDCCH (physical downlink control channel); or transmit via the transceiver a release signaling scrambled by the SPS C-RNTI to the user equipment through the PDCCH or using a RRC (radio resource control) message.

[0040] The processor may be configured to transmit via the transceiver the control signaling corresponding to an operation request for the SPS to the user equipment in response to the operation request from the user equipment, wherein the operation request comprises at least an activation request or a release request.

[0041] The processor may be configured to transmit via the transceiver the control signaling corresponding to the release request to the user equipment, if the continuous

times of not yet receiving the data transmitted by the user equipment using a corresponding SPS resource is larger than a predetermined threshold.

[0042] The processor may be configured to transmit via the transceiver the control signaling to a plurality of the user equipment through multicast or broadcast.

[0043] The processor may be further configured to obtain via the transceiver an operation request from the user equipment, wherein the amount of the operation request obtained from the user equipment in a predetermined period is larger than a predetermined threshold.

[0044] The control signaling may comprise the objective index, the processor may be configured to transmit via the transceiver the control signaling to at least the user equipment informing of the operation request for the SPS through multicast in a plurality of times, wherein the sum of the times to transmit the control signaling and the largest amount of the identification comprised in the objective index is smallest.

[0045] The control signaling may comprise the objective index.

[0046] The processor may be further configured to allocate an identification to the user equipment via the transceiver.

[0047] The identification may comprise a group identification and a user equipment identification.

[0048] When the processor is configured to transmit via the transceiver the control signaling to at least the user equipment informing of an operation request for the SPS through multicast in response to the operation request from the user equipment, the identification in the objective index may be the group identification if the transmission objectives have a same group identification and all informed of the operation request.

[0049] The SPS information may further comprise a period and a resource allocation of the SPS.

[0050] The SPS information may further comprise a release instruction of the SPS.

[0051] There is also provided a user equipment that comprises a processor and a communication circuit coupled to the processor. The processor may be configured

to receive via the communication circuit a SPS (semi-persistent scheduling) configuration message transmitted by a base station, wherein the SPS configuration message comprises at least two SPS information, each of the SPS information at least comprises a SPS C-RNTI (cell radio network temporary identity) of the SPS; receive via the communication circuit a control signaling and an objective index scrambled by the SPS C-RNTI transmitted by the base station; execute one or more operations for the SPS corresponding to the SPS C-RNTI in accordance with the control signaling if the objective index comprises a self identification of the user equipment, wherein the operation comprises at least activation or release.

[0052] The processor may be configured to at least receive via the communication circuit an activation signaling scrambled by the SPS C-RNTI through a PDCCH (physical downlink control channel); or receive via the communication circuit a release signaling scrambled by the SPS C-RNTI through the PDCCH or using a RRC message.

[0053] The processor may be configured to inform via the communication circuit the base station of an operation request corresponding to the SPS, wherein the operation request comprises at least an activation request or a release request.

[0054] The processor may be configured to transmit via the communication circuit the operation request corresponding to the SPS to the base station.

[0055] The processor may be configured to suspend using a corresponding SPS resource to transmit data to the base station for continuous N times, wherein N is larger than a predetermined threshold.

[0056] The control signaling may comprise the objective index, the processor may be further configured to try to use the SPS C-RNTI in the SPS configuration message to decode the control signaling, and determine whether the objective index comprises the self identification if the decode is successful.

[0057] The control signaling may not comprise the objective index, the processor may be further configured to determine whether the objective index comprises the self identification and use the SPS C-RNTI in the SPS configuration message to decode

the control signaling if the objective index comprises the self identification.

[0058] The processor may be further configured to receive via the communication circuit an identification allocated by the base station.

[0059] The identification may comprise a group identification and a user equipment identification.

[0060] Advantages of the present disclosure may follow. Firstly, the SPS configuration message comprises at least two SPS information, such that different SPSs can be differentiated through the SPS C-RNTI. Secondly, except that control signaling is scrambled by the SPS C-RNTI, an objective index is transmitted to the user equipment. As a result, the user equipment could determine based on the objective index that whether it should execute a control signaling, hence the supporting of multiple SPSs is realized and signaling overheads are simultaneously reduced.

### **BRIEF DESCRIPTION OF THE DRAWINGS**

[0061] FIG. 1 is a flow chart of a first embodiment of a semi-persistent scheduling method according to the disclosure.

[0062] FIG. 2 is a flow chart of a second embodiment of a semi-persistent scheduling method according to the disclosure.

[0063] FIG. 3 is a flow chart of a third embodiment of a semi-persistent scheduling method according to the disclosure

[0064] FIG. 4 is a flow chart of a fourth embodiment of a semi-persistent scheduling method according to the disclosure according to the disclosure.

[0065] FIG. 5 is a flow chart of a fifth embodiment of a semi-persistent scheduling method according to the disclosure according to the disclosure.

[0066] FIG. 6 is a flow chart of a sixth embodiment of a semi-persistent scheduling method according to the disclosure according to the disclosure.

[0067] FIG. 7 is a flow chart of a seventh embodiment of a semi-persistent scheduling method according to the disclosure according to the disclosure.

[0068] FIG. 8 is a flow chart of an eighth embodiment of a semi-persistent scheduling method according to the disclosure according to the disclosure.

[0069] FIG. 9 is a flow chart of a ninth embodiment of a semi-persistent scheduling method according to the disclosure according to the disclosure.

[0070] FIG. 10 is a flow chart of a single SPS operation example of a semi-persistent scheduling method according to the disclosure.

[0071] FIG. 11 is a flow chart of a group SPS operation example of a semi-persistent scheduling method according to the disclosure.

[0072] FIG. 12 is a block diagram of a first embodiment of a base station according to the disclosure.

[0073] FIG. 13 is a block diagram of a second embodiment of a base station according to the disclosure.

[0074] FIG. 14 is a block diagram of a third embodiment of a base station according to the disclosure.

[0075] FIG. 15 is a block diagram of a first embodiment of a user equipment according to the disclosure.

[0076] FIG. 16 is a block diagram of a second embodiment of a user equipment according to the disclosure.

[0077] FIG. 17 is a block diagram of a third embodiment of a user equipment according to the disclosure.

[0078] FIG. 18 is a block diagram of a fourth embodiment of a user equipment according to the disclosure.

[0079] This disclosure includes references to “one embodiment,” “a particular embodiment,” “some embodiments,” “various embodiments,” or “an embodiment.” The appearances of the phrases “in one embodiment,” “in a particular embodiment,” “in some embodiments,” “in various embodiments,” or “in an embodiment,” do not necessarily refer to the same embodiment. Particular features, structures, or characteristics may be combined in any suitable manner consistent with this disclosure.

[0080] Various modules, units, circuits, or other components may be described or claimed as “configured to” perform a task or tasks. In such contexts, “configured to” is used to connote structure by indicating that the modules/units/circuits/components include structure (e.g., circuitry) that performs those task or tasks during operation. As such, the modules/units/circuits/components can be said to be configured to perform the task even when the specified module/unit/circuit/component is not currently operational (e.g., is not on). The modules/units/circuits/components used with the “configured to” language include hardware—for example, circuits, memory storing program instructions executable to implement the operation, etc. Reciting that a module/unit/circuit/component is “configured to” perform one or more tasks is expressly intended not to invoke 35 U.S.C. §112(f), for that module/unit/circuit/component. Additionally, “configured to” can include a generic structure (e.g., generic circuitry) that is manipulated by software and/or firmware (e.g., an FPGA or a general-purpose processor executing software) to operate in a manner that is capable of performing the task(s) at issue. “Configured to” may also include adapting a manufacturing process (e.g., a semiconductor fabrication facility) to fabricate devices (e.g., integrated circuits) that are adapted to implement or perform one or more tasks.

[0081] As used herein, the term “based on” describes one or more factors that affect a determination. This term does not foreclose additional factors that may affect the determination. That is, a determination may be solely based on those factors or based, at least in part, on those factors. Consider the phrase “determine A based on B.” While in this case, B is a factor affects the determination of A, such a phrase does not foreclose the determination of A from also being based on C. In other instances, A may be determined based solely on B.

## **DETAILED DESCRIPTION**

[0082] For a thorough understanding of the present disclosure, numerous specific details are set forth in the following description for purposes of illustration but not of

limitation, such as particularities of system structures, interfaces, techniques, et cetera. However, it should be appreciated by those of skill in the art that, in absence of these specific details, the present disclosure may also be carried out through other implementations. In other instances, a detailed description of well-known devices, circuits, and methods is omitted, so as to avoid unnecessary details from hindering the description of the disclosure.

[0083] Referring to FIG. 1, a flow chart of a first embodiment of a semi-persistent scheduling method according to the disclosure is depicted. In this embodiment, the main body of execution is a base station, and the SPS to be discussed is an upload SPS. The base station may be connected to a core network and may perform wireless communications with a plurality of UEs to provide communications coverage for the associated geographical area. The base station may comprise, but not limited to, macro base stations, micro base stations, or pico base stations. In various embodiments, a base station can also be interchangeably referred to as a wireless base station, access point, Node B, evolved Node B (eNodeB or eNB), etc.. For purposes of illustration, the method is illustrated as being sequential. However, portions of the method may be performed in other orders or in parallel (e.g., simultaneously). The method may comprise the following steps.

[0084] Step S11 includes transmitting a SPS configuration message to a user equipment, wherein the SPS configuration message comprises at least two SPS information.

[0085] The base station could transmit the SPS configuration message to the user equipment when the user equipment enters the base station's coverage range and finishes the initial access, or when in the process of initial access. The SPS configuration message comprises at least two SPS information. Generally, each SPS corresponds to a service. Each SPS information at least comprises a SPS C-RNTI of the SPS, wherein different SPSs have different SPS C-RNTIs.

[0086] Each SPS information could further comprise a period and a resource allocation of the SPS. The resource allocation could comprise a frequency domain

allocation and/or time domain allocation. The frequency domain allocation indicates the sub-carrier wave which the user equipment should use to upload data. The time domain allocation indicates the TTI (Transmission Time Interval) in the period which the user equipment should upload data. The periods of different SPSs can be the same or different, while the resource allocations are different. In addition, when using RRC (radio resource control) messages to transmit release signaling is supported, each SPS information could comprise a release instruction of the SPS, while different SPSs have different release instructions.

[0087] Step S12 includes transmitting a control signaling and an objective index scrambled by a SPS C-RNTI to the user equipment.

[0088] The control signaling and the objective index could be separated or integrated with each other. For example, the objective index could be comprised in the control signaling. The transmission of the control signaling and the objective index could be originated by the user equipment, that is, the base station transmits in response to the request of the user equipment; could also be originated by the base station, that is, the base station transmits actively.

[0089] The objective index comprises at least an identification of user equipment. One identification corresponds to one user equipment in the base station's coverage range, wherein different user equipment has different identification. The identification could be an identification code of the user equipment's self, or be allocated by the base station to the user equipment. Since the control signaling transmitted by the base station could be received by other user equipment, it's necessary to use the objective index to indicate the transmission objective of the control signaling. The amount of the user equipment executing the SPS operation could be changed through adjusting the amount of the identifications for user equipment in the objective index, such that the control signal transmitted in one time can be responded by one user equipment or multiple user equipment.

[0090] Using the SPS C-RNTI to scramble is for indicating the SPS which the control signaling corresponds to. The user equipment represented by the

identification comprised in the objective index needs to use multiple SPS C-RNTIs in the stored SPS information to try to decode the received control signaling. After the decoding is successful, the SPS which the control signaling corresponds to is determined to be the SPS which the SPS C-RNTI used to successfully decode corresponds to, and then an operation corresponding to the SPS is executed according to the control signaling.

[0091] Generally, the control signaling comprises an activation signaling and/or a release signaling, while the operation executed by the corresponding user equipment comprises activation and/or release. After activation, the user equipment starts using the allocated SPS resource to transmit upload data in accordance with the SPS period. After release, the user equipment stops using the allocated SPS resource to transmit the upload data in accordance with the SPS period.

[0092] In an embodiment of the present disclosure, the base station could transmit the activation signaling and/or the release signaling scrambled by the SPS C-RNTI to the user equipment through a PDCCH (physical downlink control channel), and could transmit a release signaling scrambled by the SPS C-RNTI to the user equipment through using a RRC (radio resource control) message. The base station can also use the RRC message to directly transmit a release instruction to the user equipment, wherein the SPS information should comprise the release instruction of the SPS, while different SPSs have different release instructions. The control signaling transmitted through the PDCCH could use cyclic redundancy check (CRC).

[0093] The fields comprised in an un-scrambled activation signaling transmitted through the PDCCH is shown in table 1, while the fields comprised in a release signaling is shown in table 2. When the objective index is comprised in the activation signaling, a new field for representing the objective index has to be added in the activation signaling.

Table 1

|                                 | DCI format 0 | DCI format 1/1A | DCI format 2/2A/2B/2C/2D |
|---------------------------------|--------------|-----------------|--------------------------|
| TPC command for scheduled PUSCH | set to '00'  | N/A             | N/A                      |

|                                                     |                   |                                        |                                                       |
|-----------------------------------------------------|-------------------|----------------------------------------|-------------------------------------------------------|
| Cyclic shift DMRS                                   | set to '000'      | N/A                                    | N/A                                                   |
| Modulation and coding scheme and redundancy version | MSB is set to '0' | N/A                                    | N/A                                                   |
| HARQ process number                                 | N/A               | FDD: set to '000'<br>TDD: set to 0000' | FDD: set to '000'<br>TDD: set to '0000'               |
| Modulation and coding scheme                        | N/A               | MSB is set to '0'                      | For the enabled transport block:<br>MSB is set to '0' |
| Redundancy version                                  | N/A               | set to '00'                            | For the enabled transport block: set to '00'          |

Table 2

|                                                           | DCI format 0    | DCI format 1/1A                        |
|-----------------------------------------------------------|-----------------|----------------------------------------|
| TPC command for scheduled PUSCH                           | set to '00'     | N/A                                    |
| Cyclic shift DMRS                                         | set to '000'    | N/A                                    |
| Modulation and coding scheme and redundancy version       | set to '1111'   | N/A                                    |
| Resource block assignment and hopping resource allocation | Set to all '1's | N/A                                    |
| HARQ process number                                       | N/A             | FDD: set to '000'<br>TDD: set to 0000' |
| Modulation and coding scheme                              | N/A             | set to '1111'                          |
| Redundancy version                                        | N/A             | set to '00'                            |
| Resource block assignment                                 | N/A             | Set to all '1's                        |

[0094] Since the existed techniques merely support single SPS, the base station merely needs to allocate a SPS C-RNTI to each user equipment. After receiving the SPS control signaling, the user equipment merely has to use the SPS C-RNTI of itself to try to decode. If the decode is successful, a corresponding SPS operation is executed. If simply extend the existed SPS technique and respectively allocate different SPS C-RNTIs to each type of SPSs as well as each user equipment, the needed amount of SPS C-RNTIs equals to the amount of the user equipment multiplies the amount of the types of SPSs. Since the needed amount of SPS C-RNTIs is too large, it has a lower practicability.

[0095] In this embodiment, the SPS configuration message comprises at least two SPS information, such that different SPSs can be differentiated through the SPS C-RNTI, thereby realizing the support of multiple SPSs. Excepts transmitting the

control signaling scrambled by the SPS C-RNTI, the base station also transmit the objective index to the user equipment, such that the user equipment could determine based on the objective index that whether it should execute a control signaling, and determine based on the SPS C-RNTI that the corresponding SPS of executing the operations, hence the supporting of multiple SPSs is realized and signaling overheads are simultaneously reduced.

[0096] Referring to FIG. 2, a flow chart of a second embodiment of a semi-persistent scheduling method according to the disclosure is depicted. This embodiment is basing on the first embodiment of the semi-persistent scheduling method shown in FIG. 1, wherein the transmission of the control signaling and the objective index is originated by the user equipment. Since this embodiment is the extension of the first embodiment, the details identical to the first embodiment are not recited herein. For purposes of illustration, the method is illustrated as being sequential. However, portions of the method may be performed in other orders or in parallel (e.g., simultaneously). The method may comprise the following steps.

[0097] Step S111 includes transmitting a SPS configuration message to a user equipment, wherein the SPS configuration message comprises at least two SPS information.

[0098] Step S112 includes receiving an operation request for a corresponding SPS from the user equipment.

[0099] The operation request comprises an activation request and/or a release request. In addition to indicating operation type (activation/release), the operation request should also indicate that it is for which SPS(s). The user equipment could inform the base station of the operation request according to its status.

[00100] For instance, in vehicle-to-everything (V2X), user equipment could determine whether to enable a service (e.g., speed monitoring) in accordance with its status. While the service is enabled, activation request is transmitted to activate corresponding SPSs, and begin to upload status data (realtime speed) of the service periodically. While the status of the user equipment changes (e.g. when making a

stop), the service could be selectively disabled, a release request is transmitted to the base station to release the corresponding SPS, and the uploading of the status data is stopped.

[00101] What needs to be noticed is, the informing of release request could comprise explicit and implicit types. Explicit type ones means that the user equipment directly transmits the release request to the base station, while implicit type ones means that the user equipment proposes release requests through suspending using SPS resource to transmit data to the base station. The SPS resource indicates the SPS to be released. For implicit type release request, the base station needs to compare the continuous times of not yet receiving the data transmitted by the user equipment using a corresponding SPS resource and a predetermined threshold. When the continuous times is larger than the predetermined threshold, it's determined to have obtained the implicit type release request.

[00102] Step S113 includes transmitting a control signaling and an objective index to the user equipment in response to the operation request.

[00103] Wherein, the control signal should be in accordance with the operation type of the operation request, and the objective index should comprise the identification of the user equipment informing of the operation request.

[00104] In other embodiments, if the base station not obtains the operation request, it could control the user equipment to execute SPS operation through directly transmit the control signaling and the objective index to the user equipment. For instance, controlling the user equipment to release SPS when the channel quality is bad.

[00105] Referring to FIG. 3, a flow chart of a third embodiment of a semi-persistent scheduling method according to the disclosure is depicted. This embodiment is basing on the first embodiment of the semi-persistent scheduling method shown in FIG. 1, which transmits the control signaling through multicast or broadcast. For purposes of illustration, the method is illustrated as being sequential. However, portions of the method may be performed in other orders or in parallel (e.g., simultaneously). The method may comprise the following steps.

[00106] Step S121 includes transmitting a control signaling and an objective index to multiple user equipment through multicast or broadcast.

[00107] Since the SPS C-RNTI for scrambling is used to indicate different SPSs rather than different user equipment, a same control signaling can be transmitted to multiple user equipment simultaneously, so as to further reduce signaling overheads. The amount of the user equipment which receives the control signaling and the objective index could be larger than the amount of the objective user equipment (the user equipment needing to execute SPS operation in accordance with the control signaling). For instance, if three of four user equipment in a set are objective user equipment, the base station could choose to simultaneously transmit to four user equipment thorough multicast and indicate the objective user equipment in the objective index, rather than transmitting to three user equipment respectively in three times.

[00108] When the control signaling comprises the objective index, the base station could choose to transmit in multiple times while the amount of the user equipment to be transmitted is larger. Preferably, the sum of the times to transmit the control signaling and the largest amount of the identification comprised in the objective index could be adjusted, so as to obtain a smallest sum.

[00109] This embodiment could be combined with the second embodiment shown in FIG. 2. After combination, the base station transmits the control signaling and the objective index through multicast or broadcast when the amount of the obtained operation request in a predetermined period  $T$  is larger than a predetermined threshold which may be 0 or a positive integer. At this time, the objective index should at least comprise the identification of the user equipment transmitting the operation request; transmits the control signaling and the objective index through unicast when the amount of the obtained operation request is smaller than or equal to the predetermined threshold. For instance, in vehicle-to-everything (V2X), there could be multiple user equipment (vehicle) transmitting release request in a traffic jam, the base station could inform the multiple user equipment to release SPS through multicast or broadcast.

[00110] Referring to FIG. 4, a flow chart of a fourth embodiment of a semi-persistent scheduling method according to the disclosure according to the disclosure is depicted. This embodiment is basing on the first embodiment of the semi-persistent scheduling method shown in FIG. 1. For purposes of illustration, the method is illustrated as being sequential. However, portions of the method may be performed in other orders or in parallel (e.g., simultaneously). The method may further comprise the following steps.

[00111] Step S13 includes allocating identifications to user equipment.

[00112] This step should be executed before the step S12, or be executed before, after, or simultaneous with the step S11, while the SPS configuration message transmitted in the step S11 could comprise the allocated identification.

[00113] The base station could allocate the identifications to the user equipment according to predetermined strategies, for example, the sequence of entering the base station's coverage range, the location when entering the base station's coverage range, the movement direction, and etc.

[00114] In the situation which the user equipment have a larger amount, for the convenience of management, the user equipment could be divided into groups. At this time, the identification allocated to the user equipment comprises a group identification and a user equipment identification, wherein the user equipment identification means the number of the user equipment in the group.

[00115] This embodiment could be any combination of the above-mentioned embodiments. What needs to be noticed is, when the identification allocated to the user equipment comprise the group identification and the user equipment identification, the base station transmits the control signaling and the objective index through multicast, and the objectives in a transmission, that is, the user equipment in a multicast group, has the same group identification and are all objective user equipment (e.g., all transmit a same operation request), the objective index could merely comprise the group identification while omitting the user equipment identification, thereby further reducing signaling overheads.

[00116] Referring to FIG. 5, a flow chart of a fifth embodiment of a semi-persistent scheduling method according to the disclosure according to the disclosure is depicted. The method may be performed by a User Equipment (UE). The UE can be stationary or mobile, including, but not limited to, cellular phones, personal digital assistants (PDA), wireless modems, tablet computers, notebook computers, cordless phones, and so forth. For purposes of illustration, the method is illustrated as being sequential. However, portions of the method may be performed in other orders or in parallel (e.g., simultaneously). The method may further comprise the following steps.

[00117] Step S21 includes receiving a SPS configuration message transmitted by a base station, wherein the SPS configuration message comprises at least two SPS information.

[00118] Generally, the user equipment receives the SPS configuration message when it enters the base station's coverage range of the base station. The user equipment could store SPS information for the following SPS operations and data transmissions.

[00119] Step S22 includes receiving a control signaling and an objective index scrambled by a SPS C-RNTI transmitted by the base station.

[00120] Step S23 includes executing a corresponding operation for the SPS corresponding to the SPS C-RNTI in accordance with the control signaling if the objective index comprises a self identification.

[00121] The identification could be an identification code of the user equipment's self, or be the base station allocate to the user equipment. When the objective index comprises the self identification, which represents that the user equipment is the transmission objective, that is, the objective user equipment, of the control signaling, and should execute the corresponding operation.

[00122] Using the SPS C-RNTI to scramble is for indicating the SPS which the control signaling corresponds to. The user equipment could use the SPS C-RNTI in the stored SPS information in turn to try to decode the received control signaling. After the decoding is successful, the SPS which the control signaling corresponds to is

determined to be the SPS which the SPS C-RNTI used to successfully decode corresponds to.

[00123] Generally, the control signaling has two types including activation signaling and release signaling. In the situation which two conditions including the objective index comprising the self identification and the control signaling being successfully decoded are both satisfied, the user equipment determines whether the control signaling is the activation signaling or the release signaling. For instance, for the control signaling transmitted through the PDCCH, the user equipment compares the control signaled which successfully decoded with Table 1 and Table 2, so as to determine the type of the control signaling and execute the corresponding operations including activation and/or release for the corresponding SPS. After activation, the user equipment starts using the allocated SPS resource to transmit upload data in accordance with the SPS period. After release, the user equipment stops using the allocated SPS resource to transmit the upload data in accordance with the SPS period.

[00124] Through the implementations of the above-mentioned embodiment, the SPS configuration message comprises at least two SPS information, such that different SPSs can be differentiated through the SPS C-RNTI, thereby realizing the support of multiple SPSs. Excepts receiving the control signaling scrambled by the SPS C-RNTI, the user equipment also receives the objective index to the user equipment, such that the user equipment could determine based on the objective indexes that whether it should execute a control signaling, and determine based on the SPS C-RNTI that the corresponding SPS of executing the operations, hence the supporting of multiple SPSs is realized and signaling overheads are simultaneously reduced.

[00125] Referring to FIG. 6, a flow chart of a sixth embodiment of a semi-persistent scheduling method according to the disclosure according to the disclosure is depicted. This embodiment is basing on the fifth embodiment of the semi-persistent scheduling method shown in FIG. 5. For purposes of illustration, the method is illustrated as being sequential. However, portions of the method may be performed in other orders or in parallel (e.g., simultaneously). The method may further comprise the following

steps before step S22.

[00126] Step S24 includes informing the base station of an operation request corresponding to the SPS.

[00127] The user equipment could inform the base station of the operation request according to its status. The operation request comprises an activation request and/or a release request. In addition to indicating operation type (activation/release), the operation request should also indicate that it is for which SPS(s). Generally, the user equipment inform the base station of the release request after this SPS finishes uploading data and before the next SPS finishes uploading data.

[00128] What needs to be noticed is, the informing of release request could comprise explicit and implicit types. Explicit type ones means that the user equipment directly transmit the release request to the base station, while implicit type ones means that the user equipment submit release request through suspending using SPS resource to transmit data to the base station, that is, suspending using a corresponding SPS resource to transmit data to the base station for continuous N times, wherein N is larger than a predetermined threshold, while SPS resource indicates the SPS to be released.

[00129] However, in other embodiments, the user equipment could directly receive the control signaling and the objective index transmitted by the base station without informing the base station of the operation request.

[00130] Referring to FIG. 7, a flow chart of a seventh embodiment of a semi-persistent scheduling method according to the disclosure according to the disclosure is depicted. This embodiment is basing on the fifth embodiment of the semi-persistent scheduling method shown in FIG. 5, and determines whether to execute SPS operations when the objective index is comprised in the control signaling. The details identical to the fifth embodiment are not recited herein. For purposes of illustration, the method is illustrated as being sequential. However, portions of the method may be performed in other orders or in parallel (e.g., simultaneously). The method may further comprise the following steps.

[00131] Step S211 includes receiving a SPS configuration message transmitted by a base station, wherein the SPS configuration message comprises at least two SPS information.

[00132] Step S212 includes receiving a control signaling scrambled by a SPS C-RNTI transmitted by the base station, wherein the control signaling comprises the objective index.

[00133] Step S213 includes trying to use the SPS C-RNTI in the SPS configuration message to decode the control signaling.

[00134] If the decoding is successful, jump to step S214; if the decoding fails, the process terminates.

[00135] Step S214 includes determining whether the objective index comprises a self identification.

[00136] If comprises, jump to step S215; if not, the process terminates.

[00137] Step S215 includes determining the type of the control signaling and executing corresponding SPS operations.

[00138] In this embodiment, decoding is tried in advance to determine the corresponding SPS. After successfully decoding, the objective index in the control signaling is read and whether the objective index comprising the self identification is determined. If not comprises, it's unnecessary to determine the type of the control signaling, thereby reducing the operations that the user equipment need to execute. In other embodiments, the user equipment could determine the type of the control signaling in advance, and then determines whether the objective index comprises the self identification.

[00139] Referring to FIG. 8, a flow chart of an eighth embodiment of a semi-persistent scheduling method according to the disclosure according to the disclosure is depicted. This embodiment is basing on the fifth embodiment of the semi-persistent scheduling method shown in FIG. 5, and determines whether to execute SPS operations when the objective index is not comprised in the control signaling. The details identical to the fifth embodiment are not recited herein. For

purposes of illustration, the method is illustrated as being sequential. However, portions of the method may be performed in other orders or in parallel (e.g., simultaneously). The method may comprise the following steps.

[00140] Step S221 includes receiving a SPS configuration message transmitted by a base station, wherein the SPS configuration message comprises at least two SPS information.

[00141] Step S222 includes receiving a control signaling and an objective index scrambled by a SPS C-RNTI transmitted by the base station, wherein the control signaling not comprises the objective index.

[00142] Step S223 includes determining whether the objective index comprises a self identification.

[00143] If comprises, jump to step S224; if not, the process terminates.

[00144] Step S224 includes using the SPS C-RNTI in the SPS configuration message to decode the control signaling.

[00145] If the decoding is successful, jump to step S225; if the decoding fails, the process terminates.

[00146] Step S225 includes determining the type of the control signaling and executing corresponding SPS operations.

[00147] In this embodiment, the objective index in the control signaling is read in advance, and whether the objective index comprising the self identification is determined. If not comprises, it's unnecessary to try to decode, thereby reducing the operations that the user equipment need to execute and reducing the power consumption. In other embodiments, the user equipment could try to decode in advance, and then determines whether the objective index comprises the self identification.

[00148] Referring to FIG. 9, a flow chart of a ninth embodiment of a semi-persistent scheduling method according to the disclosure according to the disclosure is depicted. This embodiment is basing on the fifth embodiment of the semi-persistent scheduling method shown in FIG. 5. For purposes of illustration, the method is illustrated as

being sequential. However, portions of the method may be performed in other orders or in parallel (e.g., simultaneously). The method may further comprise the following steps before the step S22.

[00149] Step S25 includes receiving an identification allocated by a base station.

[00150] This step should be executed before the step S22, or be executed before, after, or simultaneous with the step S21, while the identification could be comprised in the SPS configuration message transmitted in the step S21.

[00151] The activation/release of the SPS could be divided into single activation/release and group activation/release in accordance with the amount of the user equipment in the objective index. The group activation/release need a base station to transmit the control signaling and the objective index through multicast or broadcast. But in addition to in group activation/release, the base station could also transmit the control signaling and the objective index through multicast or broadcast in single activation /release, which is described as follows with the help of figures.

[00152] Referring to FIG. 10, a flow chart of a single SPS operation example of a semi-persistent scheduling method according to the disclosure according to the disclosure is depicted. The base station respectively controls a UE1 and a UE2 to execute a single SPS operation. For purposes of illustration, the method is illustrated as being sequential. However, portions of the method may be performed in other orders or in parallel (e.g., simultaneously). The method may comprise the following steps.

[00153] Step S301, the base station respectively transmits a SPS configuration message to UE1 and UE2.

[00154] The SPS configuration message transmitted to the UE1 comprises at least two SPS information (including SPS C-RNTI, the period, and the resource) and an identification 1 allocated to the UE1, while the SPS configuration message transmitted to the UE2 comprises at least two SPS information (including SPS C-RNTI, the period, and the resource) and an identification 2 allocated to the UE2.

[00155] Step S302, the UE1 transmits an activation request corresponding to SPS1

to the base station.

[00156] Step S303, the base station transmits a PDCCH activation signaling with CRC which is scrambled by a SPS C-RNTI 1 and comprises an identification 1 to the UE1 and the UE2 through multicast.

[00157] Step S304, the UE1 activates the SPS1 after successfully decoding the PDCCH activation signaling using the SPS C-RNTI 1.

[00158] Step S305, the UE2 does not activate the SPS1 after successfully decoding the PDCCH activation signaling using the SPS C-RNTI 1.

[00159] Step S306, the UE1 starts to use a SPS resource 1 to upload data in accordance with a SPS period 1.

[00160] Step S307, the base station decides to activate a SPS2 for the UE2.

[00161] Step S308, the base station transmits a PDCCH activation signaling with CRC which is scrambled by a SPS C-RNTI 2 and comprises an identification 2 to the UE2.

[00162] Step S309, the UE2 activates the SPS2 after successfully decoding the PDCCH activation signaling using the SPS C-RNTI2.

[00163] Step S310, the UE2 starts to use a SPS resource 2 to upload data in accordance with a SPS period 2.

[00164] Step S311, the base station decides to release SPS1 for the UE1.

[00165] Step S312, the base station transmits a PDCCH release signaling with CRC which is scrambled by the SPS C-RNTI 1 and comprises the identification 1 to the UE1.

[00166] Step S313, the UE1 releases the SPS1 and the resource 1 after successfully decoding the PDCCH release signaling using the SPS C-RNTI 1, and stops uploading.

[00167] Step S314, the UE2 informs the base station of a release request (explicit or implicit) corresponding to SPS2.

[00168] Step S315, the base station transmits a PDCCH release signaling with CRC which is scrambled by a SPS C-RNTI 2 and comprises the identification 2 to the UE2.

[00169] Step S316, the UE2 releases the SPS2 and the resource 2 after successfully

decoding the PDCCH release signaling using the SPS C-RNTI2, and stops uploading.

[00170] What needs to be noticed is, in the left portion (the interaction between the base station and the UE1) and the right portion (the interaction between the base station and the UE1) of the figure, except the step S303 which transmits through multicast, the precedence relationship between other steps are merely for demonstrating.

[00171] Referring to FIG. 11, a flow chart of a group SPS operation example of a semi-persistent scheduling method according to the disclosure according to the disclosure is depicted. The base station simultaneously controls aUE1 and aUE2 to execute a group SPS operation. For purposes of illustration, the method is illustrated as being sequential. However, portions of the method may be performed in other orders or in parallel (e.g., simultaneously). The method may comprise the following steps.

[00172] Step S401, the base station respectively transmits a SPS configuration message to a UE1 and a UE2.

[00173] The SPS configuration message transmitted to the UE1 comprises at least two SPS information (including SPS C-RNTI, the period, and the resource) and an identification 1 allocated to the UE1, while the SPS configuration message transmitted to the UE2 comprises at least two SPS information (including SPS C-RNTI, the period, and the resource) and an identification 2 allocated to the UE2.

[00174] Step S402, the UE1 transmits an activation request corresponding to SPS1 to the base station.

[00175] Step S403, the UE2 transmits an activation request corresponding to SPS1 to the base station.

[00176] The interval between the steps S402 and S403 is smaller than a predetermined period T, while a predetermined threshold of the amount of operation requests is 1.

[00177] Step S404, the base station transmits a PDCCH activation signaling with CRC which is scrambled by a SPS C-RNTI 1as well as comprises an identification 1

and an identification 2 to the UE1 and the UE2 through multicast.

[00178] Step S405, the UE1 activates the SPS1 after successfully decoding the PDCCH activation signaling using the SPS C-RNTI 1.

[00179] Step S406, the UE1 starts to use a SPS resource 1 to upload data in accordance with a SPS period 1.

[00180] Step S407, the UE2 activates the SPS1 after successfully decoding the PDCCH activation signaling using the SPS C-RNTI 1.

[00181] Step S408, the UE2 starts to use a SPS resource 1 to upload data in accordance with a SPS period 1.

[00182] Step S409, the base station decides to release SPS1 for the UE1 and the UE2.

[00183] Step S410, the base station transmits a PDCCH release signaling with CRC which is scrambled by a SPS C-RNTI 1 as well as comprises the identification 1 and the identification 2 to the UE1 and the UE2 through multicast.

[00184] Step S411, the UE1 releases the SPS1 and the resource 1 after successfully decoding the PDCCH release signaling using the SPS C-RNTI 1, and stops uploading.

[00185] Step S412, the UE2 releases the SPS1 and the resource 1 after successfully decoding the PDCCH release signaling using the SPS C-RNTI1, and stops uploading.

[00186] Referring to FIG. 12, a block diagram of a first embodiment of a base station is depicted. The base station may comprise a first transmitting module 11 and a second transmitting module 12.

[00187] The first transmitting module 11 may be configured to transmit a SPS (semi-persistent scheduling) configuration message for a SPS to a user equipment. The SPS configuration message may comprise at least two SPS information, each of the SPS information at least comprises a SPS C-RNTI (cell radio network temporary identity) of the SPS.

[00188] The second transmitting module 12 may be configured to transmit a control signaling and an objective index scrambled by the SPS C-RNTI to the user equipment. The objective index may comprise at least an identification of one user equipment,

such that the user equipment corresponding to the identification may execute one or more operations for the SPS corresponding to the SPS C-RNTI in accordance with the control signaling.

[00189] Specifically, the second transmitting module 12 may be configured to transmit the control signaling corresponding to an operation request for the SPS to the user equipment in response to the operation request from the user equipment, wherein the operation request comprises at least an activation request or a release request.

[00190] Specifically, the second transmitting module 12 may be configured to transmit the control signaling corresponding to the release request to the user equipment when the continuous times of not yet receiving the data transmitted by the user equipment using a corresponding SPS resource is larger than a predetermined threshold

[00191] Specifically, the second transmitting module may be configured to transmit the control signaling to a plurality of the user equipment through multicast or broadcast.

[00192] Referring now to FIG. 13, a block diagram of a second embodiment of a base station according to the disclosure is depicted, which is based on the first embodiment of the base station and further comprises an allocation module 13 configured to allocate an identification to the user equipment.

[00193] Referring now to FIG. 14, a block diagram of a third embodiment of a base station is depicted. The base station may comprise a processor 110 and a transceiver 120 coupled to processor 110 via a bus.

[00194] The transceiver 120 may be configured to transmit and receive data, and serve as an interface through which the base station communicates with other communication equipment.

[00195] Processor 110 may control operations of the base station, and may also be referred to as a Central Processing Unit (CPU). Processor 110 may be an integrated circuit chip with signal processing capabilities, such as a general purpose processor, Digital Signal Processor (DSP), Application Specific Integrated Circuit (ASIC), Field

Programmable Gate Array (FPGA), or any other programmable logic devices, discrete gates, transistor logic devices, or discrete hardware components. The general purpose processor may be a microprocessor or any conventional processor.

[00196] The base station may further comprise a memory (not shown) used to store the commands and data necessary for operations of the processor 110. The memory can also store the data received by the transceiver 120.

[00197] Processor 110 may be configured to transmit via the transceiver 120a SPS (semi-persistent scheduling) configuration message for a SPS to a user equipment, wherein the SPS configuration message comprises at least two SPS information, each of the SPS information at least comprises a SPS C-RNTI (cell radio network temporary identity) of the SPS; transmit via the transceiver 120 a control signaling and an objective index scrambled by the SPS C-RNTI to the user equipment, the objective index comprises at least an identification of one user equipment, such that the user equipment corresponding to the identification executes one or more operations for the SPS corresponding to the SPS C-RNTI in accordance with the control signaling.

[00198] Specifically, processor 110 may be configured to at least transmit via the transceiver 120 an activation signaling scrambled by the SPS C-RNTI to the user equipment through a PDCCH (physical downlink control channel); or transmit via the transceiver a release signaling scrambled by the SPS C-RNTI to the user equipment through the PDCCH or using a RRC (radio resource control) message.

[00199] Specifically, processor 110 may be configured to transmit via the transceiver 120 the control signaling corresponding to an operation request for the SPS to the user equipment in response to the operation request from the user equipment, wherein the operation request comprises at least an activation request or a release request.

[00200] Specifically, processor 110 may be configured to transmit via the transceiver 120 the control signaling corresponding to the release request to the user equipment, if the continuous times of not yet receiving the data transmitted by the

user equipment using a corresponding SPS resource is larger than a predetermined threshold.

[00201] Specifically, processor 110 may be configured to transmit via the transceiver 120 the control signaling to a plurality of the user equipment through multicast or broadcast.

[00202] Specifically, processor 110 may be further configured to obtain via the transceiver 120 an operation request from the user equipment, wherein the amount of the operation request obtained from the user equipment in a predetermined period is larger than a predetermined threshold.

[00203] Specifically, the control signaling may comprise the objective index. Processor 110 may be configured to transmit via the transceiver 120 the control signaling to at least the user equipment informing of an operation request for the SPS through multicast in a plurality of times, wherein the sum of the times to transmit the control signaling and the largest amount of the identification comprised in the objective index is smallest.

[00204] Specifically, the control signaling may comprise the objective index.

[00205] Specifically, processor 110 may be further configured to allocate an identification to the user equipment via the transceiver 120.

[00206] Specifically, the identification may comprise a group identification and a user equipment identification.

[00207] Specifically, when the processor 110 is configured to transmit via the transceiver 120 the control signaling to at least the user equipment informing of an operation request for the SPS through multicast in response to the operation request from the user equipment, the identification in the objective index may be the group identification if the transmission objectives have a same group identification and all informed of the operation request.

[00208] Specifically, the SPS information may further comprise a period and a resource allocation of the SPS.

[00209] Specifically, the SPS information may further comprise a release instruction

of the SPS.

[00210] For functions of various components or modules of the base station according to the present embodiment, one may refer to the relevant description of corresponding method embodiment, thus they will not be detailed again.

[00211] Referring to FIG. 15, a block diagram of a first embodiment of a user equipment is depicted. The user equipment may comprise a first receiving module 21, a second receiving module 22 and an execution module 23.

[00212] The first receiving module 21 may be configured to receive a SPS (semi-persistent scheduling) configuration message transmitted by a base station. The SPS configuration message may comprise at least two SPS information, each of the SPS information at least comprises a SPS C-RNTI (cell radio network temporary identity) of the SPS.

[00213] The second receiving module 22 may be configured to receive a control signaling and an objective index scrambled by the SPS C-RNTI transmitted by the base station.

[00214] The execution module 23 may be configured to execute one or more operations for the SPS corresponding to the SPS C-RNTI in accordance with the control signaling if the objective index comprises a self identification of the user equipment, wherein the operation comprises at least activation or release.

[00215] Specifically, the second receiving module 22 may be configured to at least receive an activation signaling scrambled by the SPS C-RNTI through a PDCCH (physical downlink control channel); or receive a release signaling scrambled by the SPS C-RNTI through the PDCCH or using a RRC message.

[00216] Referring now to FIG. 16, a block diagram of a second embodiment of a user equipment according to the disclosure is depicted, which is based on the first embodiment of the user equipment and further comprises a decoder module 24 and a determination module 25.

[00217] The control signaling may comprise the objective index. The decoder module 24 may be configured to try to use the SPS C-RNTI in the SPS configuration

message to decode the control signaling. The determination module 25 may be configured to determine whether the objective index comprises the self identification.

[00218] Referring now to FIG. 17, a block diagram of a third embodiment of a user equipment according to the disclosure is depicted, which is based on the first embodiment of the user equipment and further comprises a determination module 26 and a decoder module 27.

[00219] The control signaling may not comprise the objective index. The determination module 26 may be configured to determine whether the objective index comprises the self identification. The decoder module 27 may be configured to use the SPS C-RNTI in the SPS configuration message to decode the control signaling if the objective index comprises the self identification.

[0001] Referring now to FIG. 18, a block diagram of a fourth embodiment of a user equipment (UE) according to the disclosure is depicted. The UE may comprise a processor 210 and a communication circuit 220 coupled to the processor 210 via a bus.

[0002] The communication circuit 220 may be configured to transmit and receive data, and serve as an interface through which the UE communicates with other communication equipment.

[0003] Processor 210 may control operations of the UE, and can also be referred to as a CPU. Processor 210 may be an integrated circuit chip with signal processing capabilities. Processor 210 may also be a general purpose processor, DSP, ASIC, FPGA, or other programmable logic devices, discrete gates, transistor logic devices, discrete hardware components. The general purpose processor may be a microprocessor or any conventional processor.

[0004] The UE may further include a memory (not shown) used to store the commands and data necessary for operations of the processor 210. The memory can also store the data received by the communication circuit 220.

[00220] Processor 210 may be configured to receive via the communication circuit 220 a SPS (semi-persistent scheduling) configuration message transmitted by a base

station , wherein the SPS configuration message comprises at least two SPS information, each of the SPS information at least comprises a SPS C-RNTI (cell radio network temporary identity) of the SPS; receive via the communication circuit 220 a control signaling and an objective index scrambled by the SPS C-RNTI transmitted by the base station ;execute one or more operations for the SPS corresponding to the SPS C-RNTI in accordance with the control signaling if the objective index comprises a self identification of the user equipment, wherein the operation comprises at least activation or release.

[00221] Specifically, processor 210 may be configured to at least receive via the communication circuit 220 an activation signaling scrambled by the SPS C-RNTI through a PDCCH (physical downlink control channel); or receive via the communication circuit 220 a release signaling scrambled by the SPS C-RNTI through the PDCCH or using a RRC message.

[00222] Specifically, processor 210 may be configured to inform via the communication circuit 220 the base station of an operation request corresponding to the SPS, wherein the operation request comprises at least an activation request or a release request.

[00223] Specifically, processor 210 may be configured to transmit via the communication circuit 220 the operation request corresponding to the SPS to the base station.

[00224] Specifically, processor 210 may be configured to suspend using a corresponding SPS resource to transmit data to the base station for continuous N times, wherein N is larger than a predetermined threshold.

[00225] Specifically, the control signaling may comprise the objective index, processor 210 may be further configured to try to use the SPS C-RNTI in the SPS configuration message to decode the control signaling, and determine whether the objective index comprises the self identification if the decode is successful.

[00226] Specifically, the control signaling may not comprise the objective index, processor 210 may be further configured to determine whether the objective index

comprises the self identification and use the SPS C-RNTI in the SPS configuration message to decode the control signaling if the objective index comprises the self identification.

[00227] Specifically, processor 210 may be further configured to receive via the communication circuit 220 an identification allocated by the base station.

[00228] Specifically, the identification may comprise a group identification and a user equipment identification.

[00229] For functions of various components or modules of the user equipment according to the present embodiment, one may refer to the relevant description of corresponding method embodiment, thus they will not be detailed again.

[00230] It will be appreciated that the disclosed base stations, UEs, and methods may also be implemented in other forms. Rather, the base stations and UEs as described are merely illustrative, for example, the division of modules or units is based solely on logic functions, thus in actual implementations there may be other division methods, e.g., multiple units or components may be combined or integrated onto another system, or some features may be ignored or not executed. In addition, mutual couplings, direct couplings, or communication connections as displayed or discussed may be achieved through some interfaces, devices, or units, and may be achieved electrically, mechanically, or in other forms.

[00231] Separated units as described may or may not be physically separated. Components displayed as units may or may not be physical units, and may reside at one location or may be distributed to multiple networked units. Part or all of the units may be selectively adopted according to actual requirements to achieve objectives of the disclosure.

[00232] Additionally, various functional units discussed in the disclosure may be integrated into one processing unit, or may be presented as various physically separated units, and two or more units may be integrated into one. The integrated units may be implemented by hardware or as software functional units.

[00233] If the integrated units are implemented as software functional units and sold

or used as standalone products, they may be stored in a computer readable storage medium. On the basis of such an understanding, the substantial technical solution or all or part of the technical solution of the disclosure may be embodied as software products. Computer software products can be stored in a storage medium and can include multiple instructions enabling a computing device (e.g., a personal computer, a server, a network device, etc.) or a processor to execute all or part of the methods as described in the disclosure. The storage medium may include all kinds of media that can store program codes, such as a USB flash disk, mobile hard drive, Read-Only Memory (ROM), Random Access Memory (RAM), magnetic disk, or optical disk.

[00234] The above description merely depicts some exemplary embodiments of the disclosure, but is not meant to limit the scope of the disclosure. Any equivalent structure or flow transformations made to the disclosure, or any direct or indirect applications of the disclosure on other related fields, shall all be covered within the protection of the disclosure.

## CLAIMS

1. A semi-persistent scheduling method, comprising:

transmitting a SPS (semi-persistent scheduling) configuration message for a SPS to a user equipment, wherein the SPS configuration message comprises at least two SPS information, each of the SPS information at least comprises a SPS C-RNTI (cell radio network temporary identity) of the SPS;

transmitting a control signaling and an objective index scrambled by the SPS C-RNTI to the user equipment, wherein the objective index comprises at least an identification of one user equipment, such that the user equipment corresponding to the identification executes one or more operations for the SPS corresponding to the SPS C-RNTI in accordance with the control signaling.

2. The method of claim 1, wherein the step of transmitting a control signaling scrambled by the SPS C-RNTI to the user equipment comprises at least:

transmitting an activation signaling scrambled by the SPS C-RNTI to the user equipment through a PDCCH (physical downlink control channel); or

transmitting a release signaling scrambled by the SPS C-RNTI to the user equipment through the PDCCH or using a RRC (radio resource control) message.

3. The method of claim 1, wherein the step of transmitting a control signaling scrambled by the SPS C-RNTI to the user equipment comprises:

transmitting the control signaling corresponding to an operation request for the SPS to the user equipment in response to the operation request from the user equipment, wherein the operation request comprises at least activation request or a release request.

4. The method of claim 3, wherein the step of transmitting the control signaling corresponding to a release request for the SPS to the user equipment in response to the release request transmitted by the user equipment comprises:

transmitting the control signaling corresponding to the release request to the user equipment if the continuous times of not yet receiving the data transmitted by the user

equipment using a corresponding SPS resource is larger than a predetermined threshold.

5. The method of claim 1, wherein the step of transmitting a control signaling scrambled by the SPS C-RNTI to the user equipment comprises:

transmitting the control signaling to a plurality of the user equipment through multicast or broadcast.

6. The method of claim 5, further comprising, before the step of transmitting the control signaling to a plurality of the user equipment through multicast or broadcast:

obtaining an operation request from the user equipment, wherein the amount of the operation request obtained from the user equipment in a predetermined period is larger than a predetermined threshold.

7. The method of claim 6, wherein the control signaling comprises the objective index, the step of transmitting the control signaling to a plurality of the user equipment through multicast comprises:

transmitting the control signaling to at least the user equipment informing of the operation request for the SPS through multicast in a plurality of times, wherein the sum of the times to transmit the control signaling and the largest amount of the identification comprised in the objective index is smallest

8. The method of any one of claims 1-6, wherein the control signaling includes the objective index.

9. The method of any one of claims 1-7, further comprising, before the step of transmitting a control signaling and an objective index scrambled by the SPS C-RNTI to the user equipment:

allocating the identification to the user equipment.

10. The method of claim 9, wherein the identification comprises:

a group identification and a user equipment identification.

11. The method of claim 10, wherein when transmitting the control signaling to at least the user equipment informing of an operation request for the SPS through

multicast in response to the operation request from the user equipment, the identification in the objective index is the group identification if the transmission objectives have a same group identification and all informed of the operation request.

12. The method of any one of claims 1-7, wherein the SPS information further comprises a period and a resource allocation of the SPS.

13. The method of claim 12, wherein the SPS information further comprises a release instruction of the SPS.

14. A semi-persistent scheduling method, comprising:

receiving a SPS (semi-persistent scheduling) configuration message transmitted by a base station, wherein the SPS configuration message comprises at least two SPS information, each of the SPS information at least comprises a SPS C-RNTI (cell radio network temporary identity) of the SPS;

receiving a control signaling and an objective index scrambled by the SPS C-RNTI transmitted by the base station;

executing one or more operations for the SPS corresponding to the SPS C-RNTI in accordance with the control signaling if the objective index comprises a self identification, wherein the operation comprises at least activation or release.

15. The method of claim 14, wherein the step of receiving a control signaling scrambled by the SPS C-RNTI from the base station comprises at least:

receiving an activation signaling scrambled by the SPS C-RNTI through a PDCCH (physical downlink control channel); or

receiving a release signaling scrambled by the SPS C-RNTI through the PDCCH or using a RRC message.

16. The method of claim 14, further comprising, before the step of receiving a control signaling and an objective index scrambled by the SPS C-RNTI transmitted by the base station:

informing the base station of an operation request corresponding to the SPS, wherein the operation request comprises at least an activation request or a release request.

17. The method of claim 16, wherein the step of informing the base station of a release request corresponding to the SPS comprises:

transmitting the operation request corresponding to the SPS to the base station.

18. The method of claim 16, wherein the step of informing the base station of a release request corresponding to the SPS comprises:

suspending using a corresponding SPS resource to transmit data to the base station for continuous N times, wherein N is larger than a predetermined threshold.

19. The method of any one of claims 14-18, wherein the control signaling comprises the objective index, after the step of receiving a control signaling and an objective index scrambled by the SPS C-RNTI transmitted by the base station further comprises:

trying to use the SPS C-RNTI in the SPS configuration message to decode the control signaling;

determining whether the objective index comprises the self identification if the decode is successful.

20. The method of any one of claims 14-18, wherein the control signaling does not comprise the objective index, after the step of receiving a control signaling and an objective index scrambled by the SPS C-RNTI transmitted by the base station further comprises:

determining whether the objective index comprises the self identification;

using the SPS C-RNTI in the SPS configuration message to decode the control signaling, if the objective index comprises the self identification.

21. The method of any one of claims 14-18, further comprising, before the step of receiving a control signaling and an objective index scrambled by the SPS C-RNTI transmitted by the base station:

receiving an identification allocated by the base station.

22. The method of claim 21, wherein the identification comprises a group identification and a user equipment identification.

23. A base station, comprising:

a first transmitting module configured to transmit a SPS (semi-persistent scheduling) configuration message for a SPS to a user equipment, wherein the SPS configuration message comprises at least two SPS information, each of the SPS information at least comprises a SPS C-RNTI (cell radio network temporary identity) of the SPS;

a second transmitting module configured to transmit a control signaling and an objective index scrambled by the SPS C-RNTI to the user equipment, wherein the objective index comprises at least an identification of one user equipment, such that the user equipment corresponding to the identification executes one or more operations for the SPS corresponding to the SPS C-RNTI in accordance with the control signaling.

24. The base station of claim 23, wherein the second transmitting module is configured to transmit the control signaling corresponding to an operation request for the SPS to the user equipment in response to the operation request from the user equipment, wherein the operation request comprises at least an activation request or a release request.

25. The base station of claim 24, wherein the second transmitting module is configured to transmit the control signaling corresponding to the release request to the user equipment when the continuous times of not yet receiving the data transmitted by the user equipment using a corresponding SPS resource is larger than a predetermined threshold

26. The base station of claim 23, wherein the second transmitting module is configured to transmit the control signaling to a plurality of the user equipment through multicast or broadcast.

27. The base station of any one of claims 23-26, further comprising:  
an allocation module configured to allocate an identification to the user equipment.

28. A user equipment, comprising:

a first receiving module configured to receive a SPS (semi-persistent scheduling) configuration message transmitted by a base station, wherein the SPS configuration message comprises at least two SPS information, each of the SPS information at least comprises a SPS C-RNTI (cell radio network temporary identity) of the SPS;

a second receiving module configured to receive a control signaling and an objective index scrambled by the SPS C-RNTI transmitted by the base station;

an execution module configured to execute one or more operations for the SPS corresponding to the SPS C-RNTI in accordance with the control signaling if the objective index comprises a self identification of the user equipment, wherein the operation comprises at least activation or release.

29. The user equipment of claim 28, wherein the second receiving module is configured to at least receive an activation signaling scrambled by the SPS C-RNTI through a PDCCH (physical downlink control channel); or receive a release signaling scrambled by the SPS C-RNTI through the PDCCH or using a RRC message.

30. The user equipment of claims 28 or 29, wherein the control signaling comprises the objective index, the user equipment further comprises:

a decoder module configured to try to use the SPS C-RNTI in the SPS configuration message to decode the control signaling;

a determination module configured to determine whether the objective index comprises the self identification.

31. The user equipment of claims 28 or 29, wherein the control signaling does not comprise the objective index, the user equipment further comprises:

a determination module configured to determine whether the objective index comprises the self identification;

a decoder module configured to use the SPS C-RNTI in the SPS configuration message to decode the control signaling, if the objective index comprises the self identification.

32. A base station, comprising a processor and a transceiver coupled to the processor; wherein the processor is configured to transmit via the transceiver a SPS

(semi-persistent scheduling) configuration message for a SPS to a user equipment, wherein the SPS configuration message comprises at least two SPS information, each of the SPS information at least comprises a SPS C-RNTI (cell radio network temporary identity) of the SPS; transmit via the transceiver a control signaling and an objective index scrambled by the SPS C-RNTI to the user equipment, the objective index comprises at least an identification of one user equipment, such that the user equipment corresponding to the identification executes one or more operations for the SPS corresponding to the SPS C-RNTI in accordance with the control signaling.

33. The base station of claim 32, wherein the processor is configured to at least transmit via the transceiver an activation signaling scrambled by the SPS C-RNTI to the user equipment through a PDCCH (physical downlink control channel); or transmit via the transceiver a release signaling scrambled by the SPS C-RNTI to the user equipment through the PDCCH or using a RRC (radio resource control) message.

34. The base station of claim 32, wherein the processor is configured to transmit via the transceiver the control signaling corresponding to an operation request for the SPS to the user equipment in response to the operation request from the user equipment, wherein the operation request comprises at least an activation request or a release request.

35. The base station of claim 34, wherein the processor is configured to transmit via the transceiver the control signaling corresponding to the release request to the user equipment, if the continuous times of not yet receiving the data transmitted by the user equipment using a corresponding SPS resource is larger than a predetermined threshold.

36. The base station of claim 32, wherein the processor is configured to transmit via the transceiver the control signaling to a plurality of the user equipment through multicast or broadcast.

37. The base station of claim 36, wherein the processor is further configured to obtain via the transceiver an operation request from the user equipment, wherein the

amount of the operation request obtained from the user equipment in a predetermined period is larger than a predetermined threshold.

38. The base station of claim 37, wherein the control signaling comprises the objective index, the processor is configured to transmit via the transceiver the control signaling to at least the user equipment informing of the operation request for the SPS through multicast in a plurality of times, wherein the sum of the times to transmit the control signaling and the largest amount of the identification comprised in the objective index is smallest.

39. The base station of any one of claims 32-37, wherein the control signaling comprises the objective index.

40. The base station of any one of claims 32-38, wherein the processor is further configured to allocate an identification to the user equipment via the transceiver.

41. The base station of claim 40, wherein the identification comprises a group identification and a user equipment identification.

42. The base station of claim 41, wherein when the processor is configured to transmit via the transceiver the control signaling to at least the user equipment informing of an operation request for the SPS through multicast in response to the operation request from the user equipment, the identification in the objective index is the group identification if the transmission objectives have a same group identification and all informed of the operation request.

43. The base station of any one of claims 32-38, wherein the SPS information further comprises a period and a resource allocation of the SPS.

44. The base station of claim 43, wherein the SPS information further comprises a release instruction of the SPS.

45. A user equipment, comprising: a processor and a communication circuit coupled to the processor; wherein the processor is configured to receive via the communication circuit a SPS (semi-persistent scheduling) configuration message transmitted by a base station, wherein the SPS configuration message comprises at

least two SPS information, each of the SPS information at least comprises a SPS C-RNTI (cell radio network temporary identity) of the SPS; receive via the communication circuit a control signaling and an objective index scrambled by the SPS C-RNTI transmitted by the base station; execute one or more operations for the SPS corresponding to the SPS C-RNTI in accordance with the control signaling if the objective index comprises a self identification of the user equipment, wherein the operation comprises at least activation or release.

46. The user equipment of claim 45, wherein the processor is configured to at least receive via the communication circuit an activation signaling scrambled by the SPS C-RNTI through a PDCCH (physical downlink control channel); or receive via the communication circuit a release signaling scrambled by the SPS C-RNTI through the PDCCH or using a RRC message.

47. The user equipment of claim 45, wherein the processor is configured to inform via the communication circuit the base station of an operation request corresponding to the SPS, wherein the operation request comprises at least an activation request or a release request.

48. The user equipment of claim 47, wherein the processor is configured to transmit via the communication circuit the operation request corresponding to the SPS to the base station.

49. The user equipment of claim 47, wherein the processor is configured to suspend using a corresponding SPS resource to transmit data to the base station for continuous N times, wherein N is larger than a predetermined threshold.

50. The user equipment of any one of claims 45-49, wherein the control signaling comprises the objective index, the processor is further configured to try to use the SPS C-RNTI in the SPS configuration message to decode the control signaling, and determine whether the objective index comprises the self identification if the decode is successful.

51. The user equipment of any one of claims 45-49, wherein the control signaling does not comprise the objective index, the processor is further configured to

determine whether the objective index comprises the self identification and use the SPS C-RNTI in the SPS configuration message to decode the control signaling if the objective index comprises the self identification.

52. The user equipment of any one of claims 45-49, wherein the processor is further configured to receive via the communication circuit an identification allocated by the base station.

53. The user equipment of claim 51, wherein the identification comprises a group identification and a user equipment identification.

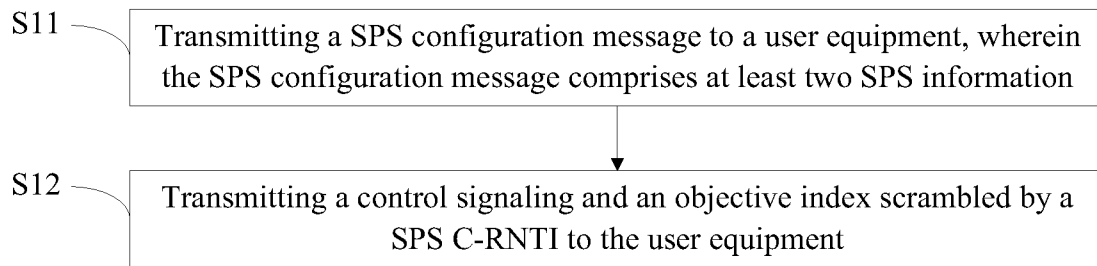


FIG. 1

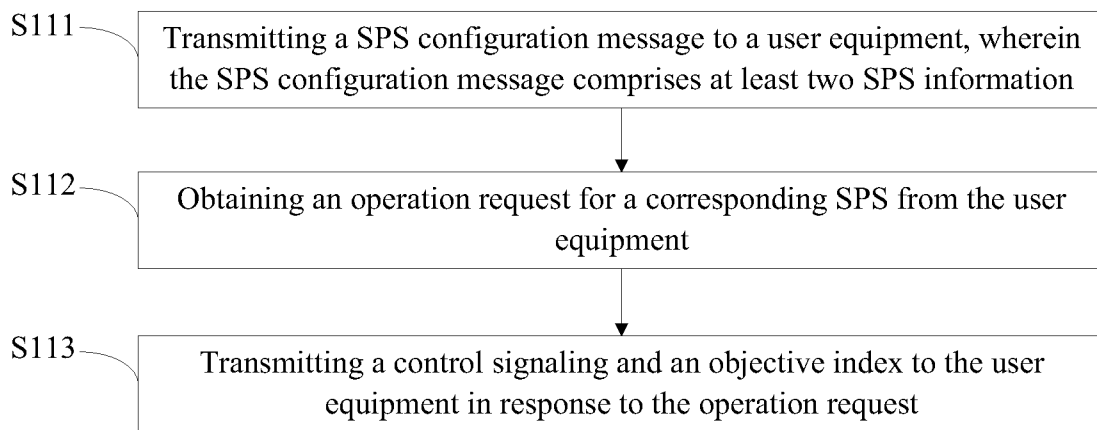


FIG. 2

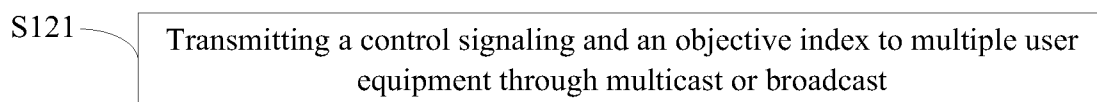


FIG. 3

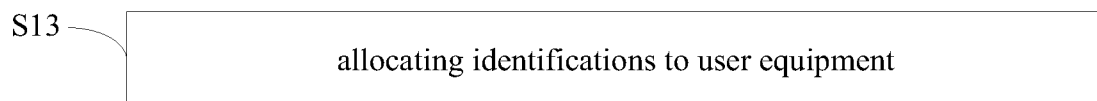


FIG. 4

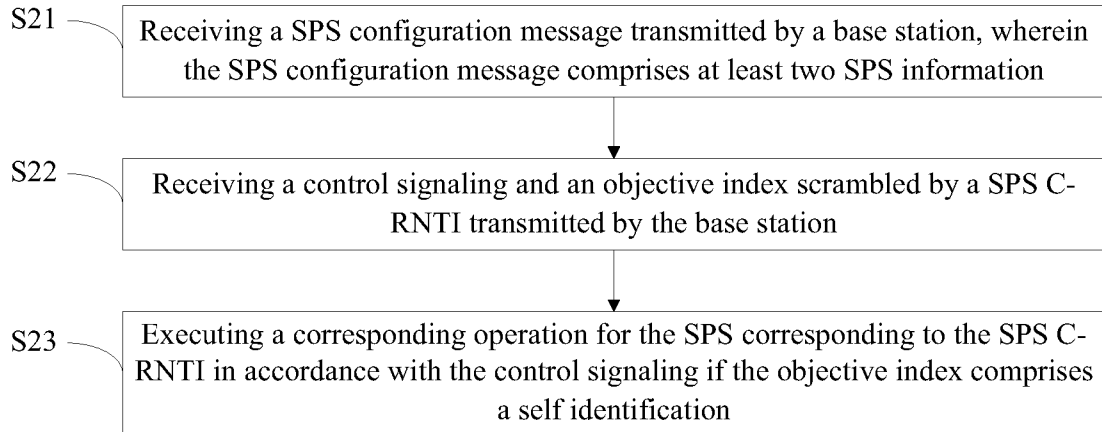


FIG. 5

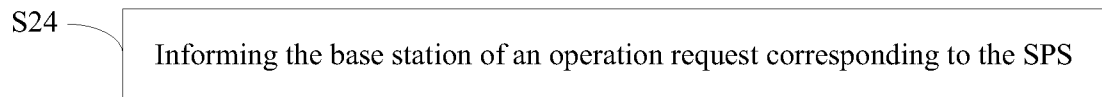


FIG. 6

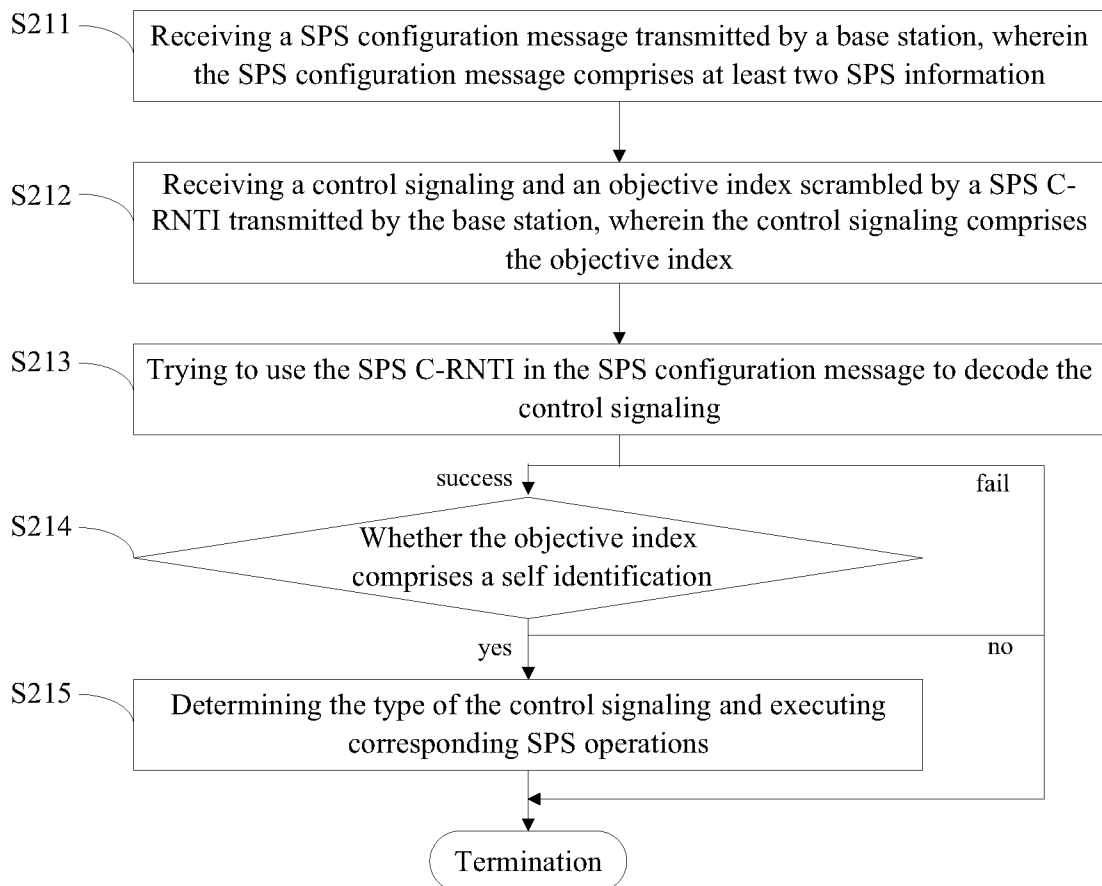


FIG. 7

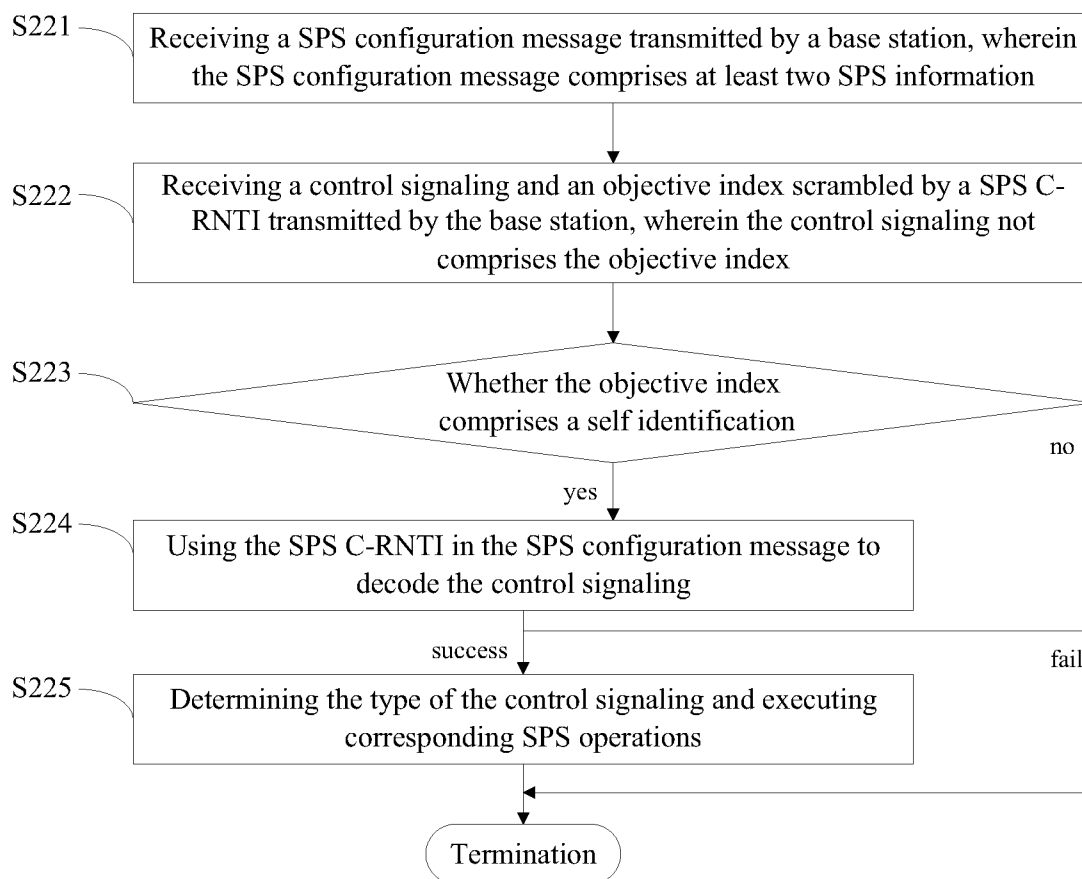


FIG. 8

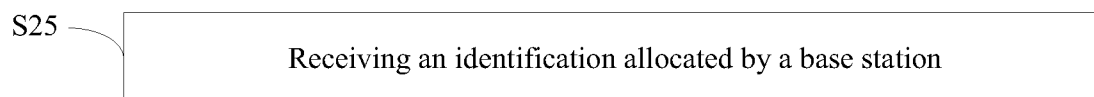


FIG. 9

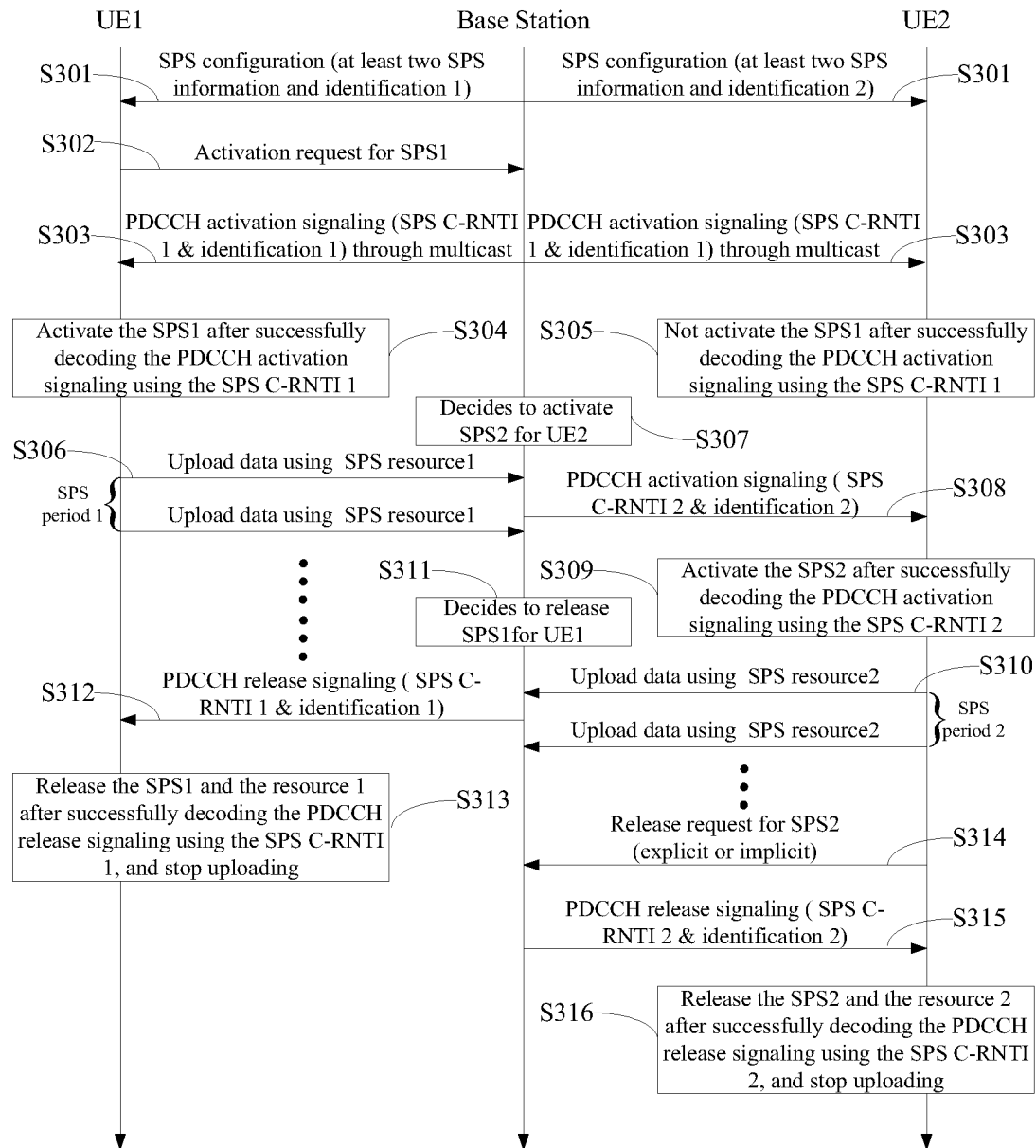


FIG. 10

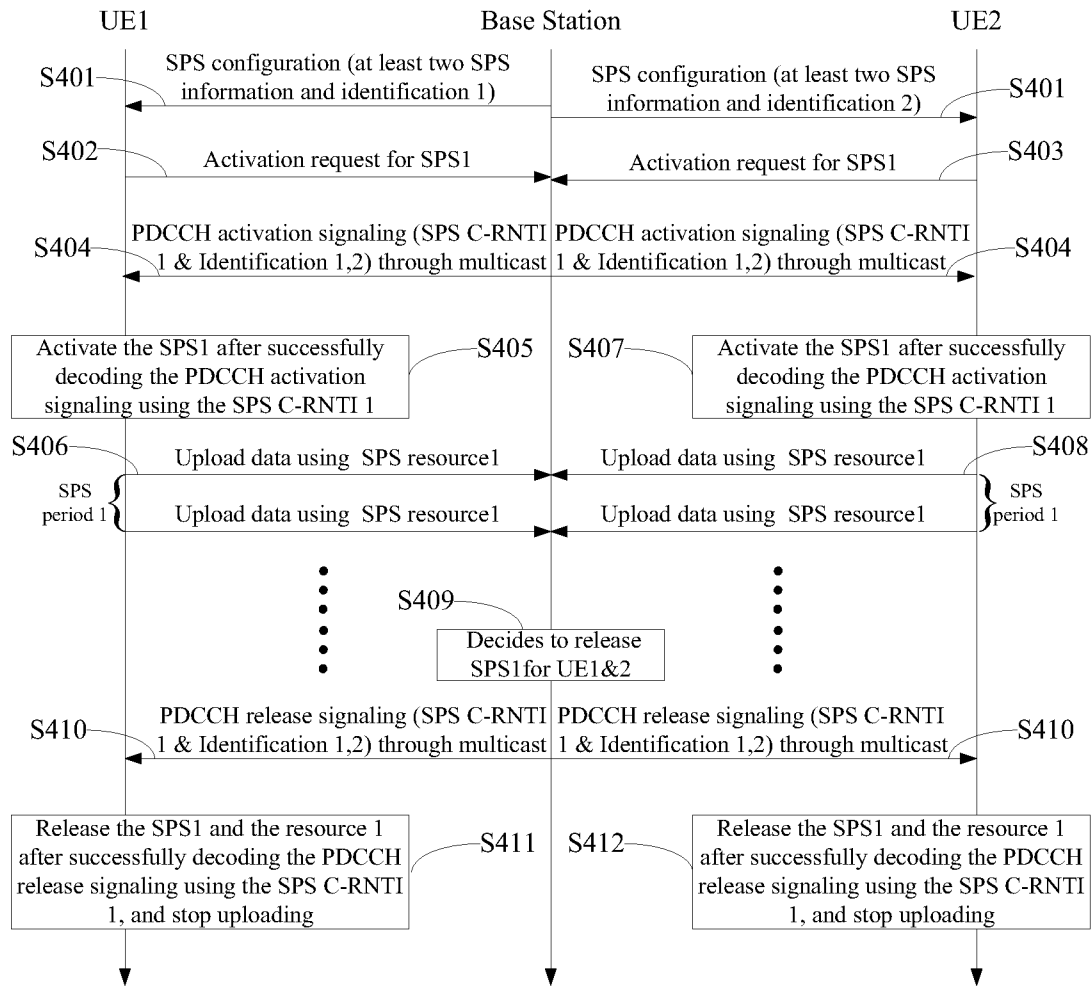


FIG. 11

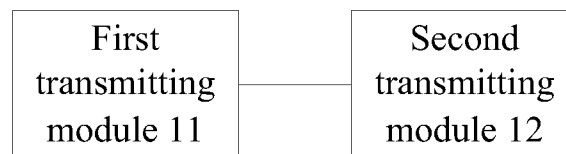


FIG. 12

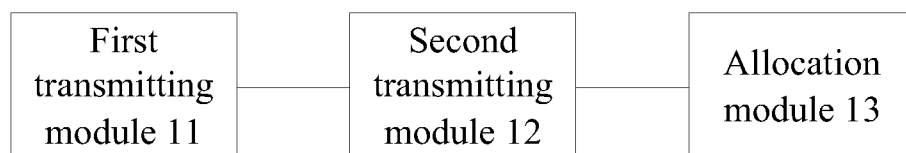


FIG. 13

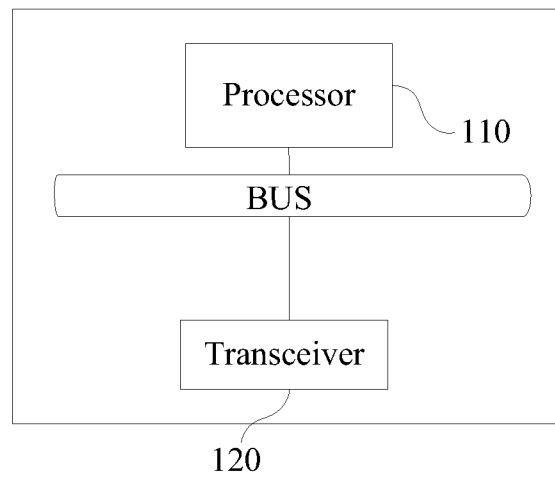


FIG. 14

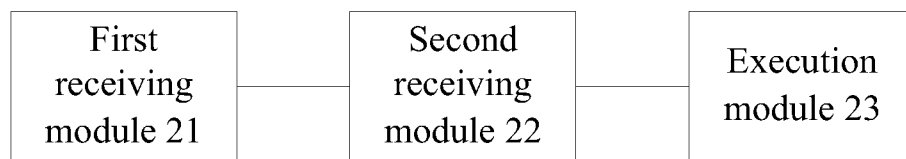


FIG. 15

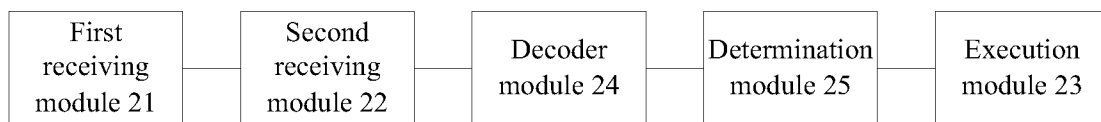


FIG. 16

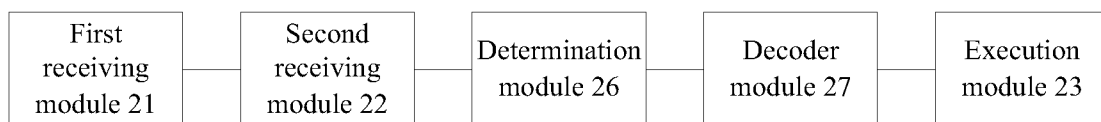


FIG. 17

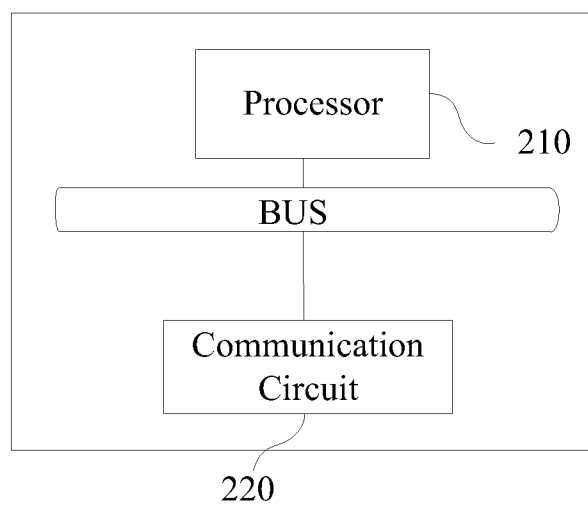


FIG. 18

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2017/070160

**A. CLASSIFICATION OF SUBJECT MATTER**

H04W 72/04(2009.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

H04W H04Q H04L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNPAT, CNKI, WPI, EPODOC, 3GPP, IEEE: SPS, semi-persistent scheduling, UE, user equipment, C-RNTI, cell radio network temporary identity, configure, ID, identification, scramble, control, signaling, objective, index, group

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

| Category* | Citation of document, with indication, where appropriate, of the relevant passages                                  | Relevant to claim No. |
|-----------|---------------------------------------------------------------------------------------------------------------------|-----------------------|
| Y         | EP 2658330 A1 (HUAWEI TECHNOLOGIES CO., LTD.) 30 October 2013 (2013-10-30)<br>description, paragraphs [0043]-[0067] | 1-53                  |
| Y         | CN 103166737 A (TD TECH. LTD.) 19 June 2013 (2013-06-19)<br>description, paragraphs [0059]-[0066]                   | 1-53                  |
| A         | CN 105594279 A (QUALCOMM INC.) 18 May 2016 (2016-05-18)<br>the whole document                                       | 1-53                  |
| A         | CN 102158973 A (CHINA ACAD TELECOM TECHNOLOGY) 17 August 2011<br>(2011-08-17)<br>the whole document                 | 1-53                  |
| A         | CN 104469747 A (PUTIAN INFORMATION TECHNOLOGY INST.) 25 March 2015<br>(2015-03-25)<br>the whole document            | 1-53                  |

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

\* Special categories of cited documents:

“A” document defining the general state of the art which is not considered to be of particular relevance

“E” earlier application or patent but published on or after the international filing date

“L” document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

“O” document referring to an oral disclosure, use, exhibition or other means

“P” document published prior to the international filing date but later than the priority date claimed

“T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

“X” document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

“Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

“&” document member of the same patent family

Date of the actual completion of the international search

08 September 2017

Date of mailing of the international search report

27 September 2017

Name and mailing address of the ISA/CN

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**INTERNATIONAL SEARCH REPORT**  
**Information on patent family members**

International application No.

**PCT/CN2017/070160**

| Patent document<br>cited in search report |           |    | Publication date<br>(day/month/year) | Patent family member(s) |              |    | Publication date<br>(day/month/year) |
|-------------------------------------------|-----------|----|--------------------------------------|-------------------------|--------------|----|--------------------------------------|
| EP                                        | 2658330   | A1 | 30 October 2013                      | CN                      | 102595600    | A  | 18 July 2012                         |
|                                           |           |    |                                      | US                      | 2013301582   | A1 | 14 November 2013                     |
|                                           |           |    |                                      | WO                      | 2012097692   | A1 | 26 July 2012                         |
| CN                                        | 103166737 | A  | 19 June 2013                         | None                    |              |    |                                      |
| CN                                        | 105594279 | A  | 18 May 2016                          | JP                      | 2016539529   | A  | 15 December 2016                     |
|                                           |           |    |                                      | EP                      | 3053398      | A1 | 10 August 2016                       |
|                                           |           |    |                                      | WO                      | 2015051212   | A1 | 09 April 2015                        |
|                                           |           |    |                                      | KR                      | 20160068777  | A  | 15 June 2016                         |
|                                           |           |    |                                      | US                      | 2015098341   | A1 | 09 April 2015                        |
|                                           |           |    |                                      | IN                      | 201647007506 | A  | 01 July 2016                         |
| CN                                        | 102158973 | A  | 17 August 2011                       | None                    |              |    |                                      |
| CN                                        | 104469747 | A  | 25 March 2015                        | None                    |              |    |                                      |