METHOD FOR DETERMINING REFERENCE SIGNAL, NETWORK DEVICE, UE, AND COMPUTER STORAGE MEDIUM

TECHNICAL FIELD

The present application relates to the field of information processing technologies, and in particular, to a method for determining a reference signal (RS), a network device, a user equipment (UE), and a computer storage medium.

BACKGROUND

Currently, in order to perform beam failure detection, a UE needs to measure a reference signal (for example, a CSI-RS, an SS/PBCH block and etc.) corresponding to a physical downlink control channel (PDCCH). Currently, there are two kinds of methods: Method 1: a network configures a group of RSs for a UE as a measurement signal for the beam failure detection; Method 2: if the network does not configure anything (i.e., does not use Method 1), the UE itself determines, based on a quasi co-location (QCL), a group of RSs as the measurement signal for the beam failure detection.

Regarding Method 2, there are some problems with the current solution. A configuration for a control resource set (CORESET) may include a plurality of transmission configuration indication (TCI) states, if the UE needs to take an RS signal indicated in each of the TCI states as a measurement RS signal for the beam failure detection, two problems may occur: a complexity of the UE is increased, and a beam associated with the QCL indicated by some of the TCI states is not used for the current PDCCH transmission. Therefore, a measurement on a reference signal corresponding to this beam cannot truly reflect a quality of the PDCCH transmission.

SUMMARY

To solve the above technical problem, embodiments of the present application provides a method for determining a reference signal (RS), a network device, a user equipment (UE), and a computer storage medium.

An embodiment of the present application provides a method for determining a reference signal (RS), applied to a network device and including:

configuring N control resource sets for a UE, where K pieces of transmission configuration indication (TCI) information is configured in each of at least part of control resource sets in the N control resource sets, and a quantity of the TCI information K configured in different control resource sets in the at least part of control resource sets is the same or different; where N and K are integers greater than or equal to 1, and at least one RS is indicated in each piece of TCI information; and

indicating to the UE the at least one RS in the K pieces of TCI information.

An embodiment of the present application provides a method for determining a reference signal (RS), applied to a UE, including:

receiving N control resource sets configured by a network side for the UE, where K pieces of transmission configuration indication (TCI) information is configured in each of at least part of control resource sets in the N control resource sets, and a quantity of the TCI information K configured in different control resource sets in the at least part of control resource sets is the same or different; where N and K are integers greater than or equal to 1, and at least one RS is indicated in each piece of TCI information; and

receiving the at least one RS in the K pieces of TCI information indicated by the network side to the UE.

An embodiment of the present application provides a network device, including:

a first communicating unit, configured to configure N control resource sets for a UE, where K pieces of transmission configuration indication (TCI) information is configured in each of at least part of control resource sets in the N control resource sets, and a quantity of the TCI information K configured in different control resource sets in the at least part of control resource sets is the same or different; where N and K are integers greater than or equal

to 1, and at least one RS is indicated in each piece of TCI information; and indicate to the UE the at least one RS in the K pieces of TCI information.

An embodiment of the present application provides a UE, including:

a second communicating unit, configured to receive N control resource sets configured by a network side for the UE, where K pieces of transmission configuration indication (TCI) information is configured in each of at least part of control resource sets in the N control resource sets, and a quantity of the TCI information K configured in different control resource sets in the at least part of control resource sets is the same or different; where N and K are integers greater than or equal to 1, and at least one RS is indicated in each piece of TCI information; and receive the at least one RS in the K pieces of TCI information indicated by the network side to the UE.

An embodiment of the present application provides a network device, including: a processor and a memory for storing a computer program capable of running on the processor,;

where the processor is configured to perform steps of the above method when the computer program is run.

An embodiment of the present application provides a UE, including: a processor and a memory for storing a computer program capable of running on the processor;

where the processor is configured to perform steps of the above method when the computer program is run.

An embodiment of the present application provides a computer storage medium storing computer executable instructions which, when being executed, implement steps of the above method.

In technical solutions according to the embodiments of the present application, when it is capable of configuring the control resource set for the UE, only K pieces of TCI are configured in part of the control resource sets, and at least one RS in the K pieces of TCI are indicated to the UE, thus avoiding that the UE measures RSs corresponding to all the TCI in all the control resource sets, thereby reducing a power consumption of the UE and improving an accuracy of beam detection performed by the UE.

BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 is a schematic flowchart 1 of a method for determining an RS according to an embodiment of the present application;

FIG. 2 is a schematic flowchart 2 of a method for determining an RS according to an embodiment of the present application;

FIG. 3 is a schematic structural diagram of a user equipment (UE) according to an embodiment of the present application; and

FIG. 4 is a schematic diagram of a hardware architecture according to an embodiment of the present application.

DESCRIPTION OF EMBODIMENTS

In order to understand the features and technical contents of the embodiments of the present application in more detail, it should first be noted that the RS proposed in the embodiments of the present application may refer to an RS signal, or an RS resource, or an RS resource group. For example, a CSI-RS resource, an index of an SS/PBCH block, or a CSI-RS resource group identifier, and the like, are all within the scope of the concept of the RS in the embodiments of the present application, which are not exhaustively listed herein.

The implementation of the embodiments of the present application is described in detail below with reference to the accompanying drawings. The accompanying drawings are for illustrative purposes only and are not intended to limit the embodiments of the present application.

Embodiment 1

An embodiment of the present application provides a method for determining an RS, which is applied to a network device. As shown in FIG. 1, the method includes:

Step 101: configuring N control resource sets for a UE, where K pieces of transmission configuration indication (TCI) information is configured in each of at least part of control resource sets in the N control resource sets, and a quantity of the TCI information K configured in different control resource sets in the at least part of control resource sets is the same or different; where N and K are integers greater than or equal to 1, and at least one RS is

indicated in the TCI information.

Step 102: indicating to the UE the at least one RS in the K pieces of TCI information.

Here, the quantity of the TCI configured in different control resource sets in the at least part of control resource sets is the same or different, that is, K corresponding to the K pieces of TCI configured in different control resource sets (CORESET) in the at least part of the CORESETs can be the same or different.

In an NR system, a network can be configured with one or more CORESETs, each CORESET can contain a time-frequency resource (such as which frequency domain resources are occupied, how many consecutive time domain symbols are occupied), and other configurations, such as a quasi co-location (QCL) for an antenna port, the QCL is provided by a high-level parameter TCI, the parameter is configured for a DM-RS antenna port received by a PDCCH.

In addition, the method may further include: configuring M search spaces for the UE, and the at least part of control resource sets is associated with at least one search space of the M search spaces, and the search spaces are used for the UE to detect at least one RS in the K pieces of TCI information in a control resource set corresponding to a PDCCH.

That is, after aiming at the at least part of control resource sets (CORESET), it is necessary to indicate a search space associated with the at least part of CORESETs to the UE, after which the UE will detect the corresponding PDCCH.

Based on the above description, various processing scenarios are separately performed below:

Scene 1

When one CORESET is configured with multiple TCI states, an RS corresponding to the activated TCI state is used as a measurement RS for beam failure detection.

The network configures N CORESETs for the UE, where K TCI states are configured on CORESET X. The network configures M search spaces for the UE to monitor the PDCCH, where CORESET X is associated with one or more of the search spaces.

In this scenario, when indicating the RS to be used, the following method is adopted, where the indicating to the UE the at least one RS in the K pieces of TCI information includes one of the following:

in the K pieces of TCI information, an RS indicated by TCI information activated through MAC CE signaling;

in the K pieces of TCI information, an RS indicated by TCI information indicated through DCI.

Specifically, for the beam failure detection, when the UE needs to determine a link quality of the PDCCH corresponding to CORESET X, it is required to determine from the K TCI states that an RS indicated in a certain TCI state is used, and the determining method has the following options:

in the K TCI states, the one activated under the indication of the MAC CE signaling.

in the K TCI states, the one activated under the indication of the DCI.

Scene 2

When one TCI state indicates one piece of QCL information, an RS associated with a spatially correlated QCL is used as the measurement RS for the beam failure detection.

The method further includes: indicating QCL information in a piece of TCI; where the QCL information corresponds to at least two pieces of RS information; where RSs indicated by the at least two pieces of RS information are the same or different, and different RS information corresponds to different QCL parameter types.

That is, the network configures N CORESETs for the UE, where one TCI state is configured on CORESET X, and the TCL state indicates one piece of QCL information, and this QCL information corresponds to two RSs, and each of the RSs corresponds to a different QCL parameter type. It should be understood that two pieces of RS information included in the QCL information may indicate the same RS, but each RS may correspond, respectively, to a different QCL parameter type.

For one TCI state indicating one piece of QCL information, one or two RSs may be configured, and each RS corresponds to a different QCL parameter type, for example, two RSs form a group of QCL information, RS1 corresponds to QCL-TypeA, and RS2 corresponds to QCL-TypeD.

QCL types can include:

QCL-type TypeA: {a Doppler shift, Doppler spread, an average delay, a delay spread};

QCL-type TypeB: {a Doppler shift, Doppler spread};

QCL-TypeC: {an average delay, a Doppler shift};

QCL-TypeD: {a spatial Rx parameter}.

The network configures M search spaces for the UE to monitor the PDCCH, where CORESET X is associated with one or more of the search spaces.

For the beam failure detection, when the UE needs to determine the link quality of the PDCCH corresponding to CORESET X, it is required to determine to use a certain RS from the two RSs indicated by the TCI state, where the instructing the UE to use one RS in the target TCI includes one of the following:

in at least two RSs included in the target TCI, using an RS corresponding to a spatial QCL parameter; that is, in the two RSs, using the RS corresponding to the spatial QCL information;

in the at least two RSs included in the target TCI, using an RS that does not correspond to the spatial QCL parameter; that is, in the two RSs, using the RS that does not correspond to the spatial QCL information;

in the at least two RSs included in the target TCI, causing the UE to select an RS;

in the at least two RSs included in the target TCI, determining an RS to be used according to serial numbers of the RSs; for example, in the two RSs, determining which one to use according to the serial numbers of the RSs, and exemplarily, the RS with a small or a large serial number can be selected, which can be set according to actual situations;

in the at least two RSs included in the target TCI, determining an RS to be used according to locations of the RSs in configuration signaling; for example, in the two RSs, determining which one to use according to the locations of the RSs in the configuration signaling, and exemplarily, the RS whose location is in the front or in the back can be determined.

Based on the foregoing solution, after the UE obtains the RS to be used, the RS is configured for measurement on the RS to determine whether a link quality corresponding to a PDCCH corresponding to the RS satisfies a predetermined threshold.

Specifically, the RS may be used in a beam failure recovery procedure or a link reconfiguration procedure. For example, through measuring the CSI-RS and/or the SS/PBCH block, the UE determines whether the link quality corresponding to the corresponding

PDCCH satisfies a predetermined/configured threshold (a hypothetical BLER performance ratio threshold difference); the UE selects a new beam (whose L1-RSPR performance is better than the threshold) that satisfies the predetermined/configured threshold through the CSI-RS and/or the SS/PBCH block; the UE selects a physical random access channel (PRACH) corresponding to the new beam to initiate transmission, or reports the new selected beam through a physical uplink control channel (PUCCH); the UE detects a response of the network.

It should be further explained that the beam mentioned in the above is actually represented by information of a signal carried by the beam. In actual use, it is represented by an index of the CSI-RS resource or the synchronization signal (SS) block/PBCH block.

It can be seen that, by adopting the foregoing solution, when it is capable of configuring the control resource set for the UE, only K pieces of TCI are configured in part of the control resource sets, and at least one RS in the K pieces of TCI are indicated to the UE, thus avoiding that the UE measures RSs corresponding to all the TCI in all the control resource sets, thereby reducing a power consumption of the UE and improving an accuracy of beam detection performed by the UE.

Embodiment 2

An embodiment of the present application provides a method for determining an RS, which is applied to a UE. As shown in FIG. 2, the method includes:

Step 201: receiving N control resource sets configured by a network side for a UE, where K pieces of transmission configuration indication (TCI) information is configured in at least part of control resource sets in the N control resource sets, and a quantity of the TCI configured in different control resource sets in the at least part of control resource sets is the same or different; where N and K are integers greater than or equal to 1, and at least one RS is indicated in the TCI information.

Step 202: receiving the at least one RS in the K pieces of TCI information indicated by the network side to the UE.

Here, the quantity of the TCI configured in different control resource sets in the at least part of control resource sets is the same or different, that is, K corresponding to the K pieces of TCI configured in different control resource sets (CORESET) in the at least part of the

CORESETs can be the same or different.

In an NR system, a network can be configured with one or more CORESETs, each CORESET can contain a time-frequency resource (such as which frequency domain resources are occupied, how many consecutive time domain symbols are occupied), and other configurations, such as a quasi co-location (QCL) for an antenna port, the QCL is provided by a high-level parameter TCI, the parameter is configured for a DM-RS antenna port received by a PDCCH.

In addition, the method may further include: receiving M search spaces configured by the network side for the UE, and the at least part of control resource sets is associated with at least one search space of the M search spaces; and

detecting at least one RS in the K pieces of TCI information in a control resource set corresponding to a PDCCH according to the configured M search spaces.

That is, after aiming at the at least part of control resource sets (CORESET), it is necessary to indicate a search space associated with the at least part of CORESETs to the UE, after which the UE will detect the corresponding PDCCH.

Based on the above description, various processing scenarios are separately performed below:

Scene 1

When one CORESET is configured with multiple TCI states, an RS corresponding to the activated TCI state is used as a measurement RS for beam failure detection.

The network configures N CORESETs for the UE, where K TCI states are configured on CORESET X. The network configures M search spaces for the UE to monitor the PDCCH, where CORESET X is associated with one or more of the search spaces.

In this scenario, when indicating the RS to be used, the following method is adopted, where the indicating to the UE the at least one RS in the K pieces of TCI information includes one of the following:

receiving an RS indicated by one piece of TCI information of the K pieces of TCI information activated through MAC CE signaling by the network side;

receiving an RS indicated by one piece of TCI information of the K pieces of TCI information activated through DCI by the network side.

Specifically, for the beam failure detection, when the UE needs to determine a link quality of the PDCCH corresponding to CORESET X, it is required to determine from the K TCI states that an RS indicated in a certain TCI state is used, and the determining method has the following options:

in the K TCI states, the one activated under the indication of the MAC CE signaling.

in the K TCI states, the one activated under the indication of the DCI.

Scene 2

When one TCI state indicates one piece of QCL information, an RS associated with a spatially correlated QCL is used as the measurement RS for the beam failure detection.

The method further includes: receiving QCL information indicated by the network side in the TCI; where the QCL information corresponds to at least two pieces of RS information;

where RSs indicated by the at least two pieces of RS information are the same or different, and different RS information corresponds to different QCL parameter types.

That is, the network configures N CORESETs for the UE, where one TCI state is configured on CORESET X, and the TCL state indicates one piece of QCL information, and this QCL information corresponds to two RSs, and each of the RSs corresponds to a different QCL parameter type. It should be understood that two pieces of RS information included in the QCL information may indicate the same RS, but each RS may correspond, respectively, to a different QCL parameter type.

For one TCI state indicating one piece of QCL information, one or two RSs may be configured, and each RS corresponds to a different QCL parameter type, for example, two RSs form a group of QCL information, RS1 corresponds to QCL-TypeA, and RS2 corresponds to QCL-TypeD.

QCL types can include:

QCL-type TypeA: {a Doppler shift, Doppler spread, an average delay, a delay spread};

QCL-type TypeB: {a Doppler shift, Doppler spread};

QCL-TypeC: {an average delay, a Doppler shift};

QCL-TypeD: {a spatial Rx parameter}.

The network configures M search spaces for the UE to monitor the PDCCH, where CORESET X is associated with one or more of the search spaces.

For the beam failure detection, when the UE needs to determine the link quality of the PDCCH corresponding to CORESET X, it is required to determine to use a certain RS from the two RSs indicated by the TCI state, where the instructing the UE to use one RS in the target TCI includes one of the following:

in at least two RSs included in the target TCI, using an RS corresponding to a spatial QCL parameter; that is, in the two RSs, using the RS corresponding to the spatial QCL information;

in the at least two RSs included in the target TCI, using an RS that does not correspond to the spatial QCL parameter; that is, in the two RSs, using the RS that does not correspond to the spatial QCL information;

in the at least two RSs included in the target TCI, causing the UE to select an RS;

in the at least two RSs included in the target TCI, determining an RS to be used according to serial numbers of the RSs; for example, in the two RSs, determining which one to use according to the serial numbers of the RSs, and exemplarily, the RS with a small or a large serial number can be selected, which can be set according to actual situations;

in the at least two RSs included in the target TCI, determining an RS to be used according to locations of the RSs in configuration signaling; for example, in the two RSs, determining which one to use according to the locations of the RSs in the configuration signaling, and exemplarily, the RS whose location is in the front or in the back can be determined.

Based on the foregoing solution, after the UE obtains the RS to be used, the RS is configured for measurement on the RS to determine whether a link quality corresponding to a PDCCH corresponding to the RS satisfies a predetermined threshold.

Specifically, the RS may be used in a beam failure recovery procedure or a link reconfiguration procedure. For example, through measuring the CSI-RS and/or the SS/PBCH block, the UE determines whether the link quality corresponding to the corresponding PDCCH satisfies a predetermined/configured threshold (a hypothetical BLER performance ratio threshold difference); the UE selects a new beam (whose L1-RSPR performance is better than the threshold) that satisfies the predetermined/configured threshold through the CSI-RS and/or the SS/PBCH block; the UE selects a PRACH corresponding to the new beam to

initiate transmission, or reports the new selected beam through a PUCCH; the UE detects a response of the network.

It should be further explained that the beam mentioned in the above is actually represented by information of a signal carried by the beam. In actual use, it is represented by an index of the CSI-RS resource or the synchronization signal (SS) block/PBCH block.

It can be seen that, by adopting the foregoing solution, when it is capable of configuring the control resource set for the UE, only K pieces of TCI are configured in part of the control resource sets, and at least one RS in the K pieces of TCI are indicated to the UE, thus avoiding that the UE measures RSs corresponding to all the TCI in all the control resource sets, thereby reducing a power consumption of the UE and improving an accuracy of beam detection performed by the UE.

Embodiment 3

An embodiment of the application provides a network device, including:

a first communicating unit, configured to configure N control resource sets for a UE, where K pieces of transmission configuration indication (TCI) information is configured in at least part of control resource sets in the N control resource sets, and a quantity of the TCI configured in different control resource sets in the at least part of control resource sets is the same or different; where N and K are integers greater than or equal to 1, and at least one RS is indicated in the TCI information; and indicate to the UE the at least one RS in the K pieces of TCI information.

Here, the quantity of the TCI configured in different control resource sets in the at least part of control resource sets is the same or different, that is, K corresponding to the K pieces of TCI configured in different Control Resource Sets (CORESET) in the at least part of the CORESETs can be the same or different.

In an NR system, a network can be configured with one or more CORESETs, each CORESET can contain a time-frequency resource (such as which frequency domain resources are occupied, how many consecutive time domain symbols are occupied), and other configurations, such as a quasi co-location (QCL) for an antenna port, the QCL is provided by a high-level parameter TCI, the parameter is configured for a DM-RS antenna port received by a PDCCH.

In addition, the first communicating unit configures M search spaces for the UE, and the at least part of control resource sets is associated with at least one search space of the M search spaces, and the search spaces are used for the UE to detect at least one RS in the K pieces of TCI information in a control resource set corresponding to PDCCH.

That is, after aiming at the at least part of control resource sets (CORESET), it is necessary to indicate a search space associated with the at least part of CORESETs to the UE, after which the UE will detect the corresponding PDCCH.

Based on the above description, various processing scenarios are separately performed below:

Scene 1

When one CORESET is configured with multiple TCI states, an RS corresponding to the activated TCI state is used as a measurement RS for beam failure detection.

The network configures N CORESETs for the UE, where K TCI states are configured on CORESET X. The network configures M search spaces for the UE to monitor the PDCCH, where CORESET X is associated with one or more of the search spaces.

In this scenario, when indicating the RS to be used, the first communicating unit includes one of the following:

in the K pieces of TCI information, an RS indicated by TCI information activated through MAC CE signaling;

in the K pieces of TCI information, an RS indicated by TCI information indicated through DCI.

Specifically, for the beam failure detection, when the UE needs to determine a link quality of the PDCCH corresponding to CORESET X, it is required to determine from the K TCI states that an RS indicated in a certain TCI state is used, and the determining method has the following options:

in the K TCI states, the one activated under the indication of the MAC CE signaling.

in the K TCI states, the one activated under the indication of the DCI.

Scene 2

When one TCI state indicates one piece of QCL information, an RS associated with a spatially correlated QCL is used as the measurement RS for the beam failure detection.

The first communicating unit indicates QCL information in a piece of TCI; where the QCL information corresponds to at least two pieces of RS information; where RSs indicated by the at least two pieces of RS information are the same or different, and different RS information corresponds to different QCL parameter types.

That is, the network configures N CORESETs for the UE, where one TCI state is configured on CORESET X, and the TCL state indicates one piece of QCL information, and this QCL information corresponds to two RSs, and each of the RSs corresponds to a different QCL parameter type. It should be understood that two pieces of RS information included in the QCL information may indicate the same RS, but each RS may correspond, respectively, to a different QCL parameter type.

For one TCI state indicating one piece of QCL information, one or two RSs may be configured, and each RS corresponds to a different QCL parameter type, for example, two RSs form a group of QCL information, RS1 corresponds to QCL-TypeA, and RS2 corresponds to QCL-TypeD.

QCL types can include:

QCL-type TypeA: {a Doppler shift, Doppler spread, an average delay, a delay spread};

QCL-type TypeB: {a Doppler shift, Doppler spread};

QCL-TypeC: {an average delay, a Doppler shift};

QCL-TypeD: {a spatial Rx parameter}.

The network configures M search spaces for the UE to monitor the PDCCH, where CORESET X is associated with one or more of the search spaces.

For the beam failure detection, when the UE needs to determine the link quality of the PDCCH corresponding to CORESET X, it is required to determine to use a certain RS from the two RSs indicated by the TCI state, where the UE is instructed to use one RS in the target TCI, the first communicating unit includes one of the following:

in at least two RSs included in the target TCI, using an RS corresponding to a spatial QCL parameter; that is, in the two RSs, using the RS corresponding to the spatial QCL information;

in the at least two RSs included in the target TCI, using an RS that does not correspond to the spatial QCL parameter; that is, in the two RSs, using the RS that does not correspond to

the spatial QCL information;

in the at least two RSs included in the target TCI, causing the UE to select an RS;

in the at least two RSs included in the target TCI, determining an RS to be used according to serial numbers of the RSs; for example, in the two RSs, determining which one to use according to the serial numbers of the RSs, and exemplarily, the RS with a small or a large serial number can be selected, which can be set according to actual situations;

in the at least two RSs included in the target TCI, determining an RS to be used according to locations of the RSs in configuration signaling; for example, in the two RSs, determining which one to use according to the locations of the RSs in the configuration signaling, and exemplarily, the RS whose location is in the front or in the back can be determined.

Based on the foregoing solution, after the UE obtains the RS to be used, the RS is configured for measurement on the RS to determine whether a link quality corresponding to a PDCCH corresponding to the RS satisfies a predetermined threshold.

Specifically, the RS may be used in a beam failure recovery procedure or a link reconfiguration procedure. For example, through measuring the CSI-RS and/or the SS/PBCH block, the UE determines whether the link quality corresponding to the corresponding PDCCH satisfies a predetermined/configured threshold (a hypothetical BLER performance ratio threshold difference); the UE selects a new beam (whose L1-RSPR performance is better than the threshold) that satisfies the predetermined/configured threshold through the CSI-RS and/or the SS/PBCH block; the UE selects a PRACH corresponding to the new beam to initiate transmission, or reports the new selected beam through a PUCCH; the UE detects a response of the network.

It should be further explained that the beam mentioned in the above is actually represented by information of a signal carried by the beam. In actual use, it is represented by an index of the CSI-RS resource or the synchronization signal (SS) block/PBCH block.

It can be seen that, by adopting the foregoing solution, when it is capable of configuring the control resource set for the UE, only K pieces of TCI are configured in part of the control resource sets, and at least one RS in the K pieces of TCI are indicated to the UE, thus avoiding that the UE measures RSs corresponding to all the TCI in all the control resource

sets, thereby reducing a power consumption of the UE and improving an accuracy of beam detection performed by the UE.

Embodiment 4

An embodiment of the present application provides a UE, as shown in FIG. 3, including:

a second communicating unit 31 for receiving N control resource sets configured by a network side for a UE, where K pieces of transmission configuration indication (TCI) information is configured in at least part of control resource sets in the N control resource sets, and a quantity of the TCI configured in different control resource sets in the at least part of control resource sets is the same or different; where N and K are integers greater than or equal to 1, and at least one RS is indicated in the TCI information; and receiving the at least one RS in the K pieces of TCI information indicated by the network side to the UE.

Here, the quantity of the TCI configured in different control resource sets in the at least part of control resource sets is the same or different, that is, K corresponding to the K pieces of TCI configured in different Control Resource Sets (CORESET) in the at least part of the CORESETs can be the same or different.

In an NR system, a network can be configured with one or more CORESETs, each CORESET can contain a time-frequency resource (such as which frequency domain resources are occupied, how many consecutive time domain symbols are occupied), and other configurations, such as a quasi co-location (QCL) for an antenna port, the QCL is provided by a high-level parameter TCI, the parameter is configured for a DM-RS antenna port received by a PDCCH.

In addition, the UE further includes:

a second communicating unit 31 is configured to receive M search spaces configured by the network side for the UE, and the at least part of control resource sets is associated with at least one search space of the M search spaces; and

the second processing unit 32 is configured to detect at least one RS in the K pieces of TCI information in a control resource set corresponding to a PDCCH according to the configured M search spaces.

That is, after aiming at the at least part of control resource sets (CORESET), it is necessary to indicate a search space associated with the at least part of CORESETs to the UE,

after which the UE will detect the corresponding PDCCH.

Based on the above description, various processing scenarios are separately performed below:

Scene 1

When one CORESET is configured with multiple TCI states, an RS corresponding to the activated TCI state is used as a measurement RS for beam failure detection.

The network configures N CORESETs for the UE, where K TCI states are configured on CORESET X. The network configures M search spaces for the UE to monitor the PDCCH, where CORESET X is associated with one or more of the search spaces.

In this scenario, when indicating the RS to be used, the second communicating unit 31 includes one of the following:

receiving an RS indicated by one piece of TCI information of the K pieces of TCI information activated through MAC CE signaling by the network side;

receiving an RS indicated by one piece of TCI information of the K pieces of TCI information activated through DCI by the network side.

Specifically, for the beam failure detection, when the UE needs to determine a link quality of the PDCCH corresponding to CORESET X, it is required to determine from the K TCI states that an RS indicated in a certain TCI state is used, and the determining method has the following options:

in the K TCI states, the one activated under the indication of the MAC CE signaling.

in the K TCI states, the one activated under the indication of the DCI.

Scene 2

When one TCI state indicates one piece of QCL information, an RS associated with a spatially correlated QCL is used as the measurement RS for the beam failure detection.

The second communicating unit 31 receives QCL information indicated by the network side in the TCI; where the QCL information corresponds to at least two pieces of RS information;

where RSs indicated by the at least two pieces of RS information are the same or different, and different RS information corresponds to different QCL parameter types.

That is, the network configures N CORESETs for the UE, where one TCI state is

configured on CORESET X, and the TCL state indicates one piece of QCL information, and this QCL information corresponds to two RSs, and each of the RSs corresponds to a different QCL parameter type. It should be understood that two pieces of RS information included in the QCL information may indicate the same RS, but each RS may correspond, respectively, to a different QCL parameter type.

For one TCI state indicating one piece of QCL information, one or two RSs may be configured, and each RS corresponds to a different QCL parameter type, for example, two RSs form a group of QCL information, RS1 corresponds to QCL-TypeA, and RS2 corresponds to QCL-TypeD.

QCL types can include:

QCL-type TypeA: {a Doppler shift, Doppler spread, an average delay, a delay spread};

QCL-type TypeB: {a Doppler shift, Doppler spread};

QCL-TypeC: {an average delay, a Doppler shift};

QCL-TypeD: {a spatial Rx parameter}.

The network configures M search spaces for the UE to monitor the PDCCH, where CORESET X is associated with one or more of the search spaces.

For the beam failure detection, when the UE needs to determine the link quality of the PDCCH corresponding to CORESET X, it is required to determine to use a certain RS from the two RSs indicated by the TCI state, where the UE is instructed to use one RS in the target TCI, the second processing unit 32 includes one of the following:

in at least two RSs included in the target TCI, using an RS corresponding to a spatial QCL parameter; that is, in the two RSs, using the RS corresponding to the spatial QCL information;

in the at least two RSs included in the target TCI, using an RS that does not correspond to the spatial QCL parameter; that is, in the two RSs, using the RS that does not correspond to the spatial QCL information;

in the at least two RSs included in the target TCI, causing the UE to select an RS;

in the at least two RSs included in the target TCI, determining an RS to be used according to serial numbers of the RSs; for example, in the two RSs, determining which one to use according to the serial numbers of the RSs, and exemplarily, the RS with a small or a

large serial number can be selected, which can be set according to actual situations;

in the at least two RSs included in the target TCI, determining an RS to be used according to locations of the RSs in configuration signaling; for example, in the two RSs, determining which one to use according to the locations of the RSs in the configuration signaling, and exemplarily, the RS whose location is in the front or in the back can be determined.

Based on the foregoing solution, after the UE obtains the RS to be used, the RS is configured for measurement on the RS to determine whether a link quality corresponding to a PDCCH corresponding to the RS satisfies a predetermined threshold.

Specifically, the RS may be used in a beam failure recovery procedure or a link reconfiguration procedure. For example, through measuring the CSI-RS and/or the SS/PBCH block, the UE determines whether the link quality corresponding to the corresponding PDCCH satisfies a predetermined/configured threshold (a hypothetical BLER performance ratio threshold difference); the UE selects a new beam (whose L1-RSPR performance is better than the threshold) that satisfies the predetermined/configured threshold through the CSI-RS and/or the SS/PBCH block; the UE selects a PRACH corresponding to the new beam to initiate transmission, or reports the new selected beam through a PUCCH; the UE detects a response of the network.

It should be further explained that the beam mentioned in the above is actually represented by information of a signal carried by the beam. In actual use, it is represented by an index of the CSI-RS resource or the synchronization signal (SS) block/PBCH block index.

It can be seen that, by adopting the foregoing solution, when it is capable of configuring the control resource set for the UE, only K pieces of TCI are configured in part of the control resource sets, and at least one RS in the K pieces of TCI are indicated to the UE, thus avoiding that the UE measures RSs corresponding to all the TCI in all the control resource sets, thereby reducing a power consumption of the UE and improving an accuracy of beam detection performed by the UE.

An embodiment of the present application further provides a hardware architectural structure of a user equipment (UE) or a network device, which, as shown in FIG. 4, includes at least one processor 41, a memory 42, and at least one network interface 43. The various

components are coupled together through a bus system 44. It will be understood that the bus system 44 is configured to implement connection and communication between these components. The bus system 44 includes, in addition to a data bus, a power bus, a control bus, and a status signal bus. However, for clarity of description, various buses are labeled as the bus system 44 in FIG. 4.

It is understood that the memory 42 in the embodiment of the present application may be a volatile memory or a non-volatile memory, or may include both volatile and non-volatile memories.

In some embodiments, the memory 42 stores the following elements, executable modules or data structures, or a subset thereof, or their extension set:

an operating system 421 and an application 422.

The processor 41 is configured to be capable of processing the method steps in Embodiment 1 or Embodiment 2, and details are not described herein.

The above apparatus according to the embodiments of the present application may be stored in a computer readable storage medium if being implemented in the form of a software functional module and sold or used as a standalone product. Based on such understanding, the essence of the technical solutions of the embodiments of the present application, or a part of the technical solutions of the present application contributing to the prior art, may be embodied in the form of a software product which is stored in a storage medium, including instructions for enabling a computer device (which may be a personal computer, a server, or a network device, etc.) to perform all or part of the methods described in the embodiments of the present application. The above storage medium includes: various mediums capable of storing program codes, such as a universal serial bus (USB) flash disk, a mobile hard disk, a read-only memory (ROM), a magnetic disk, an optical disk, or the like. Thus, the embodiments of the present application are not limited to any specific combination of hardware and software.

An embodiment of the present application provides a computer storage medium storing computer executable instructions which, when being executed, perform the steps of the method of Embodiment 1 or Embodiment 2.

While preferred embodiments of the present application have been disclosed for

purposes of illustration, those skilled in the art will recognize that various modifications, additions and substitutions are possible, and thus the scope of the present application should not be limited to the embodiments described above.

CLAIMS

1. A method for determining a reference signal, RS, applied to a network device and comprising:

configuring N control resource sets for a user equipment, UE, wherein K pieces of transmission configuration indication, TCI, information is configured in each of at least part of control resource sets in the N control resource sets, and a quantity of the TCI information K configured in different control resource sets in the at least part of control resource sets is the same or different; wherein N and K are integers greater than or equal to 1, and at least one RS is indicated in each piece of TCI information; and

indicating to the UE the at least one RS in the K pieces of TCI information.

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

configuring M search spaces for the UE, wherein each of the at least part of control resource sets is associated with at least one search space of the M search spaces, and the search spaces are used for the UE to detect a physical downlink control channel, PDCCH.

3. The method according to claim 1 or 2, wherein the at least one RS in the K pieces of TCI information indicated to the UE comprises one of the following:

in the K pieces of TCI information, an RS indicated by TCI information activated through medium access control, MAC, control element, CE, signaling;

in the K pieces of TCI information, an RS indicated by TCI information indicated through downlink control information, DCI.

4. The method according to claim 1 or 2, wherein the method further comprises:

indicating quasi co-location, QCL, information in each piece of TCI information; wherein the QCL information corresponds to at least two pieces of RS information;

wherein RSs indicated by the at least two pieces of RS information are the same or different, and different RS information corresponds to different QCL parameter types.

5. The method according to claim 1 or 4, wherein the indicating to the UE the at least one RS in the K pieces of TCI information comprises:

indicating one piece of target TCI information in the K pieces of TCI information to the UE and instructing the UE to use an RS indicated by the target TCI information.

6. The method according to claim 5, wherein the instructing the UE to use an RS indicated by the target TCI information comprises one of the following:

in at least two RSs comprised in the target TCI information, using an RS corresponding to a spatial QCL parameter;

in the at least two RSs comprised in the target TCI information, using an RS that does not correspond to the spatial QCL parameter;

in the at least two RSs comprised in the target TCI information, causing the UE to select an RS;

in the at least two RSs comprised in the target TCI information, determining an RS to be used according to serial numbers of the RSs;

in the at least two RSs comprised in the target TCI information, determining an RS to be used according to locations of the RSs in configuration signaling.

7. The method according to any one of claims 1-6, wherein the RS is configured for measurement on the RS to determine whether a link quality corresponding to a PDCCH corresponding to the RS satisfies a predetermined threshold.

8. A method for determining a reference signal, RS, applied to a user equipment, UE, and comprising:

receiving N control resource sets configured by a network side for the UE, wherein K pieces of transmission configuration indication, TCI, information is configured in each of at least part of control resource sets in the N control resource sets, and a quantity of the TCI information K configured in different control resource sets in the at least part of control resource sets is the same or different; wherein N and K are integers greater than or equal to 1, and at least one RS is indicated in each piece of TCI information; and

receiving the at least one RS in the K pieces of TCI information indicated by the network side to the UE.

9. The method according to claim 8, wherein the method further comprises:

receiving M search spaces configured by the network side for the UE, and each of the at least part of control resource sets is associated with at least one search space of the M search spaces; and

detecting a physical downlink control channel, PDCCH, based on the configured M

search spaces.

10. The method according to claim 8 or 9, wherein the receiving the at least one RS in the K pieces of TCI information indicated by the network side to the UE comprises one of the following:

receiving an RS indicated by one piece of TCI information of the K pieces of TCI information activated through medium access control, MAC, control element, CE, signaling by the network side;

receiving an RS indicated by one piece of TCI information of the K pieces of TCI information activated through downlink control information, DCI, by the network side.

11. The method according to claim 8 or 9, wherein the method further comprises:

receiving quasi co-location, QCL, information indicated by the network side in each piece of TCI information; wherein the QCL information corresponds to at least two pieces of RS information;

wherein RSs indicated by the at least two pieces of RS information are the same or different, and different RS information corresponds to different QCL parameter types.

12. The method according to claim 8 or 11, wherein the receiving the at least one RS in the K pieces of TCI information indicated by the network side to the UE comprises:

receiving one piece of target TCI information in the K pieces of TCI information indicated by the network side to the UE, and receiving an RS indicated by the target TCI information and instructed by the network side for use at the UE.

13. The method according to claim 12, wherein the receiving an RS indicated by the target TCI information and instructed by the network side for use at the UE comprises one of the following:

in at least two RSs comprised in the target TCI information, using an RS corresponding to a spatial QCL parameter;

in the at least two RSs comprised in the target TCI information, using an RS that does not correspond to the spatial QCL parameter;

in the at least two RSs comprised in the target TCI information, causing the UE to select an RS;

in the at least two RSs comprised in the target TCI information, determining an RS to be

used according to serial numbers of the RSs;

in the at least two RSs comprised in the target TCI information, determining an RS to be used according to locations of the RSs in configuration signaling.

14. The method according to any one of claims 8 to 13, wherein the RS is configured for measurement on the RS to determine whether a link quality corresponding to a PDCCH corresponding to the RS satisfies a predetermined threshold.

15. A network device, comprising:

a first communicating unit, configured to configure N control resource sets for a user equipment, UE, wherein K pieces of transmission configuration indication, TCI, information is configured in each of at least part of control resource sets in the N control resource sets, and a quantity of the TCI information K configured in different control resource sets in the at least part of control resource sets is the same or different; wherein N and K are integers greater than or equal to 1, and at least one RS is indicated in each piece of TCI information; and indicate to the UE the at least one RS in the K pieces of TCI information.

16. The network device according to claim 15, wherein the first communicating unit configures M search spaces for the UE, wherein each of the at least part of control resource sets is associated with at least one search space of the M search spaces, and the search spaces are used for the UE to detect a physical downlink control channel, PDCCH.

17. The network device according to claim 15 or 16, wherein the at least one RS in the K pieces of TCI information indicated to the UE comprises one of the following:

in the K pieces of TCI information, an RS indicated by TCI information activated through medium access control, MAC, control element, CE, signaling;

in the K pieces of TCI information, an RS indicated by TCI information indicated through downlink control information, DCI.

18. The network device according to claim 15 or 16, wherein the first communicating unit indicates quasi co-location, QCL, information in each piece of TCI information; wherein the QCL information corresponds to at least two pieces of RS information;

wherein RSs indicated by the at least two pieces of RS information are the same or different, and different RS information corresponds to different QCL parameter types.

19. The network device according to claim 15 or 18, wherein the first communicating

unit indicates one piece of target TCI information in the K pieces of TCI information to the UE and instruct the UE to use an RS indicated by the target TCI information.

20. The network device according to claim 19, wherein the first communicating unit comprises one of the following:

in at least two RSs comprised in the target TCI information, using an RS corresponding to a spatial QCL parameter;

in the at least two RSs comprised in the target TCI information, using an RS that does not correspond to the spatial QCL parameter;

in the at least two RSs comprised in the target TCI information, causing the UE to select an RS;

in the at least two RSs comprised in the target TCI information, determining an RS to be used according to serial numbers of the RSs;

in the at least two RSs comprised in the target TCI information, determining an RS to be used according to locations of the RSs in configuration signaling.

21. The network device according to any one of claims 15 to 20, wherein the RS is configured for measurement on the RS to determine whether a link quality corresponding to a PDCCH corresponding to the RS satisfies a predetermined threshold.

22. A UE, comprising:

a second communicating unit, configured to receive N control resource sets configured by a network side for the UE, wherein K pieces of transmission configuration indication, TCI, information is configured in each of at least part of control resource sets in the N control resource sets, and a quantity of the TCI information K configured in different control resource sets in the at least part of control resource sets is the same or different; wherein N and K are integers greater than or equal to 1, and at least one RS is indicated in each piece of TCI information; and receive the at least one RS in the K pieces of TCI information indicated by the network side to the UE.

23. The UE according to claim 22, wherein the second communicating unit is configured to:

receive M search spaces configured by the network side for the UE, and each of the at least part of control resource sets is associated with at least one search space of the M search

spaces; and

the UE further comprises:

a second processing unit configured to detect a physical downlink control channel, PDCCH, based on the configured M search spaces.

24. The UE according to claim 22 or 23, wherein the second communicating unit comprises one of the following:

receiving an RS indicated by one piece of TCI information of the K pieces of TCI information activated through medium access control, MAC, control element, CE, signaling by the network side;

receiving an RS indicated by one piece of TCI information of the K pieces of TCI information activated through downlink control information, DCI, by the network side.

25. The UE according to claim 22 or 23, wherein the second communicating unit receives quasi co-location, QCL, information indicated by the network side in each piece of TCI information; wherein the QCL information corresponds to at least two pieces of RS information;

wherein RSs indicated by the at least two pieces of RS information are the same or different, and different RS information corresponds to different QCL parameter types.

26. The UE according to claim 22 or 25, wherein the second communicating unit receives one piece of target TCI information in the K pieces of TCI information indicated by the network side, and receives an RS indicated by the target TCI information and instructed by the network side for use at the UE.

27. The UE according to claim 26, wherein the UE further comprises:

a second processing unit, configured to perform one of the following:

in at least two RSs comprised in the target TCI information, using an RS corresponding to a spatial QCL parameter;

in the at least two RSs comprised in the target TCI information, using an RS that does not correspond to the spatial QCL parameter;

in the at least two RSs comprised in the target TCI information, causing the UE to select an RS;

in the at least two RSs comprised in the target TCI information, determining an RS to be

used according to serial numbers of the RSs;

in the at least two RSs comprised in the target TCI information, determining an RS to be used according to locations of the RSs in configuration signaling.

28. The UE according to any one of claims 22 to 27, wherein the RS is configured for measurement on the RS to determine whether a link quality corresponding to a PDCCH corresponding to the RS satisfies a predetermined threshold.

29. A computer storage medium storing computer executable instructions which when being executed, implement steps of the method according to any one of claims 1-14.