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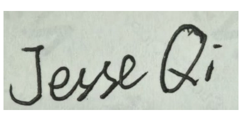

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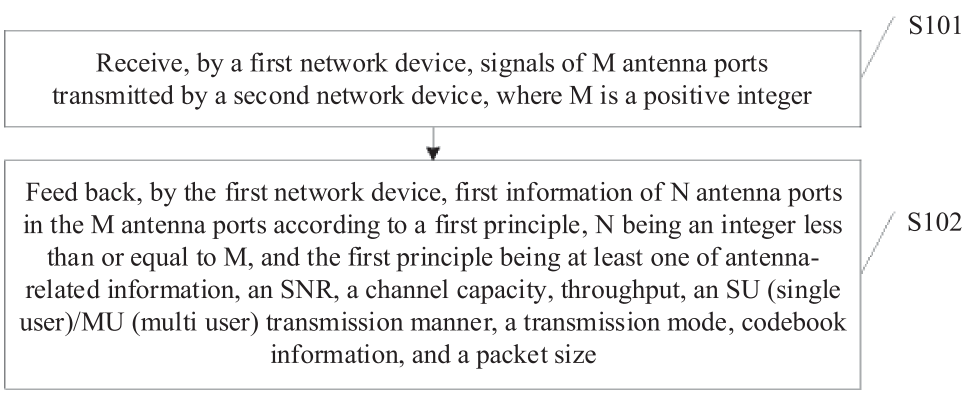
[See Continued Page]

54 **Title:** SIGNAL TRANSMISSION METHOD AND ASSOCIATED DEVICE



S101 A FIRST NETWORK DEVICE RECEIVES SIGNALS OF M ANTENNA PORTS SENT BY A SECOND NETWORK DEVICE, WHERE M IS A POSITIVE INTEGER

S102 THE FIRST NETWORK DEVICE FEEDS BACK FIRST INFORMATION OF N ANTENNA PORTS IN THE M ANTENNA PORTS ACCORDING TO A FIRST RULE, WHERE N IS AN INTEGER SMALLER THAN OR EQUAL TO M, AND THE FIRST RULE IS AT LEAST ONE OF ANTENNA ASSOCIATED INFORMATION, SNR, CHANNEL CAPACITY, THROUGHPUT, AN SU (SINGLE-USER) ZMU (MULTI-USER) TRANSMISSION MANNER, A TRANSMISSION MODE, CODEBOOK INFORMATION AND A DATA PACKET SIZE

(57) **Abstract:** A signal transmission method and an associated device. The method comprises: a first network device receives signals of M antenna ports sent by a second network device, where M is a positive integer; the first network device feeds back first in-formation of N antenna ports in the M antenna ports according to a first rule, where N is an integer smaller than or equal to M, and the first rule is at least one of antenna associated information, SNR, channel capacity, throughput, an SU (single-user)/MU (multiuser) transmission manner, a transmission mode, codebook information and a data packet size. The present invention performs the optimum antenna configuration according to at least one of antenna associated information, SNR, channel capacity, throughput, an SU/MU transmission manner, a transmission mode, codebook information or a data packet size and carries out more effective antenna selection.

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Signal Transmitting Method and Related Device

Technical Field

The present invention relates to the field of communication technologies, and in particular, to a signal transmitting method and a related device.

Background

By means of combination of transmit beamforming (Beam Forming, BF)/precoding and receiving, multiple-input multiple-output (Multiple-Input Multiple-Output, MIMO) wireless system can achieve diversity and array gains. A typical system using BF or precoding may generally be represented as:

$$y=HVs+n$$

y is a received signal vector, H is a channel matrix, V is a precoding matrix, s is a transmit symbol vector, and n is measurement noise. Optimal precoding generally requires a transmitter to fully know channel state information (CHannel State Information, CSI). A common method is that a user equipment quantifies instantaneous CSI and feeds quantified instantaneous CSI back to a base station device. CSI information fed back by an existing LTE R8 system includes a rank indication (RI), a precoding matrix indication (PMI), channel quality indication (CQI) information, and the like, where the RI and the PMI respectively indicate a quantity of used layers and a precoding matrix.

At present, to further improve the total throughput and the average throughput of cell users, a three-dimensional (3Dimensions, 3D) multi-antenna technology such as a dynamic 3D beamforming technology is used. However, in an existing cellular system, a beam at a transmit end of a base station can be adjusted only in a horizontal dimension, and a downtilt angle is fixed in a vertical dimension for each user. Therefore, various beamforming/precoding technologies and the like are based on horizontal dimension channel information. In fact, because a channel is 3D, a method for fixing a downtilt angle often cannot optimize the throughput of the system. Therefore, antenna ports corresponding to different downtilt angles may be formed on a 3D antenna by using different drive networks, that is, different antenna ports have different antenna patterns. In addition, with evolution of high-frequency technologies, a massive MIMO technology is introduced. Massive MIMO uses large-scale antennas, and channel characteristics between different antennas are not completely the same.

In conclusion, there is a need for a more effective antenna selection method in a 3D multi-antenna or large-scale antenna technology.

Summary

Embodiments of the present invention provide a signal transmitting method and a related device, to perform more effective antenna selection.

According to a first aspect, a signal transmitting method is provided, including:

receiving, by a first network device, signals of M antenna ports transmitted by a second network device, where M is a positive integer; and

feeding back, by the first network device, first information of N antenna ports in the M antenna ports according to a first criterion,

N being an integer less than or equal to M, and the first criterion being at least one of antenna-related information, an SNR, a channel capacity, throughput, an SU (single user)/MU (multi user) transmission manner, a transmission mode, codebook information, and a packet size.

In a first possible implementation, the first criterion is antenna-related information; and the feeding back, by the first network device, first information of N antenna ports in the M antenna ports according to a first criterion specifically is:

performing, by the first network device, cell selection based on measured antenna-related information of the M antenna ports, where the M antenna ports correspond to at least two cells or two transmission nodes, and each of the cells or transmission nodes corresponds to at least two antenna ports.

With reference to the first possible implementation of the first aspect, in a second possible implementation, the performing, by the first network device, cell selection based on measured antenna-related information of the M antenna ports specifically is:

selecting, by the first network device, the N antenna ports based on a comparison result of the measured antenna-related information of the M antenna ports and a first threshold, obtaining the first information of the N antenna ports, and feeding back the first information.

With reference to the first aspect, in a third possible implementation, the first criterion is a signal-to-noise ratio SNR; and the feeding back, by the first network device, first information of N antenna ports in the M antenna ports according to a first criterion specifically is:

selecting, by the first network device from the M antenna ports, N antenna ports that enable an SNR after beamforming or transmit diversity

to be less than or equal to or greater than or equal to a second threshold and that have a minimum quantity in antenna port combinations, obtaining first information of the N antenna ports, and feeding back the first information.

With reference to the first aspect, in a fourth possible implementation, the first criterion is a channel capacity; and

the feeding back, by the first network device, first information of N antenna ports in the M antenna ports according to a first criterion specifically is:

selecting, by the first network device from the M antenna ports, N antenna ports that enable the channel capacity to be less than or equal to or greater than or equal to a third threshold and that have a minimum quantity in antenna port combinations, obtaining first information of the N antenna ports, and feeding back the first information.

With reference to the first aspect, in a fifth possible implementation, the first criterion is throughput; and

the feeding back, by the first network device, first information of N antenna ports in the M antenna ports according to a first criterion specifically is:

selecting, by the first network device from the M antenna ports, N antenna ports that enable the throughput

to be less than or equal to or greater than or equal to a fourth threshold and that have a minimum quantity in antenna port combinations, obtaining first information of the N antenna ports, and feeding back the first information.

With reference to the first aspect, in a sixth possible implementation, the first criterion is an SU/MU transmission manner; and

the feeding back, by the first network device, first information of N antenna ports in the M antenna ports according to a first criterion specifically is:

selecting, by the first network device from the M antenna ports, a first group of antenna ports with optimal SU transmission, the first group of antenna ports including N1 antenna ports, obtaining first information of the N1 antenna ports, and feeding back the first information; and/or

selecting, by the first network device from the M antenna ports, a second group of antenna ports with optimal MU transmission, the second group of antenna ports including N2 antenna ports, obtaining first information of the N2 antenna ports, and feeding back the first information.

With reference to the first aspect, in a seventh possible implementation, the first criterion is a transmission mode; and the feeding back, by the first network device, first information of N antenna ports in the M antenna ports according to a first criterion specifically is:

selecting, by the first network device from the M antenna ports, an optimal first group of antenna ports whose transmission mode is transmit diversity transmission, the first group of antenna ports including N1 antenna ports, obtaining first information of the N1 antenna ports, and feeding back the first information; and/or

selecting, by the first network device from the M antenna ports, an optimal second group of antenna ports whose transmission mode is beamforming transmission, the first group of antenna ports including N2 antenna ports, obtaining first information of the N2 antenna ports, and feeding back the first information; and/or

selecting, by the first network device from the M antenna ports, an optimal third group of antenna ports whose transmission mode is spatial multiplexing transmission, the third group of antenna ports including N3 antenna ports, obtaining first information of the N3 antenna ports, and feeding back the first information.

With reference to the first aspect, in an eighth possible implementation, the first criterion is codebook information; and

the feeding back, by the first network device, first information of N antenna ports in the M antenna ports according to a first criterion specifically is:

selecting, by the first network device from the M antenna ports, N antenna ports that use first codebook information corresponding to the N antenna ports and that have optimal transmission performance, obtaining first information of the N antenna ports, and feeding back the first information.

With reference to the first aspect, in a ninth possible implementation, the first criterion is codebook information; and

the feeding back, by the first network device, first information of N antenna ports in the M antenna ports according to a first criterion specifically is:

selecting, by the first network device from the M antenna ports, N antenna ports that obtain optimal average information transmission performance through polling of all code words in a first codebook, obtaining first information of the N antenna ports, and feeding back the first information.

With reference to the first aspect, in a tenth possible implementation, the first criterion is codebook information; and

the feeding back, by the first network device, first information of N antenna ports in the M antenna ports according to a first criterion specifically is:

selecting, by the first network device from the M antenna ports, N antenna ports that obtain optimal best information transmission performance through polling of all code words in a first codebook, obtaining first information of the N antenna ports, and feeding back the first information.

With reference to the first aspect, in an eleventh possible implementation, the first criterion is packet information; and

the feeding back, by the first network device, first information of N antenna ports in the M antenna ports according to a first criterion specifically is:

selecting, by the first network device from the M antenna ports, N antenna ports that transmit first packets with optimal transmission performance, obtaining first information of the N antenna ports, and feeding back the first information; and/or

selecting, by the first network device from the M antenna ports, a minimum quantity of N antenna ports that transmit first packets, obtaining first information of the N antenna ports, and feeding back the first information; and/or

selecting, by the first network device from the M antenna ports, a minimum quantity of N antenna ports that meet a specific performance requirement when transmitting first packets, obtaining first information of the N antenna ports, and feeding back the first information.

With reference to the first aspect, the first possible implementation of the first aspect, the second possible implementation of the first aspect, the third possible implementation of the first aspect, the fourth possible implementation of the first aspect, the fifth possible implementation of the first aspect, the sixth possible implementation of the first aspect, the seventh possible implementation of the first aspect, the eighth possible implementation of the first aspect, the ninth possible implementation of the first aspect, the tenth possible implementation of the first aspect, or the eleventh possible implementation of the first aspect, in a twelfth possible implementation, the first criterion or the first threshold, the second threshold, the third threshold, and the fourth threshold are configured by the second network device by using broadcast information, higher layer signaling, or dynamic signaling.

With reference to the first aspect, the first possible implementation of the first aspect, the second possible implementation of the first aspect, the third possible implementation of the first aspect, the fourth possible implementation of the first aspect, the fifth possible implementation of the first aspect, the sixth possible implementation of the first aspect, the seventh possible implementation of the first aspect, the eighth possible implementation of the first aspect, the ninth possible implementation of the first aspect, the tenth possible implementation of the first aspect, the eleventh possible implementation of the first aspect, or the twelfth possible implementation of the first aspect, in a thirteenth possible implementation, the M antenna ports correspond to X channel state information processes CSI processes, and the N antenna ports correspond to one CSI process in the X CSI processes, where X is a positive integer.

With reference to the first aspect, the first possible implementation of the first aspect, the second possible implementation of the first aspect, the third possible implementation of the first aspect, the fourth possible implementation of the first aspect, the fifth possible implementation of the first aspect, the sixth possible implementation of the first aspect, the seventh possible implementation of the first aspect, the eighth possible implementation of the first aspect, the ninth possible implementation of the first aspect, the tenth possible implementation of the first aspect, the eleventh possible implementation of the first aspect, the twelfth possible implementation of the first aspect, or the thirteenth possible implementation of the first aspect, in a fourteenth possible implementation, the first information includes antenna-related information, channel state information CSI corresponding to the N antenna ports, or index information of the N antenna ports.

According to a second aspect, a signal transmitting method is provided, including:

transmitting, by a second network device, signals of M antenna ports to a first network device, where M is a positive integer; and

receiving, by the second network device, first information of N antenna ports in the M antenna ports that is fed back by the first network device according to a first criterion, N being an integer less than or equal to M, and the first criterion being at least one of antenna-related information, an SNR, a channel capacity, throughput, an SU (single user)/MU (multi user) transmission manner, a transmission mode, codebook information, and a packet size.

In a first possible implementation, the first criterion includes antenna-related information; and

the method further includes:

determining, by the second network device, the N antenna ports as selected antenna ports based on the antenna-related information.

With reference to the second aspect, in a second possible implementation, the first information includes channel state information CSI corresponding to the N antenna ports or index information of the N antenna ports.

With reference to the second aspect, the first possible implementation of the second aspect, or the second possible implementation of the second aspect, in a third possible implementation, the second network device configures the first criterion, a first threshold, a second threshold, a third threshold, or a fourth threshold by using broadcast information, higher layer signaling, or dynamic signaling.

According to a third aspect, a first network device is provided, including:

a receiving unit, configured to receive signals of M antenna ports transmitted by a second network device, where M is a positive integer; and

a feedback unit, configured to feed back first information of N antenna ports in the M antenna ports according to a first criterion, N being an integer less than or equal to M, and the first criterion being at least one of antenna-related information, an SNR, a channel capacity, throughput, an SU (single user)/MU (multi user) transmission manner, a transmission mode, codebook information, and a packet size.

In a first possible implementation, the first criterion is antenna-related information; and the feedback unit is specifically configured to:

perform cell selection based on measured antenna-related information of the M antenna ports, where the M antenna ports correspond to at least two cells or two transmission nodes, and each of the cells or transmission nodes corresponds to at least two antenna ports.

With reference to the first possible implementation of the third aspect, in a second possible implementation, that the feedback unit performs the step of performing cell selection based on the measured antenna-related information of the M antenna ports specifically is:

selecting, by the first network device, the N antenna ports based on a comparison result of the measured antenna-related information of the M antenna ports and a first threshold, obtaining the first information of the N antenna ports, and feeding back the first information.

With reference to the third aspect, in a third possible implementation, the first criterion is a signal-to-noise ratio SNR; and

the feedback unit is specifically configured to:

select, from the M antenna ports, N antenna ports that enable an SNR after beamforming or transmit diversity to be less than or equal to or greater than or equal to a second threshold and that have a minimum quantity in antenna port combinations, obtain first information of the N antenna ports, and feed back the first information.

With reference to the third aspect, in a fourth possible implementation, the first criterion is a channel capacity; and

the feedback unit is specifically configured to:

select, from the M antenna ports, N antenna ports that enable the channel capacity to be less than or equal to or greater than or equal to a third threshold and that have a minimum quantity in antenna port combinations, obtain first information of the N antenna ports, and feed back the first information.

With reference to the third aspect, in a fifth possible implementation, the first criterion is throughput; and

the feedback unit is specifically configured to:

select, from the M antenna ports, N antenna ports that enable the throughput to be less than or equal to or greater than or equal to a fourth threshold and that have a minimum quantity in antenna port combinations, obtain first information of the N antenna ports, and feed back the first information.

With reference to the third aspect, in a sixth possible implementation, the first criterion is an SU/MU transmission manner; and

the feedback unit is specifically configured to:

select, from the M antenna ports, a first group of antenna ports with optimal SU transmission, the first group of antenna ports including N1 antenna ports, obtain first information of the N1 antenna ports, and feed back the first information; and/or

select, from the M antenna ports, a second group of antenna ports with optimal MU transmission, the second group of antenna ports including N2 antenna ports, obtain first information of the N2 antenna ports, and feed back the first information.

With reference to the third aspect, in a seventh possible implementation, the first criterion is a transmission mode; and

the feedback unit is specifically configured to:

select, from the M antenna ports, an optimal first group of antenna ports whose transmission mode is transmit diversity transmission, the first group of antenna ports including N1 antenna ports, obtain first information of the N1 antenna ports, and feed back the first information; and/or

select, from the M antenna ports, an optimal second group of antenna ports whose transmission mode is beamforming transmission, the first group of antenna ports including N2 antenna ports, obtain first information of the N2 antenna ports, and feed back the first information; and/or

select, from the M antenna ports, an optimal third group of antenna ports whose transmission mode is spatial multiplexing transmission, the third group of antenna ports including N3 antenna ports, obtain first information of the N3 antenna ports, and feed back the first information.

With reference to the third aspect, in an eighth possible implementation, the first criterion is codebook information; and

the feedback unit is specifically configured to:

select, from the M antenna ports, N antenna ports that use first codebook information corresponding to the N antenna ports and that have optimal transmission performance, obtain first information of the N antenna ports, and feed back the first information.

With reference to the third aspect, in a ninth possible implementation, the first criterion is codebook information; and

the feedback unit is specifically configured to:

select, from the M antenna ports, N antenna ports that obtain optimal average information transmission performance through polling of all code words in a first codebook, obtain first information of the N antenna ports, and feed back the first information.

With reference to the third aspect, in a tenth possible implementation, the first criterion is codebook information; and

the feedback unit is specifically configured to:

select, from the M antenna ports, N antenna ports that obtain optimal best information transmission performance through polling of all code words in a first codebook, obtain first information of the N antenna ports, and feed back the first information.

With reference to the third aspect, in an eleventh possible implementation, the first criterion is packet information; and

the feedback unit is specifically configured to:

select, from the M antenna ports, N antenna ports that transmit first packets with optimal transmission performance, obtain first information of the N antenna ports, and feed back the first information; and/or

select, from the M antenna ports, a minimum quantity of N antenna ports that transmit first packets, obtain first information of the N antenna ports, and feed back the first information; and/or

select, by the first network device from the M antenna ports, a minimum quantity of N antenna ports that meet a specific performance requirement when transmitting first packets, obtain first information of the N antenna ports, and feed back the first information.

With reference to the third aspect, the first possible implementation of the third aspect, the second possible implementation of the third aspect, the third possible implementation of the third aspect, the fourth possible implementation of the third aspect, the fifth possible implementation of the third aspect, the sixth possible implementation of the third aspect, the seventh possible implementation of the third aspect, the eighth possible implementation of the third aspect, the ninth possible implementation of the third aspect, the tenth possible implementation of the third aspect, or the eleventh possible implementation of the third aspect, in a twelfth possible implementation, the first criterion or the first threshold, the second threshold, the third threshold, and the fourth threshold are configured by the second network device by using broadcast information, higher layer signaling, or dynamic signaling.

With reference to the third aspect, the first possible implementation of the third aspect, the second possible implementation of the third aspect, the third possible implementation of the third aspect, the fourth possible implementation of the third aspect, the fifth possible implementation of the third aspect, the sixth possible implementation of the third aspect, the seventh possible implementation of the third aspect, the eighth possible implementation of the third aspect, the ninth possible implementation of the third aspect, the tenth possible implementation of the third aspect, the eleventh possible implementation of the third aspect, or the twelfth possible implementation of the third aspect, in a thirteenth possible implementation, the M antenna ports correspond to X channel state information processes CSI processes, and the N antenna ports correspond to one CSI process in the X CSI processes, where X is a positive integer.

With reference to the third aspect, the first possible implementation of the third aspect, the second possible implementation of the third aspect, the third possible implementation of the third aspect, the fourth possible implementation of the third aspect, the fifth possible implementation of the third aspect, the sixth possible implementation of the third aspect, the seventh possible implementation of the third aspect, the eighth possible implementation of the third aspect, the ninth possible implementation of the third aspect, the tenth possible implementation of the third aspect, the eleventh possible implementation of the third aspect, the twelfth possible implementation of the third aspect, or the thirteenth possible implementation of the third aspect, in a fourteenth possible implementation, the first information includes antenna-related information, channel state information CSI corresponding to the N antenna ports, or index information of the N antenna ports.

According to a fourth aspect, a second network device is provided, including:

a transmitting unit, configured to transmit signals of M antenna ports to a first network device, where M is a positive integer; and

a receiving unit, configured to receive first information of N antenna ports in the M antenna ports that is fed back by the first network device according to a first criterion, N being an integer less than or equal to M, and the first criterion being at least one of antenna-related information, an SNR, a channel capacity, throughput, an SU (single user)/MU (multi user) transmission manner, a transmission mode, codebook information, and a packet size.

In a first possible implementation, the first criterion includes antenna-related information; and

the second network device further includes:

a determining unit, configured to determine the N antenna ports as selected antenna ports based on the antenna-related information.

With reference to the fourth aspect, in a second possible implementation, the first information includes channel state information CSI corresponding to the N antenna ports or index information of the N antenna ports.

With reference to the fourth aspect, the first possible implementation of the fourth aspect, or the second possible implementation of the fourth aspect, in a fifth possible implementation, the transmitting unit is further configured to configure the first criterion, a first threshold, a second threshold, a third threshold, or a fourth threshold by using broadcast information, higher layer signaling, or dynamic signaling.

According to a fifth aspect, a first network device is provided, including: a receiver and a transmitter, where

the receiver is configured to receive signals of M antenna ports transmitted by a second network device, where M is a positive integer; and

a transmitter is configured to feed back first information of N antenna ports in the M antenna ports according to a first criterion, N being an integer less than or equal to M, and the first criterion being at least one of antenna-related information, an SNR, a channel capacity, throughput, an SU (single user)/MU (multi user) transmission manner, a transmission mode, codebook information, and a packet size.

In a first possible implementation, the first criterion is antenna-related information; and that the transmitter performs the step of feeding back first information of N antenna ports in the M antenna ports according to a first criterion specifically is:

performing cell selection based on measured antenna-related information of the M antenna ports, where the M antenna ports correspond to at least two cells or two transmission nodes, and each of the cells or transmission nodes corresponds to at least two antenna ports.

With reference to the first possible implementation of the fifth aspect, in a second possible implementation, that the transmitter performs the step of performing cell selection based on the measured antenna-related information of the M antenna ports specifically is:

selecting, by the first network device, the N antenna ports based on a comparison result of the measured antenna-related information of the M antenna ports and a first threshold, obtaining the first information of the N antenna ports, and feeding back the first information.

With reference to the fifth aspect, in a third possible implementation, the first criterion is a signal-to-noise ratio SNR; and

that the transmitter performs the step of feeding back first information of N antenna ports in the M antenna ports according to a first criterion specifically is:

selecting, from the M antenna ports, N antenna ports that enable an SNR after beamforming or transmit diversity to be less than or equal to or greater than or equal to a second threshold and that have a minimum quantity in antenna port combinations, obtaining first information of the N antenna ports, and feeding back the first information.

With reference to the fifth aspect, in a fourth possible implementation, the first criterion is a channel capacity; and

that the transmitter performs the step of feeding back first information of N antenna ports in the M antenna ports according to a first criterion specifically is:

selecting, from the M antenna ports, N antenna ports that enable the channel capacity to be less than or equal to or greater than or equal to a third threshold and that have a minimum quantity in antenna port combinations, obtaining first information of the N antenna ports, and feeding back the first information.

With reference to the fifth aspect, in a fifth possible implementation, the first criterion is throughput; and

that the transmitter performs the step of feeding back first information of N antenna ports in the M antenna ports according to a first criterion specifically is:

selecting, by the first network device from the M antenna ports, N antenna ports that enable the throughput to be less than or equal to or greater than or equal to a fourth threshold and that have a minimum quantity in antenna port combinations, obtaining first information of the N antenna ports, and feeding back the first information.

With reference to the fifth aspect, in a sixth possible implementation, the first criterion is an SU/MU transmission manner; and

that the transmitter performs the step of feeding back first information of N antenna ports in the M antenna ports according to a first criterion specifically is:

selecting, from the M antenna ports, a first group of antenna ports with optimal SU transmission, the first group of antenna ports including N1 antenna ports, obtaining first information of the N1 antenna ports, and feeding back the first information; and/or

selecting, from the M antenna ports, a second group of antenna ports with optimal MU transmission, the second group of antenna ports including N2 antenna ports, obtaining first information of the N2 antenna ports, and feeding back the first information.

With reference to the fifth aspect, in a seventh possible implementation, the first criterion is a transmission mode; and

that the transmitter performs the step of feeding back first information of N antenna ports in the M antenna ports according to a first criterion specifically is:

selecting, from the M antenna ports, an optimal first group of antenna ports whose transmission mode is transmit diversity transmission, the first group of antenna ports including N1 antenna ports, obtaining first information of the N1 antenna ports, and feeding back the first information; and/or

selecting, from the M antenna ports, an optimal second group of antenna ports whose transmission mode is beamforming transmission, the first group of antenna ports including N2 antenna ports, obtaining first information of the N2 antenna ports, and feeding back the first information; and/or

selecting, from the M antenna ports, an optimal third group of antenna ports whose transmission mode is spatial multiplexing transmission, the third group of antenna ports including N3 antenna ports, obtaining first information of the N3 antenna ports, and feeding back the first information.

With reference to the fifth aspect, in an eighth possible implementation, the first criterion is codebook information; and

that the transmitter performs the step of feeding back first information of N antenna ports in the M antenna ports according to a first criterion specifically is:

selecting, from the M antenna ports, N antenna ports that use first codebook information corresponding to the N antenna ports and that have optimal transmission performance, obtaining first information of the N antenna ports, and feeding back the first information.

With reference to the fifth aspect, in a ninth possible implementation, the first criterion is codebook information; and

that the transmitter performs the step of feeding back first information of N antenna ports in the M antenna ports according to a first criterion specifically is:

selecting, from the M antenna ports, N antenna ports that obtain optimal average information transmission performance through polling of all code words in a first codebook, obtaining first information of the N antenna ports, and feeding back the first information.

With reference to the fifth aspect, in a tenth possible implementation, the first criterion is codebook information; and

that the transmitter performs the step of feeding back first information of N antenna ports in the M antenna ports according to a first criterion specifically is:

selecting, from the M antenna ports, N antenna ports that obtain optimal best information transmission performance through polling of all code words in a first codebook, obtaining first information of the N antenna ports, and feeding back the first information.

With reference to the fifth aspect, in an eleventh possible implementation, the first criterion is packet information; and

that the transmitter performs the step of feeding back first information of N antenna ports in the M antenna ports according to a first criterion specifically is:

selecting, from the M antenna ports, N antenna ports that transmit first packets with optimal transmission performance, obtaining first information of the N antenna ports, and feeding back the first information; and/or

selecting, from the M antenna ports, a minimum quantity of N antenna ports that transmit first packets, obtaining first information of the N antenna ports, and feeding back the first information; and/or

selecting, from the M antenna ports, a minimum quantity of N antenna ports that meet a specific performance requirement when transmitting first packets, for example, a minimum quantity of antenna ports with a specific bit error rate, obtaining first information of the N antenna ports, and feeding back the first information.

With reference to the fifth aspect, the first possible implementation of the fifth aspect, the second possible implementation of the fifth aspect, the third possible implementation of the fifth aspect, the fourth possible implementation of the fifth aspect, the fifth possible implementation of the fifth aspect, the sixth possible implementation of the fifth aspect, the seventh possible implementation of the fifth aspect, the eighth possible implementation of the fifth aspect, the ninth possible implementation of the fifth aspect, the tenth possible implementation of the fifth aspect, or the eleventh possible implementation of the fifth aspect, in a twelfth possible implementation, the first criterion or the first threshold, the second threshold, the third threshold, and the fourth threshold are configured by the second network device by using broadcast information, higher layer signaling, or dynamic signaling.

With reference to the fifth aspect, the first possible implementation of the fifth aspect, the second possible implementation of the fifth aspect, the third possible implementation of the fifth aspect, the fourth possible implementation of the fifth aspect, the fifth possible implementation of the fifth aspect, the sixth possible implementation of the fifth aspect, the seventh possible implementation of the fifth aspect, the eighth possible implementation of the fifth aspect, the ninth possible implementation of the fifth aspect, the tenth possible implementation of the fifth aspect, the eleventh possible implementation of the fifth aspect, or the twelfth possible implementation of the fifth aspect, in a thirteenth possible implementation, the M antenna ports correspond to X channel state information processes CSI processes, and the N antenna ports correspond to one CSI process in the X CSI processes, where X is a positive integer.

With reference to the fifth aspect, the first possible implementation of the fifth aspect, the second possible implementation of the fifth aspect, the third possible implementation of the fifth aspect, the fourth possible implementation of the fifth aspect, the fifth possible implementation of the fifth aspect, the sixth possible implementation of the fifth aspect, the seventh possible implementation of the fifth aspect, the eighth possible implementation of the fifth aspect, the ninth possible implementation of the fifth aspect, the tenth possible implementation of the fifth aspect, the eleventh possible implementation of the fifth aspect, the twelfth possible implementation of the fifth aspect, or the thirteenth possible implementation of the fifth aspect, in a fourteenth possible implementation, the first information includes antenna-related information, channel state information CSI corresponding to the N antenna ports, or index information of the N antenna ports.

According to a sixth aspect, a second network device is provided, including: a transmitter and a receiver, where

the transmitter is configured to transmit signals of M antenna ports to a first network device, where M is a positive integer; and

the receiver is configured to receive first information of N antenna ports in the M antenna ports that is fed back by the first network device according to a first criterion, N being an integer less than or equal to M, and the first criterion being at least one of antenna-related information, an SNR, a channel capacity, throughput, an SU (single user)/MU (multi user) transmission manner, a transmission mode, codebook information, and a packet size.

In a first possible implementation, the first criterion includes antenna-related information; and

the second network device further includes: a controller, where the controller is configured to determine the N antenna ports as selected antenna ports based on the antenna-related information.

With reference to the sixth aspect, in a second possible implementation, the first information includes channel state information CSI corresponding to the N antenna ports or index information of the N antenna ports.

With reference to the sixth aspect, the first possible implementation of the sixth aspect, or the second possible implementation of the sixth aspect, in a third possible implementation, the transmitter is further configured to configure the first criterion, a first threshold, a second threshold, a third threshold, or a fourth threshold by using broadcast information, higher layer signaling, or dynamic signaling.

It can be learned that, according to the signal transmitting method and the related device that are provided in embodiments of the present invention, an optimal antenna configuration is performed based on at least one of antenna-related information, an SNR, a channel capacity, throughput, a single-user/multi-user transmission manner, a transmission mode, codebook information, or a packet size, so that more effective antenna selection is performed.

Description of Drawings

To describe technical solutions in embodiments of the present invention or in the conventional technology more clearly, the following briefly describes the accompanying drawings needed for describing the embodiments. Clearly, the accompanying drawings in the following description merely show some embodiments of the present invention, and a person of ordinary skill in the art can still derive other drawings from these accompanying drawings without creative efforts.

FIG. 1 is a flowchart of a signal transmitting method according to an embodiment of the present invention;

FIG. 2 is a schematic diagram of a configuration of a plurality of antennas in an example of an active antenna array;

FIG. 3 is a flowchart of another signal transmitting method according to an embodiment of the present invention;

FIG. 4 is a flowchart of still another signal transmitting method according to an embodiment of the present invention;

FIG. 5 is a schematic diagram of a structure of a first network device according to an embodiment of the present invention;

FIG. 6 is a schematic diagram of a structure of a second network device according to an embodiment of the present invention;

FIG. 7 is a schematic diagram of a structure of another second network device according to an embodiment of the present invention;

FIG. 8 is a schematic diagram of a structure of another first network device according to an embodiment of the present invention;

FIG. 9 is a schematic diagram of a structure of still another second network device according to an embodiment of the present invention; and

FIG. 10 is a schematic diagram of a structure of still another second network device according to an embodiment of the present invention.

Description of Embodiments

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

FIG. 1 is a flowchart of a signal transmitting method according to an embodiment of the present invention. The method includes the following steps:

Step S101: receiving, by a first network device, signals of M antenna ports transmitted by a second network device, where M is a positive integer.

When an antenna configuration is performed, the second network device transmits configuration information of the M antenna ports to the first network device, and transmits the signals of the M antenna ports to the first network device. The first network device receives, based on the configuration information, the signals of the M antenna ports transmitted by the second network device, where M is a positive integer.

In this embodiment, the first network device may be a user equipment (User Equipment, UE), and the second network device may be a base station; or the first network device may be a user equipment, and the second network device may be a user equipment; or the first network device may be a base station, and the second network device may be a base station.

The base station may be a macro base station, a low-power node pico, or a radio remote unit RRH.

The configuration information of the M antenna ports includes a pattern of the antenna ports, that is, information such as a location of a time-frequency resource of the antenna ports, a transmitting cycle of the signals of the antenna ports, and a power.

The second network device may transmit only one piece of configuration information to the first network device. The configuration information is the configuration information of M antenna ports, or the M antenna ports are divided into a plurality of groups, and are transmitted to the first network device in a form of a plurality of pieces of configuration information. Each piece of configuration information corresponds to a configuration of one of antenna port groups.

Step S102: feeding back, by the first network device, first information of N antenna ports in the M antenna ports according to a first criterion, N being an integer less than or equal to M, and the first criterion being at least one of antenna-related information, an SNR, a channel capacity, throughput, an SU (single user)/MU (multi user) transmission manner, a transmission mode, codebook information, and a packet size.

The first network device needs to select the N antenna ports from the M antenna ports according to a specific criterion, and notify the second network device of the first information of the selected N antenna ports. Herein, the first information is channel state information CSI corresponding to the N antenna ports or index information corresponding to the N antenna ports. Alternatively, the first information of the N antenna ports is transmitted to the second network device, and the second network device determines the N antenna ports. Herein, the first information is antenna-related information.

The following describes how to feed back the first information of the N antenna ports in M antenna ports according to various first criteria through specific implementations:

In an implementation, the first criterion is antenna-related information; and

the feeding back, by the first network device, first information of N antenna ports in the M antenna ports according to a first criterion specifically is:

performing, by the first network device, cell selection based on measured antenna-related information of the M antenna ports, where the M antenna ports correspond to at least two cells or two transmission nodes, and each of the cells or transmission nodes corresponds to at least two antenna ports.

In the conventional technology, cell selection is performed only according to received signal power information such as an RSRP and RSSL RSRQ. In this embodiment, antenna correlation is also considered for cell selection, so that a user can consider selection of a cell or a transmission node more comprehensively according to a service of the user.

In a specific implementation, the performing, by the first network device, cell selection based on measured antenna-related information of the M antenna ports specifically is:

For example, M=10 corresponds to five cells, and each cell has two antennas. Cell 1 corresponds to port 0 and port 1, cell 1 corresponds to port 2 and port 3, cell 1 corresponds to port 4 and port 5, cell 1 corresponds to port 6 and port 7, and cell 1 corresponds to port 8 and port 9; and

the UE measures the five groups of antenna ports respectively corresponding to the five cells, and finds that port 0 and port 1 corresponding to cell 1 have the strongest received signal power. For example, RSRP1>RSRP2>RSRP3>RSRP4>RSRP5, RSRP1 represents the received signal power corresponding to cell 1, RSRP2 represents a received signal power corresponding to cell 2, and RSRPn represents a received signal power corresponding to cell n. However, if it is assumed that the first criterion is antenna-related information, and it is required that the antenna-related information be as large as possible, an antenna correlation coefficient is defined as Cor. For example, an antenna correlation coefficient Cor 1 of cell 1 is antenna correlation between port 0 and port 1, a channel coefficient H0 corresponding to port 0 and a channel coefficient H1 corresponding to port 1 may be obtained by means of channel estimation, and correlation between H0 and H1 is calculated to obtain Cor 1. For example, a correlation matrix may be obtained by using $H=[H_0\ H_1]$ and $R=H^H H$, or obtained according to $R_{ik}=\frac{1}{2\Delta}\int_{\theta-\Delta}^{\theta+\Delta}\exp[jz(i-k)\sin\beta]d\beta$.

i and k are respectively an i^{th} antenna and a k^{th} antenna, and Δ is an angular spread.

Cor 2, Cor 3, Cor 4, and Cor 5 are obtained according to the same method, where Com represents an antenna correlation coefficient corresponding to cell n.

In addition, Cor 2>Cor 1>Cor 3>Cor 4>Cor 5. In this case, although the received signal power of cell 1 is the strongest, cell 2 is finally selected by the UE and the UE is camped in the cell 2 as the signal power and the antenna correlation are comprehensively considered.

The first criterion herein is not limited to the antenna correlation, and may alternatively be an SU/MU, a signal transmission mode, or the like, and the first criterion may be predefined, or a base station broadcast, or a signaling notification specified by the UE.

Specifically, the performing, by the first network device, cell selection based on measured antenna-related information of the M antenna ports specifically is: selecting, by the first network device, the N antenna ports based on a comparison result of the measured antenna-related information of the M antenna ports and a first threshold, obtaining the first information of the N antenna ports, and feeding back the first information.

That is, correlation matrices or correlation coefficients of the M antenna ports are compared with a set threshold, N antenna ports whose correlation matrices or correlation coefficients are greater than or equal to the set threshold are selected, channel state information (CHannel State Signal, CSI) corresponding to the N antenna ports or index information corresponding to the N antenna ports are obtained, and the second network device is notified of the CSI corresponding to the N antenna ports or the index information corresponding to the N antenna ports, so that the second network device transmits data to the first network device through the N antenna ports.

In another implementation, the first criterion is a signal-to-noise ratio SNR; and

the feeding back, by the first network device, first information of N antenna ports in the M antenna ports according to a first criterion specifically is:

selecting, by the first network device from the M antenna ports, N antenna ports that enable an SNR after beamforming or transmit diversity to be less than or equal to or greater than or equal to a second threshold and that have a minimum quantity in antenna port combinations, obtaining first information of the N antenna ports, and feeding back the first information.

For example, the base station configures M antenna ports for the UE. As shown in FIG. 2, a schematic diagram of a plurality of antennas in another antenna array, M=88, and the UE traverses all antenna port combinations from N=1 to N=88 in the M ports. For a value of each N, a quantity of combinations that need to be traversed is c. For example, for N=4, there are combinations including a combination 1 (a11, a12, a13, a14), a combination 2 (a12, a13, a14, a15), a combination 3 (a13, a14, a15, a16), a combination 4 (a14, a15, a16, a17), a combination 5 (a15, a16, a17, a18), a combination 6 (b11, b12, b13, b14), ... For each combination, for example, the combination 1 (a11, a12, a13, a14), the UE obtains a channel $H_{N,1}$ by using a11, a12, a13, and a14, and then traverses all precoding matrices W_i to obtain a signal-to-noise ratio:

$$SNR_{N,\ m,\ i}=\frac{\left|H_{n,m}W_i\right|^2}{\sigma^2}$$

$H_{n,m}$ represents an m^{th} configuration in a case in which the N antenna ports are combined, W_i represents an i^{th} precoding matrix, and σ^2 is noise.

All SNRs of all N port combinations are traversed, to find a quantity of precoding matrices in a case of the maximum SNR, for example, max($SNR_{N,\ m,\ i}$, N=4, $1\le m\le C_M^4$, $1\le i\le X_4$)=5 dB, where X_4 represents that N=4. For N=5, traversing is performed by using the foregoing same method, and max($SNR_{N,\ m,\ i}$, N=5, $1\le m\le C_M^5$, and $1<i\le X_5$)=7 dB. If the base station notifies the UE that the first criterion for antenna selection is a minimum quantity of antennas to ensure that SNR is greater than or equal to 6 dB, N=5 may happen to ensure that 6 dB can be reached, and is the minimum quantity of antennas required to reach 6 dB. Therefore, the UE may feed back, to the base station, indexes corresponding to numbers of an antenna combination whose SNR reaches 7 dB when N=5, for example, a11, b12, c14, and d11. By using N>5, an obtained signal-to-noise ratio is higher than that obtained when N=5. However, for some channels, only a specific SNR performance requirement needs to be met, and no larger SNR is required. Using more antennas may cause a base station to waste transmit power.

In still another implementation, the first criterion is a channel capacity; and

the feeding back, by the first network device, first information of N antenna ports in the M antenna ports according to a first criterion specifically is:

selecting, by the first network device from the M antenna ports, N antenna ports that enable the channel capacity to be less than or equal to or greater than or equal to a third threshold and that have a minimum quantity in antenna port combinations, obtaining first information of the N antenna ports, and feeding back the first information.

Because of the channel capacity C=Blog2(1+SNR), in this implementation, a process of performing antenna port selection based on the channel capacity is similar to the process of performing antenna port selection based on the SNR in the foregoing implementation, and details are not described herein again.

In still another implementation, the first criterion is throughput; and

the feeding back, by the first network device, first information of N antenna ports in the M antenna ports according to a first criterion specifically is:

selecting, by the first network device from the M antenna ports, N antenna ports that enable the throughput to be less than or equal to or greater than or equal to a fourth threshold and that have a minimum quantity in antenna port combinations, obtaining first information of the N antenna ports, and feeding back the first information.

Similarly, in this implementation, a process of performing antenna port selection based on the throughput is similar to the process of performing antenna port selection based on the SNR or the channel capacity in the foregoing implementation, and details are not described herein again.

In still another implementation, the first criterion is an SU/MU transmission manner; and

the feeding back, by the first network device, first information of N antenna ports in the M antenna ports according to a first criterion specifically is:

selecting, by the first network device from the M antenna ports, a first group of antenna ports with optimal SU transmission, the first group of antenna ports including N1 antenna ports, obtaining first information of the N1 antenna ports, and feeding back the first information; and/or

selecting, by the first network device from the M antenna ports, a second group of antenna ports with optimal MU transmission, the second group of antenna ports including N2 antenna ports, obtaining first information of the N2 antenna ports, and feeding back the first information.

In this implementation, for example, if the base station configures the UE to select an antenna in a manner in which SU transmission is optimal, the UE traverses all the antennas and selects an antenna in a manner in which the antenna optimizes the performance of the UE. For example,

antennas a11, b13, g15, and H18 are selected, and antenna index information of a11, b13, g15, and H18 is reported to the base station.

For another example, the base station configures the UE 1 to select an antenna in a manner in which MU pairing is optimal. The base station may notify UE 1 of information about pairing users, for example, information about users UE 2 and UE 3 that are paired with UE 1, including antenna information of UE 2 and UE 3. UE 1 selects an antenna in a manner in which total performance of all the users after pairing is optimal, for example, selects antennas c13, d12, e11, and f18, and notifies the base station of the antenna index information corresponding to the antennas.

Information about a group of antenna ports with optimal SU transmission and information about a group of antenna ports with optimal MU transmission may also be fed back at the same time. For example, a SU may select cross polarization antennas, and correlation between the antennas is small, which facilitates spatial multiplexing. When MUs are paired, it is better for each user to select a co-polar antenna, to facilitate beamforming for each user. The SU means that a user transmits a packet of the user separately on one time-frequency resource, and the MU means that multiple users may transmit packets of the users in a spatial multiplexing manner on the same time-frequency resource.

In still another implementation, the first criterion is a transmission mode; and the feeding back, by the first network device, first information of N antenna ports in the M antenna ports according to a first criterion specifically is:

selecting, by the first network device from the M antenna ports, an optimal first group of antenna ports whose transmission mode is transmit diversity transmission, the first group of antenna ports including N1 antenna ports, obtaining first information of the N1 antenna ports, and feeding back the first information; and/or

selecting, by the first network device from the M antenna ports, an optimal second group of antenna ports whose transmission mode is beamforming transmission, the first group of antenna ports including N2 antenna ports, obtaining first information of the N2 antenna ports, and feeding back the first information; and/or

selecting, by the first network device from the M antenna ports, an optimal third group of antenna ports whose transmission mode is spatial multiplexing transmission, the third group of antenna ports including N3 antenna ports, obtaining first information of the N3 antenna ports, and feeding back the first information.

In still another implementation, the first criterion is codebook information; and the feeding back, by the first network device, first information of N antenna ports in the M antenna ports according to a first criterion specifically is:

selecting, by the first network device from the M antenna ports, N antenna ports that use first codebook information corresponding to the N antenna ports and that have optimal transmission performance, obtaining first information of the N antenna ports, and feeding back the first information.

Codebook information refers to information that includes a plurality of precoding matrices.

In still another implementation, the first criterion is codebook information.

For example, the M antenna ports are divided into X groups, and the base station separately configures a codebook set for each group of antenna ports. The user equipment calculates an SNR based on the configured codebook set, and feeds back the SNR to a base station device. For example, a first group of antenna ports corresponds to an antenna configuration 1 and includes antenna ports port 0 and port 1, the base station configures a codebook set C1 for the antenna configuration 1, and a precoding matrix included in C1 is (W_{11}, W_{12}, W_{1n}, ..., W_{1N}). A second group of antenna ports corresponds to an antenna configuration 2 and includes antenna ports port 2 and port 3, a codebook set C2 is configured for the antenna configuration 2, and a precoding matrix included in C2 is (W_{21}, W_{22}, W_{2n}, ..., W_{2N}). A third group of antenna ports corresponds to an antenna configuration 3 and includes antenna ports port 4 and port 5, a codebook set C3 is configured for the antenna configuration 3, and a precoding matrix included in C3 is (W_{31}, W_{32}, W_{3n}, ..., W_{3N}). A fourth group of antenna ports corresponds to an antenna configuration 4 and includes antenna ports port 6 and port 7, a codebook set C4 is configured for the antenna configuration 4, and a precoding matrix included in C4 is (W_{41}, W_{42}, W_{4n}, ..., W_{4N}). The user equipment feeds back, based on corresponding antenna ports of each antenna configuration, an optimal rank (rank), a PMI(i), and an SNR(i) in a codebook set Ci corresponding to each antenna configuration, and the base station compares each SNR(i) to select a best antenna for the user equipment to configure. Alternatively, the UE compares each SNR(i) to select a best antenna configuration, and feeds back first information corresponding to the best antenna configuration to the base station, where the first information includes an antenna index and or a CSI fed back to the base station. For example, the UE separately measures four groups of antenna ports to obtain the third group of antenna ports port 4 and port 5, and traverses in the precoding matrix (W_{31}, W_{32}, W_{3n}, ..., W_{3N}) included in C3, to obtain an optimal SNR higher than those of the other three groups of antenna ports. Therefore, the UE feeds back an index corresponding to the third group of antenna ports to the base station. A codebook set is configured for each group of antenna ports, and the user equipment calculates an SNR based on the codebook set, and feeds back the SNR to the base station device. For example, the codebook set C1 is configured for the antenna configuration 1, the codebook set C2 is configured for the antenna configuration 2, the codebook set C3 is configured for the antenna configuration 3, and the codebook set C4 is configured for the antenna configuration 4. When the user equipment performs RRM measurement, the user equipment performs random beamforming (random beamforming) in a codebook set Ci corresponding to each antenna configuration based on a pilot of each antenna configuration to calculate and report an average reference signal receiving power (Reference Signal Receiving Power, RSRP) or a reference signal receiving quality (Reference Signal Receiving Quality, RSRQ). For example, the user equipment performs random beamforming on all codebooks in C1 based on a pilot of the antenna configuration 1 to obtain an RSRP 1, performs random beamforming on all codebooks in C2 based on a pilot of the antenna configuration 2 to obtain an RSRP 2, ..., and the UE feeds back an index corresponding to an antenna configuration with the maximum RSRP to the base station.

The feeding back, by the first network device, first information of N antenna ports in the M antenna ports according to a first criterion specifically is:

selecting, by the first network device from the M antenna ports, N antenna ports that obtain optimal average information transmission performance through polling of all code words in a first codebook, obtaining first information of the N antenna ports, and feeding back the first information.

In still another implementation, the first criterion is codebook information; and

the feeding back, by the first network device, first information of N antenna ports in the M antenna ports according to a first criterion specifically is:

selecting, by the first network device from the M antenna ports, N antenna ports that obtain optimal best information transmission performance through polling of all code words in a first codebook, obtaining first information of the N antenna ports, and feeding back the first information.

In still another implementation, the first criterion is packet information, the packet information including a transport block size and a modulation and coding scheme; and

the feeding back, by the first network device, first information of N antenna ports in the M antenna ports according to a first criterion specifically is:

selecting, by the first network device from the M antenna ports, N antenna ports that transmit first packets with optimal transmission performance, obtaining first information of the N antenna ports, and feeding back the first information; and/or

selecting, by the first network device from the M antenna ports, a minimum quantity of N antenna ports that transmit first packets, obtaining first information of the N antenna ports, and feeding back the first information; and/or selecting, by the first network device from the M antenna ports, a minimum quantity of N antenna ports that meet a specific performance requirement when transmitting first packets, for example, a minimum quantity of antenna ports with a specific bit error rate, obtaining first information of the N antenna ports, and feeding back the first information.

It should be noted that, in the foregoing embodiment, the first criterion, the first threshold, the second threshold, the third threshold, and the fourth threshold are configured by the second network device by using broadcast information, higher layer signaling, or dynamic signaling.

The M antenna ports correspond to X channel state information processes (CSI process), and the N antenna ports correspond to one CSI process in the X CSI processes, where X is a positive integer. Each CSI process corresponds to a specific measurement resource. For example, each CSI process is configured with one signal measurement resource and one interference measurement resource. The UE obtains CSI based on the signal measurement resource and the interference measurement resource and reports the CSI. For example, if M=20 corresponds to five CSI processes, every four antenna ports correspond to one CSI process, and N=4.

It can be learned that, according to the signal transmitting method provided in this embodiment of the present invention, an optimal antenna configuration is performed based on at least one of antenna-related information, an SNR, a channel capacity, throughput, a single-user/multi-user transmission manner, a transmission mode, codebook information, or a packet size, so that more effective antenna selection is performed.

FIG. 3 is a flowchart of another signal transmitting method according to an embodiment of the present invention. The method includes the following steps:

Step S201: transmitting, by a second network device, signals of M antenna ports to a first network device, where M is a positive integer.

When an antenna configuration is performed, the second network device transmits configuration information of the M antenna ports to the first network device, and transmits the signals of the M antenna ports to the first network device. The first network device receives, based on the configuration information, the signals of the M antenna ports transmitted by the second network device, where M is a positive integer.

In this embodiment, the first network device may be a user equipment (User Equipment, UE), and the second network device may be a base station; or the first network device may be a user equipment, and the second network device may be a user equipment; or the first network device may be a base station, and the second network device may be a base station.

The base station may be a macro base station, a low-power node pico, or a radio remote unit RRH.

The configuration information of the M antenna ports includes a pattern of the antenna ports, that is, information such as a location of a time-frequency resource of the antenna ports, a transmitting cycle of the signals of the antenna ports, and a power.

The second network device may transmit only one piece of configuration information to the first network device. The configuration information is the configuration information of M antenna ports, or the M antenna ports are divided into a plurality of groups, and are transmitted to the first network device in a form of a plurality of pieces of configuration information. Each piece of configuration information corresponds to a configuration of one of antenna port groups.

Step S202: receiving, by the second network device, first information of N antenna ports in the M antenna ports that is fed back by the first network device according to a first criterion, N being an integer less than or equal to M, and the first criterion being at least one of antenna-related information, an SNR, a channel capacity, throughput, an SU (single user)/MU (multi user) transmission manner, a transmission mode, codebook information, and a packet size.

The first network device needs to select the N antenna ports from the M antenna ports according to a specific criterion, and notify the second network device of the first information of the selected N antenna ports. Herein, the first information is channel state information CSI corresponding to the N antenna ports or index information corresponding to the N antenna ports. Alternatively, the first information of the N antenna ports is transmitted to the second network device, and the second network device determines the N antenna ports. Herein, the first information is antenna-related information.

The second network device configures the first criterion, a first threshold, a second threshold, a third threshold, or a fourth threshold by using broadcast information, higher layer signaling, or dynamic signaling.

It can be learned that, according to the signal transmitting method provided in this embodiment of the present invention, the first network device performs an optimal antenna configuration based on at least one of antenna-related information, an SNR, a channel capacity, throughput, a single-user/multi-user transmission manner, a transmission mode, codebook information, or a packet size, and feeds back obtained antenna-related information, channel state information CSI corresponding to the N antenna ports, or index information of the N antenna ports to the second network device, so that the first network device performs more effective antenna selection.

FIG. 4 is a flowchart of still another signal transmitting method according to an embodiment of the present invention. The method includes the following steps:

Step S301: transmitting, by a second network device, signals of M antenna ports to a first network device, where M is a positive integer.

Step S302: receiving, by the second network device, first information of N antenna ports in the M antenna ports that is fed back by the first network device according to a first criterion, N being an integer less than or equal to M, the first criterion being at least one of antenna-related information, an SNR, a channel capacity, throughput, an SU (single user)/MU (multi user) transmission manner, a transmission mode, codebook information, and a packet size, and the first information including antenna-related information.

Step S301 and step S302 are respectively the same as step S201 and step S202 in the foregoing embodiment. Specifically, the first information herein includes antenna-related information.

Step S303: determining, by the second network device, the N antenna ports as selected antenna ports based on the antenna-related information.

The second network device determines the N antenna ports as selected antenna ports based on the antenna-related information.

It can be learned that, according to the signal transmitting method provided in this embodiment of the present invention, the first network device performs an optimal antenna configuration based on at least one of antenna-related information, an SNR, a channel capacity, throughput, a single-user/multi-user transmission manner, a transmission mode, codebook information, or a packet size, and feeds back obtained antenna-related information to the second network device, and the second network device determines selected antenna ports, so that the first network device performs more effective antenna selection.

FIG. 5 is a schematic diagram of a structure of a first network device according to an embodiment of the present invention. The first network device 1000 includes: a receiving unit 11 and a feedback unit 12.

The receiving unit 11 is configured to receive signals of M antenna ports transmitted by a second network device, where M is a positive integer.

When an antenna configuration is performed, the second network device transmits configuration information of the M antenna ports to the first network device, and transmits the signals of the M antenna ports to the first network device. The first network device receives, based on the configuration information, the signals of the M antenna ports transmitted by the second network device, where M is a positive integer.

In this embodiment, the first network device may be a user equipment (User Equipment, UE), and the second network device may be a base station; or the first network device may be a user equipment, and the second network device may be a user equipment; or the first network device may be a base station, and the second network device may be a base station.

The base station may be a macro base station, a low-power node pico, or a radio remote unit RRH.

The configuration information of the M antenna ports includes a pattern of the antenna ports, that is, information such as a location of a time-frequency resource of the antenna ports, a transmitting cycle of the signals of the antenna ports, and a power.

The second network device may transmit only one piece of configuration information to the first network device. The configuration information is the configuration information of M antenna ports, or the M antenna ports are divided into a plurality of groups, and are transmitted to the first network device in a form of a plurality of pieces of configuration information. Each piece of configuration information corresponds to a configuration of one of antenna port groups.

The feedback unit 12 is configured to feed back first information of N antenna ports in the M antenna ports according to a first criterion, N being an integer less than or equal to M, and the first criterion being at least one of antenna-related information, an SNR, a channel capacity, throughput, an SU (single user)/MU (multi user) transmission manner, a transmission mode, codebook information, and a packet size.

The first network device needs to select the N antenna ports from the M antenna ports according to a specific criterion, and notify the second network device of the first information of the selected N antenna ports. Herein, the first information is channel state information CSI corresponding to the N antenna ports or index information corresponding to the N antenna ports. Alternatively, the first information of the N antenna ports is transmitted to the second network device, and the second network device determines the N

antenna ports. Herein, the first information is antenna-related information.

The following describes how the feedback unit 12 feeds back the first information of the N antenna ports in M antenna ports according to various first criteria through specific implementations:

In an implementation, the first criterion is antenna-related information; and

the feedback unit 12 is specifically configured to perform cell selection based on measured antenna-related information of the M antenna ports, where the M antenna ports correspond to at least two cells or two transmission nodes, and each of the cells or transmission nodes corresponds to at least two antenna ports.

In the conventional technology, cell selection is performed only according to received signal power information such as an RSRP and RSSL RSRQ. In this embodiment, antenna correlation is also considered for cell selection, so that a user can consider selection of a cell or a transmission node more comprehensively according to a service of the user.

In a specific implementation, the performing, by the first network device, cell selection based on measured antenna-related information of the M antenna ports specifically is:

For example, M=10 corresponds to five cells, and each cell has two antennas. Cell 1 corresponds to port 0 and port 1, cell 1 corresponds to port 2 and port 3, cell 1 corresponds to port 4 and port 5, cell 1 corresponds to port 6 and port 7, and cell 1 corresponds to port 8 and port 9; and

the UE measures the five groups of antenna ports respectively corresponding to the five cells, and finds that port 0 and port 1 corresponding to cell 1 have the strongest received signal power. For example, RSRP1>RSRP2>RSRP3>RSRP4>RSRP5, RSRP1 represents the received signal power corresponding to cell 1, RSRP2 represents a received signal power corresponding to cell 2, and RSRPn represents a received signal power corresponding to cell n. However, if it is assumed that the first criterion is antenna-related information, and it is required that the antenna-related information be as large as possible, an antenna correlation coefficient is defined as Cor. For example, an antenna correlation coefficient Cor 1 of cell 1 is antenna correlation between port 0 and port 1, a channel coefficient H0 corresponding to port 0 and a channel coefficient H1 corresponding to port 1 may be obtained by means of channel estimation, and correlation between H0 and H1 is calculated to obtain Cor 1. For example, a correlation matrix may be obtained by using $H=[H_0\ H_1]$ and $R=H^H H$,

or obtained according to $R_{ik}=\frac{1}{2\Delta}\int_{\theta-\Delta}^{\theta+\Delta}\exp[jz(i-k)\sin\beta]d\beta$.

i and k are respectively an i^{th} antenna and a k^{th} antenna, and Δ is an angular spread.

Cor 2, Cor 3, Cor 4, and Cor 5 are obtained according to the same method, where Com represents an antenna correlation coefficient corresponding to cell n.

In addition, Cor 2>Cor 1>Cor 3>Cor 4>Cor 5. In this case, although the received signal power of cell 1 is the strongest, cell 2 is finally selected by the UE and the UE is camped in the cell 2 as the signal power and the antenna correlation are comprehensively considered.

The first criterion herein is not limited to the antenna correlation, and may alternatively be an SU/MU, a signal transmission mode, or the like, and the first criterion may be predefined, or a base station broadcast, or a signaling notification specified by the UE.

Specifically, that the feedback unit 12 performs the step of performing cell selection based on measured antenna-related information of the M antenna ports specifically is: selecting, by the first network device, the N antenna ports based on a comparison result of the measured antenna-related information of the M antenna ports and a first threshold, obtaining the first information of the N antenna ports, and feeding back the first information.

That is, correlation matrices or correlation coefficients of the M antenna ports are compared with a set threshold, N antenna ports whose correlation matrices or correlation coefficients are greater than or equal to the set threshold are selected, channel state information (CHannel State Signal, CSI) corresponding to the N antenna ports or index information corresponding to the N antenna ports are obtained, and the second network device is notified of the CSI corresponding to the N antenna ports or the index information corresponding to the N antenna ports, so that the second network device transmits data to the first network device through the N antenna ports.

In another implementation, the first criterion is a signal-to-noise ratio SNR; and

the feedback unit 12 is specifically configured to select, from the M antenna ports, N antenna ports that enable an SNR after beamforming or transmit diversity to be less than or equal to or greater than or equal to a second threshold and that have a minimum quantity in antenna port combinations, obtain first information of the N antenna ports, and feed back the first information.

For example, the base station configures M antenna ports for the UE. As shown in FIG. 2, a schematic diagram of a plurality of antennas in another antenna array, M=88, and the UE traverses all antenna port combinations from N=1 to N=88 in the M ports. For a value of each N, a quantity of combinations that need to be traversed is c. For example, for N=4, there are combinations including a combination 1 (a11, a12, a13, a14), a combination 2 (a12, a13, a14, a15), a combination 3 (a13, a14, a15, a16), a combination 4 (a14, a15, a16, a17), a combination 5 (a15, a16, a17, a18), a combination 6 (b11, b12, b13, b14), ... For each combination, for example, the combination 1 (a11, a12, a13, a14), the UE obtains a channel $H_{N,1}$ by using a11, a12, a13, and a14, and then traverses all precoding matrices W_i to obtain a signal-to-noise ratio:

$$SNR_{N,\ m,\ i} = \frac{\left|H_{n,m} W_i\right|^2}{\sigma^2}$$

$H_{n,m}$ represents an m^{th} configuration in a case in which the N antenna ports are combined, W_i represents an i^{th} precoding matrix, and σ^2 is noise.

All SNRs of all N port combinations are traversed, to find a quantity of precoding matrices in a case of the maximum SNR, for example, max($SNR_{N,\ m,\ i}$, N=4, $1 \le m \le C_M^4$, $1 \le i \le X_4$)=5 dB, where X_4 represents that N=4. For N=5, traversing is performed by using the foregoing same method, and max($SNR_{N,\ m,\ i}$, N=5, $1 \le m \le C_M^5$, and $1 < i \le X_5$)=7 dB. If the base station notifies the UE that the first criterion for antenna selection is a minimum quantity of antennas to ensure that SNR is greater than or equal to 6 dB, N=5 may happen to ensure that 6 dB can be reached, and is the minimum quantity of antennas required to reach 6 dB. Therefore, the UE may feed back, to the base station, indexes corresponding to numbers of an antenna combination whose SNR reaches 7 dB when N=5, for example, a11, b12, c14, and d11. By using N>5, an obtained signal-to-noise ratio is higher than that obtained when N=5. However, for some channels, only a specific SNR performance requirement needs to be met, and no larger SNR is required. Using more antennas may cause a base station to waste transmit power.

In still another implementation, the first criterion is a channel capacity; and

the feedback unit 12 is specifically configured to select, from the M antenna ports, N antenna ports that enable the channel capacity to be less than or equal to or greater than or equal to a third threshold and that have a minimum quantity in antenna port combinations, obtain first information of the N antenna ports, and feed back the first information.

Because of the channel capacity C=Blog2(1+SNR), in this implementation, a process of performing antenna port selection based on the channel capacity is similar to the process of performing antenna port selection based on the SNR in the foregoing implementation, and details are not described herein again.

In still another implementation, the first criterion is throughput; and

the feedback unit 12 is specifically configured to select, from the M antenna ports, N antenna ports that enable the throughput to be less than or equal to or greater than or equal to a fourth threshold and that have a minimum quantity in antenna port combinations, obtain first information of the N antenna ports, and feed back the first information.

Similarly, in this implementation, a process of performing antenna port selection based on the throughput is similar to the process of performing antenna port selection based on the SNR or the channel capacity in the foregoing implementation, and details are not described herein again.

In still another implementation, the first criterion is an SU/MU transmission manner; and

the feedback unit 12 is specifically configured to select, from the M antenna ports, a first group of antenna ports with optimal SU transmission, the first group of antenna ports including N1 antenna ports, obtain first information of the N1 antenna ports, and feed back the first information; and/or

the first network device selects, from the M antenna ports, a second group of antenna ports with optimal MU transmission, the second group of antenna ports including N2 antenna ports, obtains first information of the N2 antenna ports, and feeds back the first information.

In this implementation, for example, if the base station configures the UE to select an antenna in a manner in which SU transmission is optimal, the UE traverses all the antennas and selects an antenna in a manner in which the antenna optimizes the performance of the UE. For example, antennas a11, b13, g15, and H18 are selected, and antenna index information of a11, b13, g15, and H18 is reported to the base station.

For another example, the base station configures the UE 1 to select an antenna in a manner in which MU pairing is optimal. The base station may notify UE 1 of information about pairing users, for example, information about users UE 2 and UE 3 that are paired with UE 1, including antenna information of UE 2 and UE 3. UE 1 selects an antenna in a manner in which total performance of all the users after pairing is optimal, for example, selects antennas c13, d12, e11, and f18, and notifies the base station of the antenna index information corresponding to the antennas.

Information about a group of antenna ports with optimal SU transmission and information about a group of antenna ports with optimal MU transmission may also be fed back at the same time. For example, a SU may select cross polarization antennas, and correlation between the antennas is small, which facilitates spatial multiplexing. When MUs are paired, it is better for each user to select a co-polar antenna, to facilitate beamforming for each user. The SU means that a user transmits a packet of the user separately on one time-frequency resource, and the MU means that multiple users may transmit packets of the users in a spatial multiplexing manner on the same time-frequency resource.

In still another implementation, the first criterion is a transmission mode; and

the feedback unit 12 is specifically configured to select, from the M antenna ports, an optimal first group of antenna ports whose transmission mode is transmit diversity transmission, the first group of antenna ports including N1 antenna ports, obtain first information of the N1 antenna ports, and feed back the first information; and/or

the first network device selects, from the M antenna ports, an optimal second group of antenna ports whose transmission mode is beamforming transmission, the first group of antenna ports including N2 antenna ports, obtains first information of the N2 antenna ports, and feeds back the first information; and/or

the first network device selects, from the M antenna ports, an optimal third group of antenna ports whose transmission mode is spatial multiplexing transmission,

the third group of antenna ports including N3 antenna ports, obtains first information of the N3 antenna ports, and feeds back the first information.

In still another implementation, the first criterion is codebook information; and

the feedback unit 12 is specifically configured to select, from the M antenna ports, N antenna ports that use first codebook information and that have optimal transmission performance, obtain first information of the N antenna ports, and feed back the first information.

Codebook information refers to information that includes a plurality of precoding matrices.

In still another implementation, the first criterion is codebook information.

For example, the M antenna ports are divided into X groups, and the base station separately configures a codebook set for each group of antenna ports. The user equipment calculates an SNR based on the configured codebook set, and feeds back the SNR to a base station device. For example, a first group of antenna ports corresponds to an antenna configuration 1 and includes antenna ports port 0 and port 1, the base station configures a codebook set C1 for the antenna configuration 1, and a precoding matrix included in C1 is (W_{11}, W_{12}, W_{1n}, ..., W_{1N}). A second group of antenna ports corresponds to an antenna configuration 2 and includes antenna ports port 2 and port 3, a codebook set C2 is configured for the antenna configuration 2, and a precoding matrix included in C2 is (W_{21}, W_{22}, W_{2n}, ..., W_{2N}). A third group of antenna ports corresponds to an antenna configuration 3 and includes antenna ports port 4 and port 5, a codebook set C3 is configured for the antenna configuration 3, and a precoding matrix included in C3 is (W_{31}, W_{32}, W_{3n}, ..., W_{3N}). A fourth group of antenna ports corresponds to an antenna configuration 4 and includes antenna ports port 6 and port 7, a codebook set C4 is configured for the antenna configuration 4, and a precoding matrix included in C4 is (W_{41}, W_{42}, W_{4n}, ..., W_{4N}). The user equipment feeds back, based on corresponding antenna ports of each antenna configuration, an optimal rank (rank), a PMI(i), and an SNR(i) in a codebook set Ci corresponding to each antenna configuration, and the base station compares each SNR(i) to select a best antenna for the user equipment to configure. Alternatively, the UE compares each SNR(i) to select a best antenna configuration, and feeds back first information corresponding to the best antenna configuration to the base station, where the first information includes an antenna index and or a CSI fed back to the base station. For example, the UE separately measures four groups of antenna ports to obtain the third group of antenna ports port 4 and port 5, and traverses in the precoding matrix (W_{31}, W_{32}, W_{3n}, ..., W_{3N}) included in C3, to obtain an optimal SNR higher than those of the other three groups of antenna ports. Therefore, the UE feeds back an index corresponding to the third group of antenna ports to the base station. A codebook set is configured for each group of antenna ports, and the user equipment calculates an SNR based on the codebook set, and feeds back the SNR to the base station device. For example, the codebook set C1 is configured for the antenna configuration 1, the codebook set C2 is configured for the antenna configuration 2, the codebook set C3 is configured for the antenna configuration 3, and the codebook set C4 is configured for the antenna configuration 4. When the user equipment performs RRM measurement, the user equipment performs random beamforming (random beamforming) in a codebook set Ci corresponding to each antenna configuration based on a pilot of each antenna configuration to calculate and report an average reference signal receiving power (Reference Signal Receiving Power, RSRP) or a reference signal receiving quality (Reference Signal Receiving Quality, RSRQ). For example, the user equipment performs random beamforming on all codebooks in C1 based on a pilot of the antenna configuration 1 to obtain an RSRP 1, performs random beamforming on all codebooks in C2 based on a pilot of the antenna configuration 2 to obtain an RSRP 2, ..., and the UE feeds back an index corresponding to an antenna configuration with the maximum RSRP to the base station.

The feedback unit 12 is specifically configured to select, from the M antenna ports, N antenna ports that obtain optimal average information transmission performance through polling of all code words in a first codebook, obtain first information of the N antenna ports, and feed back the first information.

In still another implementation, the first criterion is codebook information; and

the feedback unit 12 is specifically configured to select, from the M antenna ports, N antenna ports that poll all code words in a first codebook

so that the best information transmission performance in the code words is optimal, obtain first information of the N antenna ports, and feed back the first information.

In still another implementation, the first criterion is packet information, the packet information including a transport block size and a modulation and coding scheme; and

the feedback unit 12 is specifically configured to select, from the M antenna ports, N antenna ports that transmit first packets with optimal transmission performance, obtain first information of the N antenna ports, and feed back the first information; and/or

the first network device selects, from the M antenna ports, a minimum quantity of N antenna ports that transmit first packets, obtains first information of the N antenna ports, and feeds back the first information; and/or

the first network device selects, from the M antenna ports, a minimum quantity of N antenna ports that meet a specific performance requirement when transmitting first packets, for example, a minimum quantity of antenna ports with a specific bit error rate, obtains first information of the N antenna ports, and feeds back the first information.

It should be noted that, in the foregoing embodiment, the first criterion, the first threshold, the second threshold, the third threshold, and the fourth threshold are configured by the second network device by using broadcast information, higher layer signaling, or dynamic signaling.

The M antenna ports correspond to X channel state information processes (CSI process), and the N antenna ports correspond to one CSI process in the X CSI processes, where X is a positive integer. Each CSI process corresponds to a specific measurement resource. For example, each CSI process is configured with one signal measurement resource and one interference measurement resource. The UE obtains CSI based on the signal measurement resource and the interference measurement resource and reports the CSI. For example, if M=20 corresponds to five CSI processes, every four antenna ports correspond to one CSI process, and N=4.

It can be learned that, according to the first network device provided in this embodiment of the present invention, an optimal antenna configuration is performed based on at least one of antenna-related information, an SNR, a channel capacity, throughput, a single-user/multi-user transmission manner, a transmission mode, codebook information, or a packet size, so that more effective antenna selection is performed.

FIG. 6 is a schematic diagram of a structure of a second network device according to an embodiment of the present invention. The second network device 2000 includes: a transmitting unit 21 and a receiving unit 22.

The transmitting unit 21 is configured to transmit signals of M antenna ports to a first network device, where M is a positive integer.

When an antenna configuration is performed, the transmitting unit 21 transmits configuration information of the M antenna ports to the first network device, and transmits the signals of the M antenna ports to the first network device. The first network device receives, based on the configuration information, the signals of the M antenna ports transmitted by the transmitting unit 21, where M is a positive integer. In this embodiment, the first network device may be a user equipment (User Equipment, UE), and the second network device may be a base station; or the first network device may be a user equipment, and the second network device may be a user equipment; or the first network device may be a base station, and the second network device may be a base station.

The base station may be a macro base station, a low-power node pico, or a radio remote unit RRH.
The configuration information of the M antenna ports includes a pattern of the antenna ports, that is, information such as a location of a time-frequency resource of the antenna ports, a transmitting cycle of the signals of the antenna ports, and a power.
The second network device may transmit only one piece of configuration information to the first network device. The configuration information is the configuration information of M antenna ports, or the M antenna ports are divided into a plurality of groups, and are transmitted to the first network device in a form of a plurality of pieces of configuration information. Each piece of configuration information corresponds to a configuration of one of antenna port groups.
The receiving unit 22 is configured to receive first information of N antenna ports in the M antenna ports that is fed back by the first network device according to a first criterion, N being an integer less than or equal to M, and the first criterion being at least one of antenna-related information, an SNR, a channel capacity, throughput, an SU (single user)/MU (multi user) transmission manner, a transmission mode, codebook information, and a packet size.
The first network device needs to select the N antenna ports from the M antenna ports according to a specific criterion, and notify the receiving unit 22 of the second network device of the first information of the selected N antenna ports. Herein, the first information is channel state information CSI corresponding to the N antenna ports or index information corresponding to the N antenna ports. Alternatively, the first information of the N antenna ports is transmitted to the second network device, and the second network device determines the N antenna ports. Herein, the first information is antenna-related information.
The second network device configures the first criterion, a first threshold, a second threshold, a third threshold, or a fourth threshold by using broadcast information, higher layer signaling, or dynamic signaling.
It can be learned that, according to the second network device provided in this embodiment of the present invention, the first network device performs an optimal antenna configuration based on at least one of antenna-related information, an SNR, a channel capacity, throughput, a single-user/multi-user transmission manner, a transmission mode, codebook information, or a packet size, and feeds back obtained

antenna-related information, channel state information CSI corresponding to the N antenna ports, or index information of the N antenna ports to the second network device, so that the first network device performs more effective antenna selection.

FIG. 7 is a schematic diagram of a structure of another second network device according to an embodiment of the present invention. The second network device 3000 includes: a transmitting unit 31, a receiving unit 32, and a determining unit 33.

The transmitting unit 31 is configured to transmit signals of M antenna ports to a first network device, where M is a positive integer.

The receiving unit 32 is configured to receive first information of N antenna ports in the M antenna ports that is fed back by the first network device according to a first criterion, N being an integer less than or equal to M, the first criterion being at least one of antenna-related information, an SNR, a channel capacity, throughput, an SU (single user)/MU (multi user) transmission manner, a transmission mode, codebook information, and a packet size, and the first information including antenna-related information.

Functions of the transmitting unit 31 and the receiving unit 32 are respectively the same as those of the transmitting unit 21 and the receiving unit 22 in the foregoing embodiment. Specifically, the first information herein includes antenna-related information.

The determining unit 33 is configured to determine the N antenna ports as selected antenna ports based on the antenna-related information.

The determining unit 33 determines the N antenna ports as selected antenna ports based on the antenna-related information.

It can be learned that, according to the second network device provided in this embodiment of the present invention, the first network device performs an optimal antenna configuration based on at least one of antenna-related information, an SNR, a channel capacity, throughput, a single-user/multi-user transmission manner, a transmission mode, codebook information, or a packet size, and feeds back obtained antenna-related information to the second network device, and the second network device determines selected antenna ports, so that the first network device performs more effective antenna selection.

FIG. 8 is a schematic diagram of a structure of another first network device according to an embodiment of the present invention. The first network device 4000 includes: a receiver 41 and a transmitter 42.

The receiver 41 is configured to receive signals of M antenna ports transmitted by a second network device, where M is a positive integer; and

the transmitter 42 is configured to feed back first information of N antenna ports in the M antenna ports according to a first criterion, N being an integer less than or equal to M, and the first criterion being at least one of antenna-related information, an SNR, a channel capacity, throughput, an SU (single user)/MU (multi user) transmission manner, a transmission mode, codebook information, and a packet size.

In an implementation, the first criterion is antenna-related information; and

that the transmitter 42 performs the step of feeding back first information of N antenna ports in the M antenna ports according to a first criterion specifically is:

performing cell selection based on measured antenna-related information of the M antenna ports, where the M antenna ports correspond to at least two cells or two transmission nodes, and each of the cells or transmission nodes corresponds to at least two antenna ports.

In another implementation, that the transmitter 42 performs the step of performing cell selection based on the measured antenna-related information of the M antenna ports specifically is:

selecting, by the first network device, the N antenna ports based on a comparison result of the measured antenna-related information of the M antenna ports and a first threshold, obtaining the first information of the N antenna ports, and feeding back the first information.

In still another implementation, the first criterion is a signal-to-noise ratio SNR; and

that the transmitter 42 performs the step of feeding back first information of N antenna ports in the M antenna ports according to a first criterion specifically is:

selecting, from the M antenna ports, N antenna ports that enable an SNR after beamforming or transmit diversity to be less than or equal to or greater than or equal to a second threshold and that have a minimum quantity in antenna port combinations, obtaining first information of the N antenna ports, and feeding back the first information.

In still another implementation, the first criterion is a channel capacity; and

that the transmitter 42 performs the step of feeding back first information of N antenna ports in the M antenna ports according to a first criterion specifically is:

selecting, from the M antenna ports, N antenna ports that enable the channel capacity to be less than or equal to or greater than or equal to a third threshold and that have a minimum quantity in antenna port combinations, obtaining first information of the N antenna ports, and feeding back the first information.

In still another implementation, the first criterion is throughput; and

that the transmitter 42 performs the step of feeding back first information of N antenna ports in the M antenna ports according to a first criterion specifically is:

selecting, by the first network device from the M antenna ports, N antenna ports that enable the throughput to be less than or equal to or greater than or equal to a fourth threshold and that have a minimum quantity in antenna port combinations, obtaining first information of the N antenna ports, and feeding back the first information.

In still another implementation, the first criterion is an SU/MU transmission manner; and

that the transmitter 42 performs the step of feeding back first information of N antenna ports in the M antenna ports according to a first criterion specifically is:

selecting, from the M antenna ports, a first group of antenna ports with optimal SU transmission, the first group of antenna ports including N1 antenna ports, obtaining first information of the N1 antenna ports, and feeding back the first information; and/or

selecting, from the M antenna ports, a second group of antenna ports with optimal MU transmission, the second group of antenna ports including N2 antenna ports, obtaining first information of the N2 antenna ports, and feeding back the first information.

In still another implementation, the first criterion is a transmission mode; and

that the transmitter 42 performs the step of feeding back first information of N antenna ports in the M antenna ports according to a first criterion specifically is:

selecting, from the M antenna ports, an optimal first group of antenna ports whose transmission mode is transmit diversity transmission, the first group of antenna ports including N1 antenna ports, obtaining first information of the N1 antenna ports, and feeding back the first information; and/or

selecting, from the M antenna ports, an optimal second group of antenna ports whose transmission mode is beamforming transmission, the first group of antenna ports including N2 antenna ports, obtaining first information of the N2 antenna ports, and feeding back the first information; and/or

selecting, from the M antenna ports, an optimal third group of antenna ports whose transmission mode is spatial multiplexing transmission, the third group of antenna ports including N3 antenna ports, obtaining first information of the N3 antenna ports, and feeding back the first information.

In still another implementation, the first criterion is codebook information; and

that the transmitter 42 performs the step of feeding back first information of N antenna ports in the M antenna ports according to a first criterion specifically is:

selecting, from the M antenna ports, N antenna ports that use first codebook information and that have optimal transmission performance, obtaining first information of the N antenna ports, and feeding back the first information.

In still another implementation, the first criterion is codebook information; and

that the transmitter 42 performs the step of feeding back first information of N antenna ports in the M antenna ports according to a first criterion specifically is:

selecting, from the M antenna ports, N antenna ports that obtain optimal average information transmission performance through polling of all code words in a first codebook, obtaining first information of the N antenna ports, and feeding back the first information.

In still another implementation, the first criterion is codebook information; and

that the transmitter 42 performs the step of feeding back first information of N antenna ports in the M antenna ports according to a first criterion specifically is:

selecting, from the M antenna ports, N antenna ports that obtain optimal best information transmission performance through polling of all code words in a first codebook, obtaining first information of the N antenna ports, and feeding back the first information.

In still another implementation, the first criterion is packet information; and

that the transmitter 42 performs the step of feeding back first information of N antenna ports in the M antenna ports according to a first criterion specifically is:

selecting, from the M antenna ports, N antenna ports that transmit first packets with optimal transmission performance, obtaining first information of the N antenna ports, and feeding back the first information; and/or

selecting, from the M antenna ports, a minimum quantity of N antenna ports that transmit first packets, obtaining first information of the N antenna ports, and feeding back the first information.

In the foregoing embodiments or implementations, the first criterion, the first threshold, the second threshold, the third threshold, and the fourth threshold are configured by the second network device by using broadcast information, higher layer signaling, or dynamic signaling.

In the foregoing embodiments or implementations, the M antenna ports correspond to X channel state information processes CSI processes, and the N antenna ports correspond to one CSI process in the X CSI processes, where X is a positive integer.

In the foregoing embodiments or implementations, the first information includes antenna-related information, channel state information CSI corresponding to the N antenna ports, or index information of the N antenna ports.

It can be learned that, according to the first network device provided in this embodiment of the present invention, an optimal antenna configuration is performed based on at least one of antenna-related information, an SNR, a channel capacity, throughput, a single-user/multi-user transmission manner, a transmission mode, codebook information, or a packet size, so that more effective antenna selection is performed.

FIG. 9 is a schematic diagram of a structure of still another second network device according to an embodiment of the present invention. The second network device 5000 includes: a transmitter and a receiver.

The transmitter 51 is configured to transmit signals of M antenna ports to a first network device, where M is a positive integer.

The receiver 52 is configured to receive first information of N antenna ports in the M antenna ports that is fed back by the first network device according to a first criterion, N being an integer less than or equal to M, and the first criterion being at least one of antenna-related information, an SNR, a channel capacity, throughput, an SU (single user)/MU (multi user) transmission manner, a transmission mode, codebook information, and a packet size.

The first information includes channel state information CSI corresponding to the N antenna ports or index information of the N antenna ports.

It can be learned that, according to the second network device provided in this embodiment of the present invention, the first network device performs an optimal antenna configuration based on at least one of antenna-related information, an SNR, a channel capacity, throughput, a single-user/multi-user transmission manner, a transmission mode, codebook information, or a packet size, and feeds back obtained antenna-related information, channel state information CSI corresponding to the N antenna ports, or index information of the N antenna ports to the second network device, so that the first network device performs more effective antenna selection.

FIG. 10 is a schematic diagram of a structure of still another second network device according to an embodiment of the present invention. The second network device 6000 includes: a transmitter, a receiver, and a controller.

The transmitter 61 is configured to transmit signals of M antenna ports to a first network device, where M is a positive integer.

The receiver 62 is configured to receive first information of N antenna ports in the M antenna ports that is fed back by the first network device according to a first criterion, N being an integer less than or equal to M, the first criterion being at least one of antenna-related information, an SNR, a channel capacity, throughput, an SU (single user)/MU (multi user) transmission manner, a transmission mode, codebook information, and a packet size, and the first information including antenna-related information.

the controller 63 is configured to determine the N antenna ports as selected antenna ports based on the antenna-related information.

It can be learned that, according to the second network device provided in this embodiment of the present invention, the first network device performs an optimal antenna configuration based on at least one of antenna-related information, an SNR, a channel capacity, throughput, a single-user/multi-user transmission manner, a transmission mode, codebook information, or a packet size, and feeds back obtained antenna-related information to the second network device, and the second network device determines selected antenna ports, so that the first network device performs more effective antenna selection.

It should be noted that, for simplicity of description, the foregoing method embodiments are described as a combination of a series of actions. However, a person skilled in the art should understand that the present invention is not limited to the described action sequence, because according to the present invention, some steps may be performed in another order or simultaneously. In addition, a person skilled in the art should also understand that the embodiments described in the specification are all example embodiments, and used actions and modules are not necessarily mandatory to the present invention.

In the foregoing embodiments, the descriptions of the embodiments have respective focuses. For a part that is not described in detail in an embodiment, reference may be made to related descriptions in other embodiments.

According to the foregoing descriptions of the implementations, a person skilled in the art may clearly understand that the present invention may be implemented by using hardware, firmware, or a combination thereof. When the functions are implemented by using software, the functions described above may be stored in a computer-readable medium or transmitted as one or more instructions or code on a computer-readable medium. The computer-readable medium includes a computer storage medium and a communication medium, where the communication medium includes any medium that facilitates transmission of a computer program from one place to another. The storage medium may be any available medium that can be accessed by computer. This is used as an example but is not limited to: The computer-readable medium may include a random access memory (Random Access Memory, RAM), a read-only memory (Read-Only Memory, ROM), an electrically erasable programmable read-only memory (Electrically Erasable Programmable Read-Only Memory, EEPROM), a compact disc read-only memory (Compact Disc Read-Only Memory, CD-ROM) or another optical disk storage, a magnetic disk storage medium or another magnetic storage device, or any other medium that can be used to carry or store expected program code in a form of an instruction or a data structure and that can be accessed by a computer. In addition, any connection may appropriately become a computer-readable medium. For example, if the software is transmitted from a website, a server, or another remote source by using a coaxial cable, an optical fiber cable, a twisted pair, a digital subscriber line (Digital Subscriber Line, DSL), or a wireless technology such as infrared, radio, and microwave, the coaxial cable, the optical fiber cable, the twisted pair, the DSL, or the wireless technology such as infrared, wireless, and microwave are included in fixation of a medium to which the software belongs. As used in the present invention, a disk (Disk) and a disc (disc) include a compact disc (CD), a laser disc, an optical disc, a digital versatile optical disc (DVD), a floppy disk, and a blue optical disc, where the disk generally copies data magnetically, and the disc copies data optically by using a laser. Combinations of the disk and the disc should also be included in the protection scope of the computer-readable medium.

In conclusion, the foregoing descriptions are merely exemplary embodiments of the technical solutions of the present invention, and are not intended to limit the protection scope of the present invention. Any modification, equivalent replacement, improvement, and the like made in the spirit and principles of the present invention shall fall within the protection scope of the present invention.

Claims

1. A signal transmitting method, characterized by comprising:

receiving, by a first network device, signals of M antenna ports transmitted by a second network device, wherein M is a positive integer; and

feeding back, by the first network device, first information of N antenna ports in the M antenna ports according to a first criterion, N being an integer less than or equal to M, and the first criterion being at least one of antenna-related information, an SNR, a channel capacity, throughput, an SU (single user)/MU (multi user) transmission manner, a transmission mode, codebook information, and a packet size.

2. The method according to claim 1, wherein the first criterion is antenna-related information; and

the feeding back, by the first network device, first information of N antenna ports in the M antenna ports according to a first criterion specifically is:

performing, by the first network device, cell selection based on measured antenna-related information of the M antenna ports, wherein the M antenna ports correspond to at least two cells or two transmission nodes, and each of the cells or transmission nodes corresponds to at least two antenna ports.

3. The method according to claim 2, wherein the performing, by the first network device, cell selection based on measured antenna-related information of the M antenna ports specifically is:

selecting, by the first network device, the N antenna ports based on a comparison result of the measured antenna-related information of the M antenna ports and a first threshold, obtaining the first information of the N antenna ports, and feeding back the first information.

4. The method according to claim 1, wherein the first criterion is a signal-to-noise ratio SNR; and

the feeding back, by the first network device, first information of N antenna ports in the M antenna ports according to a first criterion specifically is:

selecting, by the first network device from the M antenna ports, N antenna ports that enable an SNR after beamforming or transmit diversity to be less than or equal to or greater than or equal to a second threshold and that have a minimum quantity in antenna port combinations, obtaining first information of the N antenna ports, and feeding back the first information.

5. The method according to claim 1, wherein the first criterion is a channel capacity; and

the feeding back, by the first network device, first information of N antenna ports in the M antenna ports according to a first criterion specifically is:

selecting, by the first network device from the M antenna ports, N antenna ports that enable the channel capacity to be less than or equal to or greater than or equal to a third threshold and that have a minimum quantity in antenna port combinations, obtaining first information of the N antenna ports, and feeding back the first information.

6. The method according to claim 1, wherein the first criterion is throughput; and

the feeding back, by the first network device, first information of N antenna ports in the M antenna ports according to a first criterion specifically is:

selecting, by the first network device from the M antenna ports, N antenna ports that enable the throughput to be less than or equal to or greater than or equal to a fourth threshold and that have a minimum quantity in antenna port combinations, obtaining first information of the N antenna ports, and feeding back the first information.

7. The method according to claim 1, wherein the first criterion an SU/MU transmission manner; and

the feeding back, by the first network device, first information of N antenna ports in the M antenna ports according to a first criterion specifically is:

selecting, by the first network device from the M antenna ports, a first group of antenna ports with optimal SU transmission, the first group of antenna ports comprising N1 antenna ports, obtaining first information of the N1 antenna ports, and feeding back the first information; and/or

selecting, by the first network device from the M antenna ports, a second group of antenna ports with optimal MU transmission, the second group of antenna ports comprising N2 antenna ports, obtaining first information of the N2 antenna ports, and feeding back the first information.

8. The method according to claim 1, wherein the first criterion is a transmission mode; and the feeding back, by the first network device, first information of N antenna ports in the M antenna ports according to a first criterion specifically is:

selecting, by the first network device from the M antenna ports, an optimal first group of antenna ports whose transmission mode is transmit diversity transmission, the first group of antenna ports comprising N1 antenna ports, obtaining first information of the

N1 antenna ports, and feeding back the first information; and/or

selecting, by the first network device from the M antenna ports, an optimal second group of antenna ports whose transmission mode is beamforming transmission, the first group of antenna ports comprising N2 antenna ports, obtaining first information of the N2 antenna ports, and feeding back the first information; and/or

selecting, by the first network device from the M antenna ports, an optimal third group of antenna ports whose transmission mode is spatial multiplexing transmission, the third group of antenna ports comprising N3 antenna ports, obtaining first information of the N3 antenna ports, and feeding back the first information.

9. The method according to claim 1, wherein the first criterion is codebook information; and

the feeding back, by the first network device, first information of N antenna ports in the M antenna ports according to a first criterion specifically is:

selecting, by the first network device from the M antenna ports, N antenna ports that use first codebook information corresponding to the N antenna ports and that have optimal transmission performance, obtaining first information of the N antenna ports, and feeding back the first information.

10. The method according to claim 1, wherein the first criterion is codebook information; and

the feeding back, by the first network device, first information of N antenna ports in the M antenna ports according to a first criterion specifically is:

selecting, by the first network device from the M antenna ports, N antenna ports that obtain optimal average information transmission performance through polling of all code words in a first codebook, obtaining first information of the N antenna ports, and feeding back the first information.

11. The method according to claim 1, wherein the first criterion is codebook information; and

the feeding back, by the first network device, first information of N antenna ports in the M antenna ports according to a first criterion specifically is:

selecting, by the first network device from the M antenna ports, N antenna ports that obtain optimal best information transmission performance through polling of all code words in a first codebook so that the best information transmission performance in the code words is optimal, obtaining first information of the N antenna ports, and feeding back the first information.

12. The method according to claim 1, wherein the first criterion is packet information; and

the feeding back, by the first network device, first information of N antenna ports in the M antenna ports according to a first criterion specifically is:

selecting, by the first network device from the M antenna ports, N antenna ports that transmit first packets with optimal transmission performance, obtaining first information of the N antenna ports, and feeding back the first information; and/or

selecting, by the first network device from the M antenna ports, a minimum quantity of N antenna ports that transmit first packets, obtaining first information of the N antenna ports, and feeding back the first information; and/or

selecting, by the first network device from the M antenna ports, a minimum quantity of N antenna ports that meet a specific performance requirement when transmitting first packets, obtaining first information of the N antenna ports, and feeding back the first information.

13. The method according to claims 1 to 12, wherein the first criterion or the first threshold, the second threshold, the third threshold, and the fourth threshold are configured by the second network device by using broadcast information, higher layer signaling, or dynamic signaling.

14. The method according to claims 1 to 13, wherein the M antenna ports correspond to X channel state information processes CSI processes, and the N antenna ports correspond to one CSI process in the X CSI processes, wherein X is a positive integer.

15. The method according to claims 1 to 14, wherein the first information comprises antenna-related information, channel state information CSI corresponding to the N antenna ports, or index information of the N antenna ports.

16. A signal transmitting method, characterized by comprising:

transmitting, by a second network device, signals of M antenna ports to a first network device, wherein M is a positive integer; and

receiving, by the second network device, first information of N antenna ports in the M antenna ports that is fed back by the first network device according to a first criterion, N being an integer less than or equal to M, and the first criterion being at least one of antenna-related information, an SNR, a channel capacity, throughput, an SU (single user)/MU (multi user) transmission manner, a transmission mode, codebook information, and a packet size.

17. The method according to claim 16, wherein the first information comprises antenna-related information; and

the method further comprises:

determining, by the second network device, the N antenna ports as selected antenna ports based on the antenna-related information.

18. The method according to claim 16, wherein the first information comprises channel state information CSI corresponding to the N antenna ports or index information of the N antenna ports.

19. The method according to any one of claims 16 to 18, further comprising:

configuring, by the second network device, the first criterion, a first threshold, a second threshold, a third threshold, or a fourth threshold by using broadcast information, higher layer signaling, or dynamic signaling.

20. A first network device, characterized by comprising:

a receiving unit, configured to receive signals of M antenna ports transmitted by a second network device, wherein M is a positive integer; and

a feedback unit, configured to feed back first information of N antenna ports in the M antenna ports according to a first criterion, N being an integer less than or equal to M, and the first criterion being at least one of antenna-related information, an SNR, a channel capacity, throughput, an SU (single user)/MU (multi user) transmission manner, a transmission mode, codebook information, and a packet size.

21. The first network device according to claim 20, wherein the first criterion is antenna-related information; and

the feedback unit is specifically configured to:

perform cell selection based on measured antenna-related information of the M antenna ports, wherein the M antenna ports correspond to at least two cells or two transmission nodes, and each of the cells or transmission nodes corresponds to at least two antenna ports.

22. The first network device according to claim 21, wherein that the feedback unit performs the step of performing cell selection based on measured antenna-related information of the M antenna ports specifically is:

selecting, by the first network device, the N antenna ports based on a comparison result of the measured antenna-related information of the M antenna ports and a first threshold, obtaining the first information of the N antenna ports, and feeding back the first information.

23. The first network device according to claim 20, wherein the first criterion is a signal-to-noise ratio SNR; and

the feedback unit is specifically configured to:

select, from the M antenna ports, N antenna ports that enable an SNR after beamforming or transmit diversity to be less than or equal to or greater than or equal to a second threshold and that have a minimum quantity in antenna port combinations, obtain first information of the N antenna ports, and feed back the first information.

24. The first network device according to claim 20, wherein the first criterion is a channel capacity; and

the feedback unit is specifically configured to:

select, from the M antenna ports, N antenna ports that enable the channel capacity to be less than or equal to or greater than or equal to a third threshold and that have a minimum quantity in antenna port combinations, obtain first information of the N antenna ports, and feed back the first information.

25. The first network device according to claim 20, wherein the first criterion is throughput; and

the feedback unit is specifically configured to:

select, from the M antenna ports, N antenna ports that enable the throughput to be less than or equal to or greater than or equal to a fourth threshold and that have a minimum quantity in antenna port combinations, obtain first information of the N antenna ports, and feed back the first information.

26. The first network device according to claim 20, wherein the first criterion is an SU/MU transmission manner; and

the feedback unit is specifically configured to:

select, from the M antenna ports, a first group of antenna ports with optimal SU transmission, the first group of antenna ports comprising N1 antenna ports, obtain first information of the N1 antenna ports, and feed back the first information; and/or

select, from the M antenna ports, a second group of antenna ports with optimal MU transmission, the second group of antenna ports comprising N2 antenna ports, obtain first information of the N2 antenna ports, and feed back the first information.

27. The first network device according to claim 20, wherein the first criterion is a

transmission mode; and

the feedback unit is specifically configured to:

select, from the M antenna ports, an optimal first group of antenna ports whose transmission mode is transmit diversity transmission, the first group of antenna ports comprising N1 antenna ports, obtain first information of the N1 antenna ports, and feed back the first information; and/or

select, from the M antenna ports, an optimal second group of antenna ports whose transmission mode is beamforming transmission, the first group of antenna ports comprising N2 antenna ports, obtain first information of the N2 antenna ports, and feed back the first information; and/or

select, from the M antenna ports, an optimal third group of antenna ports whose transmission mode is spatial multiplexing transmission, the third group of antenna ports comprising N3 antenna ports, obtain first information of the N3 antenna ports, and feed back the first information.

28. The first network device according to claim 20, wherein the first criterion is codebook information; and

the feedback unit is specifically configured to:

select, from the M antenna ports, N antenna ports that use first codebook information corresponding to the N antenna ports and that have optimal transmission performance, obtain first information of the N antenna ports, and feed back the first information.

29. The first network device according to claim 20, wherein the first criterion is codebook information; and

the feedback unit is specifically configured to:

select, from the M antenna ports, N antenna ports that obtain optimal average information transmission performance through polling of all code words in a first codebook, obtain first information of the N antenna ports, and feed back the first information.

30. The first network device according to claim 20, wherein the first criterion is codebook information; and

the feedback unit is specifically configured to:

select, from the M antenna ports, N antenna ports that obtain optimal best information transmission performance through polling of all code words in a first codebook, obtain first information of the N antenna ports, and feed back the first information.

31. The first network device according to claim 20, wherein the first criterion is packet information; and

the feedback unit is specifically configured to:

select, from the M antenna ports, N antenna ports that transmit first packets with optimal transmission performance, obtain first information of the N antenna ports, and feed back the first information; and/or

select, from the M antenna ports, a minimum quantity of N antenna ports that transmit first packets, obtain first information of the N antenna ports, and feed back the first information; and/or

select, from the M antenna ports, a minimum quantity of N antenna ports that meet a specific performance requirement when transmitting first packets, for example, a minimum quantity of antenna ports with a specific bit error rate, obtain first information of the N antenna ports, and feed back the first information.

32. The first network device according to claims 20 to 31, wherein the first criterion or the first threshold, the second threshold, the third threshold, and the fourth threshold are configured by the second network device by using broadcast information, higher layer signaling, or dynamic signaling.

33. The first network device according to claims 20 to 32, wherein the M antenna ports correspond to X channel state information processes CSI processes, and the N antenna ports correspond to one CSI process in the X CSI processes, wherein X is a positive integer.

34. The method according to claims 20 to 33, wherein the first information comprises antenna-related information, channel state information CSI corresponding to the N antenna ports, or index information of the N antenna ports.

35. A second network device, characterized by comprising:

a transmitting unit, configured to transmit signals of M antenna ports to a first network device, wherein M is a positive integer; and

a receiving unit, configured to receive first information of N antenna ports in the M antenna ports that is fed back by the first network device according to a first criterion, N being an integer less than or equal to M, and the first criterion being at least one of antenna-related information, an SNR, a channel capacity, throughput, an SU (single user)/MU (multi user) transmission manner, a transmission mode, codebook information, and a packet size.

36. The second network device according to claim 35, wherein the first information comprises antenna-related information; and

the second network device further comprises:

a determining unit, configured to determine the N antenna ports as selected antenna ports based on the antenna-related information.

37. The second network device according to claim 35, wherein the first information comprises channel state information CSI corresponding to the N antenna ports or index information of the N antenna ports.

38. The second network device according to any one of claims 35 to 37, wherein the transmitting unit is further configured to configure the first criterion, a first threshold, a second threshold, a third threshold, and a fourth threshold by using broadcast information, higher layer signaling, or dynamic signaling.

39. A first network device, characterized by comprising: a receiver and a transmitter, wherein

the receiver is configured to receive signals of M antenna ports transmitted by a second network device, wherein M is a positive integer; and

the transmitter is configured to feed back first information of N antenna ports in the M antenna ports according to a first criterion, N being an integer less than or equal to M, and the first criterion being at least one of antenna-related information, an SNR, a channel capacity, throughput, an SU (single user)/MU (multi user) transmission manner, a transmission mode, codebook information, and a packet size.

40. The first network device according to claim 39, wherein the first criterion is antenna-related information; and

that the transmitter performs the step of feeding back first information of N antenna ports in the M antenna ports according to a first criterion specifically is:

performing cell selection based on measured antenna-related information of the M antenna ports, wherein the M antenna ports correspond to at least two cells or two transmission nodes, and each of the cells or transmission nodes corresponds to at least two antenna ports.

41. The first network device according to claim 40, wherein that the transmitter performs the step of performing cell selection based on measured antenna-related information of the M antenna ports specifically is:

selecting, by the first network device, the N antenna ports based on a comparison result of the measured antenna-related information of the M antenna ports and a first threshold, obtaining the first information of the N antenna ports, and feeding back the first information.

42. The first network device according to claim 39, wherein the first criterion is a signal-to-noise ratio SNR; and

that the transmitter performs the step of feeding back first information of N antenna ports in the M antenna ports according to a first criterion specifically is:

selecting, from the M antenna ports, N antenna ports that enable an SNR after beamforming or transmit diversity to be less than or equal to or greater than or equal to a second threshold and that have a minimum quantity in antenna port combinations, obtaining first information of the N antenna ports, and feeding back the first information.

43. The first network device according to claim 39, wherein the first criterion is a channel capacity; and

that the transmitter performs the step of feeding back first information of N antenna ports in the M antenna ports according to a first criterion specifically is:

selecting, from the M antenna ports, N antenna ports that enable the channel capacity to be less than or equal to or greater than or equal to a third threshold and that have a minimum quantity in antenna port combinations, obtaining first information of the N antenna ports, and feeding back the first information.

44. The first network device according to claim 39, wherein the first criterion is throughput; and

that the transmitter performs the step of feeding back first information of N antenna ports in the M antenna ports according to a first criterion specifically is:

selecting, by the first network device from the M antenna ports, N antenna ports that enable the throughput to be less than or equal to or greater than or equal to a fourth threshold and that have a minimum quantity in antenna port combinations, obtaining first information of the N antenna ports, and feeding back the first information.

45. The first network device according to claim 39, wherein the first criterion is an SU/MU transmission manner; and

that the transmitter performs the step of feeding back first information of N antenna ports in the M antenna ports according to a first criterion specifically is:

selecting, from the M antenna ports, a first group of antenna ports with optimal SU transmission, the first group of antenna ports comprising N1 antenna ports, obtaining first information of the N1 antenna ports, and feeding back the first information; and/or selecting, from the M antenna ports, a second group of antenna ports with optimal MU transmission, the second group of antenna ports comprising N2 antenna ports, obtaining first information of the N2 antenna ports, and feeding back the first information.

46. The first network device according to claim 39, wherein the first criterion is a transmission mode; and

that the transmitter performs the step of feeding back first information of N antenna ports in the M antenna ports according to a first criterion specifically is:

selecting, from the M antenna ports, an optimal first group of antenna ports whose transmission mode is transmit diversity transmission, the first group of antenna ports comprising N1 antenna ports, obtaining first information of the N1 antenna ports, and feeding back the first information; and/or

selecting, from the M antenna ports, an optimal second group of antenna ports whose transmission mode is beamforming transmission, the first group of antenna ports comprising N2 antenna ports, obtaining first information of the N2 antenna ports, and feeding back the first information; and/or

selecting, from the M antenna ports, an optimal third group of antenna ports whose transmission mode is spatial multiplexing transmission, the third group of antenna ports comprising N3 antenna ports, obtaining first information of the N3 antenna ports, and feeding back the first information.

47. The first network device according to claim 39, wherein the first criterion is codebook information; and

that the transmitter performs the step of feeding back first information of N antenna ports in the M antenna ports according to a first criterion specifically is:

selecting, from the M antenna ports, N antenna ports that use first codebook information corresponding to the N antenna ports and that have optimal transmission performance, obtaining first information of the N antenna ports, and feeding back the first information.

48. The first network device according to claim 39, wherein the first criterion is codebook information; and

that the transmitter performs the step of feeding back first information of N antenna ports in the M antenna ports according to a first criterion specifically is:

selecting, from the M antenna ports, N antenna ports that obtain optimal average information transmission performance through polling of all code words in a first codebook, obtaining first information of the N antenna ports, and feeding back the first information.

49. The first network device according to claim 39, wherein the first criterion is codebook information; and

that the transmitter performs the step of feeding back first information of N antenna ports in the M antenna ports according to a first criterion specifically is:

selecting, from the M antenna ports, N antenna ports that obtain optimal best information transmission performance through polling of all code words in a first codebook, obtaining first information of the N antenna ports, and feeding back the first information.

50. The first network device according to claim 39, wherein the first criterion is packet information; and

that the transmitter performs the step of feeding back first information of N antenna ports in the M antenna ports according to a first criterion specifically is:

selecting, from the M antenna ports, N antenna ports that transmit first packets with optimal transmission performance, obtaining first information of the N antenna ports, and feeding back the first information; and/or

selecting, from the M antenna ports, a minimum quantity of N antenna ports that transmit first packets, obtaining first information of the N antenna ports, and feeding back the first information; and/or

selecting, from the M antenna ports, a minimum quantity of N antenna ports that meet a specific performance requirement when transmitting first packets, for example, a minimum quantity of antenna ports with a specific bit error rate, obtaining first information of the N antenna ports, and feeding back the first information.

51. The first network device according to claims 39 to 50, wherein the first criterion or the first threshold, the second threshold, the third threshold, and the fourth threshold are configured by the second network device by using broadcast information, higher layer signaling, or dynamic signaling.

52. The first network device according to claims 39 to 51, wherein the M antenna ports correspond to X channel state information processes CSI processes, and the N antenna ports correspond to one CSI process in the X CSI processes, wherein X is a positive

integer.

53. The first network device according to claims 39 to 52, wherein the first information comprises antenna-related information, channel state information CSI corresponding to the N antenna ports, or index information of the N antenna ports.

54. A second network device, characterized by comprising: a transmitter and a receiver, wherein

the transmitter is configured to transmit signals of M antenna ports to a first network device, wherein M is a positive integer; and

the receiver is configured to receive first information of N antenna ports in the M antenna ports that is fed back by the first network device according to a first criterion, N being an integer less than or equal to M, and the first criterion being at least one of antenna-related information, an SNR, a channel capacity, throughput, an SU (single user)/MU (multi user) transmission manner, a transmission mode, codebook information, and a packet size.

55. The second network device according to claim 54, wherein the first information comprises antenna-related information; and

the second network device further comprises: a controller, wherein

the controller is configured to determine the N antenna ports as selected antenna ports based on the antenna-related information.

56. The second network device according to claim 54, wherein the first information comprises channel state information CSI corresponding to the N antenna ports or index information of the N antenna ports.

57. The second network device according to any one of claims 54 to 56, wherein the transmitter is further configured to configure the first criterion, a first threshold, a second threshold, a third threshold, and a fourth threshold by using broadcast information, higher layer signaling, or dynamic signaling.

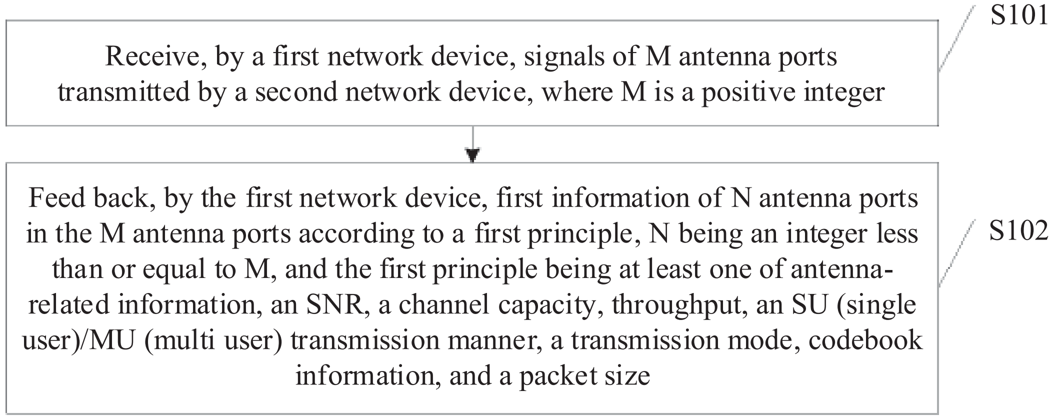
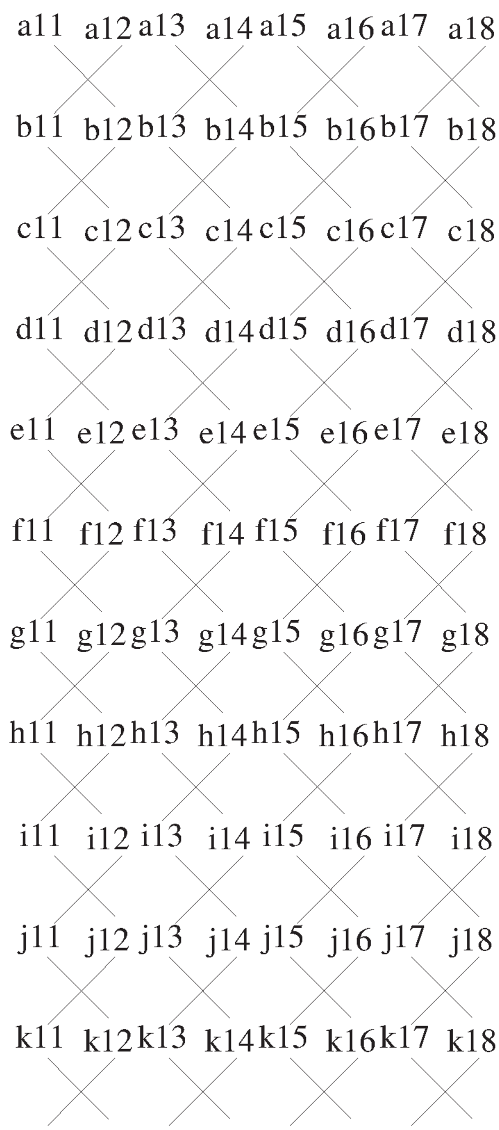

S101
Receive, by a first network device, signals of M antenna ports transmitted by a second network device, where M is a positive integer
S102
Feed back, by the first network device, first information of N antenna ports in the M antenna ports according to a first principle, N being an integer less than or equal to M, and the first principle being at least one of antenna-related information, an SNR, a channel capacity, throughput, an SU (single user)/MU (multi user) transmission manner, a transmission mode, codebook information, and a packet size

FIG. 1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b11 b12 b13 b14 b15 b16 b17 b18
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d11 d12 d13 d14 d15 d16 d17 d18
e11 e12 e13 e14 e15 e16 e17 e18
f11 f12 f13 f14 f15 f16 f17 f18
g11 g12 g13 g14 g15 g16 g17 g18
h11 h12 h13 h14 h15 h16 h17 h18
i11 i12 i13 i14 i15 i16 i17 i18
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k11 k12 k13 k14 k15 k16 k17 k18

FIG. 2

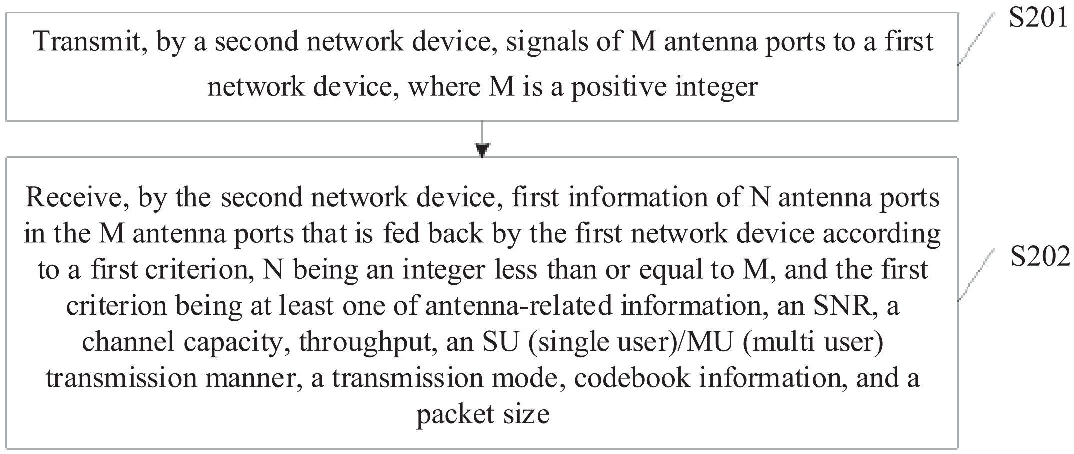

FIG. 3

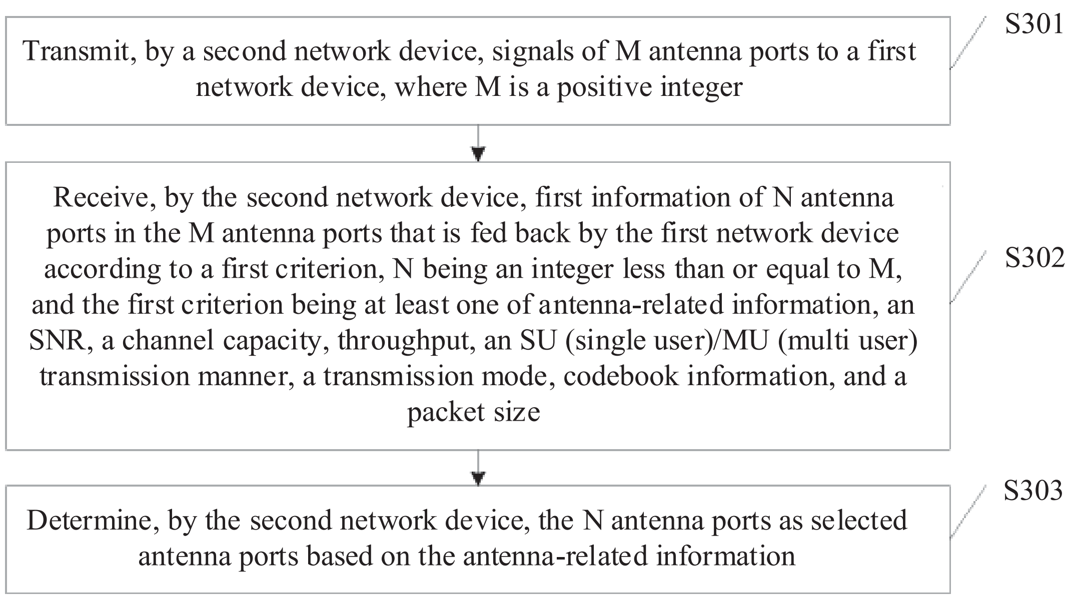

FIG. 4

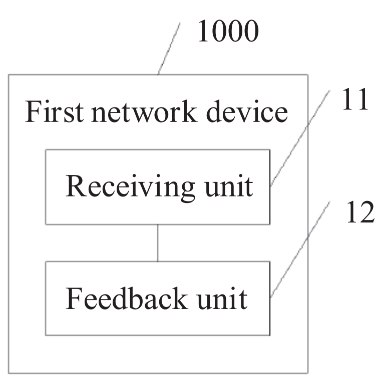

FIG. 5

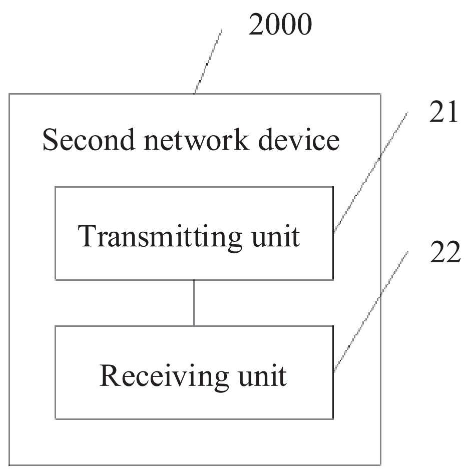

FIG. 6

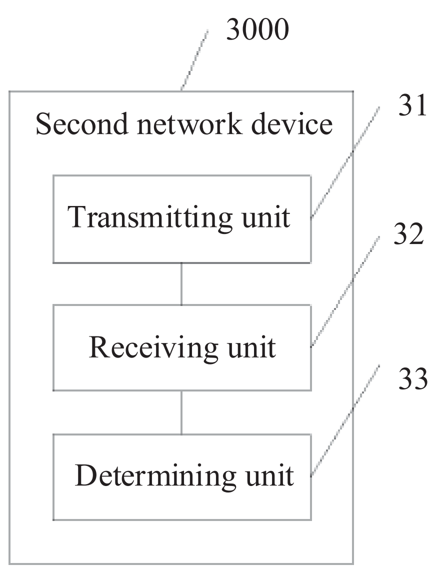

FIG. 7

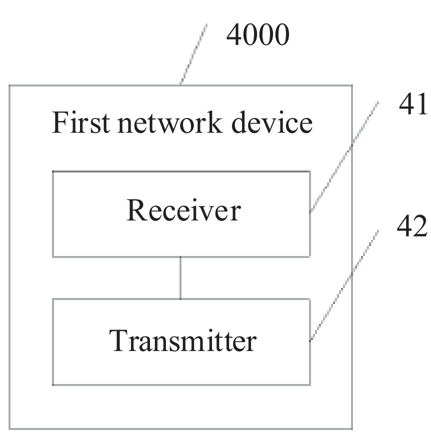

FIG. 8

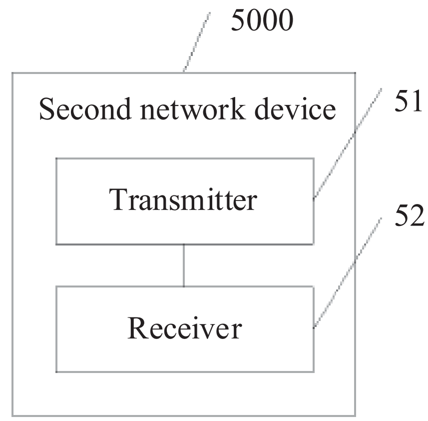
5000
Second network device
51
Transmitter
52
Receiver

FIG. 9

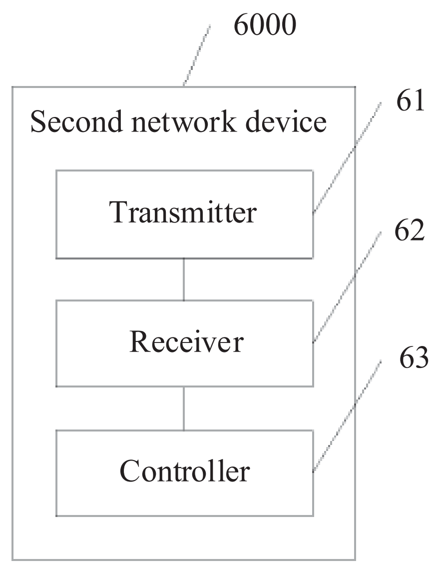
6000
Second network device
61
Transmitter
62
Receiver
63
Controller

FIG. 10

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2014/083479

A. CLASSIFICATION OF SUBJECT MATTER

H04B 7/06 (2006.01) i; H04B 7/08 (2006.01) 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)

H04B; H04W; H04Q

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: confirm, port, Signal-to-Noise, SNR, codebook, antenna, feedback, feed back, throughput, select+, determin+, capability, group, data packet, mode, way, relate

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 1918817 A (LG ELECTRONICS INC.) 21 February 2007 (21.02.2007) description, page 14, the second paragraph to page 15, the second paragraph, and figures 4-6	1-57
A	CN 101015137 A (SAMSUNG ELECTRONICS CO., LTD. et al.) 08 August 2007 (08.08.2007) the whole document	1-57
A	CN 101359952 A (HUAWEI TECHNOLOGIES CO., LTD.) 04 February 2009 (04.02.2009) the whole document	1-57
A	CN 101013917 A (ZTE CORP.) 08 August 2007 (08.08.2007) the whole document	1-57

☐ 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	Date of mailing of the international search report
08 April 2015	06 May 2015

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2014/08 3479

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
CN 1918817 A	21 February 2007	US 2005195912 A1	08 September 2005
		CN 101764633 A	30 June 2010
		KR 20050081239 A	18 August 2005
		WO 2005076758 A2	25 August 2005
		KR 20060005826 A	18 January 2006
		US 2010185777 A1	22 July 2010
		AT 532275 T	15 November 2011
		EP 1719265 A2	08 November 2006
CN 101015137 A	08 August 2007	KR 20060005683 A	18 January 2006
		US 2006039494 A1	23 February 2006
		EP 1759470 A1	07 March 2007
		JP 2008506330 A	28 February 2008
		WO 2006006826 A1	19 January 2006
CN 101359952 A	04 February 2009	None	
CN 101013917 A	08 August 2007	None	

Form PCT/ISA/210 (patent family annex) (July 2009)