

(12) International Application Published According to the Patent Cooperation Treaty

(19) World Intellectual Property
Organization

International Office



(43) International Publication Date

February 4, 2016 (02-04-2016)

(10) International Publication No.

WIPO | PCT

WO 2016/015307 A1

(51) International Patent Classification:

H04B 7/06 (01-2006) *H04B 7/08* (01-2006)

(21) International Application No.: PCT/
CN2014/083479

(22) International Filing Date: July 31, 2014 (07-31-2014)

(25) Filing Language: Chinese

(26) Publication Language: Chinese

(71) Applicant: **Huawei Technologies Co., Ltd.**
[CN/CN] Huawei Administration Building,
Bantian, Longgang District, Shenzhen, Guangdong
518129 (CN)

(72) Inventors: **LIU Kunpeng**; Huawei
Administration Building, Bantian, Longgang
District, Shenzhen, Guangdong, China 518129
(CN). **ZHANG Leiming**; Huawei Administration
Building, Bantian, Longgang District, Shenzhen,
Guangdong, China 518129 (CN). **LIU Jianghua**;
Huawei Administration Building, Bantian,
Longgang District, Shenzhen, Guangdong, China
518129 (CN).

(74) Agent: Guangzhou Scihead Patent Agent Co.,
Ltd.; Room 1508, Huihua Business and Trade
Building, No. 80, Xianlie Middle Road, Yueshi
District, Guangzhou, Guangdong, China 510070
(CN).

(81) Designated States (except where otherwise
indicated, every available state protection is
requested): AE, AG, AL, AM, AO, AT, AU, AZ,
BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH,
CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ,
EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT,
HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN,
KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY,
MA, MD, ME, MG, MK, MN, MW, MX, MY,
MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH,
PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE,
SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN,
TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM,
ZW.

(84) Designated States (except where otherwise
indicated, every available regional protection is
requested) ARIPO (BW, GH, GM, KE, LR, LS,
MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM,
ZW), Eurasia (AM, AZ, BY, KG, KZ, RU, TJ,
TM), Europe (AL, AT, BE, BG, CH, CY, CZ, DE,
DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT,
LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO,

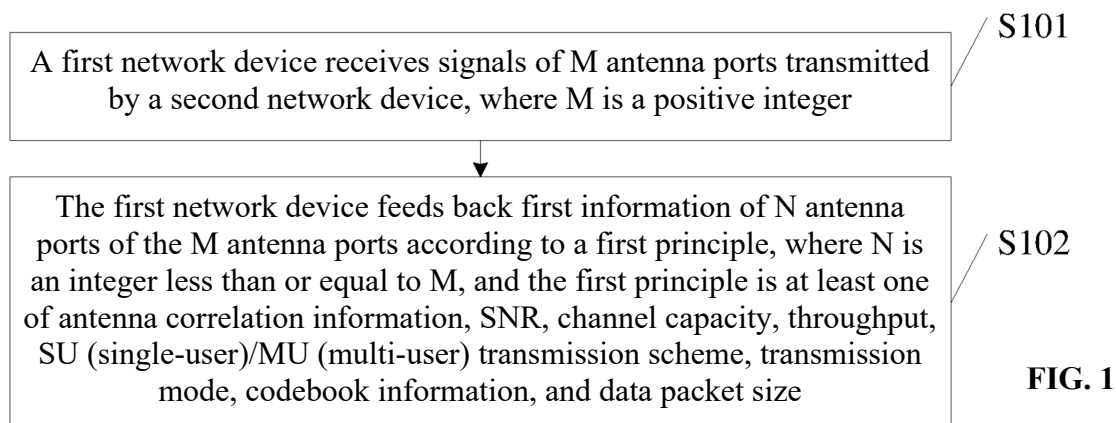
[See next page]

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

(54) Title of Invention: Signal Transmission Method and Associated Device



WO 2016/015307 A1



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)/MU (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 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)/MU (multi-user) 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.

(57) Abstract: A signal transmission method and an associated device. The method comprises: a first network device receiving signals of M antenna ports transmitted by a second network device, where M is a positive integer; and the first network device feeding back first information of N antenna ports of the M antenna ports according to a first criterion, where N is an integer less than or equal to M, and the first criterion is at least one of antenna correlation information, SNR, channel capacity, throughput, SU (single-user)/MU (multi-user) transmission scheme, transmission mode, codebook information, and data packet size. Embodiments of the present invention perform optimal antenna configuration according to at least one of antenna correlation information, SNR, channel capacity, throughput, single-user/multi-user transmission scheme, transmission mode, codebook information, or data packet size and carry out more effective antenna selection.

WO 2016/015307 A1



RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

This International Publication:

— includes international search report (Treaty, Article 21(3)).

Signal Transmission Method and Associated Device

Field of the Invention

The present invention relates to the field of telecommunications technology and in particular to a signal transmission method and an associated device.

Background of the Invention

By merging transmit beamforming (BF)/precoding with reception, multiple-input multiple-output (MIMO) wireless systems can attain diversity and array gain. The typical system using BF or precoding generally may be expressed as:

$$\mathbf{y} = \mathbf{H}\mathbf{V}\mathbf{s} + \mathbf{n}$$

where $\mathbf{y}$ is the receive signal vector, $\mathbf{H}$ is the channel matrix, $\mathbf{V}$ is the precoding matrix, $\mathbf{s}$ is the transmitted symbol vector, and $\mathbf{n}$ is the noise vector. Optimal precoding generally requires that the transmitter have full knowledge of the channel state information (CSI). A common method involves the user equipment quantifying instantaneous CSI and feeding it back to base station equipment. CSI information that is fed back by existing LTE R8 systems includes rank indicator (RI), precoding matrix indicator (PMI), and channel quality indicator (CQI), wherein RI and PMI indicate the number of layers and the precoding matrix, respectively, that are used.

To further increase cell user total throughput rates and mean throughput rates, three-dimensional (3D) multi-antenna technologies, such as dynamic 3D beamforming technology, are now used. However, in current cellular systems, base station transmitter beams can only be adjusted in the horizontal dimension, while, in the vertical dimension, every user has a fixed downtilt angle; thus, each beamforming/precoding technology is based on horizontal channel information. In fact, because the channels are 3D, the fixed downtilt angle method often fails to achieve optimal system throughput. Therefore, it is possible to use different drive networks among 3D antennas to form antenna ports corresponding to different downtilt angles; that is, the antenna patterns of different antenna ports differ. At the same time, as high-frequency technology progresses, massive MIMO technology will be introduced; massive MIMO employs antennas on a large scale, and the channel characteristics between different antennas will not be entirely the same.

In summary, 3D multi-antenna or massive MIMO technology requires a more effective antenna selection method.

Summary of the Invention

An embodiment of the present invention provides a signal transmission method and an associated device for performing more effective antenna selection.

A first aspect provides a signal transmission method comprising:

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

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

In a first possible implementation, the first criterion is antenna correlation information; and

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

the first network device performing cell selection according to antenna correlation information of the M antenna ports after they have been measured, 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.

In a second possible implementation in conjunction with the first possible implementation of the first aspect, the first network device performing cell selection according to antenna correlation information of the M antenna ports after they have been measured specifically is:

the first network device selecting the N antenna ports according to the results of comparing antenna correlation information of the measured M antenna ports to a first threshold value, obtaining first information of the N antenna ports, and providing feedback.

In a third possible implementation in conjunction with the first aspect, the first criterion is signal-to-noise ratio (SNR); and

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

the first network device selecting N antenna ports from among M antenna ports, where N is the smallest number of antenna ports, among antenna port combinations, that causes SNR to be less than or equal to or greater than or equal to a second threshold value after beamforming or transmit diversity, obtaining first information of the N antenna ports, and providing feedback.

In a fourth possible implementation in conjunction with the first aspect, the first criterion is channel capacity; and

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

the first network device selecting N antenna ports from among M antenna ports, where N is the smallest number of antenna ports, among antenna port combinations, that causes channel capacity to be less than or equal to or greater than or equal to a third threshold value, obtaining

first information of the N antenna ports, and providing feedback.

In a fifth possible implementation in conjunction with the first aspect, the first criterion is throughput; and

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

the first network device selecting N antenna ports from among M antenna ports, where N is the smallest number of antenna ports, among antenna port combinations, that causes throughput to be less than or equal to or greater than or equal to a fourth threshold value, obtaining first information of the N antenna ports, and providing feedback.

In a sixth possible implementation in conjunction with the first aspect, the first criterion is SU/MU transmission scheme; and

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

the first network device selecting from among M antenna ports a first group of antenna ports having optimal SU transmission, wherein the first group of antenna ports contains N1 antenna ports, obtaining first information of the N1 antenna ports, and providing feedback; and/or

the first network device selecting from among M antenna ports a second group of antenna ports having optimal MU transmission, wherein the second group of antenna ports contains N2 antenna ports, obtaining first information of the N2 antenna ports, and providing feedback.

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

the first network device selecting from among M antenna ports a first group of antenna ports whereby the transmission mode is optimal for transmit diversity transmission, wherein the first group of antenna ports contains N1 antenna ports, obtaining first information of the N1 antenna ports, and providing feedback; and/or

the first network device selecting from among M antenna ports a second group of antenna ports whereby the transmission mode is optimal for beamforming transmission, wherein the first group of antenna ports contains N2 antenna ports, obtaining first information of the N2 antenna ports, and providing feedback; and/or

the first network device selecting from among M antenna ports a third group of antenna ports whereby the transmission mode is optimal for spatial multiplexing transmission, wherein the third group of antenna ports contains N3 antenna ports, obtaining first information of the N3 antenna ports, and providing feedback.

In an eighth possible implementation in conjunction with the first aspect, the first criterion is codebook information; and

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

the first network device selecting from among M antenna ports the N antenna ports having optimal transmission performance as determined using the corresponding first codebook information, obtaining first information of the N antenna ports, and providing feedback.

In a ninth possible implementation in conjunction with the first aspect, the first criterion is codebook information; and

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

the first network device selecting from among M antenna ports the N antenna ports whereby polling all the code words in first codebooks results in optimal average information transmission performance, obtaining first information of the N antenna ports, and providing feedback.

In a tenth possible implementation in conjunction with the first aspect, the first criterion is codebook information; and

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

the first network device selecting from among M antenna ports the N antenna ports whereby polling all the code words in first codebooks results in optimal best information transmission performance, obtaining first information of the N antenna ports, and providing feedback.

In an eleventh possible implementation in conjunction with the first aspect, the first criterion is data packet information; and

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

the first network device selecting from among M antenna ports the N antenna ports whereby transmission of first data packets has optimal transmission performance, obtaining first information of the N antenna ports, and providing feedback; and/or

the first network device selecting from among M antenna ports the N antenna ports whereby the smallest number of first data packets are transmitted, obtaining first information of the N antenna ports, and providing feedback; and/or

the first network device selecting N antenna ports from among M antenna ports, where N is the smallest number whereby transmission of first data packets meets a certain performance requirement, obtaining first information of the N antenna ports, and providing feedback.

In a twelfth possible implementation in conjunction with the first aspect or a first possible implementation of the first aspect or a second possible implementation of the first aspect or a third possible implementation of the first aspect or a fourth possible implementation of the first aspect or a fifth possible implementation of the first aspect or a sixth possible implementation of the first aspect or a seventh possible implementation of the first aspect or an eighth possible implementation of the first aspect

or a ninth possible implementation of the first aspect or a tenth possible implementation of the first aspect or an eleventh possible implementation of the first aspect, the second network device configures the first criterion or the first threshold value, second threshold value, third threshold value, and fourth threshold value by broadcasting information, high-layer signaling, or dynamic signaling.

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

In a fourteenth possible implementation in conjunction with the first aspect or a first possible implementation of the first aspect or a second possible implementation of the first aspect or a third possible implementation of the first aspect or a fourth possible implementation of the first aspect or a fifth possible implementation of the first aspect or a sixth possible implementation of the first aspect or a seventh possible implementation of the first aspect or an eighth possible implementation of the first aspect or a ninth possible implementation of the first aspect or a tenth possible implementation of the first aspect or an eleventh possible implementation of the first aspect or a twelfth possible implementation of the first aspect or a thirteenth possible implementation of the first aspect, the first information comprises antenna correlation information or channel state information (CSI) corresponding to the N antenna ports or index information of the N antenna ports.

A second aspect provides a signal transmission method comprising:

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

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

size.

In a first possible implementation, the first information comprises antenna correlation information; and

the method further comprises:

the second network device determining that the N antenna ports are the selected antenna ports according to the antenna correlation information.

In a second possible implementation in conjunction with the second aspect, the first information comprises channel state information (CSI) corresponding to the N antenna ports or index information of the N antenna ports.

In a third possible implementation in conjunction with the second aspect or the first possible implementation of the second aspect or the second possible implementation of the second aspect, the second network device configures the first criterion, first threshold value, second threshold value, third threshold value, or fourth threshold value by broadcasting information, high-layer signaling, or dynamic signaling.

A third aspect provides a first network device comprising:

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

a feedback unit, which is for feeding back first information of N antenna ports of the M antenna ports according to a first criterion, where N is an integer less than or equal to M, and the first criterion is at least one of antenna correlation information, SNR, channel capacity, throughput, SU (single-user)/MU (multi-user) transmission scheme, transmission mode, codebook information, and data packet size.

In a first possible implementation, the first criterion is antenna correlation information; and

the feedback unit is specifically for:

performing cell selection according to antenna correlation information of the M antenna ports after they have been measured, 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.

In a second possible implementation in conjunction with the first possible implementation of the third aspect, the feedback unit executes the step of performing cell selection according to antenna correlation information of the M antenna ports after they have been measured; specifically:

the first network device selecting the N antenna ports according to the results of comparing antenna correlation information of the measured M antenna ports having a first threshold value, obtaining first information of the N antenna ports, and providing feedback.

In a third possible implementation in conjunction with the third aspect, the first criterion is signal-to-noise ratio (SNR); and

the feedback unit is specifically for:

selecting N antenna ports from among M antenna ports, where N is the smallest number of antenna ports, among antenna port combinations, that causes SNR to be less than or equal to or greater than or equal to a second threshold value after beamforming or transmit diversity, obtaining first information of the N antenna ports, and providing feedback.

In a fourth possible implementation in conjunction with the third aspect, the first criterion is channel capacity; and

the feedback unit is specifically for:

selecting N antenna ports from among M antenna ports, where N is the smallest number of antenna ports, among antenna port combinations, that causes channel capacity to be less than or equal to or greater than or equal to a third threshold value, obtaining first information of the N antenna ports, and providing feedback.

In a fifth possible implementation in conjunction with the third aspect, the first criterion is throughput; and

the feedback unit is specifically for:

selecting N antenna ports from among M antenna ports, where N is the smallest number of antenna ports, among antenna port combinations, that causes throughput to be less than or equal to or greater than or equal to a fourth threshold value, obtaining first information of the N antenna ports, and providing feedback.

In a sixth possible implementation in conjunction with the third aspect, the first criterion is SU/MU transmission scheme; and

the feedback unit is specifically for:

selecting from among M antenna ports a first group of antenna ports having optimal SU transmission, wherein the first group of antenna ports contains N1 antenna ports, obtaining first information of the N1 antenna ports, and providing feedback; and/or

selecting from among M antenna ports a second group of antenna ports having optimal MU transmission, wherein the second group of antenna ports contains N2 antenna ports, obtaining first information of the N2 antenna ports, and providing feedback.

In a seventh possible implementation in conjunction with the third aspect, the first criterion is transmission mode; and

the feedback unit is specifically for:

selecting from among M antenna ports a first group of antenna ports whereby the transmission mode is optimal for transmit diversity transmission, wherein the first group of antenna ports contains N1 antenna ports, obtaining first information of the N1 antenna ports, and providing feedback; and/or

selecting from among M antenna ports a second group of antenna ports whereby the transmission mode is optimal for beamforming transmission,

wherein the first group of antenna ports contains N_2 antenna ports, obtaining first information of the N_2 antenna ports, and providing feedback; and/or

selecting from among M antenna ports a third group of antenna ports whereby the transmission mode is optimal for spatial multiplexing transmission, wherein the third group of antenna ports contains N_3 antenna ports, obtaining first information of the N_3 antenna ports, and providing feedback.

In an eighth possible implementation in conjunction with the third aspect, the first criterion is codebook information; and

the feedback unit is specifically for:

selecting from among M antenna ports the N antenna ports having optimal transmission performance as determined using the corresponding first codebook information, obtaining first information of the N antenna ports, and providing feedback.

In a ninth possible implementation in conjunction with the third aspect, the first criterion is codebook information; and

the feedback unit is specifically for:

selecting from among M antenna ports the N antenna ports whereby polling all the code words in first codebooks results in optimal average information transmission performance, obtaining first information of the N antenna ports, and providing feedback.

In a tenth possible implementation in conjunction with the third aspect, the first criterion is codebook information; and

the feedback unit is specifically for:

selecting from among M antenna ports the N antenna ports whereby polling all the code words in first codebooks results in optimal best information transmission performance, obtaining first information of the N antenna ports, and providing feedback.

In an eleventh possible implementation in conjunction with the third aspect, the first criterion is data packet information; and

the feedback unit is specifically for:

selecting from among M antenna ports the N antenna ports whereby transmission of first data packets has optimal transmission performance, obtaining first information of the N antenna ports, and providing feedback; and/or

selecting from among M antenna ports the N antenna ports whereby the smallest number of first data packets are transmitted, obtaining first information of the N antenna ports, and providing feedback; and/or

the first network device selecting N antenna ports from among M antenna ports, where N is the smallest number whereby transmission of first data packets meets a certain performance requirement, obtaining first information of the N antenna ports, and providing feedback.

In a twelfth possible implementation in conjunction with the third aspect or a first possible implementation of the third aspect or a second possible implementation of the third aspect or a third possible implementation of the third aspect or a fourth possible implementation of the third aspect or a fifth possible implementation of the third aspect or a sixth possible implementation of the third aspect or

a seventh possible implementation of the third aspect or an eighth possible implementation of the third aspect or a ninth possible implementation of the third aspect or a tenth possible implementation of the third aspect or an eleventh possible implementation of the third aspect, the second network device configures the first criterion or the first threshold value, second threshold value, third threshold value, and fourth threshold value by broadcasting information, high-layer signaling, or dynamic signaling.

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

In a fourteenth possible implementation in conjunction with the third aspect or a first possible implementation of the third aspect or a second possible implementation of the third aspect or a third possible implementation of the third aspect or a fourth possible implementation of the third aspect or a fifth possible implementation of the third aspect or a sixth possible implementation of the third aspect or a seventh possible implementation of the third aspect or an eighth possible implementation of the third aspect or a ninth possible implementation of the third aspect or a tenth possible implementation of the third aspect or an eleventh possible implementation of the third aspect or a twelfth possible implementation of the third aspect or a thirteenth possible implementation of the third aspect, the first information comprises antenna correlation information or channel state information (CSI) corresponding to the N antenna ports or index information of the N antenna ports.

A fourth aspect provides a second network device comprising:

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

a receiving unit, which is for receiving first information of N antenna ports of the M antenna ports fed back by the first network device according to a first criterion, where N is an integer less than or equal to M, and the first criterion is at least one of antenna correlation information, SNR, channel capacity, throughput, SU (single-user)/MU

(multi-user) transmission scheme, transmission mode, codebook information, and data packet size.

In a first possible implementation, the first information comprises antenna correlation information; and

the second network device further comprises:

a determining unit, which is for determining that the N antenna ports are the selected antenna ports according to the antenna correlation information.

In a second possible implementation in conjunction with the fourth aspect, the first information comprises channel state information (CSI) corresponding to the N antenna ports or index information of the N antenna ports.

In a fifth possible implementation in conjunction with the fourth aspect or the first possible implementation of the fourth aspect or the second possible implementation of the fourth aspect, the transmitting unit is further for configuring the first criterion, first threshold value, second threshold value, third threshold value, or fourth threshold value by broadcasting information, high-layer signaling, or dynamic signaling.

A fifth aspect provides a first network device comprising: a receiver and a transmitter; wherein the receiver is for receiving signals of M antenna ports transmitted by a second network device, where M is a positive integer; and

the transmitter is for feeding back first information of N antenna ports of the M antenna ports according to a first criterion, where N is an integer less than or equal to M, and the first criterion is at least one of antenna correlation information, SNR, channel capacity, throughput, SU (single-user)/MU (multi-user) transmission scheme, transmission mode, codebook information, and data packet size.

In a first possible implementation, the first criterion is antenna correlation information; and

the transmitter executes the step of feeding back first information of N antenna ports of the M antenna ports according to the first criterion; specifically:

performing cell selection according to antenna correlation information of the M antenna ports after they have been measured, 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.

In a second possible implementation in conjunction with the first possible implementation of the fifth aspect, the transmitter executes the step of performing cell selection according to antenna correlation information of the M antenna ports after they have been measured; specifically:

the first network device selecting the N antenna ports according to the results of comparing antenna correlation information of the measured M antenna ports having first

threshold value, obtaining first information of the N antenna ports, and providing feedback.

In a third possible implementation in conjunction with the fifth aspect, the first criterion is signal-to-noise ratio (SNR); and

the transmitter executes the step of feeding back first information of N antenna ports of the M antenna ports according to the first criterion; specifically:

selecting N antenna ports from among M antenna ports, where N is the smallest number of antenna ports, among antenna port combinations, that causes SNR to be less than or equal to or greater than or equal to a second threshold value after beamforming or transmit diversity, obtaining first information of the N antenna ports, and providing feedback.

In a fourth possible implementation in conjunction with the fifth aspect, the first criterion is channel capacity; and

the transmitter executes the step of feeding back first information of N antenna ports of the M antenna ports according to the first criterion; specifically:

selecting N antenna ports from among M antenna ports, where N is the smallest number of antenna ports, among antenna port combinations, that causes channel capacity to be less than or equal to or greater than or equal to a third threshold value, obtaining first information of the N antenna ports, and providing feedback.

In a fifth possible implementation in conjunction with the fifth aspect, the first criterion is throughput; and

the transmitter executes the step of feeding back first information of N antenna ports of the M antenna ports according to the first criterion; specifically:

the first network device selects N antenna ports from among M antenna ports, where N is the smallest number of antenna ports, among antenna port combinations, that causes throughput to be less than or equal to or greater than or equal to a fourth threshold value, obtaining first information of the N antenna ports, and providing feedback.

In a sixth possible implementation in conjunction with the fifth aspect, the first criterion is SU/MU transmission scheme; and

the transmitter executes the step of feeding back first information of N antenna ports of the M antenna ports according to the first criterion; specifically:

selecting from among M antenna ports a first group of antenna ports having optimal SU transmission, wherein the first group of antenna ports contains N1 antenna ports, obtaining first information of the N1 antenna ports, and providing feedback; and/or

selecting from among M antenna ports a second group of antenna ports having optimal MU transmission, wherein the second group of antenna ports contains N2 antenna ports, obtaining first information of the N2 antenna ports, and providing feedback.

In a seventh possible implementation in conjunction with the fifth aspect, the first criterion is transmission mode; and

the transmitter executes the step of feeding back first information of N antenna ports of the M antenna ports according to the first criterion; specifically:

selecting from among M antenna ports a first group of antenna ports whereby the transmission mode is optimal for transmit diversity transmission, wherein the first group of antenna ports contains N1 antenna ports, obtaining first information of the N1 antenna ports, and providing feedback; and/or

selecting from among M antenna ports a second group of antenna ports whereby the transmission mode is optimal for beamforming transmission, wherein the first group of antenna ports contains N2 antenna ports, obtaining first information of the N2 antenna ports, and providing feedback; and/or

selecting from among M antenna ports a third group of antenna ports whereby the transmission mode is optimal for spatial multiplexing transmission, wherein the third group of antenna ports contains N3 antenna ports, obtaining first information of the N3 antenna ports, and providing feedback.

In an eighth possible implementation in conjunction with the fifth aspect, the first criterion is codebook information; and

the transmitter executes the step of feeding back first information of N antenna ports of the M antenna ports according to the first criterion; specifically:

selecting from among M antenna ports the N antenna ports having optimal transmission performance as determined using the corresponding first codebook information, obtaining first information of the N antenna ports, and providing feedback.

In a ninth possible implementation in conjunction with the fifth aspect, the first criterion is codebook information; and

the transmitter executes the step of feeding back first information of N antenna ports of the M antenna ports according to the first criterion; specifically:

selecting from among M antenna ports the N antenna ports whereby polling all the code words in first codebooks results in optimal average information transmission performance, obtaining first information of the N antenna ports, and providing feedback.

In a tenth possible implementation in conjunction with the fifth aspect, the first criterion is codebook information; and

the transmitter executes the step of feeding back first information of N antenna ports of the M antenna ports according to the first criterion; specifically:

selecting from among M antenna ports the N antenna ports whereby polling all the code words in first codebooks results in optimal best information transmission performance, obtaining first information of the N antenna ports, and providing feedback.

In an eleventh possible implementation in conjunction with the fifth aspect, the first criterion is data packet information; and

the transmitter executes the step of feeding back first information of N antenna ports of the M antenna ports according to the first criterion; specifically:

selecting from among M antenna ports the N antenna ports whereby transmission of first data packets has optimal transmission performance, obtaining first information of the N antenna ports, and providing feedback; and/or

selecting from among M antenna ports the N antenna ports whereby the smallest number of first data packets are transmitted, obtaining first information of the N antenna ports, and providing feedback; and/or

selecting N antenna ports from among M antenna ports, where N is the smallest number whereby transmission of first data packets meets a certain performance requirement (e.g., the smallest number N of antenna ports having a certain bit error rate), obtaining first information of the N antenna ports, and providing feedback.

In a twelfth possible implementation in conjunction with the fifth aspect or a first possible implementation of the fifth aspect or a second possible implementation of the fifth aspect or a third possible implementation of the fifth aspect or a fourth possible implementation of the fifth aspect or a fifth possible implementation of the fifth aspect or a sixth possible implementation of the fifth aspect or a seventh possible implementation of the fifth aspect or an eighth possible implementation of the fifth aspect or a ninth possible implementation of the fifth aspect or a tenth possible implementation of the fifth aspect or an eleventh possible implementation of the fifth aspect, the second network device configures the first criterion or the first threshold value, second threshold value, third threshold value, and fourth threshold value by broadcasting information, high-layer signaling, or dynamic signaling.

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

In a fourteenth possible implementation in conjunction with the fifth aspect or a first possible implementation of the fifth aspect or a second possible implementation of the fifth aspect or a third possible implementation of the fifth aspect or a fourth possible implementation of the fifth aspect or a fifth possible implementation of the fifth aspect or a sixth possible implementation of the fifth aspect or a seventh possible implementation of the fifth aspect or an eighth possible implementation of the fifth aspect

or a ninth possible implementation of the fifth aspect or a tenth possible implementation of the fifth aspect or an eleventh possible implementation of the fifth aspect or a twelfth possible implementation of the fifth aspect or a thirteenth possible implementation of the fifth aspect, the first information comprises antenna correlation information or channel state information (CSI) corresponding to the N antenna ports or index information of the N antenna ports.

A sixth aspect provides a network device comprising: a transmitter and a receiver;
wherein the transmitter is for transmitting signals of M antenna ports to a first network device, where M is a positive integer; and
the receiver is for receiving first information of N antenna ports of the M antenna ports fed back by the first network device according to a first criterion, where N is an integer less than or equal to M, and the first criterion is at least one of antenna correlation information, SNR, channel capacity, throughput, SU (single-user)/MU (multi-user) transmission scheme, transmission mode, codebook information, and data packet size.

In a first possible implementation, the first information comprises antenna correlation information;

the second network device further comprises: a controller;
wherein the controller is for determining that the N antenna ports are the selected antenna ports according to the antenna correlation information.

In a second possible implementation in conjunction with the sixth aspect, the first information comprises channel state information (CSI) corresponding to the N antenna ports or index information of the N antenna ports.

In a third possible implementation in conjunction with the sixth aspect or the first possible implementation of the sixth aspect or the second possible implementation of the sixth aspect, the transmitter is further for configuring the first criterion, first threshold value, second threshold value, third threshold value, or fourth threshold value by broadcasting information, high-layer signaling, or dynamic signaling.

Clearly, on the basis of the signal transmission method and associated device provided by an embodiment of the present invention, antennas are configured optimally according to at least one of antenna correlation information, SNR, channel capacity, throughput, single-user/multi-user transmission scheme, transmission mode, codebook information, or data packet size, and antenna selection is carried out more effectively.

Explanation of the Drawings

For a clearer explanation of embodiments of the present invention or technical schemes of the prior art, drawings required by the embodiments are introduced in a simple manner below; obviously, the drawings described below are merely some embodiments of the present invention; a person with ordinary skill in the art would be able to obtain other drawings based on these drawings without expending creative effort.

FIG. 1 is a flowchart of a signal transmission method provided by an embodiment of the present invention;

FIG. 2 is a configuration diagram of multiple antennas in an exemplary active antenna array.

FIG. 3 is a flowchart of another signal transmission method provided by an embodiment of the present invention.

FIG. 4 is a flowchart of yet another signal transmission method provided by an embodiment of the present invention.

FIG. 5 is a structural diagram of a first network device provided by an embodiment of the present invention.

FIG. 6 is a structural diagram of a second network device provided by an embodiment of the present invention.

FIG. 7 is a structural diagram of another second network device provided by an embodiment of the present invention.

FIG. 8 is a structural diagram of another first network device provided by an embodiment of the present invention.

FIG. 9 is a structural diagram of yet another second network device provided by an embodiment of the present invention.

FIG. 10 is a structural diagram of yet another second network device provided by an embodiment of the present invention.

Specific Embodiments

Technical schemes in embodiments of the present invention are described clearly and completely below in light of drawings of embodiments of the present invention; obviously, the described embodiments are merely some embodiments of the present invention and not all the embodiments. All other embodiments obtained by a person with ordinary skill in the art on the basis of embodiments in the present invention without expending creative effort fall within the protective scope of the present invention.

Refer to FIG. 1, which is a flowchart of a signal transmission method provided by an embodiment of the present invention; this method comprises the steps below:

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

During antenna configuration, a second network device transmits configuration information of M antenna ports to a first network device and transmits signals of the M antenna ports to the first network device, which receives the signals of the M antenna ports transmitted by the second network device based on the configuration information, where M is a positive integer; in the present embodiment, the first network device may be user equipment (UE), and the second network device may be a base station; alternatively, the first network device may be user equipment, and the second network device may be user equipment; alternatively, 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 remote radio head (RRH).

The configuration information of the M antenna ports comprises an antenna port pattern, i.e., information such as positions of antenna port time-frequency resources and transmission cycles and powers of antenna port signals.

It is possible that the second network device transmits only one piece of configuration information to the first network device, wherein the configuration information is the configuration information of the M antenna ports; alternatively, that the M antenna ports are divided into multiple groups, and transmission to the first network device takes the form of multiple pieces of configuration information, with each piece of configuration information corresponding to the configuration of one of the antenna port groups.

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

The first network device needs to select N antenna ports from among M antenna ports according to a certain criterion and to notify the second network device of first information of the selected N antenna ports, wherein the first information is channel state information (CSI) corresponding to the N antenna ports or index information corresponding to the N antenna ports; alternatively, first information of the N antenna ports is transmitted to the second network device, which determines the N antenna ports, wherein the first information is antenna correlation information.

Specific implementations are used below to introduce how first information of N antenna ports of M antenna ports is fed back according to each first criterion.

In an implementation, the first criterion is antenna correlation information; and the first network device feeding back first information of N antenna ports of the M antenna ports according to the first criterion specifically is:

the first network device performing cell selection according to antenna correlation information of the M antenna ports after they have been measured, wherein the M antenna ports correspond to at least two cells or two transmission nodes, and each cell or transmission node corresponds to at least two antenna ports.

In the prior art, the only information taken into consideration when performing cell selection is received signal power information, e.g., RSRP, RSSI, and RSRQ; however, in the present embodiment, cell selection also takes into consideration antenna correlation, with the result that users can more comprehensively consider cell or transmission node selection based on their own business matters.

During specific implementation, the first network device performing cell selection according to antenna correlation information of the M antenna ports after they have been measured specifically is:

for example, $M = 10$, corresponding to 5 cells, each cell having 2 antennas, cell 1 corresponding to port0 and port1,

cell 1 corresponding to port2 and port3, cell 1 corresponding to port4 and port5, cell 1 corresponding to port6 and port7, and cell 1 corresponding to port8 and port9;

UE measures the 5 groups of antenna ports corresponding to these 5 cells and discovers that the received signal power is strongest for ports0,1 corresponding to cell 1; for example, $RSRP_1 > RSRP_2 > RSRP_3 > RSRP_4 > RSRP_5$, with $RSRP_1$ representing the received signal power corresponding to cell 1, $RSRP_2$ representing the received signal power corresponding to cell 2, and $RSRP_n$ representing the received signal power corresponding to cell n. However, if we assume that the first criterion is antenna correlation information, and if we require that more antenna correlation information is better, then the antenna correlation coefficient will be defined as Cor; for example, the antenna correlation coefficient Cor1 for cell 1 is the antenna correlation for port0 and port1; it is possible to use channel estimation to obtain the channel coefficient H0 corresponding to port0 and the channel coefficient H1 corresponding to port1 and to calculate Cor1 using the correlation between H0 and H1; for example, the correlation matrix can be

obtained from $H = [H_0 \ H_1]$, $R = H^H H$ or obtained on the basis of $R_{ik} = \frac{1}{2\Delta} \int_{\theta-\Delta}^{\theta+\Delta} \exp[jz(i-k) \sin \beta] d\beta$,

where i and k are the i^{th} and k^{th} antennas, respectively, and Δ is angle spread.

The same method is used to obtain Cor2, Cor3, Cor4, Cor5... Cor n , which represents the antenna correlation coefficient corresponding to cell n.

Moreover, $Cor_2 > Cor_1 > Cor_3 > Cor_4 > Cor_5$; thus, though cell 1 has the strongest received signal power, UE, giving comprehensive consideration to signal power and antenna correlation, ultimately selects cell 2 and stays in cell 2.

The first criterion here is not limited to antenna correlation, but can also be SU/MU, transmission mode, etc.; moreover, the first criterion may be predefined or provided through base station broadcasting or a specific signal notification from UE.

Specifically, the first network device performing cell selection according to antenna correlation information of the M antenna ports after they have been measured specifically is: the first network device selecting the N antenna ports according to the results of comparing antenna correlation information of the measured M antenna ports to a first threshold value, obtaining first information of the N antenna ports, and providing feedback.

That is, a correlation matrix or correlation coefficient of the M antenna ports is compared to a set threshold value, and the N antenna ports for which the correlation matrix or correlation coefficient is greater than or equal to or less than or equal to the set threshold value are selected, and channel state information (CSI) corresponding to the N antenna ports or index information of the N antenna ports is obtained; moreover, the CSI corresponding to these N antenna ports or the index information corresponding to these N antenna ports is provided as a notification to the second network device so as to cause the second network device to transmit data on these N antenna ports to the first network device.

In another implementation, the first criterion is signal-to-noise ratio (SNR); and the first network device feeding back first information of N antenna ports of the M antenna ports according to the first criterion specifically is:

the first network device selecting N antenna ports from among M antenna ports, where N is the smallest number of antenna ports, among antenna port combinations, that causes SNR to be less than or equal to or greater than or equal to a second threshold value after beamforming or transmit diversity, obtaining first information of the N antenna ports, and providing feedback.

For example, the base station configures M antenna ports for UE; as shown in FIG. 2, which is a diagram of multiple antennas in an example of another antenna array, M = 88, and UE traverses all the antenna port combinations from N = 1 to N = 88 among the M ports; for each value of N, the number of combinations to be traversed is c; for example, for N = 4, there are the following combinations: combination 1 is a11, a12, a13, and a14; combination 2 is a12, a13, a14, and a15; combination 3 is a13, a14, a15, and a16; combination 4 is a14, a15, a16, and a17; combination 5 is a15, a16, a17, and a18; combination 6 is b11, b12, b13, b14, ...; for each combination (e.g., combination 1 a11, a12, a13, and a14), UE obtains channel $H_{N,1}$ through a11, a12, a13, and a14 and then traverses all of the precoding matrices W_i to obtain the signal-to-noise ratio:

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

where $H_{N,m}$ represents the m^{th} configuration in combinations of N antenna ports, W_i represents the i^{th} precoding matrix, and σ^2 is noise;

all SNRs in combinations of N ports are traversed to find the maximum; for example, $\max(SNR_{N,m,i}, N = 4, 1 \leq m \leq C^4_M, 1 \leq i \leq X_4) = 5$ dB, where X_4 indicates the number of precoding matrices when N = 4. As for N = 5, traversal is carried out using the same method as described above: $\max(SNR_{N,m,i}, N = 5, 1 \leq m \leq C^5_M, 1 \leq i \leq X_5) = 7$ dB; if the base station notifies UE that the first criterion for antenna selection is the smallest number of antennas where SNR is greater than or equal to 6 dB, then N = 5 is exactly capable of attaining 6 dB and is the smallest number of antennas necessary to achieve 6 dB. Therefore, UE can provide the labels of the antenna combination characterized by N = 5 and 7 dB, e.g., a11, b12, c14, and d11, and the corresponding indices as feedback to the base station. If N > 5 is used, the resulting signal-to-noise ratio will be higher than for N = 5, but some channels only need to meet a certain SNR performance requirement and do not require a larger SNR; the use of more antennas will thus cause the base station to waste transmission power.

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

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

the first network device selecting N antenna ports from among M antenna ports, where N is the smallest number of antenna ports, among antenna port combinations, that causes channel capacity to be less than or equal to or greater than or equal to a third threshold value, obtaining first information of the N antenna ports, and providing feedback.

Because channel capacity $C = B \log_2(1 + \text{SNR})$, the process of selecting antenna ports according to channel capacity in the present implementation is similar to the process of selecting antenna ports according to SNR in the implementation above and will not be discussed further here.

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

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

the first network device selecting N antenna ports from among M antenna ports, where N is the smallest number of antenna ports, among antenna port combinations, that causes throughput to be less than or equal to or greater than or equal to a fourth threshold value, obtaining first information of the N antenna ports, and providing feedback.

Similarly, the process of selecting antenna ports according to throughput in the present implementation is similar to the process of selecting antenna ports according to SNR or channel capacity in the implementations above and will not be discussed further here.

In yet another implementation, the first criterion is SU/MU transmission scheme; and

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

the first network device selecting from among M antenna ports a first group of antenna ports having optimal SU transmission, wherein the first group of antenna ports contains N1 antenna ports, obtaining first information of the N1 antenna ports, and providing feedback; and/or

the first network device selecting from among M antenna ports a second group of antenna ports having optimal MU transmission, wherein the second group of antenna ports contains N2 antenna ports, obtaining first information of the N2 antenna ports, and providing feedback.

In the present implementation, for example, the base station configures UE to select antennas in accordance with the optimal SU transmission scheme; thus, UE traverses all the antennas and selects the antennas in such a manner that UE's own performance becomes optimal;

for example, it selects a11, b13, g15, and h18, and thus the antenna index information for a11, b13, g15, and h18 is reported to the base station.

In another example, the base station configures UE1 to select antennas in accordance with the optimal MU matching scheme; the base station can notify UE1 of user matching information, e.g., information on users UE2 and UE3, which are matched with UE1, including UE2 and UE3 antenna information; UE1 selects the antennas in such a manner that the total performance of all matched users becomes optimal; for example, it selects antennas c13, d12, e11, and f18 and notifies the base station of the corresponding antenna index information.

Information based on the antenna port group that has optimal SU transmission and information based on the antenna port group that has optimal MU transmission can both be provided as feedback. For example, cross-polarized antennas may be selected for SU because such antennas have low correlation, which aids spatial multiplexing; in the case of MU matching, each user optimally should select co-polarized antennas because they facilitate beamforming by each user. The SU in this case is the user alone transmitting its own data packet on a time-frequency resource, and the MU is multiple users transmitting their respective data packets, which can be on the same time-frequency resource through spatial multiplexing.

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

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

the first network device selecting from among M antenna ports a first group of antenna ports whereby the transmission mode is optimal for transmit diversity transmission, wherein the first group of antenna ports contains N1 antenna ports, obtaining first information of the N1 antenna ports, and providing feedback; and/or

the first network device selecting from among M antenna ports a second group of antenna ports whereby the transmission mode is optimal for beamforming transmission, wherein the first group of antenna ports contains N2 antenna ports, obtaining first information of the N2 antenna ports, and providing feedback; and/or

the first network device selecting from among M antenna ports a third group of antenna ports whereby the transmission mode is optimal for spatial multiplexing transmission, wherein the third group of antenna ports contains N3 antenna ports, obtaining first information of the N3 antenna ports, and providing feedback.

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

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

the first network device selecting from among M antenna ports the N antenna ports having optimal transmission performance as determined using the corresponding first codebook information, obtaining first information of the N antenna ports, and providing feedback.

Codebook information refers to information containing multiple precoding matrices;

In yet another implementation, the first criterion is codebook information;

for example, the M antenna ports are divided into X groups, and the base station individually configures one codebook set for each antenna port group. The user equipment calculates the SNR based on the configured codebook set and feeds it back to the base station equipment. For example, the first group of antenna ports corresponds to antenna configuration 1, comprising antenna ports port0 and port1; the base station configures codebook set C1 for antenna configuration 1, and the precoding matrices included in C1 are W_{11} , W_{12} , W_{1n} , ..., W_{1N} ; the second group of antenna ports corresponds to antenna configuration 2, comprising antenna ports port2 and port3; codebook set C2 is configured for antenna configuration 2, and the precoding matrices included in C2 are W_{21} , W_{22} , W_{2n} , ..., W_{2N} ; the third group of antenna ports corresponds to antenna configuration 3, comprising antenna ports port4 and port5; codebook set C3 is configured for antenna configuration 3, and the precoding matrices included in C3 are W_{31} , W_{32} , W_{3n} , ..., W_{3N} ; the fourth group of antenna ports corresponds to antenna configuration 4, comprising antenna ports port6 and port7; codebook set C4 is configured for antenna configuration 4, and the precoding matrices included in C4 are W_{41} , W_{42} , W_{4n} , ..., W_{4N} . Based on the antenna ports corresponding to each antenna configuration, the user equipment provides one optimal rank, PMI(i), and SNR(i) in the corresponding codebook set C_i as feedback; the base station compares each SNR(i) to select the best antenna for the user equipment to configure; alternatively, UE compares each SNR(i) to select a best antenna configuration and feeds its corresponding first information back to the base station; the first information, including antenna indices and/or CSI, are fed back to the base station. For example, UE separately measures four groups of antenna ports, obtains antenna ports port4 and port5 in the third group, and traverses the precoding matrices included in C3, which are W_{31} , W_{32} , W_{3n} , ..., W_{3N} ; the optimal SNR obtained is higher than in the other three groups of antenna ports; therefore, UE provides the indices corresponding to the third antenna port group to the base station. One codebook set is configured for each antenna port group, and the user equipment calculates the SNR based on this codebook set and feeds it back to the base station equipment. For example, the codebook set C1 is configured for antenna configuration 1, the codebook set C2 is configured for antenna configuration 2, the codebook set C3 is configured for antenna configuration 3, and the codebook set C4 is configured for antenna configuration 4. During RRM measurement, the user equipment employs a random beamforming approach in the codebook set C_i corresponding to the pilot frequency of each antenna configuration to calculate and report the mean reference signal receiving power (RSRP) or reference signal receiving quality (RSRQ); for example, the user equipment at the pilot frequency of antenna configuration 1 uses all the codebooks in C1 to conduct random beamforming and obtain RSRP1; for the pilot frequency of antenna configuration 2, all the codebooks in C2 are used

to conduct random beamforming and obtain RSRP2, ...; and UE feeds back the index corresponding to the antenna configuration having the largest RSRP to the base station.

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

the first network device selecting from among M antenna ports the N antenna ports whereby polling all the code words in first codebooks results in optimal average information transmission performance, obtaining first information of the N antenna ports, and providing feedback.

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

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

the first network device selecting from among M antenna ports the N antenna ports whereby polling all the code words in first codebooks results in optimal best information transmission performance, obtaining first information of the N antenna ports, and providing feedback.

In yet another implementation, the first criterion is data packet information, and the data information comprises transport block size and modulation and coding scheme; and

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

the first network device selecting from among M antenna ports the N antenna ports whereby transmission of first data packets has optimal transmission performance, obtaining first information of the N antenna ports, and providing feedback; and/or

the first network device selecting from among M antenna ports the N antenna ports whereby the smallest number of first data packets are transmitted, obtaining first information of the N antenna ports, and providing feedback; and/or

the first network device selecting N antenna ports from among M antenna ports, where N is the smallest number whereby transmission of first data packets meets a certain performance requirement (e.g., the smallest number N of antenna ports having a certain bit error rate), obtaining first information of the N antenna ports, and providing feedback.

It needs to be explained that, in the embodiments above, the second network device configures the first criterion, first threshold value, second threshold value, third threshold value, and fourth threshold value by broadcasting information, high-layer signaling, or dynamic

signaling.

The M antenna ports correspond to X channel state information processing processes (CSI processes), and the N antenna ports correspond to one CSI process among the X CSI processes, where X is a positive integer. Each CSI process corresponds to a certain measurement resource; for example, each CSI process configures a signal measurement resource and an interference measurement resource; UE obtains the CSI based on the signal measurement resource and interference measurement resource and reports it. For example, if M = 20 corresponds to 5 CSI processes, then every 4 antenna ports correspond to 1 CSI process, and N = 4.

Clearly, on the basis of the signal transmission method provided by an embodiment of the present invention, antennas are configured optimally according to at least one of antenna correlation information, SNR, channel capacity, throughput, single-user/multi-user transmission scheme, transmission mode, codebook information, or data packet size, and antenna selection is carried out more effectively.

Refer to FIG. 3, which is a flowchart of another signal transmission method provided by an embodiment of the present invention; the method comprises the steps below:

step S201: a second network device transmits signals of M antenna ports to a first network device, where M is a positive integer.

During antenna configuration, the second network device transmits configuration information of M antenna ports to the first network device and transmits signals of the M antenna ports to the first network device, which receives the signals of the M antenna ports transmitted by the second network device based on the configuration information, where M is a positive integer; in the present embodiment, the first network device may be user equipment (UE), and the second network device may be a base station; alternatively, the first network device may be user equipment, and the second network device may be user equipment; alternatively, 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 remote radio head (RRH).

The configuration information of the M antenna ports comprises an antenna port pattern, i.e., information such as positions of antenna port time-frequency resources and transmission cycles and powers of antenna port signals.

It is possible that the second network device transmits only one piece of configuration information to the first network device and that this configuration information is the configuration information of the M antenna ports; alternatively, that the M antenna ports are divided into multiple groups, and transmission to the first network device takes the form of multiple pieces of configuration information, with each piece of configuration information corresponding to the configuration of one of the antenna port groups.

Step S202: the second network device receives first information of N antenna ports of the M antenna ports fed back by the first network device according to a first criterion, where N is an integer less than or equal to M, and the first criterion is at least one of antenna correlation information, SNR, channel capacity, throughput, SU (single-user)

/MU (multi-user) transmission scheme, transmission mode, codebook information, and data packet size.

The first network device needs to select N antenna ports from among M antenna ports according to a certain criterion and to notify the second network device of first information of the selected N antenna ports, wherein the first information is channel state information (CSI) corresponding to the N antenna ports or index information corresponding to the N antenna ports; alternatively, first information of the N antenna ports is transmitted to the second network device, which determines the N antenna ports, wherein the first information is antenna correlation information.

The second network device configures the first criterion, first threshold value, second threshold value, third threshold value, or fourth threshold value by broadcasting information, high-layer signaling, or dynamic signaling.

Clearly, on the basis of the signal transmission method provided by an embodiment of the present invention, the first network device optimally configures antennas according to at least one of antenna correlation information, SNR, channel capacity, throughput, single-user/multi-user transmission scheme, transmission mode, codebook information, or data packet size, and it feeds back the obtained antenna correlation information or the channel state information (CSI) corresponding to the N antenna ports or the index information of the N antenna ports to the second network device, with the result that the first network device selects antennas more effectively.

Refer to FIG. 4, which is a flowchart of yet another signal transmission method provided by an embodiment of the present invention; the method comprises the steps below:

step S301: a second network device transmits signals of M antenna ports to a first network device, where M is a positive integer; and

step S302: the second network device receives first information of N antenna ports of the M antenna ports fed back by the first network device according to a first criterion, where N is an integer less than or equal to M , and the first criterion is at least one of antenna correlation information, SNR, channel capacity, throughput, SU (single-user)/MU (multi-user) transmission scheme, transmission mode, codebook information, and data packet size; and the first information comprises antenna correlation information.

Step S301 and S302 are the same as steps S201 and S202 in the foregoing embodiment, and, specifically, the first information herein comprises antenna correlation information.

Step S303: the second network device determines that the N antenna ports are the selected antenna ports according to the antenna correlation information.

The second network device determines that the N antenna ports are the selected antenna ports according to the antenna correlation information.

Clearly, on the basis of the signal transmission method provided by an embodiment of the present invention, the first network device optimally configures antennas according to at least one of antenna correlation information, SNR, channel capacity, throughput, single-user/multi-user transmission scheme, transmission mode, codebook information, or data packet size, and it feeds back the obtained antenna correlation information to the second network device, which determines the selected antenna ports, with the result that the first network device selects antennas more effectively.

Refer to FIG. 5, which is a structural diagram of a first network device provided by an embodiment of the present invention; the first network device 1000 comprises:

a receiving unit 11, which is for receiving signals of M antenna ports transmitted by a second network device, where M is a positive integer.

During antenna configuration, a second network device transmits configuration information of M antenna ports to a first network device and transmits signals of M antenna ports to a first network device, which receives the signals of the M antenna ports transmitted by the second network device based on the configuration information, where M is a positive integer; in the present embodiment, the first network device may be user equipment (UE), and the second network device may be a base station; alternatively, the first network device may be user equipment, and the second network device may be user equipment; alternatively, 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 remote radio head (RRH).

The configuration information of the M antenna ports comprises an antenna port pattern, i.e., information such as positions of antenna port time-frequency resources and transmission cycles and powers of antenna port signals.

It is possible that the second network device transmits only one piece of configuration information to the first network device and that this configuration information is the configuration information of the M antenna ports; alternatively, that the M antenna ports are divided into multiple groups, and transmission to the first network device takes the form of multiple pieces of configuration information, with each piece of configuration information corresponding to the configuration of one of the antenna port groups.

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

The first network device needs to select N antenna ports from among M antenna ports according to a certain criterion and to notify the second network device of first information of the selected N antenna ports, wherein the first information is channel state information (CSI) corresponding to the N antenna ports or index information corresponding to the N antenna ports; alternatively, first information of the N antenna ports is transmitted to the second network device, which determines the N

antenna ports, wherein the first information is antenna correlation information.

Specific implementations are used below to introduce how the feedback unit 12 feeds back first information of N antenna ports of M antenna ports according to each first criterion.

In an implementation, the first criterion is antenna correlation information.

The feedback unit 12 is specifically for performing cell selection according to antenna correlation information of the M antenna ports after they have been measured, 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.

In the prior art, the only information taken into consideration when performing cell selection is received signal power information, e.g., RSRP, RSSI, and RSRQ; however, in the present embodiment, cell selection also takes into consideration antenna correlation, with the result that users can more comprehensively consider cell or transmission node selection based on their own business matters.

During specific implementation, the first network device performing cell selection based on antenna correlation information of the M antenna ports after they have been measured specifically is:

for example, $M = 10$, corresponding to 5 cells, each cell having 2 antennas, cell 1 corresponding to port0 and port1, cell 1 corresponding to port2 and port3, cell 1 corresponding to port4 and port5, cell 1 corresponding to port6 and port7, and cell 1 corresponding to port8 and port9;

UE measures the 5 groups of antenna ports corresponding to these 5 cells and discovers that the received signal power is strongest for ports0,1 corresponding to cell 1; for example, $RSRP_1 > RSRP_2 > RSRP_3 > RSRP_4 > RSRP_5$, with $RSRP_1$ representing the received signal power corresponding to cell 1, $RSRP_2$ representing the received signal power corresponding to cell 2, and $RSRP_n$ representing the received signal power corresponding to cell n. However, if we assume that the first criterion is antenna correlation information, and if we require that more antenna correlation information is better, then the antenna correlation coefficient will be defined as Cor_1 ; for example, the antenna correlation coefficient Cor_1 for cell 1 is the antenna correlation for port0 and port1; it is possible to use channel estimation to obtain the channel coefficient H_0 corresponding to port0 and the channel coefficient H_1 corresponding to port1 and to calculate Cor_1 by calculating the correlation between H_0 and H_1 ; for example, the correlation matrix can be obtained from $H = [H_0 \ H_1]$, $R = H^H H$

or obtained on the basis of $R_{ik} = \frac{1}{2\Delta} \int_{\theta-\Delta}^{\theta+\Delta} \exp[jz(i-k) \sin \beta] d\beta$,

where i and k are the i^{th} and k^{th} antennas, respectively, and Δ is angle spread.

The same method is used to obtain Cor_2 , Cor_3 , Cor_4 , $Cor_5 \dots Cor_n$, which represents the antenna correlation coefficient corresponding to cell n.

Moreover, $Cor_2 > Cor_1 > Cor_3 > Cor_4 > Cor_5$; thus, though cell 1 has the strongest received signal power,

UE, giving comprehensive consideration to signal power and antenna correlation, ultimately selects cell 2 and stays in cell 2.

The first criterion here is not limited to antenna correlation, but can also be SU/MU, transmission mode, etc.; moreover, the first criterion may be predefined or provided through base station broadcasting or specific signal notification from UE.

Specifically, the feedback unit 12 executes the step of performing cell selection according to antenna correlation information of the M antenna ports after they have been measured; specifically: the first network device selecting the N antenna ports according to the results of comparing antenna correlation information of the measured M antenna ports to a first threshold value, obtaining first information of the N antenna ports, and providing feedback.

That is, a correlation matrix or correlation coefficient of the M antenna ports is compared to a set threshold value, and the N antenna ports for which the correlation matrix or correlation coefficient is greater than or equal to or less than or equal to the set threshold value are selected, and channel state information (CSI) corresponding to the N antenna ports or index information of the N antenna ports is obtained; moreover the CSI corresponding to these N antenna ports or the index information corresponding to these N antenna ports is provided as a notification to the second network device so as to cause the second network device to transmit data on these N antenna ports to the first network device.

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

the first feedback unit 12 is specifically for selecting N antenna ports from among M antenna ports, where N is the smallest number of antenna ports, among antenna port combinations, that causes SNR to be less than or equal to or greater than or equal to a second threshold value after beamforming or transmit diversity, obtaining first information of the N antenna ports, and providing feedback.

For example, the base station configures M antenna ports for UE; as shown in FIG. 2, which is a diagram of multiple antennas in an example of another antenna array, M = 88, and UE traverses all the antenna port combinations from N = 1 to N = 88 among the M ports; for each value of N, the number of combinations to be traversed is c; for example, for N = 4, there are the following combinations: combination 1 is a11, a12, a13, and a14; combination 2 is a12, a13, a14, and a15; combination 3 is a13, a14, a15, and a16; combination 4 is a14, a15, a16, and a17; combination 5 is a15, a16, a17, and a18; combination 6 is b11, b12, b13, b14, ...; for each combination (e.g., combination 1 a11, a12, a13, and a14), UE obtains channel $H_{N,1}$ through a11, a12, a13, and a14 and then traverses all of the precoding matrices W_i to obtain the signal-to-noise ratio:

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

where $H_{N,m}$ represents the m^{th} configuration in combinations of N antenna ports, W_i represents the i^{th} precoding matrix, and σ^2 is noise;

all SNRs in combinations of N ports are traversed to find the maximum; for example, $\max(\text{SNR}_{N,m,i}, N = 4, 1 \leq m \leq C_M^4, 1 \leq i \leq X_4) = 5 \text{ dB}$, where X_4 indicates the number of precoding matrices when $N = 4$. As for $N = 5$, traversal is carried out using the same method as described above: $\max(\text{SNR}_{N,m,i}, N = 5, 1 \leq m \leq C_M^5, 1 \leq i \leq X_5) = 7 \text{ dB}$; if the base station notifies UE that the first criterion for antenna selection is the smallest number of antennas where SNR is greater than or equal to 6 dB, then $N = 5$ is exactly capable of attaining 6 dB and is the smallest number of antennas necessary to achieve 6 dB. Therefore, UE can provide the labels of the antenna combination characterized by $N = 5$ and 7 dB, e.g., a11, b12, c14, and d11, and the corresponding indices as feedback to the base station. If $N > 5$ is used, the resulting signal-to-noise ratio will be higher than for $N = 5$; but some channels only need to meet a certain SNR performance requirement and do not require a larger SNR; the use of more antennas will thus cause the base station to waste transmission power.

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

the feedback unit 12 is specifically for selecting N antenna ports from among M antenna ports, where N is the smallest number of antenna ports, among antenna port combinations, that causes channel capacity to be less than or equal to or greater than or equal to a third threshold value, obtaining first information of the N antenna ports, and providing feedback.

Because channel capacity $C = \text{Blog}_2(1 + \text{SNR})$, the process of selecting antenna ports according to channel capacity in the present implementation is similar to the process of selecting antenna ports according to SNR in the implementation above and will not be discussed further here.

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

the feedback unit 12 is specifically for selecting N antenna ports from among M antenna ports, where N is the smallest number of antenna ports, among antenna port combinations, that causes throughput to be less than or equal to or greater than or equal to a fourth threshold value, obtaining first information of the N antenna ports, and providing feedback.

Similarly, the process of selecting antenna ports according to throughput in the present implementation is similar to the process of selecting antenna ports according to SNR or channel capacity in the implementations above and will not be discussed further here.

In yet another implementation, the first criterion is SU/MU transmission scheme; and

the feedback unit 12 is specifically for selecting from among M antenna ports a first group of antenna ports having optimal SU transmission, wherein the first group of antenna ports contains N1 antenna ports, obtaining first information of the N1 antenna ports, and providing feedback; and/or

the first network device selecting from among M antenna ports a second group of antenna ports having optimal MU transmission, wherein the second group of antenna ports contains N2 antenna ports, obtaining first information of the N2 antenna ports, and providing feedback.

In the present implementation, for example, the base station configures UE to select antennas in accordance with the optimal SU transmission scheme; thus, UE traverses all the antennas and selects the antennas in such a manner that UE's own performance becomes optimal; for example, it selects a11, b13, g15, and h18, and thus the antenna index information for a11, b13, g15, and h18 is reported to the base station.

In another example, the base station configures UE1 to select antennas in accordance with the optimal MU matching scheme; the base station can notify UE1 of user matching information, e.g., information on users UE2 and UE3, which are matched with UE1, including UE2 and UE3 antenna information; UE1 selects the antennas in such a manner that the total performance of all matched users becomes optimal; for example, it selects antennas c13, d12, e11, and f18 and notifies the base station of the corresponding antenna index information.

Information based on the antenna port group that has optimal SU transmission and information based on the antenna port group that has optimal MU transmission can both be provided as feedback. For example, cross-polarized antennas may be selected for SU because such antennas have low correlation, which aids spatial multiplexing; in the case of MU matching, each user optimally should select co-polarized antennas because they facilitate each user's beamforming. The SU in this case is the user alone transmitting its own data packet on a time-frequency resource, and the MU is multiple users sending their respective data packets, which can be on the same time-frequency resource through spatial multiplexing.

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

the feedback unit 12 is specifically for selecting from among M antenna ports a first group of antenna ports whereby the transmission mode is optimal for transmit diversity transmission, wherein the first group of antenna ports contains N1 antenna ports, obtaining first information of the N1 antenna ports, and providing feedback; and/or

the first network device selecting from among M antenna ports a second group of antenna ports whereby the transmission mode is optimal for beamforming transmission, wherein the first group of antenna ports contains N2 antenna ports, obtaining first information of the N2 antenna ports, and providing feedback; and/or

the first network device selecting from among M antenna ports a third group of antenna ports whereby the transmission mode is optimal for spatial multiplexing transmission, wherein the third group of antenna ports contains N3 antenna ports, obtaining first information of the N3 antenna ports, and providing feedback.

In yet another implementation, the first criterion is codebook information; and the feedback unit 12 is specifically for selecting from among M antenna ports the N antenna ports having optimal transmission performance when first codebook information is used, obtaining first information of the N antenna ports, and providing feedback.

Codebook information refers to information containing multiple precoding matrices.

In yet another implementation, the first criterion is codebook information;

for example, the M antenna ports are divided into X groups, and the base station individually configures one codebook set for each antenna port group. The user equipment calculates the SNR based on the configured codebook set and feeds it back to the base station equipment. For example, the first group of antenna ports corresponds to antenna configuration 1, comprising antenna ports port0 and port1; the base station configures codebook set C1 for antenna configuration 1, and the precoding matrices included in C1 are W_{11} , W_{12} , W_{1n} , ..., W_{1N} ; the second group of antenna ports corresponds to antenna configuration 2, comprising antenna ports port2 and port3; codebook set C2 is configured for antenna configuration 2, and the precoding matrices included in C2 are W_{21} , W_{22} , W_{2n} , ..., W_{2N} ; the third group of antenna ports corresponds to antenna configuration 3, comprising antenna ports port4 and port5; codebook set C3 is configured for antenna configuration 3, and the precoding matrices included in C3 are W_{31} , W_{32} , W_{3n} , ..., W_{3N} ; the fourth group of antenna ports corresponds to antenna configuration 4, comprising antenna ports port6 and port7; codebook set C4 is configured for antenna configuration 4, and the precoding matrices included in C4 are W_{41} , W_{42} , W_{4n} , ..., W_{4N} . Based on the antenna ports corresponding to each antenna configuration, the user equipment provides one optimal rank, PMI(i), and SNR(i) in the corresponding codebook set C_i as feedback; the base station compares each SNR(i) to select the best antenna for the user equipment to configure; alternatively, UE compares each SNR(i) to select a best antenna configuration and feeds its corresponding first information back to the base station; the first information, including antenna indices and/or CSI, are fed back to the base station. For example, UE separately measures four groups of antenna ports, obtains antenna ports port4 and port5 in the third group, and traverses the precoding matrices included in C3, which are W_{31} , W_{32} , W_{3n} , ..., W_{3N} ; the optimal SNR obtained is higher than in the other three groups of antenna ports; therefore, UE provides the indices corresponding to the third antenna port group to the base station. One codebook set is configured for each antenna port group, and the user equipment calculates the SNR based on this codebook set and feeds it back to the base station equipment. For example, the codebook set C1 is configured for antenna configuration 1, the codebook set C2 is configured for antenna configuration 2, the codebook set C3 is configured for antenna configuration 3, and the codebook set C4 is configured for antenna configuration 4. During RRM measurement, the user equipment employs a random beamforming approach in the codebook set C_i corresponding to the pilot frequency of each antenna configuration to calculate and report the mean reference signal receiving power (RSRP) or reference signal receiving quality (RSRQ); for example, the user equipment at the pilot frequency of antenna configuration 1 uses all the codebooks in C1 to

conduct random beamforming and obtain RSRP1; for the pilot frequency of antenna configuration 2, all the codebooks in C2 are used to conduct random beamforming and obtain RSRP2, ...; and UE feeds back the index corresponding to the antenna configuration having the largest RSRP to the base station.

The feedback unit 12 is specifically for selecting from among M antenna ports the N antenna ports whereby polling all the code words in first codebooks results in optimal average information transmission performance, obtaining first information of the N antenna ports, and providing feedback.

In yet another implementation, the first criterion is codebook information; and the feedback unit 12 is specifically for selecting from among M antenna ports the N antenna ports whereby polling all the code words in first codebooks results in optimal best information transmission performance, obtaining first information of the N antenna ports, and providing feedback.

In yet another implementation, the first criterion is data packet information, and the data information comprises transport block size and modulation and coding scheme;

The feedback unit 12 is specifically for selecting from among M antenna ports the N antenna ports whereby transmission of first data packets has optimal transmission performance, obtaining first information of the N antenna ports, and providing feedback; and/or

the first network device selecting from among M antenna ports the N antenna ports whereby the smallest number of first data packets are transmitted, obtaining first information of the N antenna ports, and providing feedback; and/or

the first network device selecting N antenna ports from among M antenna ports, where N is the smallest number whereby transmission of first data packets meets a certain performance requirement (e.g., the smallest number N of antenna ports having a certain bit error rate), obtaining first information of the N antenna ports, and providing feedback.

It needs to be explained that, in the embodiments above, the second network device configures the first criterion, first threshold value, second threshold value, third threshold value, and fourth threshold value by broadcasting information, high-layer signaling, or dynamic signaling.

The M antenna ports correspond to X channel state information processing processes (CSI processes), and the N antenna ports correspond to one CSI process among the X CSI processes, where X is a positive integer. Each CSI process corresponds to a certain measurement resource; for example, each CSI process configures a signal measurement resource and an interference measurement

resource; UE obtains the CSI based on the signal measurement resource and interference measurement resource and reports it. For example, if $M = 20$ corresponds to 5 CSI processes, then every 4 antenna ports correspond to 1 CSI process, and $N = 4$.

Clearly, on the basis of the first network device provided by an embodiment of the present invention, antennas are configured optimally according to at least one of antenna correlation information, SNR, channel capacity, throughput, single-user/multi-user transmission scheme, transmission mode, codebook information, or data packet size, and antenna selection is carried out more effectively.

Refer to FIG. 6, which is a structural diagram of a second network device provided by an embodiment of the present invention; the second network device 2000 comprises:

a transmitting unit 21, which is for transmitting signals of M antenna ports to a first network device, where M is a positive integer.

During antenna configuration, the transmitting unit 21 transmits configuration information of M antenna ports to a first network device and transmits signals of M antenna ports to a first network device, which receives the signals of the M antenna ports transmitted by the transmitting unit 21 based on the configuration information, where M is a positive integer; in the present embodiment, the first network device may be user equipment (UE), and the second network device may be a base station; alternatively, the first network device may be user equipment, and the second network device may be user equipment; alternatively, 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 remote radio head (RRH).

The configuration information of the M antenna ports comprises an antenna port pattern, i.e., information such as positions of antenna port time-frequency resources and transmission cycles and powers of antenna port signals.

It is possible that the second network device transmits only one piece of configuration information to the first network device and that this configuration information is the configuration information of the M antenna ports; alternatively, that the M antenna ports are divided into multiple groups, and transmission to the first network device takes the form of multiple pieces of configuration information, with each piece of configuration information corresponding to the configuration of one of the antenna port groups.

The receiving unit 22 is for receiving first information of N antenna ports of the M antenna ports transmitted by the first network device according to a first criterion, where N is an integer less than or equal to M , and the first criterion is at least one of antenna correlation information, SNR, channel capacity, throughput, SU (single-user)/MU (multi-user) transmission scheme, transmission mode, codebook information, and data packet size.

The first network device needs to select N antenna ports from among M antenna ports according to a certain criterion and to notify the receiving unit 22 of the second network device of first information of the selected N antenna ports, wherein the first information is channel state information (CSI) corresponding to the N antenna ports or index information corresponding to the N antenna ports;

alternatively, first information of the N antenna ports is transmitted to the second network device, which determines the N antenna ports, wherein the first information is antenna correlation information.

The second network device configures the first criterion, first threshold value, second threshold value, third threshold value, or fourth threshold value by broadcasting information, high-layer signaling, or dynamic signaling.

Clearly, on the basis of a second network device provided by an embodiment of the present invention, a first network device optimally configures antennas according to at least one of antenna correlation information, SNR, channel capacity, throughput, single-user/multi-user transmission scheme, transmission mode, codebook information, or data packet size, and it feeds back the obtained antenna correlation information or the channel state information (CSI) corresponding to the N antenna ports or the index information of the N antenna ports to the second network device, with the result that the first network device selects antennas more effectively.

Refer to FIG. 7, which is a structural diagram of another second network device provided by an embodiment of the present invention; the second network device 3000 comprises:

a transmitting unit 31, which is for transmitting signals of M antenna ports to a first network device, where M is a positive integer; and

a receiving unit 32, which is for receiving first information of N antenna ports of the M antenna ports fed back by the first network device according to a first criterion, where N is an integer less than or equal to M, and the first criterion is at least one of antenna correlation information, SNR, channel capacity, throughput, SU (single-user)/MU (multi-user) transmission scheme, transmission mode, codebook information, and data packet size.

The functions of the transmitting unit 31 and the receiving unit 32 are the same as those of the transmitting unit 21 and receiving unit 22, respectively, of the foregoing embodiment, wherein the first information specifically comprises antenna correlation information.

A determining unit 33 is for determining that the N antenna ports are the selected antenna ports according to the antenna correlation information.

Determining unit 33 determines that the N antenna ports are the selected antenna ports according to the antenna correlation information.

Clearly, on the basis of the second network device provided by an embodiment of the present invention, the first network device optimally configures antennas according to at least one of antenna correlation information, SNR, channel capacity, throughput, single-user/multi-user transmission scheme, transmission mode, codebook information, or data packet size, and it feeds back the obtained antenna correlation information to the second network device, which determines the selected antenna ports, with the result that the first network device selects antennas more effectively.

Refer to FIG. 8, which is a structural diagram of another first network device provided by an embodiment of the present invention; the first network device 4000 comprises: a receiver 41 and a transmitter 42.

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

the transmitter 42 is for feeding back first information of N antenna ports of the M antenna ports according to a first criterion, where N is an integer less than or equal to M, and the first criterion is at least one of antenna correlation information, SNR, channel capacity, throughput, SU (single-user)/MU (multi-user) transmission scheme, transmission mode, codebook information, and data packet size.

In an implementation, the first criterion is antenna correlation information;

the transmitter 42 executes the step of feeding back first information of N antenna ports of the M antenna ports according to a first criterion; specifically:

performing cell selection according to antenna correlation information of the M antenna ports after they have been measured, 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.

In another implementation, the transmitter 42 executes the step of performing cell selection according to antenna correlation information of the M antenna ports after they have been measured; specifically:

the first network device selecting the N antenna ports according to the results of comparing antenna correlation information of the measured M antenna ports to a first threshold value, obtaining first information of the N antenna ports, and providing feedback.

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

the transmitter 42 executes the step of feeding back first information of N antenna ports of the M antenna ports according to a first criterion; specifically:

selecting N antenna ports from among M antenna ports, where N is the smallest number of antenna ports, among antenna port combinations, that causes SNR to be less than or equal to or greater than or equal to a second threshold value after beamforming or transmit diversity, obtaining first information of the N antenna ports, and providing feedback.

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

the transmitter 42 executes the step of feeding back first information of N antenna ports of the M antenna ports according to a first criterion; specifically:

selecting N antenna ports from among M antenna ports, where N is the smallest number of antenna ports, among antenna port combinations, that causes channel capacity to be less than or equal to or greater than or equal to a third threshold value, obtaining first information of the N antenna ports, and

providing feedback.

In yet another implementation, the first criterion is throughput;

the transmitter 42 executes the step of feeding back first information of N antenna ports of the M antenna ports according to a first criterion; specifically:

the first network device selecting N antenna ports from among M antenna ports, where N is the smallest number of antenna ports, among antenna port combinations, that causes throughput to be less than or equal to or greater than or equal to a fourth threshold value, obtaining first information of the N antenna ports, and providing feedback

In yet another implementation, the first criterion is SU/MU transmission scheme; and

the transmitter 42 executes the step of feeding back first information of N antenna ports of the M antenna ports according to a first criterion; specifically:

selecting from among M antenna ports a first group of antenna ports having optimal SU transmission, wherein the first group of antenna ports contains N1 antenna ports, obtaining first information of the N1 antenna ports, and providing feedback; and/or

selecting from among M antenna ports a second group of antenna ports having optimal MU transmission, wherein the second group of antenna ports contains N2 antenna ports, obtaining first information of the N2 antenna ports, and providing feedback.

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

the transmitter 42 executes the step of feeding back first information of N antenna ports of the M antenna ports according to a first criterion; specifically:

selecting from among M antenna ports a first group of antenna ports whereby the transmission mode is optimal for transmit diversity transmission, wherein the first group of antenna ports contains N1 antenna ports, obtaining first information of the N1 antenna ports, and providing feedback; and/or

selecting from among M antenna ports a second group of antenna ports whereby the transmission mode is optimal for beamforming transmission, wherein the first group of antenna ports contains N2 antenna ports, obtaining first information of the N2 antenna ports, and providing feedback; and/or

selecting from among M antenna ports a third group of antenna ports whereby the transmission mode is optimal for spatial multiplexing transmission, wherein the third group of antenna ports contains N3 antenna ports, obtaining first information of the N3 antenna ports, and providing feedback.

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

the transmitter 42 executes the step of feeding back first information of N antenna ports of the M antenna ports according to the first criterion; specifically:

selecting from among M antenna ports the N antenna ports having optimal transmission performance when first codebook information is used, obtaining first information of the N antenna ports, and providing feedback.

In yet another implementation, the first criterion is codebook information;

the transmitter 42 executes the step of feeding back first information of N antenna ports of the M antenna ports according to the first criterion; specifically:

selecting from among M antenna ports the N antenna ports whereby polling all the code words in first codebooks results in optimal average information transmission performance, obtaining first information of the N antenna ports, and providing feedback.

In yet another implementation, the first criterion is codebook information;

the transmitter 42 executes the step of feeding back first information of N antenna ports of the M antenna ports according to the first criterion; specifically:

selecting from among M antenna ports the N antenna ports whereby polling all the code words in first codebooks results in optimal best information transmission performance, obtaining first information of the N antenna ports, and providing feedback.

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

the transmitter 42 executes the step of feeding back first information of N antenna ports of the M antenna ports according to the first criterion; specifically:

selecting from among M antenna ports the N antenna ports whereby transmission of first data packets has optimal transmission performance, obtaining first information of the N antenna ports, and providing feedback; and/or

selecting from among M antenna ports the N antenna ports whereby the smallest number of first data packets are transmitted, obtaining first information of the N antenna ports, and providing feedback.

In each of the embodiments or implementations above, the second network device configures the first criterion, first threshold value, second threshold value, third threshold value, or fourth threshold value by broadcasting information, high-layer signaling, or dynamic signaling.

In each of the embodiments or implementations above, the M antenna ports correspond to X channel state information processing processes (CSI processes), and N antenna ports correspond to one CSI process among the X CSI processes, where X is a positive integer.

In each of the embodiments or implementations above, the first information comprises antenna correlation information or channel state information (CSI) corresponding to the N antenna ports or index information of the N antenna ports.

Clearly, on the basis of the first network device provided by an embodiment of the present invention, antennas are configured optimally according to at least one of antenna correlation information, SNR, channel capacity, throughput, single-user/multi-user transmission scheme, transmission mode, codebook

information, or data packet size, and antenna selection is carried out more effectively.

Refer to FIG. 9, which is a structural diagram of yet another second network device provided by an embodiment of the present invention; the second network device 5000 comprises: a transmitter and a receiver;

the transmitter 51 is for transmitting signals of M antenna ports to a first network device, where M is a positive integer; and

the receiver 52 is for receiving first information of N antenna ports of the M antenna ports fed back by the first network device according to a first criterion, where N is an integer less than or equal to M , and the first criterion is at least one of antenna correlation information, SNR, channel capacity, throughput, SU (single-user)/MU (multi-user) transmission scheme, transmission mode, codebook information, and data packet size.

The first information comprises channel state information (CSI) corresponding to the N antenna ports or index information of the N antenna ports or antenna correlation information.

Clearly, on the basis of the second network device provided by an embodiment of the present invention, the first network device optimally configures antennas according to at least one of antenna correlation information, SNR, channel capacity, throughput, single-user/multi-user transmission scheme, transmission mode, codebook information, or data packet size, and it feeds back the obtained antenna correlation information or the channel state information (CSI) corresponding to the N antenna ports or the index information of the N antenna ports to the second network device, with the result that the first network device selects antennas more effectively.

Refer to FIG. 10, which is a structural diagram of yet another second network device provided by an embodiment of the present invention; the second network device 6000 comprises: a transmitter, a receiver, and a controller.

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

The receiver 62 is for receiving first information of N antenna ports of the M antenna ports fed back by the first network device according to a first criterion, where N is an integer less than or equal to M , and the first criterion is at least one of antenna correlation information, SNR, channel capacity, throughput, SU (single-user)/MU (multi-user) transmission scheme, transmission mode, codebook information, and data packet size; and the first information comprises antenna correlation information.

The controller 63 is for determining that the N antenna ports are the selected antenna ports according to the antenna

correlation information.

Clearly, on the basis of the second network device provided by an embodiment of the present invention, the first network device optimally configures antennas according to at least one of antenna correlation information, SNR, channel capacity, throughput, single-user/multi-user transmission scheme, transmission mode, codebook information, or data packet size, and it feeds back the obtained antenna correlation information to the second network device, which determines the selected antenna ports, with the result that the first network device selects antennas more effectively.

It needs to be explained that, for the purpose of simplicity in description, the foregoing method embodiments are presented as a series of action combinations. However, persons skilled in the art should know that the present invention is not limited to the described action sequence because some of the steps may be performed in another sequence or concurrently according to the present invention. In addition, persons skilled in the art should also know that the embodiments described herein are preferred embodiments, and actions and modules relating to them are not necessarily required by the present invention.

In the embodiments described above, the description of each embodiment has its own emphasis. For a part that is not described in detail within an embodiment, reference may be made to related descriptions of other embodiments.

Through the description of the above embodiments, persons skilled in the art can clearly understand that the present invention can be implemented as hardware, firmware, or a combination thereof. When implemented as software, the functions described above may be stored in or transmitted as one or more instructions or code on a computer readable medium. Computer readable media include computer storage media and communication media, where communication media include any media that facilitate transfer of a computer program from one location to another. A storage medium may be any available medium that can be accessed by a computer. For example (but not limited to), computer readable media may include random access memory (RAM), read-only memory (ROM), electrically erasable programmable read-only memory (EEPROM), compact disc read-only memory (CD-ROM), or other optical disc storage or magnetic storage media or other magnetic storage device, or any other media that can be used to carry or store desired program code in the form of instructions or data structures and that can be accessed by a computer. In addition, any connection may suitably become a computer readable medium. For example, if the software is using coaxial cable, fiber optic cable, twisted pair, digital subscriber line (DSL), or wireless technology such as infrared, radio, or microwave for transmission from a website, server, or other remote source, then the coaxial cable, fiber optic cable, twisted pair,

DSL or wireless technology such as infrared, wireless, and microwave is included in the stabilizing of the associated medium. As used in the present invention, “disk” and “disc” include a compact disc (CD), a laser disc, a compact disc, a digital versatile disc (DVD), a floppy disk, and a Blu-ray disc, wherein a disk generally magnetically copies data, and a disc uses a laser to optically replicate data. Combinations of the above should also be included within the protective scope of computer readable media.

In summary, the above are merely preferred embodiments of the technical scheme of the present invention and are not used to limit the protective scope of the present invention. Any modification, equivalent substitution, or improvement made in keeping with the spirit and principles of the present invention shall be included within the protective scope of the present invention.

CLAIMS

1. A signal transmission method, characterized in that it comprises:
 - a first network device receiving signals of M antenna ports transmitted by a second network device, where M is a positive integer; and
 - the first network device feeding back first information of N antenna ports of the M antenna ports according to a first criterion, where N is an integer less than or equal to M, and the first criterion is at least one of antenna correlation information, SNR, channel capacity, throughput, SU (single-user)/MU (multi-user) transmission scheme, transmission mode, codebook information, and data packet size.
2. The method as described in claim 1, characterized in that the first criterion is antenna correlation information; and
 - the first network device feeding back first information of N antenna ports of the M antenna ports according to the first criterion specifically is:
 - the first network device performing cell selection according to antenna correlation information of the M antenna ports after they have been measured, 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 as described in claim 2, characterized in that the first network device performing cell selection according to antenna correlation information of the M antenna ports after they have been measured specifically is:
 - the first network device selecting the N antenna ports according to the results of comparing antenna correlation information of the measured M antenna ports to a first threshold value, obtaining first information of the N antenna ports, and providing feedback.
4. The method as described in claim 1, characterized in that the first criterion is signal-to-noise ratio (SNR); and
 - the first network device feeding back first information of N antenna ports of the M antenna ports according to the first criterion specifically is:
 - the first network device selecting N antenna ports from among M antenna ports, where N is the smallest number of antenna ports, among antenna port combinations, that causes SNR to be less than or equal to or greater than or equal to a second threshold value after beamforming or transmit diversity,

obtaining first information of the N antenna ports, and providing feedback.

5. The method as described in claim 1, characterized in that, the first criterion is channel capacity; and

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

the first network device selecting N antenna ports from among M antenna ports, where N is the smallest number of antenna ports, among antenna port combinations, that causes channel capacity to be less than or equal to or greater than or equal to a third threshold value, obtaining first information of the N antenna ports, and providing feedback.

6. The method as described in claim 1, characterized in that the first criterion is throughput; and

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

the first network device selecting N antenna ports from among M antenna ports, where N is the smallest number of antenna ports, among antenna port combinations, that causes throughput to be less than or equal to or greater than or equal to a fourth threshold value, obtaining first information of the N antenna ports, and providing feedback.

7. The method as described in claim 1, characterized in that the first criterion is SU/MU transmission scheme; and

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

the first network device selecting from among M antenna ports a first group of antenna ports having optimal SU transmission, wherein the first group of antenna ports contains N1 antenna ports, obtaining first information of the N1 antenna ports, and providing feedback; and/or

the first network device selecting from among M antenna ports a second group of antenna ports having optimal MU transmission, wherein the second group of antenna ports contains N2 antenna ports, obtaining first information of the N2 antenna ports, and providing feedback.

8. The method as described in claim 1, characterized in that the first criterion is transmission mode; the first network device feeding back first information of N antenna ports of the M antenna ports according to the first criterion specifically is:

the first network device selecting from among M antenna ports a first group of antenna ports whereby the transmission mode is optimal for transmit diversity transmission, wherein the first group of antenna ports contains N1 antenna ports, obtaining first information of the N1 antenna ports, and providing feedback; and/or

the first network device selecting from among M antenna ports a second group of antenna ports whereby the transmission mode is optimal for beamforming transmission, wherein the first group of antenna ports contains N2 antenna ports, obtaining first information of the N2 antenna ports, and providing feedback; and/or

the first network device selecting from among M antenna ports a third group of antenna ports whereby the transmission mode is optimal for spatial multiplexing transmission, wherein the third group of antenna ports contains N3 antenna ports, obtaining first information of the N3 antenna ports, and providing feedback.

9. The method as described in claim 1, characterized in that the first criterion is codebook information; and

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

the first network device selecting from among M antenna ports the N antenna ports having optimal transmission performance as determined using the corresponding first codebook information, obtaining first information of the N antenna ports, and providing feedback.

10. The method as described in claim 1, characterized in that the first criterion is codebook information;

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

the first network device selecting from among M antenna ports the N antenna ports whereby polling all the code words in first codebooks results in optimal average information transmission performance, obtaining first information of the N antenna ports, and providing feedback.

11. The method as described in claim 1, characterized in that the first criterion is codebook information;

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

the first network device selecting from among M antenna ports the N antenna ports whereby polling all the code words in first codebooks results in optimal best information transmission performance, obtaining first information of the N antenna ports, and providing feedback.

12. The method as described in claim 1, characterized in that the first criterion is data packet information;

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

the first network device selecting from among M antenna ports the N antenna ports whereby transmission of first data packets has optimal transmission performance, obtaining first information of the N antenna ports, and providing feedback; and/or

the first network device selecting from among M antenna ports the N antenna ports whereby the smallest number of first data packets are transmitted, obtaining first information of the N antenna ports, and providing feedback; and/or

the first network device selecting N antenna ports from among M antenna ports, where N is the smallest number whereby transmission of first data packets meets a certain performance requirement, obtaining first information of the N antenna ports, and providing feedback.

13. The method as described in claims 1 through 12, characterized in that the second network device configures the first criterion or the first threshold value, second threshold value, third threshold value, and fourth threshold value by broadcasting information, high-layer signaling, or dynamic signaling.

14. The method as described in claims 1 through 13, characterized in that the M antenna ports correspond to X channel state information processing processes (CSI processes), and N antenna ports correspond to one CSI process among the X CSI processes, where X is a positive integer.

15. The method as described in claims 1 through 14, characterized in that the first information comprises antenna correlation information or channel state information (CSI) corresponding to the N antenna ports, or index information of the N antenna ports.

16. A signal transmission method, characterized in that it comprises:

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

the second network device receiving first information of N antenna ports of the M antenna ports fed back by the first network device according to a first criterion, where N is an integer less than or equal to M, and the first criterion is at least one of antenna correlation information, SNR, channel capacity, throughput, SU (single-user)/

MU (multi-user) transmission scheme, transmission mode, codebook information, and data packet size.

17. The method as described in claim 16, characterized in that the first information comprises antenna correlation information;

the method further comprises:

the second network device determining that the N antenna ports are the selected antenna ports according to the antenna correlation information.

18. The method as described in claim 16, characterized in that 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 as described in any of claims 16 through 18, characterized in that it further comprises:

the second network device, which configures the first criterion, first threshold value, second threshold value, third threshold value, or fourth threshold value by broadcasting information, high-layer signaling, or dynamic signaling.

20. A first network device, characterized in that it comprises:

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

a feedback unit, which is for feeding back first information of N antenna ports of the M antenna ports according to a first criterion, where N is an integer less than or equal to M, and the first criterion is at least one of antenna correlation information, SNR, channel capacity, throughput, SU (single-user)/MU (multi-user) transmission scheme, transmission mode, codebook information, and data packet size.

21. The first network device as described in claim 20, characterized in that the first criterion is antenna correlation information; and

the feedback unit is specifically for:

performing cell selection according to antenna correlation information of the M antenna ports after they have been measured, 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 as described in claim 21, characterized in that the feedback unit executes the step of performing cell selection according to antenna correlation information of the M antenna ports after they have been measured; specifically:

the first network device selecting the N antenna ports according to the results of comparing antenna correlation information of the measured M antenna ports having a first threshold value, obtaining first information of the N antenna ports, and providing feedback.

23. The first network device as described in claim 21, characterized in that the first criterion is signal-to-noise ratio (SNR); and

the feedback unit is specifically for:

selecting N antenna ports from among M antenna ports, where N is the smallest number of antenna ports, among antenna port combinations, that causes SNR to be less than or equal to or greater than or equal to a second threshold value after beamforming or transmit diversity, obtaining first information of the N antenna ports, and providing feedback.

24. The first network device as described in claim 20, characterized in that the first criterion is channel capacity; and

the feedback unit is specifically for:

selecting N antenna ports from among M antenna ports, where N is the smallest number of antenna ports, among antenna port combinations, that causes channel capacity to be less than or equal to or greater than or equal to a third threshold value, obtaining first information of the N antenna ports, and providing feedback.

25. The first network device as described in claim 20, characterized in that the first criterion is throughput; and

the feedback unit is specifically for:

selecting N antenna ports from among M antenna ports, where N is the smallest number of antenna ports, among antenna port combinations, that causes throughput to be less than or equal to or greater than or equal to a fourth threshold value, obtaining first information of the N antenna ports, and providing feedback.

26. The first network device as described in claim 20, characterized in that the first criterion is SU/MU transmission scheme; and

the feedback unit is specifically for:

selecting from among M antenna ports a first group of antenna ports having optimal SU transmission, wherein the first group of antenna ports contains N1 antenna ports, obtaining first information of the N1 antenna ports, and providing feedback; and/or

selecting from among M antenna ports a second group of antenna ports having optimal MU transmission, wherein the second group of antenna ports contains N2 antenna ports, obtaining first information of the N2 antenna ports, and providing feedback.

27. The first network device as described in claim 20, characterized in that the first criterion is transmission mode; and

the feedback unit is specifically for:

selecting from among M antenna ports a first group of antenna ports whereby the transmission mode is optimal for transmit diversity transmission, wherein the first group of antenna ports contains N1 antenna ports, obtaining first information of the N1 antenna ports, and providing feedback; and/or

selecting from among M antenna ports a second group of antenna ports whereby the transmission mode is optimal for beamforming transmission, wherein the first group of antenna ports contains N2 antenna ports, obtaining first information of the N2 antenna ports, and providing feedback; and/or

selecting from among M antenna ports a third group of antenna ports whereby the transmission mode is optimal for spatial multiplexing transmission, wherein the third group of antenna ports contains N3 antenna ports, obtaining first information of the N3 antenna ports, and providing feedback.

28. The first network device as described in claim 20, characterized in that the first criterion is codebook information; and

the feedback unit is specifically for:

selecting from among M antenna ports the N antenna ports having optimal transmission performance as determined using the corresponding first codebook information, obtaining first information of the N antenna ports, and providing feedback.

29. The first network device as described in claim 20, characterized in that the first criterion is codebook information; and

the feedback unit is specifically for:

selecting from among M antenna ports the N antenna ports whereby polling all the code words in first codebooks results in optimal average information transmission performance, obtaining first information of the N antenna ports, and providing feedback.

30. The first network device as described in claim 20, characterized in that the first criterion is codebook information; and

the feedback unit is specifically for:

selecting from among M antenna ports the N antenna ports whereby polling all the code words in first codebooks results in optimal best information transmission performance, obtaining first information of the N antenna ports, and providing feedback.

31. The first network device as described in claim 20, characterized in that the first criterion is data packet information; and

the feedback unit is specifically for:

selecting from among M antenna ports the N antenna ports whereby transmission of first data packets has optimal transmission performance, obtaining first information of the N antenna ports, and providing feedback; and/or

selecting from among M antenna ports the N antenna ports whereby the smallest number of first data packets are transmitted, obtaining first information of the N antenna ports, and providing feedback; and/or

selecting N antenna ports from among M antenna ports, where N is the smallest number whereby transmission of first data packets meets a certain performance requirement (e.g., the smallest number N of antenna ports having a certain bit error rate), obtaining first information of the N antenna ports, and providing feedback.

32. The first network device as described in claims 20 through 31, characterized in that the second network device configures the first criterion or the first threshold value, second threshold value, third threshold value, and fourth threshold value by broadcasting information, high-layer signaling, or dynamic signaling.

33. The first network device as described in claims 20 through 32, characterized in that the M antenna ports correspond to X channel state information processing processes (CSI processes), and N antenna ports correspond to one CSI process among the X CSI processes, where X is a positive integer.

34. The first network device as described in claims 20 through 33, characterized in that the first information comprises

antenna correlation information or channel state information (CSI) corresponding to the N antenna ports or index information of the N antenna ports.

35. A second network device, characterized in that it comprises:

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

a receiving unit, which is for receiving first information of N antenna ports of the M antenna ports fed back by the first network device according to a first criterion, where N is an integer less than or equal to M, and the first criterion is at least one of antenna correlation information, SNR, channel capacity, throughput, SU (single-user)/MU (multi-user) transmission scheme, transmission mode, codebook information, and data packet size.

36. The second network device as described in claim 35, characterized in that the first information comprises antenna correlation information; and

the second network device further comprises:

a determining unit, which is for determining that the N antenna ports are the selected antenna ports according to the antenna correlation information.

37. The second network device as described in claim 35, characterized in that 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 as described in any of claims 35 through 37, characterized in that the transmitting unit is further for configuring the first criterion, first threshold value, second threshold value, third threshold value, and fourth threshold value by broadcasting information, high-layer signaling, or dynamic signaling.

39. A first network device, characterized in that it comprises: a receiver and a transmitter;

wherein the receiver is for receiving signals of M antenna ports transmitted by a second network device, where M is a positive integer; and

the transmitter is for feeding back first information of N antenna ports of the M antenna ports according to a first criterion,

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

40. The first network device as described in claim 39, characterized in that the first criterion is antenna correlation information;

the transmitter executes the step of feeding back first information of N antenna ports of the M antenna ports according to the first criterion; specifically:

performing cell selection according to antenna correlation information of the M antenna ports after they have been measured, 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 as described in claim 40, characterized in that the transmitter executes the step of performing cell selection according to antenna correlation information of the M antenna ports after they have been measured; specifically:

the first network device selecting the N antenna ports according to the results of comparing antenna correlation information of the measured M antenna ports having a first threshold value, obtaining first information of the N antenna ports, and providing feedback.

42. The first network device as described in claim 39, characterized in that the first criterion is signal-to-noise ratio (SNR); and

the transmitter executes the step of feeding back first information of N antenna ports of the M antenna ports according to the first criterion; specifically:

selecting N antenna ports from among M antenna ports, where N is the smallest number of antenna ports, among antenna port combinations, that causes SNR to be less than or equal to or greater than or equal to a second threshold value after beamforming or transmit diversity, obtaining first information of the N antenna ports, and providing feedback.

43. The first network device as described in claim 39, characterized in that the first criterion is channel capacity; and

the transmitter executes the step of feeding back first information of N antenna ports of

the M antenna ports according to the first criterion; specifically:

selecting N antenna ports from among M antenna ports, where N is the smallest number of antenna ports, among antenna port combinations, that causes channel capacity to be less than or equal to or greater than or equal to a third threshold value, obtaining first information of the N antenna ports, and providing feedback.

44. The first network device as described in claim 39, characterized in that the first criterion is throughput; and

the transmitter executes the step of feeding back first information of N antenna ports of the M antenna ports according to the first criterion; specifically:

the first network device selects N antenna ports from among M antenna ports, where N is the smallest number of antenna ports, among antenna port combinations, that causes throughput to be less than or equal to or greater than or equal to a fourth threshold value, obtaining first information of the N antenna ports, and providing feedback.

45. The first network device as described in claim 39, characterized in that the first criterion is SU/MU transmission scheme; and

the transmitter executes the step of feeding back first information of N antenna ports of the M antenna ports according to the first criterion; specifically:

selecting from among M antenna ports a first group of antenna ports having optimal SU transmission, wherein the first group of antenna ports contains N1 antenna ports, obtaining first information of the N1 antenna ports, and providing feedback; and/or

selecting from among M antenna ports a second group of antenna ports having optimal MU transmission, wherein the second group of antenna ports contains N2 antenna ports, obtaining first information of the N2 antenna ports, and providing feedback.

46. The first network device as described in claim 39, characterized in that the first criterion is transmission mode; and

the transmitter executes the step of feeding back first information of N antenna ports of the M antenna ports according to the first criterion; specifically:

selecting from among M antenna ports a first group of antenna ports whereby the transmission mode is optimal for transmit diversity transmission, wherein the first group of antenna ports contains N1 antenna ports, obtaining first information of the N1 antenna ports,

and providing feedback; and/or

selecting from among M antenna ports a second group of antenna ports whereby the transmission mode is optimal for beamforming transmission, wherein the first group of antenna ports contains N2 antenna ports, obtaining first information of the N2 antenna ports, and providing feedback; and/or

selecting from among M antenna ports a third group of antenna ports whereby the transmission mode is optimal for spatial multiplexing transmission, wherein the third group of antenna ports contains N3 antenna ports, obtaining first information of the N3 antenna ports, and providing feedback.

47. The first network device as described in claim 39, characterized in that the first criterion is codebook information; and

the transmitter executes the step of feeding back first information of N antenna ports of the M antenna ports according to the first criterion; specifically:

selecting from among M antenna ports the N antenna ports having optimal transmission performance as determined using the corresponding first codebook information, obtaining first information of the N antenna ports, and providing feedback.

48. The first network device as described in claim 39, characterized in that the first criterion is codebook information; and

the transmitter executes the step of feeding back first information of N antenna ports of the M antenna ports according to the first criterion; specifically:

selecting from among M antenna ports the N antenna ports whereby polling all the code words in first codebooks results in optimal average information transmission performance, obtaining first information of the N antenna ports, and providing feedback.

49. The first network device as described in claim 39, characterized in that the first criterion is codebook information; and

the transmitter executes the step of feeding back first information of N antenna ports of the M antenna ports according to the first criterion; specifically:

selecting from among M antenna ports the N antenna ports whereby polling all the code words in first codebooks results in optimal best information transmission performance, obtaining first information of the N antenna ports, and providing feedback.

50. The first network device as described in claim 39, characterized in that the first criterion is data packet information; and

the transmitter executes the step of feeding back first information of N antenna ports of the M antenna ports according to the first criterion; specifically:

selecting from among M antenna ports the N antenna ports whereby transmission of first data packets has optimal transmission performance, obtaining first information of the N antenna ports, and providing feedback; and/or

selecting from among M antenna ports the N antenna ports whereby the smallest number of first data packets are transmitted, obtaining first information of the N antenna ports, and providing feedback; and/or

selecting N antenna ports from among M antenna ports, where N is the smallest number whereby transmission of first data packets meets a certain performance requirement (e.g., the smallest number N of antenna ports having a certain bit error rate), obtaining first information of the N antenna ports, and providing feedback.

51. The first network device as described in claims 39 through 50, characterized in that the second network device configures the first criterion or the first threshold value, second threshold value, third threshold value, and fourth threshold value by broadcasting information, high-layer signaling, or dynamic signaling.

52. The first network device as described in claims 39 through 51, characterized in that the M antenna ports correspond to X channel state information processing processes (CSI processes), and N antenna ports correspond to one CSI process among the X CSI processes, where X is a positive integer.

53. The first network device as described in claims 39 through 52, characterized in that the first information comprises antenna correlation information or channel state information (CSI) corresponding to the N antenna ports or index information of the N antenna ports.

54. A second network device, characterized in that it comprises: a transmitter and a receiver;

wherein the transmitter is for transmitting signals of M antenna ports to a first network device, where M is a positive integer; and

the receiver is for receiving first information of N antenna ports of the M antenna ports fed back by the first network device according to a first criterion, where N is an integer less than or equal to M, and the first criterion is at least one of antenna correlation information, SNR, channel capacity, throughput, SU (single-user)/MU

(multi-user) transmission scheme, transmission mode, codebook information, and data packet size.

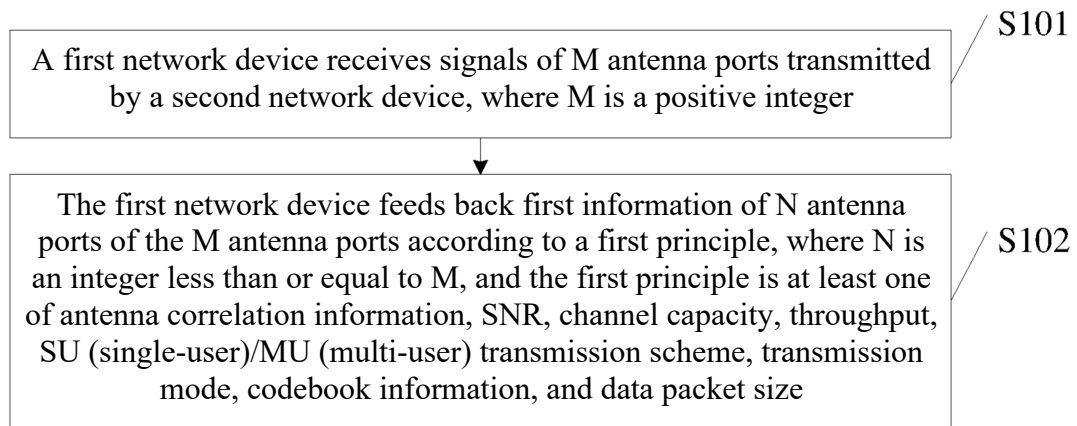
55. The second network device as described in claim 54, characterized in that the first information comprises antenna correlation information;

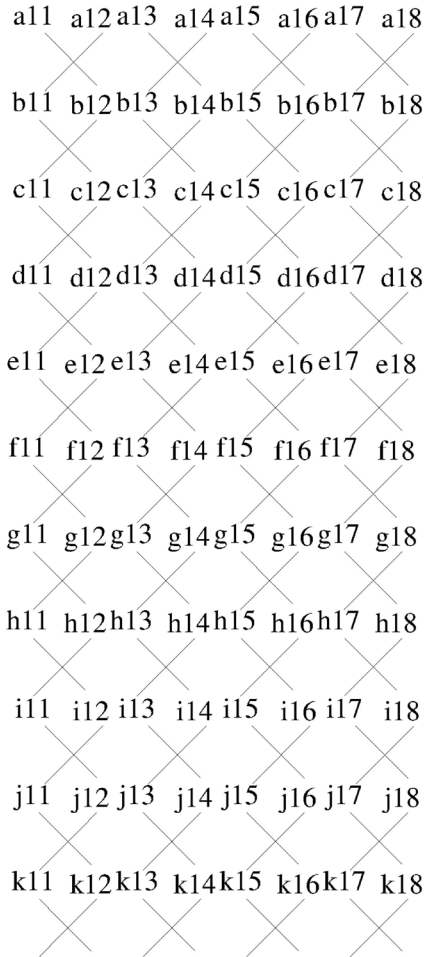
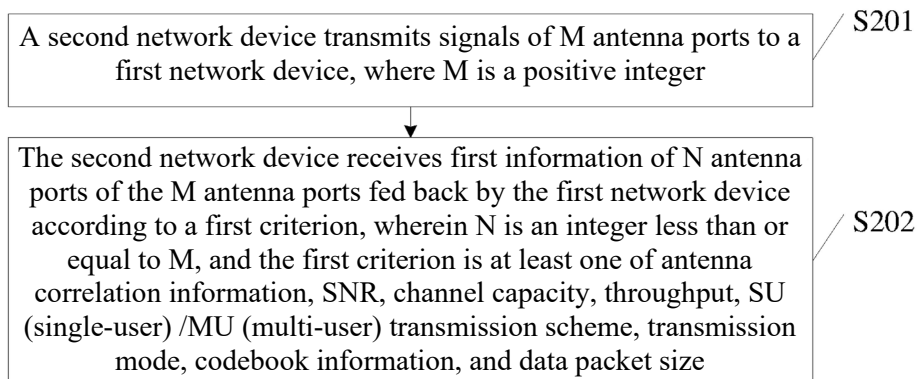
the second network device further comprises: a controller;

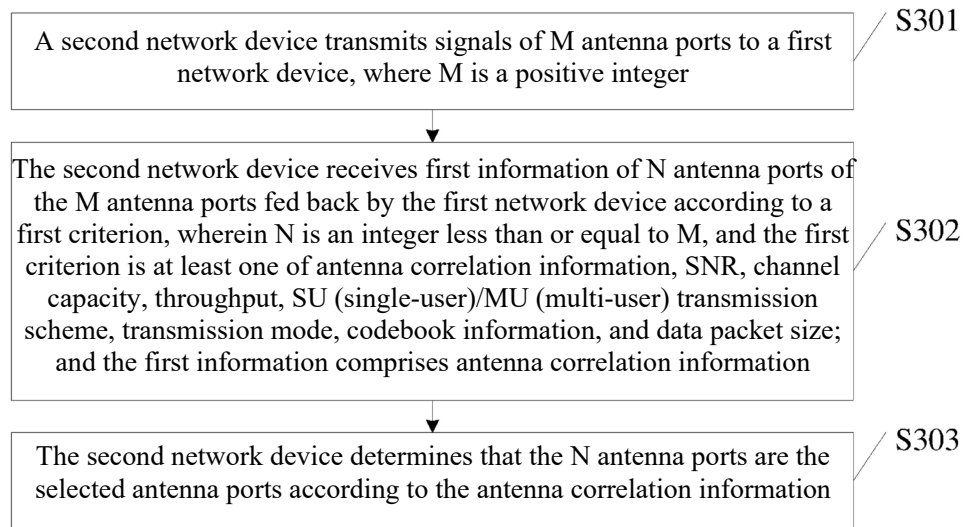
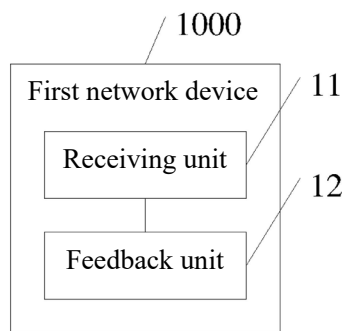
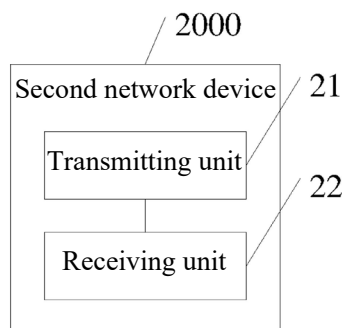
wherein the controller is for determining that the N antenna ports are the selected antenna ports according to the antenna correlation information.

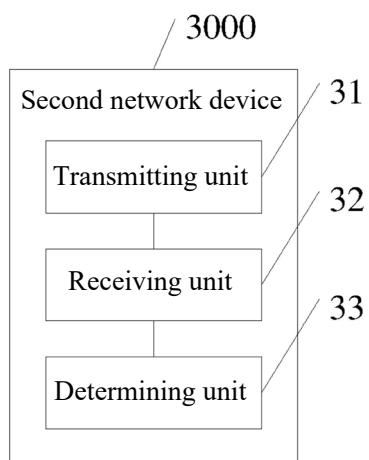
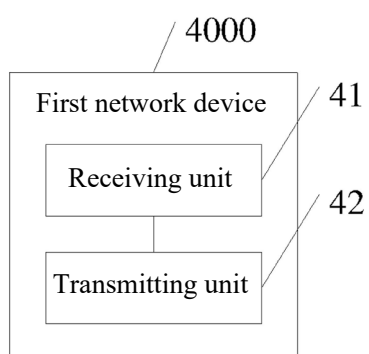
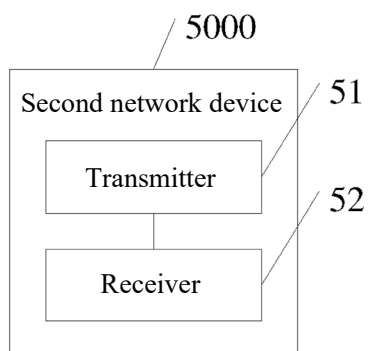
56. The second network device as described in claim 54, characterized in that the first information comprises channel state information (CSI) corresponding to the N antenna ports or index information of the N antenna ports.

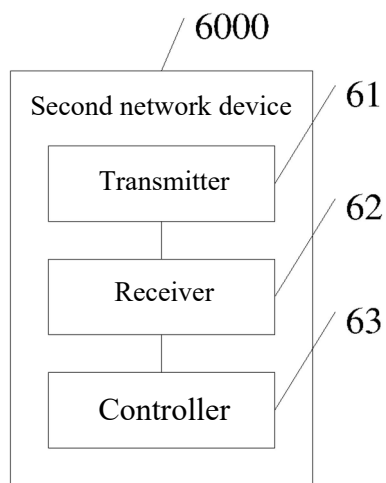
57. The second network device as described in any of claims 54 through 56, characterized in that the transmitter is further for configuring the first criterion, first threshold value, second threshold value, third threshold value, and fourth threshold value by broadcasting information, high-layer signaling, or dynamic signaling.

**FIG. 1**

**FIG. 2****FIG. 3**

**FIG. 4****FIG. 5****FIG. 6**

**FIG. 7****FIG. 8****FIG. 9**

**FIG. 10**