# CHANNEL STATE INFORMATION REPORTING METHOD AND APPARATUS

## CROSS-REFERENCE TO RELATED APPLICATIONS

**[0001]** This application claims priority to Chinese Patent Application No. 202410406126.2 filed with the China National Intellectual Property Administration on April 3, 2024 and entitled "CHANNEL STATE INFORMATION REPORTING METHOD AND APPARATUS", and Chinese Patent Application No. 202410579889.7 filed with the China National Intellectual Property Administration on May 10, 2024 and entitled "CHANNEL STATE INFORMATION REPORTING METHOD AND APPARATUS", which are incorporated herein by reference in their entireties.

## TECHNICAL FIELD

**[0002]** This application relates to the communication field, and in particular, to a channel state information reporting method and an apparatus.

## BACKGROUND

**[0003]** In 5th generation (5th generation, 5G) communication systems, application of the massive multiple-input multiple-output (massive multiple-input multiple-output, massive MIMO) technology plays a crucial role in improving system spectral efficiency. When the MIMO technology is used, before sending data to a terminal, a base station needs to receive channel state information (channel state information, CSI) fed back by the terminal to the base station, and precode the data based on the CSI. Therefore, accurate CSI is important to system performance.

**[0004]** Currently, signaling overheads for indicating codebook subset restriction (codebook subset restriction, CBSR) are high, and how to reduce signaling overheads of CBSR for a large number of ports is a problem worthy of attention.

## SUMMARY

**[0005]** Embodiments of this application provide a channel state information reporting method and an apparatus, to reduce signaling overheads for indicating CBSR.

**[0006]** According to a first aspect, this application provides a channel state information reporting method. The method includes: determining first information, where the first information indicates one or more of P spatial-domain vector groups, spatial-domain vectors included in the one or more spatial-domain vector groups are not used for precoding matrix indicator PMI calculation, the P spatial-domain vector groups are determined based on a spatial-domain vector set, the spatial-domain vector set includes $N_1*N_2*O_1*O_2$ spatial-domain vectors, $O_1$ represents an oversampling factor in a first dimension, $O_2$ represents an oversampling factor in a second dimension, $N_1$ represents the number of antenna ports in the first dimension, $N_2$ represents the number of antenna ports in the second dimension, each of the P spatial-domain vector groups includes K spatial-domain vectors, $P*K=N_1*N_2*O_1*O_2$, $O_1$, $O_2$, $N_1$, and $N_2$ are all positive integers, and P and K are both integers greater than 1; and sending the first information to a terminal.

**[0007]** According to the foregoing method, the first information may indicate, in spatial-domain vector groups, that all the spatial-domain vectors included in the one or more spatial-domain vector groups are not used for PMI calculation, thereby effectively reducing signaling overheads for indicating CBSR.

**[0008]** In a possible design, the first information occupies P bits, and the P bits are in one-to-one correspondence with the P spatial-domain vector groups.

**[0009]** In a possible design, a value of a bit in the P bits that corresponds to a part of or all the one or more spatial-domain vector groups is 0, indicating that PMI reporting for precoding corresponding to the part of or all the spatial-domain vector groups is not allowed.

**[0010]** In a possible design, the P spatial-domain vector groups are determined based on a first grouping manner and the spatial-domain vector set, and second information is sent to the terminal, where the second information indicates the first grouping manner, the first grouping manner is one of M preset grouping manners, and M is an integer greater than 1. According to the foregoing design, the second information may indicate the grouping manner used to determine the P spatial-domain vector groups.

**[0011]** In a possible design, the second information occupies $\lceil \log_2 M \rceil$ bits.

**[0012]** In a possible design, the M preset grouping manners include two or more of the following: each spatial-domain vector group includes $N_1*O_1$ spatial-domain vectors in the first dimension, $P=N_2*O_2$, and $K=N_1*O_1$; each spatial-domain vector group includes $N_2*O_2$ spatial-domain vectors in the second dimension, $P=N_1*O_1$, and $K=N_2*O_2$; or each spatial-domain vector group includes $n_1*n_2$ spatial-domain vectors, $n_1$ represents the number of spatial-domain vectors in the first dimension, $n_2$ represents the number of spatial-domain vectors in the second dimension, $N_1*O_1$ is an integer multiple of $n_1$, $N_2*O_2$ is an integer multiple of $n_2$, and $n_1$ and $n_2$ are positive integers.

**[0013]** In a possible design, the first information includes P bits, and the P bits ordered from start to end are associated with the P spatial-domain vector groups in ascending order of maximum spatial-domain vector indexes in the spatial-domain vector groups; or the P bits ordered from start to end are associated with the P spatial-domain vector groups in ascending order of minimum spatial-domain vector indexes in the spatial-domain vector groups.

**[0014]** In a possible design, third information is sent to the terminal, where the third information indicates a maximum allowed amplitude coefficient corresponding to each of the P spatial-domain vector groups, or the third information indicates a maximum allowed amplitude coefficient corresponding to each of the P spatial-domain vector groups except the one or more spatial-domain vector groups.

**[0015]** In a possible design, before the first information is sent to the terminal, indication information is sent to the terminal, where the indication information indicates $N_1$ and $N_2$. According to the foregoing design, information indicating $N_1$ and $N_2$ does not need to be carried for each CBSR indication, thereby reducing unnecessary signaling overheads.

**[0016]** According to a second aspect, this application provides a channel state information reporting method. The method includes: receiving first information from an access network device, where the first information indicates one or more of P spatial-domain vector groups, spatial-domain vectors included in the one or more spatial-domain vector groups are not used for PMI calculation, the P spatial-domain vector groups are determined based on a spatial-domain vector set, the spatial-domain vector set includes $N_1*N_2*O_1*O_2$ spatial-domain vectors, $O_1$ represents an oversampling factor in a first dimension, $O_2$ represents an oversampling factor in a second dimension, $N_1$ represents the number of antenna ports in the first dimension, $N_2$ represents the number of antenna ports in the second dimension, each of the P spatial-domain vector groups includes K spatial-domain vectors, $P*K=N_1*N_2*O_1*O_2$, $O_1$, $O_2$, $N_1$, and $N_2$ are all positive integers, and P and K are both integers greater than 1; calculating a PMI based on the first information; and sending the PMI to the access network device.

**[0017]** According to the foregoing method, the first information may indicate, in spatial-domain vector groups, that all the spatial-domain vectors included in the one or more spatial-domain vector groups are not used for PMI calculation, thereby effectively reducing signaling overheads for indicating CBSR.

**[0018]** In a possible design, the first information occupies P bits, and the P bits are in one-to-one correspondence with the P spatial-domain vector groups.

**[0019]** In a possible design, a value of a bit corresponding to a part of or all the one or more spatial-domain vector groups is 0, indicating that PMI reporting for precoding corresponding to the part of or all the spatial-domain vector groups is not allowed.

**[0020]** In a possible design, the P spatial-domain vector groups are determined based on a first grouping manner and the spatial-domain vector set, and second information sent from the access network device is received, where the second information indicates the first grouping manner, the first grouping manner is one of M preset grouping manners, and M is an integer greater than 1.

**[0021]** In a possible design, the second information occupies $\lceil \log_2 M \rceil$ bits.

**[0022]** In a possible design, the M preset grouping manners include two or more of the following: each spatial-domain vector group includes $N_1*O_1$ spatial-domain vectors in the first dimension, $P=N_2*O_2$, and $K=N_1*O_1$; each spatial-domain vector group includes $N_2*O_2$ spatial-domain vectors in the second dimension, $P=N_1*O_1$, and $K=N_2*O_2$; or each spatial-domain vector group includes $n_1*n_2$ spatial-domain vectors, $n_1$ represents the number of spatial-domain vectors in the first dimension, $n_2$ represents the number of spatial-domain vectors in the second dimension, $N_1*O_1$ is an integer multiple of $n_1$, $N_2*O_2$ is an integer multiple of $n_2$, and $n_1$ and $n_2$ are positive integers.

**[0023]** In a possible design, the first information includes P bits, and the P bits ordered from start to end are associated with the P spatial-domain vector groups in ascending order of maximum spatial-domain vector indexes in the spatial-domain vector groups; or the P bits ordered from start to end are associated with the P spatial-domain vector groups in ascending order of minimum spatial-domain vector indexes in the spatial-domain vector groups.

**[0024]** In a possible design, third information from the access network device is received, where the third information indicates a maximum allowed amplitude coefficient corresponding to each of the P spatial-domain vector groups, or the third information indicates a maximum allowed amplitude coefficient corresponding to each of the P spatial-domain vector groups except the one or more spatial-domain vector groups. Therefore, a restriction range of the CBSR can be expanded by using the third information, so that codebook performance can be further improved.

**[0025]** In a possible design, before the first information from the access network device is received, indication information from the access network device is received, where the indication information indicates $N_1$ and $N_2$. According to the foregoing design, information indicating $N_1$ and $N_2$ does not need to be carried for each CBSR indication, thereby reducing unnecessary signaling overheads.

**[0026]** According to a third aspect, this application provides a channel state information reporting method. The method includes: determining information 1 and m pieces of information 2, where the information 1 indicates m of Q spatial-domain vector groups, the m pieces of information 2 are in one-to-one correspondence with the m spatial-domain vector groups, each piece of information 2 indicates n spatial-domain vectors in a corresponding spatial-domain vector group, the n spatial-domain vectors indicated by each piece of information 2 are not used for PMI

calculation, the Q spatial-domain vector groups are determined based on a spatial-domain vector set, the spatial-domain vector set includes $N_1*N_2*O_1*O_2$ spatial-domain vectors, $O_1$ represents an oversampling factor in a first dimension, $O_2$ represents an oversampling factor in a second dimension, $N_1$ represents the number of antenna ports in the first dimension, $N_2$ represents the number of antenna ports in the second dimension, $O_1$, $O_2$, $N_1$, and $N_2$ are all positive integers, each of the Q spatial-domain vector groups includes S spatial-domain vectors, $Q*S=N_1*N_2*O_1*O_2$, and Q, S, m, and n are positive integers; and sending the information 1 and the m pieces of information 2 to a terminal.

**[0027]** According to the foregoing method, the number (for example, m) of spatial-domain vector groups that need to be selected and the number (for example, n) of spatial-domain vectors that need to be selected in the selected spatial-domain vector group are fixed, so that the number of spatial-domain vectors that are not selected can be fixed, thereby effectively reducing signaling overheads for indicating CBSR.

**[0028]** In a possible design, the information 1 occupies $\lceil \log_2 C_Q^m \rceil$ bits, and the information 2 occupies $\lceil \log_2 C_S^n \rceil$ bits.

**[0029]** In a possible design, $Q=O_1*O_2$, $K=N_1*N_2$, the $O_1*O_2$ spatial-domain vector groups are orthogonal groups, $N_1*N_2$ spatial-domain vectors in each spatial-domain vector group are orthogonal, the information 1 occupies $\lceil \log_2 C_{O_1*O_2}^m \rceil$ bits, and the information 2 occupies $\lceil \log_2 C_{N_1*N_2}^n \rceil$ bits.

**[0030]** In a possible design, $Q=N_1*N_2$, $K=O_1*O_2$, the $N_1*N_2$ spatial-domain vector groups are oversampled spatial-domain vector groups, the information 1 occupies $\lceil \log_2 C_{N_1*N_2}^m \rceil$ bits, and the information 2 occupies $\lceil \log_2 C_{O_1*O_2}^n \rceil$ bits.

**[0031]** In a possible design, before the information 1 and the m pieces of information 2 are sent to the terminal, indication information is sent to the terminal, where the indication information indicates $N_1$ and $N_2$. According to the foregoing design, information indicating $N_1$ and $N_2$ does not need to be carried for each CBSR indication, thereby reducing unnecessary signaling overheads.

**[0032]** In a possible design, information 3 is sent to the terminal, where the information 3 indicates a maximum allowed amplitude coefficient corresponding to each spatial-domain vector in each of the m spatial-domain vector groups, or the information 3 indicates a maximum allowed amplitude coefficient corresponding to each spatial-domain vector in each of the m spatial-domain vector groups except n spatial-domain vectors indicated by corresponding information 2. Therefore, a restriction range of the CBSR can be expanded by using the information 3, so that codebook performance can be further improved.

**[0033]** According to a fourth aspect, this application provides a channel state information

reporting method. The method includes: receiving information 1 and m pieces of information 2 from an access network device, where the information 1 indicates m of Q spatial-domain vector groups, the m pieces of information 2 are in one-to-one correspondence with the m spatial-domain vector groups, each piece of information 2 indicates n spatial-domain vectors in a corresponding spatial-domain vector group, the n spatial-domain vectors indicated by each piece of information 2 are not used for PMI calculation, the Q spatial-domain vector groups are determined based on a spatial-domain vector set, the spatial-domain vector set includes $N_1*N_2*O_1*O_2$ spatial-domain vectors, $O_1$ represents an oversampling factor in a first dimension, $O_2$ represents an oversampling factor in a second dimension, $N_1$ represents the number of antenna ports in the first dimension, $N_2$ represents the number of antenna ports in the second dimension, $O_1$, $O_2$, $N_1$, and $N_2$ are all positive integers, each of the Q spatial-domain vector groups includes S spatial-domain vectors, $Q*S=N_1*N_2*O_1*O_2$, and Q, S, m, and n are positive integers; calculating a PMI based on the information 1 and the m pieces of information 2; and sending the PMI to the access network device.

**[0034]** According to the foregoing method, the number (for example, m) of spatial-domain vector groups that need to be selected and the number (for example, n) of spatial-domain vectors that need to be selected in the selected spatial-domain vector group are fixed, so that the number of spatial-domain vectors that are not selected can be fixed, thereby effectively reducing signaling overheads for indicating CBSR.

**[0035]** In a possible design, the information 1 occupies $\lceil \log_2 C_Q^m \rceil$ bits, and the information 2 occupies $\lceil \log_2 C_S^n \rceil$ bits.

**[0036]** In a possible design, $Q=O_1*O_2$, $K=N_1*N_2$, the $O_1*O_2$ spatial-domain vector groups are orthogonal groups, $N_1*N_2$ spatial-domain vectors in each spatial-domain vector group are orthogonal, the information 1 occupies $\lceil \log_2 C_{O_1*O_2}^m \rceil$ bits, and the information 2 occupies $\lceil \log_2 C_{N_1*N_2}^n \rceil$ bits.

**[0037]** In a possible design, $Q=N_1*N_2$, $K=O_1*O_2$, the $N_1*N_2$ spatial-domain vector groups are oversampled spatial-domain vector groups, the information 1 occupies $\lceil \log_2 C_{N_1*N_2}^m \rceil$ bits, and the information 2 occupies $\lceil \log_2 C_{O_1*O_2}^n \rceil$ bits.

**[0038]** In a possible design, before the information 1 and the m pieces of information 2 from the access network device are received, indication information from the access network device is received, where the indication information indicates $N_1$ and $N_2$. According to the foregoing design, information indicating $N_1$ and $N_2$ does not need to be carried for each CBSR indication, thereby reducing unnecessary signaling overheads.

**[0039]** In a possible design, information 3 from the access network device is received, where the information 3 indicates a maximum allowed amplitude coefficient corresponding to each

spatial-domain vector in each of the m spatial-domain vector groups, or the information 3 indicates a maximum allowed amplitude coefficient corresponding to each spatial-domain vector in each of the m spatial-domain vector groups except n spatial-domain vectors indicated by corresponding information 2. Therefore, a restriction range of the CBSR can be expanded by using the information 3, so that codebook performance can be further improved.

**[0040]** According to a fifth aspect, this application provides a channel state information reporting method. The method includes: determining information A and information B, where the information A indicates whether each of $N_1*O_1$ spatial-domain vector groups includes a spatial-domain vector that is not used for PMI calculation, each of the $N_1*O_1$ spatial-domain vector groups includes $N_2*O_2$ spatial-domain vectors in a second dimension in a spatial-domain vector set, the information B indicates whether each of $N_2*O_2$ spatial-domain vector groups includes a spatial-domain vector that is not used for PMI calculation, each of the $N_2*O_2$ spatial-domain vector groups includes $N_1*O_1$ spatial-domain vectors in a first dimension in the spatial-domain vector set, the spatial-domain vector set includes $N_1*N_2*O_1*O_2$ spatial-domain vectors, $O_1$ represents an oversampling factor in the first dimension, $O_2$ represents an oversampling factor in the second dimension, $N_1$ represents the number of antenna ports in the first dimension, $N_2$ represents the number of antenna ports in the second dimension, and $O_1$, $O_2$, $N_1$, and $N_2$ are all positive integers; and sending the information A and the information B to a terminal.

**[0041]** According to the foregoing method, two-dimensional coordinates of one or more spatial-domain vectors in the spatial-domain vector set that are not used for PMI calculation can be determined by using two bitmaps, that is, the information A and the information B, thereby effectively reducing signaling overheads for indicating CBSR.

**[0042]** In a possible design, the information A includes $N_1*O_1$ bits, and the information B includes $N_2*O_2$ bits.

**[0043]** In a possible design, information C and/or information D are/is sent to the terminal, where the information C indicates a maximum allowed amplitude coefficient corresponding to each of the $N_1*O_1$ spatial-domain vector groups, and the information D indicates a maximum allowed amplitude coefficient corresponding to each of the $N_2*O_2$ spatial-domain vector groups. Therefore, a restriction range of the CBSR can be expanded by using the information C and/or the information D, so that codebook performance can be further improved.

**[0044]** In a possible design, before the information A and the information B are sent to the terminal, indication information is sent to the terminal, where the indication information indicates $N_1$ and $N_2$. According to the foregoing design, information indicating $N_1$ and $N_2$ does not need to be carried for each CBSR indication, thereby reducing unnecessary signaling overheads.

**[0045]** According to a sixth aspect, this application provides a channel state information

reporting method. The method includes: receiving information A and information B from an access network device, where the information A indicates whether each of $N_1*O_1$ spatial-domain vector groups includes a spatial-domain vector that is not used for PMI calculation, each of the $N_1*O_1$ spatial-domain vector groups includes $N_2*O_2$ spatial-domain vectors in a second dimension in a spatial-domain vector set, the information B indicates whether each of $N_2*O_2$ spatial-domain vector groups includes a spatial-domain vector that is not used for PMI calculation, each of the $N_2*O_2$ spatial-domain vector groups includes $N_1*O_1$ spatial-domain vectors in a first dimension in the spatial-domain vector set, the spatial-domain vector set includes $N_1*N_2*O_1*O_2$ spatial-domain vectors, $O_1$ represents an oversampling factor in the first dimension, $O_2$ represents an oversampling factor in the second dimension, $N_1$ represents the number of antenna ports in the first dimension, $N_2$ represents the number of antenna ports in the second dimension, and $O_1$, $O_2$, $N_1$, and $N_2$ are all positive integers; calculating a PMI based on the information A and the information B; and sending the PMI to the access network device.

**[0046]** According to the foregoing method, two-dimensional coordinates of one or more spatial-domain vectors in the spatial-domain vector set that are not used for PMI calculation can be determined by using two bitmaps, that is, the information A and the information B, thereby effectively reducing signaling overheads for indicating CBSR.

**[0047]** In a possible design, the information A includes $N_1*O_1$ bits, and the information B includes $N_2*O_2$ bits.

**[0048]** In a possible design, information C and/or information D from the access network device are/is received, where the information C indicates a maximum allowed amplitude coefficient corresponding to each of the $N_1*O_1$ spatial-domain vector groups, and the information D indicates a maximum allowed amplitude coefficient corresponding to each of the $N_2*O_2$ spatial-domain vector groups. Therefore, a restriction range of the CBSR can be expanded by using the information C and/or the information D, so that codebook performance can be further improved.

**[0049]** In a possible design, before the information A and the information B from the access network device are received, indication information from the access network device is received, where the indication information indicates $N_1$ and $N_2$. According to the foregoing design, information indicating $N_1$ and $N_2$ does not need to be carried for each CBSR indication, thereby reducing unnecessary signaling overheads.

**[0050]** According to a seventh aspect, this application provides a communication apparatus. The communication apparatus may be a first apparatus, or may be modules or units (for example, chips, chip systems, or circuits) in the first apparatus that perform, in a one-to-one correspondence manner, the methods/operations/steps/actions described in any one of the first aspect, the third aspect, or the fifth aspect, or may be used in combination with the first apparatus.

**[0051]** According to an eighth aspect, this application provides a communication apparatus. The communication apparatus may be a second apparatus, or may be modules or units (for example, chips, chip systems, or circuits) in the second apparatus that perform, in a one-to-one correspondence manner, the methods/operations/steps/actions described in any one of the second aspect, the fourth aspect, or the sixth aspect, or may be used in combination with the second apparatus.

**[0052]** According to a ninth aspect, this application provides a communication device, including at least one processing element. At least one storage element is configured to store a program and data. The at least one processing element is configured to read and execute the program and the data that are stored in the storage element, to implement the method according to any one of the foregoing aspects of this application.

**[0053]** In a possible design, the communication device further includes the at least one storage element.

**[0054]** According to a tenth aspect, this application further provides a computer program. When the computer program is run on a computer, the computer is enabled to perform the method according to any one of the foregoing aspects.

**[0055]** According to an eleventh aspect, this application provides a communication apparatus. The apparatus includes an interface circuit and at least one processor. The interface circuit is configured to provide input and/or output of a program or instructions for the at least one processor. The at least one processor is configured to execute the program or the instructions, to enable the communication apparatus to implement the method according to any one of the foregoing aspects.

**[0056]** In a possible manner, the communication apparatus includes at least one memory, and the at least one memory is configured to store the program or the instructions.

**[0057]** According to a twelfth aspect, this application provides a computer storage medium. The storage medium stores a software program. When the software program is read and executed by one or more processors, the method according to any one of the foregoing aspects may be implemented.

**[0058]** According to a thirteenth aspect, this application provides a computer program product including instructions. When the instructions are run on a computer, the computer is enabled to perform the method according to any one of the foregoing aspects.

**[0059]** According to a fourteenth aspect, this application provides a chip system. The chip system includes at least one chip and a memory. The at least one chip is configured to read and execute a program stored in the memory, to implement the method according to any one of the foregoing aspects.

**[0060]** According to a fifteenth aspect, this application provides a communication system. The

communication system includes at least one terminal and a base station. The base station is configured to perform the method according to the first aspect, and the terminal is configured to perform the method according to the second aspect; or the base station is configured to perform the method according to the third aspect, and the terminal is configured to perform the method according to the fourth aspect; or the base station is configured to perform the method according to the fifth aspect, and the terminal is configured to perform the method according to the sixth aspect.

**[0061]** In this application, the implementations provided in the foregoing aspects may be further combined to provide more implementations.

## BRIEF DESCRIPTION OF DRAWINGS

**[0062]** FIG. 1 is an architectural diagram of a possible communication system according to this application;

**[0063]** FIG. 2 is a structural diagram of modules included in an access network device and a terminal according to this application;

**[0064]** FIG. 3 is a diagram of a baseband hardware implementation according to this application;

**[0065]** FIG. 4 is a flowchart of reporting CSI by a terminal according to this application;

**[0066]** FIG. 5 is a diagram of generating a Type I codebook;

**[0067]** FIG. 6 is an overview flowchart of a channel state information reporting method according to this application;

**[0068]** FIG. 7A is a diagram of a possible grouping manner according to this application;

**[0069]** FIG. 7B is a diagram of another possible grouping manner according to this application;

**[0070]** FIG. 8A is a diagram 1 of a grouping manner A according to this application;

**[0071]** FIG. 8B is a diagram 2 of the grouping manner A according to this application;

**[0072]** FIG. 9A is a diagram 1 of a grouping manner B according to this application;

**[0073]** FIG. 9B is a diagram 2 of the grouping manner B according to this application;

**[0074]** FIG. 10 is a diagram of a grouping manner D according to this application;

**[0075]** FIG. 11 is an overview flowchart of another channel state information reporting method according to this application;

**[0076]** FIG. 12 is an overview flowchart of still another channel state information reporting method according to this application;

**[0077]** FIG. 13A is a diagram of information A according to this application;

**[0078]** FIG. 13B is a diagram of information B according to this application;

**[0079]** FIG. 14 is an overview flowchart of yet another channel state information reporting method according to this application;

**[0080]** FIG. 15A is a diagram of m spatial-domain vector groups according to this application;

**[0081]** FIG. 15B is a diagram of M spatial-domain vector groups according to this application;

**[0082]** FIG. 16 is a diagram of a communication apparatus according to this application; and

**[0083]** FIG. 17 is a diagram of another communication apparatus according to this application.

## DESCRIPTION OF EMBODIMENTS

**[0084]** The following describes specific implementations of this application by using examples with reference to accompanying drawings in embodiments of this application. The detailed descriptions of the following embodiments should not be understood in a limitative sense. Terms used in embodiments of this application are merely used to explain specific embodiments of this application, but are not intended to limit this application.

**[0085]** Embodiments of this application may be applied to various communication systems, for example, a long term evolution (long term evolution, LTE) system, an LTE frequency division duplex (frequency division duplex, FDD) system, an LTE time division duplex (time division duplex, TDD) system, a worldwide interoperability for microwave access (worldwide interoperability for microwave access, WIMAX) communication system, a 5G system or a new radio (new radio, NR) system, a future communication system or other similar communication systems (for example, 6G), an ultra-wideband (ultra-wideband, UWB) system, or a wireless fidelity (wireless fidelity, Wi-Fi) system.

**[0086]** FIG. 1 is a diagram of a possible non-limiting system. As shown in FIG. 1, the communication system 1000 includes a radio access network 100 and a core network 200. Optionally, the communication system 1000 may further include the internet 300. The radio access network 100 may include at least one radio access network device (for example, 110a and 110b in FIG. 1), and may further include at least one terminal (for example, 120a to 120j in FIG. 1). The terminal is connected to the radio access network device in a wireless manner, and the radio access network device is connected to the core network in a wireless or wired manner. A core network device and a radio access network device may be different physical devices independent of each other, or functions of the core network device and logical functions of the radio access network device may be integrated into a same physical device, or a part of functions of the core network device and a part of functions of the radio access network device may be integrated into one physical device. Terminals may be connected to each other and radio access network devices may be connected to each other in a wired or wireless manner. FIG. 1 is merely a diagram. The

communication system may further include other network devices, for example, a wireless relay device and a wireless backhaul device not shown in FIG. 1.

**[0087]** The radio access network device may be a base station (base station), an evolved NodeB (evolved NodeB, eNodeB), a transmission reception point (transmission reception point, TRP), a next generation NodeB (next generation NodeB, gNB) in a 5G mobile communication system, a next generation NodeB in a 6th generation (6th generation, 6G) mobile communication system, a base station in a future mobile communication system, an access node in a Wi-Fi system, or the like. Alternatively, the radio access network may be an open access network (open RAN, O-RAN, or ORAN) or a cloud radio access network (cloud radio access network, CRAN). Alternatively, the radio access network may be a communication system integrating two or more of the foregoing systems. The radio access network device may be a macro base station (for example, 110a in FIG. 1), or may be a micro base station or an indoor station (for example, 110b in FIG. 1), or may be a relay node, a donor node, or the like.

**[0088]** In addition, the radio access network device may alternatively be a module or unit that completes a part of functions of a base station, for example, a central unit (central unit, CU), a distributed unit (distributed unit, DU), a CU-control plane (control plane, CP), a CU-user plane (user plane, UP), or a radio unit (radio unit, RU). In different systems, the CU (or the CU-CP and the CU-UP), the DU, or the RU may have different names, but a person skilled in the art may understand meanings thereof. For example, in the ORAN system, the CU may also be referred to as an O-CU (open CU), the DU may also be referred to as an O-DU, the CU-CP may also be referred to as an O-CU-CP, the CU-UP may also be referred to as an O-CU-UP, and the RU may also be referred to as an O-RU. For ease of description, the CU, the CU-CP, the CU-UP, the DU, and the RU are used as examples for description in this application. Any one of the CU (or the CU-CP or the CU-UP), the DU, and the RU in this application may be implemented by using a software module, a hardware module, or a combination of a software module and a hardware module.

**[0089]** A specific technology and a specific device form that are used for the radio access network device are not limited in embodiments of this application. For ease of description, the radio access network device is briefly referred to as an access network device below for description. It may be understood that the access network device may be referred to as a communication apparatus. For example, the access network device may be understood as an apparatus having a function of the access network device. For example, the apparatus having the function of the access network device may be the access network device, or a part of elements, for example, a CU or a DU, in the access network device. Alternatively, the apparatus may be an apparatus that can support the access network device in implementing the function, for example, a chip system, a

hardware circuit, a software module, or a hardware circuit plus a software module. The apparatus may be installed in the access network device, or may be used in combination with the access network device. In embodiments of this application, the chip system may include a chip, or may include a chip and another discrete component.

**[0090]** The terminal may also be referred to as a terminal device, user equipment (user equipment, UE), a mobile station, a mobile terminal, or the like. The terminal may be widely used in various scenarios, for example, device-to-device (device-to-device, D2D) communication, vehicle-to-everything (vehicle-to-everything, V2X) communication, machine-type communication (machine-type communication, MTC), internet of things (internet of things, IoT), virtual reality, augmented reality, industrial control, autonomous driving, telemedicine, smart grid, smart furniture, smart office, smart wearable, smart transportation, and smart city. The terminal may be a mobile phone, a tablet computer, a computer with a wireless transceiver function, a wearable device, a vehicle, an uncrewed aerial vehicle, a helicopter, an airplane, a ship, a robot, a robot arm, a smart home device, or the like.

**[0091]** A specific technology and a specific device form that are used for the terminal are not limited in embodiments of this application. It may be understood that the terminal may be referred to as a communication apparatus. For example, the terminal may be understood as an apparatus having a function of the terminal. For example, the apparatus having the function of the terminal may be the terminal, or may be an apparatus that can support the terminal in implementing the function, for example, a chip system, a hardware circuit, a software module, or a hardware circuit plus a software module. The apparatus may be installed in the terminal, or may be used in combination with the terminal.

**[0092]** The access network device and the terminal may be fixed or movable. The access network device and the terminal may be deployed on land, including indoor, outdoor, hand-held, or vehicle-mounted devices; or may be deployed on water; or may be deployed on airplanes, balloons, and artificial satellites. Application scenarios of the access network device and the terminal are not limited in embodiments of this application.

**[0093]** Roles of the access network device and the terminal may be relative. For example, the helicopter or unmanned aerial vehicle 120i in FIG. 1 may be configured as a mobile access network device. For the terminal 120j accessing the radio access network 100 through 120i, the unmanned aerial vehicle 120i is an access network device. However, for the access network device 110a, 120i is a terminal, that is, 110a and 120i communicate with each other by using a radio air interface protocol. Certainly, 110a and 120i may alternatively communicate with each other by using an interface protocol between access network devices. In this case, for 110a, 120i is also an access network device. 110a and 110b in FIG. 1 may be referred to as communication apparatuses having

a function of an access network device, and 120a to 120j in FIG. 1 may be referred to as communication apparatuses having a function of a terminal.

**[0094]** Communication between an access network device and a terminal, between access network devices, and between terminals may be performed on a licensed spectrum, an unlicensed spectrum, or both, and may be performed on a spectrum below 6 gigahertz (gigahertz, GHz), a spectrum above 6 GHz, or both. Spectrum resources used for wireless communication are not limited in embodiments of this application.

**[0095]** FIG. 2 is a structural diagram of modules included in an access network device and a terminal according to this application. A radio resource control (radio resource control, RRC) signaling exchange module is a module used by the access network device and the terminal to send and receive RRC signaling. A medium access control (medium access control, MAC) signaling exchange module is a module used by the access network device and the terminal to send and receive medium access control-control element (MAC control element, MAC-CE) signaling. A physical layer (Physical Layer, PHY) signaling and data exchange module is a module used by the access network device and the terminal to send and receive uplink/downlink control signaling and uplink/downlink data.

**[0096]** It may be understood that, in embodiments of this application, a physical downlink shared channel (physical downlink shared channel, PDSCH), a physical downlink control channel (physical downlink control channel, PDCCH), a physical uplink control channel (physical uplink control channel, PUCCH), and a physical uplink shared channel (physical uplink shared channel, PUSCH) are merely used as examples of a downlink data channel, a downlink control channel, an uplink control channel, and an uplink data channel respectively. In different systems and different scenarios, the data channel and the control channel may have different names. This is not limited in embodiments of this application.

**[0097]** FIG. 3 is a diagram of a possible baseband (baseband) hardware implementation in a terminal or an access network device. The baseband may be implemented by using a processing system including one or more processors (processors). The processor includes a microprocessor (for example, X86 or ARM), a microcontroller, a digital signal processor (digital signal processor, DSP), a field programmable gate array (field programmable gate array, FPGA), a GPU, a programmable logic device (programmable logic device, PLD), a state machine, gating logic, a discrete hardware circuit, and other appropriate hardware configured as various functions. That is, the processor used in the baseband may be configured to implement processes described below and any one or more steps in the processes.

**[0098]** The processing system may be implemented by using a bus architecture, usually represented by a bus (bus). The bus may include any number of interconnect buses and bridges,

depending on specific applications and overall design constraints of the processing system. The bus may couple various circuits together, including one or more processors (usually represented by a processor), a memory (memory), and a computer-readable medium (computer-readable medium). The bus may be further coupled to various other circuits, such as a timing source, a peripheral, a voltage regulator, and a power management circuit. Therefore, details are not further described. A bus interface (bus interface) provides interfaces between the bus and a transceiver and between the bus and an interface.

**[0099]** The transceiver provides a communication interface or an apparatus that is configured to communicate with various other apparatuses through a wireless transmission medium. The transceiver may be coupled to an antenna array, and the transceiver and the antenna array may be configured together to communicate with a corresponding network type. At least one interface (for example, a network interface and/or a user interface) provides a communication interface or an apparatus for communication through an internal bus or via an external transmission medium.

**[00100]** The processor is responsible for managing the bus and general processing, including executing software stored on the computer-readable medium. When the software is executed by the processor, the software enables the processing system to perform various functions described below for any specific device. Functions that may be implemented by the processor, the memory, and the computer-readable medium may be: encoding, decoding, rate matching, de-rate matching, scrambling, descrambling, modulation, demodulation, layer mapping, fast Fourier transform (fast Fourier transform, FFT), inverse fast Fourier transform (inverse fast Fourier transform, IFFT), inverse discrete Fourier transform (inverse discrete Fourier transform, IDFT), precoding, resource element (resource element, RE) mapping, channel equalization, RE demapping, digital beamforming (beamforming, BF), add cyclic prefix (cyclic prefix, CP), remove CP, and the like.

**[00101]** The following briefly describes basic concepts in this application.

**[00102]** 1. CSI

**[00103]** When a signal is transmitted from a transmit end to a receive end through a radio channel, the signal may fade due to scattering, reflection, or distance-dependent energy attenuation. The CSI is used to represent a feature of a radio channel, and may include a channel quality indicator (channel quality indicator, CQI), a precoding matrix indicator (precoding matrix indicator, PMI), a CSI-RS resource indicator (CSI-RS resource indicator, CRI), a synchronization signal/physical broadcast channel block resource indicator (synchronization signal/physical broadcast channel block resource indicator, SSBRI), a layer indicator (layer indicator, LI), a rank indicator (rank indicator, RI), or the like. The CSI may be sent by a terminal to an access network device through a PUCCH or a PUSCH.

**[00104]** In embodiments of this application, if there is no logical conflict, the "CSI" and a "CSI

report (CSI report)" may be interchanged, and "reporting", "feedback", and "sending" may be interchanged.

**[00105]** In a frequency division duplex (frequency division duplex, FDD) system, because an interval between uplink and downlink frequency bands is greater than a bandwidth, uplink and downlink channels are not completely reciprocal. In a conventional FDD system, a basic procedure in which a terminal sends CSI to an access network device is shown in FIG. 4.

**[00106]** With reference to FIG. 4, the access network device first needs to send signaling, where the signaling is used to configure channel measurement, and notify the terminal of time and behavior for channel measurement, which corresponds to A in FIG. 4. Then, the access network device sends a pilot to the terminal, where the pilot is used for channel measurement, which corresponds to B in FIG. 4. For example, the pilot may also be referred to as a reference signal (reference signal, RS), which is a signal known by both a transmit end and a receive end and provided by the transmit end to the receive end for channel estimation or channel sounding. Reference signals are classified into uplink reference signals and downlink reference signals. Unless otherwise specified, the reference signal in this application is a downlink reference signal. For example, the downlink reference signal may be a CSI-RS or a demodulation reference signal (demodulation reference signal, DMRS). This is not limited in this application. The terminal performs measurement based on the pilot sent by the access network device, obtains final CSI through calculation, and reports the CSI to the access network device, which corresponds to C in FIG. 4. The access network device sends data based on the CSI fed back by the terminal, which corresponds to D in FIG. 4. The access network device determines, based on an RI fed back by the terminal, the number of streams for transmitting data to the terminal. The access network device determines, based on a CQI fed back by the terminal, a modulation order for transmitting data to the terminal and a code rate for channel coding. The access network device determines, based on a PMI fed back by the terminal, precoding for transmitting data to the terminal.

**[00107]** In a time division duplex (time division duplex, TDD) system, an uplink channel and a downlink channel use a same frequency band, and therefore are reciprocal. An access network device may obtain CSI of the downlink channel based on the uplink channel by using the channel reciprocity, to precode downlink data. However, in some cases, for example, for a cell edge user, the access network device may obtain a large uplink channel estimation error due to low transmit power of the user. In such cases, precoding may alternatively be determined based on CSI fed back by a terminal. A specific procedure is similar to that in the FDD system.

**[00108]** 2. Type I (Type I) codebook

**[00109]** In a 5G communication system, the Type I codebook uses a two-stage codebook structure $W= W_1*W_2$, which is designed not only to meet a link performance requirement, but also

to consider feedback overheads during codebook design. A wideband spatial-domain vector group, namely, $W_1$, is selected based on a wideband spatial characteristic of a channel, and a spatial-domain vector, namely, $W_2$, is selected based on a subband characteristic of the channel. In addition, in a process of determining $W_2$, a phase difference between two polarization directions may be further quantized, to implement phase adjustment between the polarization directions.

**[00110]** For example, as shown in FIG. 5, a process of generating the Type I codebook includes the following steps:

**[00111]** (1) Determine a spatial-domain vector set, that is, a set of all weights in each codebook.

**[00112]** The spatial-domain vector set may be determined based on $N_1$, $N_2$, $O_1$, and $O_2$. $O_1$ represents an oversampling factor in a first dimension, $O_2$ represents an oversampling factor in a second dimension, $N_1$ represents the number of antenna ports in the first dimension, and $N_2$ represents the number of antenna ports in the second dimension. The oversampling factor may also be referred to as a discrete Fourier transform (discrete Fourier transform, DFT) oversampling factor, and the number of antenna ports may also be referred to as the number of logical antenna ports. For example, the first dimension and the second dimension represent two different directions of a same polarization. For example, the first dimension is a horizontal direction, and the second dimension is a vertical direction; or the second dimension is the horizontal direction, and the first dimension is the vertical direction. In the following examples, only the example in which the first dimension is the horizontal direction and the second dimension is the vertical direction is used for description.

**[00113]** (2) Select a wideband spatial-domain vector group from the spatial-domain vector set, that is, generate $W_1$.

**[00114]** (3) Select a spatial-domain vector based on $W_1$ and adjust a phase, that is, generate $W_2$.

**[00115]** For example, if the first dimension is the horizontal direction and the second dimension is the vertical direction, during spatial-domain vector forming (or beamforming), $N_1$ weight vectors in the horizontal dimension and $N_2$ weight vectors in the vertical dimension may be formed, leading to $N_1*N_2$ weight vectors in total. The $N_1*N_2$ weight vectors are orthogonal to each other, that is, there is no interference between spatial-domain vectors formed through weighting by using these weight vectors. The number of weight vectors is increased in the horizontal direction and the vertical direction through DFT oversampling, so that more weight vectors can be generated. When an antenna form is fixed, that is, when $N_1$ and $N_2$ are determined, values of $O_1$ and $O_2$ also determine spatial-domain vector density in the horizontal direction and the vertical direction. Larger values of $O_1$ and $O_2$ indicate a smaller step between spatial-domain vectors during spatial-domain vector scanning and higher precision, but also cause a drawback that weight vectors are no longer orthogonal to each other, that is, there is interference between spatial-domain vectors.

**[00116]** The Type I codebook may be extended to more ports, for example, 64 ports or 128 ports, by extending values of the numbers (namely, $N_1$ and $N_2$) of logical antenna ports. For dual-polarized antennas, the number of CSI-RS antenna ports supported by the Type I codebook is equal to $2*N_1*N_2$. For example, to support CSI measurement of 64 ports, a possible value of ($N_1$, $N_2$) needs to be configured to (8, 4), and when the oversampling factors in the horizontal direction and the vertical direction are both 1, that is, values of $O_1$ and $O_2$ are 1, 32 orthogonal weight vectors are generated for each polarization direction. To support CSI measurement of 128 ports, a possible value of ($N_1$, $N_2$) needs to be configured to (8, 8) or (16, 4), and when values of $O_1$ and $O_2$ are 1, 64 orthogonal weight vectors are generated for each polarization direction.

**[00117]** For example, CBSR may be indicated for the Type I codebook by using a bitmap (bitmap) including $O_1*O_2*N_1*N_2$ bits. A value 0 of a bit indicates that a spatial-domain vector corresponding to the bit cannot be selected for PMI calculation (or is not used for PMI calculation), and 1 indicates that the spatial-domain vector corresponding to the bit can be selected for PMI calculation. For example, for CBSR of a 128-port Type I codebook, RRC signaling overheads may reach 1024 bits at most, where $2N_1*N_2=128$, and maximum values of $O_1$ and $O_2$ are both 4. It can be learned that the foregoing CBSR indication manner incurs extremely high signaling overheads, and is not applicable to feedback scenarios of CBSR with large numbers of ports. In addition, a Type II (Type II) codebook or an enhanced Type II (enhanced Type II) codebook also has the problem of high signaling overheads for indicating CBSR. The following embodiments are applicable to both Type I scenarios and Type II scenarios. This is not limited in this application.

**[00118]** Unless otherwise specified in this specification, a "terminal" and an "access network device" are used as execution bodies for description.

**[00119]** The "terminal" may be understood as an apparatus having a function of a terminal, an apparatus implementing a function of a terminal, or a module (for example, a chip or a circuit) in a terminal. The "access network device" may be understood as an apparatus having a function of an access network device, an apparatus implementing a function of an access network device, or a module (for example, a chip or a circuit) in an access network device, or may be all or a part of modules or units (for example, a CU, a DU, or an RU) implementing a function of an access network device, a logical module, software, or the like.

**[00120]** In this application, "sending" and "receiving" indicate signal transmission directions. For example, "sending information to XX" may be understood as that a destination end of the information is XX, and the "sending the information" may include direct sending, or may include indirect sending through another unit or module; "receiving information from YY" may be understood as that a source end of the information is YY, and the "receiving the information" may include directly receiving the information from YY, or may include indirectly receiving the

information from YY through another unit or module. In addition, the "sending" may also be understood as "outputting" of a chip interface, and the "receiving" may also be understood as "inputting" of a chip interface. In other words, the "sending" or the "receiving" may be performed between devices, for example, between an access network device and a terminal through an air interface, or may be performed in a device, for example, between components, modules, chips, software modules, or hardware modules in the device through a bus, a cable, or an interface.

**[00121]** Based on this, to reduce signaling overheads for indicating CBSR and improve communication performance, this application provides a channel state information reporting method. As shown in FIG. 6, the method may specifically include the following steps.

**[00122]** 600. An access network device determines first information.

**[00123]** The first information indicates one or more of P spatial-domain vector groups, spatial-domain vectors included in the one or more spatial-domain vector groups are not used for PMI calculation, and P is an integer greater than 1. It may also be understood as that the spatial-domain vectors included in the one or more spatial-domain vector groups are restricted from being used for PMI calculation, or the spatial-domain vectors included in the one or more spatial-domain vector groups are restricted vectors. It should be noted that one spatial-domain vector group includes at least two spatial-domain vectors. Elements in one spatial-domain vector may represent weights of antenna ports. Signals of the antenna ports may be linearly superimposed based on the weights of the antenna ports represented by the elements in the spatial-domain vector, to form a high-signal-strength region, such as a beam, in a specific spatial direction. In this application, a spatial-domain vector may be replaced with a beam vector or a beam.

**[00124]** For example, that the spatial-domain vectors included in the one or more spatial-domain vector groups are not used for PMI calculation may also be described as that the spatial-domain vectors included in the one or more spatial-domain vector groups are not selected, or the spatial-domain vectors included in the one or more spatial-domain vector groups are not selected for PMI calculation.

**[00125]** For example, if the access network device determines that one or more spatial-domain vectors cannot be selected (or cannot be used for PMI calculation), the access network device determines a spatial-domain vector group in which the one or more spatial-domain vectors are located, that is, one or more of the P spatial-domain vector groups. The first information indicates the one or more spatial-domain vector groups in the P spatial-domain vector groups and determined by the access network device. That the spatial-domain vectors included in the one or more spatial-domain vector groups are not used for PMI calculation means that all the spatial-domain vectors included in the one or more spatial-domain vector groups indicated by the first information are not used for PMI calculation. In the foregoing manner, the access network device may not need to

separately indicate whether each spatial-domain vector is used for PMI calculation, but indicate a spatial-domain vector group in which a spatial-domain vector that is not used for PMI calculation is located, where all spatial-domain vectors included in the spatial-domain vector group are not used for PMI calculation, thereby effectively reducing signaling overheads for indicating CBSR.

**[00126]** For example, the access network device determines that a spatial-domain vector A and a spatial-domain vector C are not used for PMI calculation, where the spatial-domain vector A belongs to a spatial-domain vector group 1, the spatial-domain vector group 1 includes four spatial-domain vectors, the spatial-domain vector C belongs to a spatial-domain vector group 3, and the spatial-domain vector group 3 also includes four spatial-domain vectors. In this case, the access network device determines first information, where the first information indicates the spatial-domain vector group 1 and the spatial-domain vector group 3, so that all the four spatial-domain vectors included in the spatial-domain vector group 1 and the four spatial-domain vectors included in the spatial-domain vector group 3 are not used for PMI calculation.

**[00127]** In a possible implementation, the first information may occupy P bits, and the P bits are in one-to-one correspondence with the P spatial-domain vector groups. A value of a bit in the P bits that corresponds to the one or more spatial-domain vector groups is 0, a value 0 of a bit indicates that PMI reporting for any precoding corresponding to a spatial-domain vector group associated with the bit is not allowed, and a value 1 of a bit indicates that PMI reporting for precoding corresponding to a spatial-domain vector group associated with the bit is allowed. In another possible implementation, a value of a bit in the P bits that corresponds to a part of or all the one or more spatial-domain vector groups is 0, indicating that PMI reporting for precoding corresponding to the part of or all the spatial-domain vector groups is not allowed.

**[00128]** For example, the P bits ordered from start to end are associated with the P spatial-domain vector groups in ascending order of maximum spatial-domain vector indexes in the spatial-domain vector groups; or the P bits ordered from start to end are associated with the P spatial-domain vector groups in ascending order of minimum spatial-domain vector indexes in the spatial-domain vector groups; or the P bits ordered from start to end are associated with the P spatial-domain vector groups in ascending order of average spatial-domain vector indexes in the spatial-domain vector groups. In addition, the one-to-one mapping relationship between the P bits and the P spatial-domain vector groups may alternatively be established in other manners. This is not limited in this application.

**[00129]** For example, for any spatial-domain vector group, where the spatial-domain vector group may include at least two spatial-domain vectors, and each spatial-domain vector has a corresponding spatial-domain vector index, a maximum spatial-domain vector index in the spatial-domain vector group is a maximum spatial-domain vector index in spatial-domain vector indexes

respectively corresponding to the at least two spatial-domain vectors in the spatial-domain vector group; a minimum spatial-domain vector index in the spatial-domain vector group is a minimum spatial-domain vector index in the spatial-domain vector indexes respectively corresponding to the at least two spatial-domain vectors in the spatial-domain vector group; and an average spatial-domain vector index in the spatial-domain vector group is an average value of the spatial-domain vector indexes respectively corresponding to the at least two spatial-domain vectors in the spatial-domain vector group.

**[00130]** The P spatial-domain vector groups are determined based on a spatial-domain vector set.

**[00131]** In two polarization directions, the spatial-domain vector set includes $2*N_1*N_2*O_1*O_2$ spatial-domain vectors. In one polarization direction, the spatial-domain vector set includes $N_1*N_2*O_1*O_2$ spatial-domain vectors. For example, the $2*N_1*N_2*O_1*O_2$ spatial-domain vectors include $v_{l,m}$ and $\varphi_n v_{l,m}$, $v_{l,m}$ and $\varphi_n v_{l,m}$ are spatial-domain vectors in two different polarization directions, $l$ represents a weight selected in a first dimension, $m$ represents a weight selected in a second dimension, and $\varphi_n$ represents an inter-polarization phase. When $v_{l,m}$ belongs to a spatial-domain vector group, $\varphi_n v_{l,m}$ also belongs to the spatial-domain vector group. When $v_{l,m}$ is not used for PMI calculation, $\varphi_n v_{l,m}$ is not used for PMI calculation either. Therefore, $v_{l,m}$ and $\varphi_n v_{l,m}$ may be considered as one spatial-domain vector. In the following descriptions, an example in which the spatial-domain vector set includes $N_1*N_2*O_1*O_2$ spatial-domain vectors is used for description, and a polarization direction of the spatial-domain vectors is not limited. In other words, the following uses spatial-domain vectors in one polarization direction as an example for description, and same operations may be performed on spatial-domain vectors in the other polarization direction with reference thereto.

**[00132]** $O_1$ represents an oversampling factor in the first dimension, $O_2$ represents an oversampling factor in the second dimension, $N_1$ represents the number of antenna ports in the first dimension, $N_2$ represents the number of antenna ports in the second dimension, and $O_1$, $O_2$, $N_1$, and $N_2$ are all positive integers.

**[00133]** The following describes possible implementations of the P spatial-domain vector groups.

**[00134]** Possible implementation 1: The spatial-domain vector set may be divided into P spatial-domain vector groups, and each spatial-domain vector group may include a same number of spatial-domain vectors. If each spatial-domain vector group includes K spatial-domain vectors, $P*K=N_1*N_2*O_1*O_2$, where K is a positive integer, and any two of the P spatial-domain vector groups do not include a same spatial-domain vector.

**[00135]** For example, if $N_1=4$, $N_2=2$, $O_1=2$, and $O_2=2$, the spatial-domain vector set includes 32

spatial-domain vectors in total, and the P spatial-domain vector groups may be shown by dashed boxes in FIG. 7A. Each spatial-domain vector group includes four spatial-domain vectors, and P=8.

**[00136]** Possible implementation 2: The spatial-domain vector set may be divided into P spatial-domain vector groups, at least two spatial-domain vector groups include different numbers of spatial-domain vectors, and a total number of spatial-domain vectors included in the P spatial-domain vector groups is equal to a total number of spatial-domain vectors included in the spatial-domain vector set, that is, the total number of spatial-domain vectors included in the P spatial-domain vector groups is equal to $2N_1*N_2*O_1*O_2$, where any two of the P spatial-domain vector groups do not include a same spatial-domain vector.

**[00137]** For example, if $N_1=4$, $N_2=2$, $O_1=2$, and $O_2=2$, the spatial-domain vector set includes 32 spatial-domain vectors in total, and the P spatial-domain vector groups may be shown by dashed boxes in FIG. 7B, where P=6.

**[00138]** In both the possible implementation 1 and the possible implementation 2, the P spatial-domain vector groups are determined based on all the spatial-domain vectors included in the spatial-domain vector set. In addition, the P spatial-domain vector groups may alternatively be determined based on a part of spatial-domain vectors included in the spatial-domain vector set. This is not limited in this application. It may be understood that grouping manners shown in FIG. 7A and FIG. 7B are merely examples, and are not intended to limit this application.

**[00139]** For example, the spatial-domain vector set may be divided into $O_1*O_2$ spatial-domain vector groups, and $N_1*N_2$ spatial-domain vectors in each spatial-domain vector group are orthogonal. Therefore, the $O_1*O_2$ spatial-domain vector groups are $O_1*O_2$ orthogonal spatial-domain vector groups. The P spatial-domain vector groups may alternatively be determined based on a part of spatial-domain vectors included in the spatial-domain vector set. The part of spatial-domain vectors herein may include a plurality of spatial-domain vector groups in the $O_1*O_2$ spatial-domain vector groups. For example, the part of spatial-domain vectors may include four of the $O_1*O_2$ spatial-domain vector groups.

**[00140]** In some possible embodiments, a grouping manner used for the P spatial-domain vector groups may be predefined in a protocol or preconfigured by using signaling. In this case, a terminal does not need to be further notified of the grouping manner used for the P spatial-domain vector groups.

**[00141]** In some other possible embodiments, the access network device may further determine second information, and send the second information to the terminal, where the second information indicates a first grouping manner, the first grouping manner is one of M preset grouping manners, and M is an integer greater than 1. The P spatial-domain vector groups are determined based on

the first grouping manner and the spatial-domain vector set.

**[00142]** The first information and the second information may be carried in one message, or may be carried in two messages. This is not limited in this application.

**[00143]** For example, the second information may occupy $\lceil \log_2 M \rceil$ bits, that is, any one of the M preset grouping manners may be indicated by using $\lceil \log_2 M \rceil$ bits.

**[00144]** For example, assuming that M=4, the second information may include 2 bits. A value 00 of the second information indicates the first grouping manner, a value 01 of the second information indicates a second grouping manner, a value 10 of the second information indicates a third grouping manner, and a value 11 of the second information indicates a fourth grouping manner.

**[00145]** For example, the M preset grouping manners may include two or more of the following:

**[00146]** Grouping manner A: Each spatial-domain vector group includes $N_1*O_1$ spatial-domain vectors in the first dimension, $P=N_2*O_2$, and $K=N_1*O_1$.

**[00147]** For example, assuming that the first dimension represents a horizontal direction, the grouping manner A may also be understood as that the spatial-domain vectors in the spatial-domain vector set are grouped by row, and all spatial-domain vectors in each row form one spatial-domain vector group.

**[00148]** As shown in FIG. 8A, if $N_1=4$, $N_2=2$, $O_1=2$, and $O_2=2$, the spatial-domain vector set includes 32 spatial-domain vectors in total. Assuming that the first dimension is the horizontal direction, four spatial-domain vector groups may be determined based on the spatial-domain vector set and the grouping manner A, each spatial-domain vector group includes eight spatial-domain vectors, and the four spatial-domain vector groups may be shown by dashed boxes in FIG. 8A.

**[00149]** Based on the grouping manner A, the number of spatial-domain vectors included in each spatial-domain vector group may be further restricted. For example, each spatial-domain vector group includes K consecutive spatial-domain vectors in the first dimension, $P*K=N_1*N_2*O_1*O_2$, and K is divisible by $N_1*O_1$, or in other words, K is an integer multiple of $N_1*O_1$. Such a grouping manner is denoted as a grouping manner A'.

**[00150]** As shown in FIG. 8B, if $N_1=4$, $N_2=2$, $O_1=2$, $O_2=2$, and K=4, the spatial-domain vector set includes 32 spatial-domain vectors in total. Assuming that the first dimension is the horizontal direction, eight spatial-domain vector groups may be determined based on the spatial-domain vector set and the grouping manner A', each spatial-domain vector group includes four spatial-domain vectors, and the eight spatial-domain vector groups may be shown by dashed boxes in FIG. 8B.

**[00151]** In addition, that each spatial-domain vector group includes K consecutive spatial-

domain vectors in the first dimension may be replaced with that each spatial-domain vector group includes K spatial-domain vectors in the first dimension, where the K spatial-domain vectors may be non-consecutive. For example, an offset between adjacent spatial-domain vectors in the K spatial-domain vectors is 1 or 2. Alternatively, the K spatial-domain vectors may be partly consecutive and partly non-consecutive. For example, selecting K spatial-domain vectors from the $N_1*O_1$ spatial-domain vectors in the first dimension may include $C_{N_1*O_1}^{K}$ manners, and may be specifically predefined by using a table or the like.

**[00152]** Grouping manner B: Each spatial-domain vector group includes $N_2*O_2$ spatial-domain vectors in the second dimension, $P=N_1*O_1$, and $K=N_2*O_2$.

**[00153]** For example, assuming that the second dimension represents a vertical direction, the grouping manner B may also be understood as that the spatial-domain vectors in the spatial-domain vector set are grouped by column, and all spatial-domain vectors in each column form one spatial-domain vector group.

**[00154]** As shown in FIG. 9A, if $N_1=4$, $N_2=4$, $O_1=4$, and $O_2=2$, the spatial-domain vector set includes 128 spatial-domain vectors in total. Assuming that the second dimension is the vertical direction, 16 spatial-domain vector groups may be determined based on the spatial-domain vector set and the grouping manner B, each spatial-domain vector group includes eight spatial-domain vectors, and the 16 spatial-domain vector groups may be shown by dashed boxes in FIG. 9A.

**[00155]** Similar to the grouping manner A, based on the grouping manner B, the number of spatial-domain vectors included in each spatial-domain vector group may be further restricted. For example, each spatial-domain vector group includes K consecutive spatial-domain vectors in the second dimension, $P*K=N_1*N_2*O_1*O_2$, and K is divisible by $N_2*O_2$, or in other words, K is an integer multiple of $N_2*O_2$. Such a grouping manner is denoted as a grouping manner B'.

**[00156]** As shown in FIG. 9B, if $N_1=4$, $N_2=4$, $O_1=4$, $O_2=2$, and $K=4$, the spatial-domain vector set includes 128 spatial-domain vectors in total. Assuming that the second dimension is the vertical direction, 32 spatial-domain vector groups may be determined based on the spatial-domain vector set and the grouping manner B', each spatial-domain vector group includes four spatial-domain vectors, and the 32 spatial-domain vector groups may be shown by dashed boxes in FIG. 9B.

**[00157]** Further, that each spatial-domain vector group includes K consecutive spatial-domain vectors in the second dimension may be replaced with that each spatial-domain vector group includes K spatial-domain vectors in the second dimension, where the K spatial-domain vectors may be non-consecutive. For example, an offset between adjacent spatial-domain vectors in the K spatial-domain vectors is 1 or 2. Alternatively, the K spatial-domain vectors may be partly consecutive and partly non-consecutive. For example, selecting K spatial-domain vectors from the $N_2*O_2$ spatial-domain vectors in the second dimension may include $C_{N_2*O_2}^{K}$ manners, and may be

specifically predefined by using a table or the like.

**[00158]** Grouping manner C: Each spatial-domain vector group includes $n_1*n_2$ spatial-domain vectors, $n_1$ represents the number of spatial-domain vectors in the first dimension, $n_2$ represents the number of spatial-domain vectors in the second dimension, $N_1*O_1$ is an integer multiple of $n_1$, $N_2*O_2$ is an integer multiple of $n_2$, and $n_1$ and $n_2$ are positive integers.

**[00159]** As shown in FIG. 7A, if $N_1=4$, $N_2=2$, $O_1=2$, $O_2=2$, $n_1=2$, and $n_2=2$, the spatial-domain vector set includes 32 spatial-domain vectors in total, eight spatial-domain vector groups may be determined based on the spatial-domain vector set and the grouping manner C, each spatial-domain vector group includes four spatial-domain vectors, and the eight spatial-domain vector groups may be shown by dashed boxes in FIG. 7A.

**[00160]** Based on the grouping manner C, the following may be further restricted: the number of spatial-domain vectors included in each spatial-domain vector group, a value of $n_1$ and/or a value of $n_2$, whether $n_1$ spatial-domain vectors in the first dimension in each spatial-domain vector group are consecutive and/or whether $n_2$ spatial-domain vectors in the second dimension in each spatial-domain vector group are consecutive, or the like.

**[00161]** When each spatial-domain vector group includes $n_1*n_2$ spatial-domain vectors, the values of $n_1$ and $n_2$ may be indicated or determined by using the second information. Alternatively, it may be understood as that there are M value combinations of $n_1$ and $n_2$, the M value combinations of $n_1$ and $n_2$ may be understood as the M preset grouping manners, and the M value combinations of $n_1$ and $n_2$ may be indicated or determined by using the second information.

**[00162]** In a possible implementation, for the values of $n_1$ and $n_2$, refer to the following Table 1.

Table 1 Examples of possible values of $n_1$ and $n_2$ for a Type-I codebook

| Second information | $n_1$ | $n_2$ |
|---|---|---|
| 1 | $N_1*O_1$ | 1 |
| 2 | 1 | $N_2*O_2$ |
| 3 | 1 | 2 |
| 4 | 2 | 1 |
| 5 | 2 | 2 |
| 6 | 1 | 4 |
| 7 | 4 | 1 |
| 8 | 1 | 1 |

**[00163]** The second information in Table 1 may be higher layer RRC information or other signaling. This is not limited in this application. For Table 1, $M=8$, and the second information may occupy $\lceil \log_2 8 \rceil$ bits, that is, 3 bits.

**[00164]** In another possible implementation, the values of $n_1$ and $n_2$ may not be directly indicated, but determined based on Table 2. The values of $n_1$ and $n_2$ are respectively in direct proportion to $N_1*O_1$ and $N_2*O_2$. For details, refer to the following Table 2.

Table 2 Examples of possible values of $\frac{N_1*O_1}{n_1}$ and $\frac{N_2*O_2}{n_2}$ for a Type-I codebook

| Second information | $\frac{N_1 * O_1}{n_1}$ | $\frac{N_2 * O_2}{n_2}$ |
|---|---|---|
| 1 | $N_1*O_1$ | 1 |
| 2 | 1 | $N_2*O_2$ |
| 3 | 1 | 2 |
| 4 | 2 | 1 |
| 5 | 2 | 2 |
| 6 | 1 | 4 |
| 7 | 4 | 1 |
| … | … | … |

**[00165]** The second information in Table 2 may be higher layer RRC information or other signaling. This is not limited in this application.

**[00166]** In addition, if the P spatial-domain vector groups may alternatively be determined based on a part of spatial-domain vectors included in the spatial-domain vector set, the part of spatial-domain vectors herein may include a plurality of spatial-domain vector groups in $O_1*O_2$ spatial-domain vector groups, where the $O_1*O_2$ spatial-domain vector groups are determined based on the spatial-domain vector set, each of the $O_1*O_2$ spatial-domain vector groups includes $N_1*N_2$ spatial-domain vectors, and the $N_1*N_2$ spatial-domain vectors in each spatial-domain vector group are orthogonal.

**[00167]** In this case, the P spatial-domain vector groups may be determined in but not limited to the following manners:

each spatial-domain vector group includes $N_1$ spatial-domain vectors in the first dimension, $P=N_2$, and $K=N_1$;

each spatial-domain vector group includes $N_2$ spatial-domain vectors in the second dimension, $P=N_1$, and $K=N_2$; or

each spatial-domain vector group includes $n_1*n_2$ spatial-domain vectors, $n_1$ represents the number of spatial-domain vectors in the first dimension, $n_2$ represents the number of spatial-domain vectors in the second dimension, $N_1$ is an integer multiple of $n_1$, $N_2$ is an integer multiple of $n_2$, and $n_1$ and $n_2$ are positive integers.

**[00168]** When each spatial-domain vector group includes $n_1*n_2$ spatial-domain vectors, values

of $n_1$ and $n_2$ may be indicated or determined by using the second information. Alternatively, it may be understood as that there are M value combinations of $n_1$ and $n_2$, the M value combinations of $n_1$ and $n_2$ may be understood as the M preset grouping manners, and the M value combinations of $n_1$ and $n_2$ may be indicated or determined by using the second information.

**[00169]** In a possible implementation, for the values of $n_1$ and $n_2$, refer to the following Table 3.

Table 3 Examples of possible values of $n_1$ and $n_2$ for a Type II codebook

| Second information | $n_1$ | $n_2$ |
|---|---|---|
| 1 | $N_1$ | 1 |
| 2 | 1 | $N_2$ |
| 3 | 1 | 2 |
| 4 | 2 | 1 |
| 5 | 2 | 2 |
| 6 | 1 | 4 |
| 7 | 4 | 1 |
| 8 | 1 | 1 |

**[00170]** The second information in Table 3 may be higher layer RRC information or other signaling. This is not limited in this application.

**[00171]** In another possible implementation, the values of $n_1$ and $n_2$ may not be directly indicated, but determined based on Table 4. The values of $n_1$ and $n_2$ are respectively in direct proportion to $N_1$ and $N_2$. For details, refer to the following Table 4.

Table 4 Examples of possible values of $\frac{N_1}{n_1}$ and $\frac{N_2}{n_2}$ for a Type-II codebook

| Second information | $\frac{N_1}{n_1}$ | $\frac{N_2}{n_2}$ |
|---|---|---|
| 1 | $N_1$ | 1 |
| 2 | 1 | $N_2$ |
| 3 | 1 | 2 |
| 4 | 2 | 1 |
| 5 | 2 | 2 |
| 6 | 1 | 4 |
| 7 | 4 | 1 |
| … | … | … |

**[00172]** The second information in Table 4 may be higher layer RRC information or other signaling. This is not limited in this application.

**[00173]** In addition, in a possible implementation, any first value group corresponds to at least one second value group, the first value group is formed by a value of $N_1$ and a value of $N_2$, and the second value group is formed by a value of $n_1$ and a value of $n_2$. Alternatively, it may be understood as that one or more value combinations of $n_1$ and $n_2$ are bound to a group of values of $N_1$ and $N_2$, where a larger value of $N_1$ indicates a larger value of $n_1$, and similarly, a larger value of $N_2$ indicates a larger value of $n_2$. In other words, the values of $n_1$ and $n_2$ are respectively in direct proportion to the values of $N_1$ and $N_2$.

**[00174]** Therefore, when the value of $N_1$ and the value of $N_2$ are determined, the value of $n_1$ and the value of $n_2$ may include a plurality of possible combinations, and one of the plurality of possible combinations may be indicated by using the second information.

**[00175]** Table 5 shows a mapping relationship between a first value group and a second value group for a Type-I codebook. The second information in Table 5 may be higher layer RRC information or other signaling. This is not limited in this application.

Table 5

| $N_1$ | $N_2$ | Second information | $n_1$ | $n_2$ |
|---|---|---|---|---|
| 16 | 4 | 1 | $N_1*O_1$ | 1 |
| | | 2 | 1 | $N_2*O_2$ |
| | | 3 | 4 $O_1$ | $O_2$ |
| 8 | 8 | 1 | $N_1*O_1$ | 1 |
| | | 2 | 1 | $N_2*O_2$ |
| | | 3 | 2 $O_1$ | 2 $O_2$ |
| 16 | 2 | 1 | $N_1*O_1$ | 1 |
| | | 2 | 1 | $N_2*O_2$ |
| | | 3 | 8 $O_1$ | $O_2$ |
| 8 | 4 | 1 | $N_1*O_1$ | 1 |
| | | 2 | 1 | $N_2*O_2$ |
| | | 3 | 2 $O_1$ | $O_2$ |
| | | 4 | 4 $O_1$ | 2 $O_2$ |
| 8 | 3 | 1 | 1 | 1 |
| | | 2 | $N_1*O_1$ | 1 |
| | | 3 | 1 | $N_2*O_2$ |
| 6 | 4 | 1 | 1 | 1 |
| | | 2 | $N_1*O_1$ | 1 |
| | | 3 | 1 | $N_2*O_2$ |

**[00176]** Table 6 shows a mapping relationship between a first value group and a second value

group for a Type-II codebook. The second information in Table 6 may be higher layer RRC information or other signaling. This is not limited in this application.

Table 6

| $N_1$ | $N_2$ | Second information | $n_1$ | $n_2$ |
|---|---|---|---|---|
| 16 | 4 | 1 | $N_1$ | 1 |
| | | 2 | 1 | $N_2$ |
| | | 3 | 4 | 1 |
| 8 | 8 | 1 | $N_1$ | 1 |
| | | 2 | 1 | $N_2$ |
| | | 3 | 2 | 2 |
| 16 | 2 | 1 | $N_1$ | 1 |
| | | 2 | 1 | $N_2$ |
| | | 3 | 8 | 1 |
| 8 | 4 | 1 | $N_1$ | 1 |
| | | 2 | 1 | $N_2$ |
| | | 3 | 2 | 1 |
| | | 4 | 4 | 2 |
| 8 | 3 | 1 | 1 | 1 |
| | | 2 | $N_1$ | 1 |
| | | 3 | 1 | $N_2$ |
| 6 | 4 | 1 | 1 | 1 |
| | | 2 | $N_1$ | 1 |
| | | 3 | 1 | $N_2$ |

**[00177]** In addition, in a possible implementation, there is at least one first value group for which no corresponding second value group is configured. Alternatively, it may be understood as that none of the at least one first value group corresponds to a second value group. For example, if $2N_1*N_2=48$, for example, $N_1=8$ and $N_2=3$, the value of $n_1$ and the value of $n_2$ may not be configured.

**[00178]** Grouping manner D: $P=O_1*O_2$, each spatial-domain vector group includes $N_1*N_2$ spatial-domain vectors, and the $N_1*N_2$ spatial-domain vectors in each spatial-domain vector group are orthogonal, that is, the P spatial-domain vector groups are $O_1*O_2$ orthogonal spatial-domain vector groups (or orthogonal groups). Alternatively, $P=N_1*N_2$, each spatial-domain vector group includes $O_1*O_2$ spatial-domain vectors, and spatial-domain vectors at corresponding positions in any two oversampled groups are orthogonal, that is, the P spatial-domain vector groups are $N_1*N_2$ oversampled groups.

**[00179]** For example, the spatial-domain vector set may be divided into $O_1*O_2$ spatial-domain vector groups, and $N_1*N_2$ spatial-domain vectors in each spatial-domain vector group are orthogonal. Therefore, the $O_1*O_2$ spatial-domain vector groups are $O_1*O_2$ orthogonal spatial-domain vector groups. The spatial-domain vector set may alternatively be divided into $N_1*N_2$ oversampled groups, each oversampled group includes $O_1*O_2$ spatial-domain vectors, and spatial-domain vectors at corresponding positions in any two oversampled groups are orthogonal. For example, for any two oversampled groups, for example, an oversampled group 1 and an oversampled group 2, when an offset of a spatial-domain vector A in the oversampled group 1 relative to a spatial-domain vector B in the oversampled group 2 is an integer multiple of an oversampling factor, the spatial-domain vector A is orthogonal to the spatial-domain vector B, and a position of the spatial-domain vector A in the oversampled group 1 corresponds to a position of the spatial-domain vector B in the oversampled group 2. The oversampling factor herein may be $O_1$ or $O_2$.

**[00180]** For example, if $N_1=4$, $N_2=2$, $O_1=4$, and $O_2=2$, the spatial-domain vector set includes 64 spatial-domain vectors in total. As shown in FIG. 10, each circle represents one spatial-domain vector, the spatial-domain vector set may be divided into eight oversampled groups, each oversampled group includes eight spatial-domain vectors, spatial-domain vectors corresponding to circles included in each dashed box form one oversampled group, and spatial-domain vectors at corresponding positions in any two oversampled groups are orthogonal. For example, spatial-domain vectors corresponding to black circles in any two oversampled groups are orthogonal. For another example, spatial-domain vectors corresponding to hatched circles in any two oversampled groups are also orthogonal. The spatial-domain vector set may alternatively be divided into eight orthogonal groups, and each orthogonal group includes eight spatial-domain vectors. For example, spatial-domain vectors respectively corresponding to eight black circles in FIG. 10 form one orthogonal spatial-domain vector group, and spatial-domain vectors respectively corresponding to eight hatched circles in FIG. 10 also form one orthogonal spatial-domain vector group.

**[00181]** It may be understood that the grouping manner A to the grouping manner D are merely examples, and there may be other possible grouping manners. This is not limited in this application.

**[00182]** 610. The access network device sends the first information to the terminal. Correspondingly, the terminal receives the first information from the access network device.

**[00183]** For example, the access network device sends an RRC message to the terminal, where the RRC message includes the first information. In addition, the first information may alternatively be carried by using other signaling or messages. This is not limited in this application.

**[00184]** In addition, in a possible implementation, the access network device may further send third information to the terminal, where the third information indicates a maximum allowed

amplitude coefficient corresponding to each of the P spatial-domain vector groups, or the third information indicates a maximum allowed amplitude coefficient corresponding to each of the P spatial-domain vector groups except the one or more spatial-domain vector groups indicated by the first information.

**[00185]** A maximum allowed amplitude coefficient of a spatial-domain vector is used to restrict maximum transmit power in a spatial-domain vector direction corresponding to the spatial-domain vector. A maximum allowed amplitude coefficient corresponding to a spatial-domain vector group may be understood as a minimum value or a maximum value of maximum allowed amplitude coefficients corresponding to spatial-domain vectors in the spatial-domain vector group. Alternatively, spatial-domain vectors in each spatial-domain vector group may correspond to a same maximum allowed amplitude coefficient; in this case, a maximum allowed amplitude coefficient corresponding to a spatial-domain vector group may be understood as a maximum allowed amplitude coefficient corresponding to each spatial-domain vector in the spatial-domain vector group.

**[00186]** In another possible implementation, the third information may indicate a maximum allowed amplitude coefficient corresponding to each spatial-domain vector in each of the P spatial-domain vector groups except the one or more spatial-domain vector groups indicated by the first information.

**[00187]** For example, it is assumed that P=8, the eight spatial-domain vector groups are denoted as a spatial-domain vector group 1 to a spatial-domain vector group 8, and the first information indicates four of the eight spatial-domain vector groups. For example, the four spatial-domain vector groups indicated by the first information are the spatial-domain vector group 1, the spatial-domain vector group 3, the spatial-domain vector group 4, and the spatial-domain vector group 8. Then, the third information indicates a maximum allowed amplitude coefficient corresponding to each spatial-domain vector in the spatial-domain vector group 2, a maximum allowed amplitude coefficient corresponding to each spatial-domain vector in the spatial-domain vector group 5, a maximum allowed amplitude coefficient corresponding to each spatial-domain vector in the spatial-domain vector group 6, and a maximum allowed amplitude coefficient corresponding to each spatial-domain vector in the spatial-domain vector group 7.

**[00188]** The first information and the third information may be carried in one message, or may be carried in two messages. This is not limited in this application.

**[00189]** In the foregoing manner, a restriction range of the CBSR can be expanded by using the third information, that is, indicating a maximum allowed amplitude of a spatial-domain vector that can be used for PMI calculation, so that codebook performance can be further improved.

**[00190]** Optionally, before 610, that is, before the access network device sends the first

information to the terminal, the access network device may further send indication information to the terminal, where the indication information indicates $N_1$ and $N_2$. In other words, the indication information and the first information may be carried by using two messages.

**[00191]** For example, the access network device may send the indication information to the terminal once, and send the first information to the terminal a plurality of times. In other words, when the values of $N_1$ and $N_2$ remain unchanged, the CBSR may be indicated a plurality of times. Alternatively, it may be understood as that if the values of $N_1$ and $N_2$ remain unchanged, information indicating $N_1$ and $N_2$ may not need to be carried for each CBSR indication. In the foregoing design, the indication information (that is, the information indicating $N_1$ and $N_2$) may not be bound to the first information (that is, information indicating the CBSR) for sending, thereby reducing unnecessary signaling overheads.

**[00192]** 620. The terminal determines a PMI based on the first information.

**[00193]** For example, the terminal determines the one or more of the P spatial-domain vector groups based on the first information, and does not use any spatial-domain vector in the one or more spatial-domain vector groups when calculating the PMI, that is, does not use, when calculating the PMI, precoding associated with any spatial-domain vector in the one or more spatial-domain vector groups. Optionally, the terminal may further calculate the PMI with reference to the third information.

**[00194]** 630. The terminal sends the PMI to the access network device. Correspondingly, the access network device receives the PMI from the terminal.

**[00195]** In conclusion, according to the method provided in the embodiment shown in FIG. 6, the access network device may indicate, in spatial-domain vector groups, that all the spatial-domain vectors included in the one or more spatial-domain vector groups are not used for PMI calculation, thereby effectively reducing signaling overheads for indicating CBSR. In addition, the access network device may further send the third information to the terminal, to indicate a maximum allowed amplitude of a spatial-domain vector used for PMI calculation, so that codebook performance can be further improved.

**[00196]** To reduce signaling overheads for indicating CBSR and improve communication performance, this application further provides a channel state information reporting method. As shown in FIG. 11, the method may specifically include the following steps.

**[00197]** 1100. An access network device determines information 1 and m pieces of information 2.

**[00198]** The information 1 indicates m of Q spatial-domain vector groups, the m pieces of information 2 are in one-to-one correspondence with the m spatial-domain vector groups, each piece of information 2 indicates n spatial-domain vectors in a corresponding spatial-domain vector

group, and the n spatial-domain vectors are not used for PMI calculation. Q, m, and n are positive integers, m≤Q, and values of n and m may be agreed on in a protocol or preconfigured by using signaling.

**[00199]** For example, the m pieces of information 2 ordered from start to end are associated with the m spatial-domain vector groups in ascending order of maximum spatial-domain vector indexes in the spatial-domain vector groups; or the m pieces of information 2 ordered from start to end are associated with the m spatial-domain vector groups in ascending order of minimum spatial-domain vector indexes in the spatial-domain vector groups; or the m pieces of information 2 ordered from start to end are associated with the m spatial-domain vector groups in ascending order of average spatial-domain vector indexes in the spatial-domain vector groups. In addition, the one-to-one mapping relationship between the m pieces of information 2 and the m spatial-domain vector groups may alternatively be established in other manners. This is not limited in this application.

**[00200]** For example, the Q spatial-domain vector groups are determined based on a spatial-domain vector set. For related descriptions of the spatial-domain vector set, refer to related content in the embodiment shown in FIG. 6. The spatial-domain vector set includes $N_1*N_2*O_1*O_2$ spatial-domain vectors, $O_1$ represents an oversampling factor in a first dimension, $O_2$ represents an oversampling factor in a second dimension, $N_1$ represents the number of antenna ports in the first dimension, $N_2$ represents the number of antenna ports in the second dimension, and $O_1$, $O_2$, $N_1$, and $N_2$ are all positive integers.

**[00201]** For possible implementations of the Q spatial-domain vector groups, refer to the implementations of the P spatial-domain vector groups. For example, the Q spatial-domain vector groups may be specifically determined in any one of the grouping manner A to the grouping manner D in the embodiment shown in FIG. 6, or the Q spatial-domain vector groups may be determined in other possible grouping manners. This is not limited in this application.

**[00202]** In some possible embodiments, a grouping manner used for the Q spatial-domain vector groups may be predefined in a protocol or preconfigured by using signaling. In this case, a terminal does not need to be further notified of the grouping manner.

**[00203]** In some other possible embodiments, the access network device may further determine information 3, and send information 3 to the terminal, where the information 3 indicates a second grouping manner, and the second grouping manner is one of a plurality of preset grouping manners. The Q spatial-domain vector groups are determined based on the second grouping manner and the spatial-domain vector set. For the plurality of preset grouping manners, refer to related descriptions of the M preset grouping manners. Details are not described herein again.

**[00204]** In a possible implementation, each of the Q spatial-domain vector groups includes S

spatial-domain vectors, $Q*S=N_1*N_2*O_1*O_2$, S is a positive integer, and $S \geq n$. For example, the information 1 occupies $\lceil \log_2 C_Q^m \rceil$ bits, and the information 2 occupies $\lceil \log_2 C_S^n \rceil$ bits.

**[00205]** In an example, $Q=O_1*O_2$, $K=N_1*N_2$, the $O_1*O_2$ spatial-domain vector groups are orthogonal groups, and $N_1*N_2$ spatial-domain vectors in each spatial-domain vector group are orthogonal. For example, the information 1 occupies $\lceil \log_2 C_{O_1*O_2}^m \rceil$ bits, and the information 2 occupies $\lceil \log_2 C_{N_1*N_2}^n \rceil$ bits.

**[00206]** For example, when $O_1=O_2=m=4$, the information 1 occupies $\lceil \log_2 C_{16}^4 \rceil = 11$ bits; or when $O_1=O_2=4$ and m=2, the information 1 occupies $\lceil \log_2 C_{16}^2 \rceil = 7$ bits.

**[00207]** For another example, currently, for CBSR of a 128-port Type I codebook, RRC signaling overheads may reach 1024 bits at most, where $2N_1*N_2=128$, and maximum values of $O_1$ and $O_2$ are both 4. In the foregoing example, when $O_1=O_2=m=4$, the information 1 occupies $\lceil \log_2 C_{16}^4 \rceil = 11$ bits; when $N_1=N_2=8$ and m=6, the information 2 occupies $\lceil \log_2 C_{64}^6 \rceil = 27$ bits; and the information 1 and the six pieces of information 2 occupy 11+6*27=173 bits in total.

**[00208]** In another example, $Q=N_1*N_2$, $K=O_1*O_2$, and the $N_1*N_2$ spatial-domain vector groups are oversampled spatial-domain vector groups. For example, the information 1 occupies $\lceil \log_2 C_{N_1*N_2}^m \rceil$ bits, and the information 2 occupies $\lceil \log_2 C_{O_1*O_2}^n \rceil$ bits.

**[00209]** For example, when $N_1=N_2=8$ and m=4, the information 1 occupies $\lceil \log_2 C_{64}^4 \rceil = 20$ bits; or when $N_1=N_2=8$ and m=6, the information 1 occupies $\lceil \log_2 C_{64}^6 \rceil = 27$ bits.

**[00210]** For another example, currently, for CBSR of a 128-port Type I codebook, RRC signaling overheads may reach 1024 bits at most, where $2N_1*N_2=128$, and maximum values of $O_1$ and $O_2$ are both 4. In the foregoing example, when $N_1=N_2=8$ and m=4, the information 1 occupies $\lceil \log_2 C_{64}^4 \rceil = 20$ bits; when $O_1=O_2=m=4$, the information 2 occupies $\lceil \log_2 C_{16}^4 \rceil = 11$ bits; and the information 1 and the four pieces of information 2 occupy 20+4*11=64 bits in total.

**[00211]** In addition, in a possible implementation, the access network device may further send information 3 to the terminal, where the information 3 indicates a maximum allowed amplitude coefficient corresponding to each spatial-domain vector in each of the m spatial-domain vector groups, or the information 3 indicates a maximum allowed amplitude coefficient corresponding to each spatial-domain vector in each of the m spatial-domain vector groups except n spatial-domain vectors indicated by corresponding information 2.

**[00212]** For example, assuming that Q=8, m=1, and n=2, the information 1 indicates one of the eight spatial-domain vector groups, where the one spatial-domain vector group is denoted as a spatial-domain vector group a. If the spatial-domain vector group a includes 16 spatial-domain vectors, and information 2 corresponding to the spatial-domain vector group a indicates two of the 16 spatial-domain vectors included in the spatial-domain vector group a, maximum allowed

amplitude coefficients corresponding to the remaining 14 spatial-domain vectors may be indicated by using the information 3.

**[00213]** 1110. The access network device sends the information 1 and the m pieces of information 2 to the terminal. Correspondingly, the terminal receives the information 1 and the m pieces of information 2 from the access network device.

**[00214]** For example, the access network device sends RRC signaling to the terminal, where the RRC signaling includes the information 1 and the m pieces of information 2. In addition, the information 1 and the m pieces of information 2 may alternatively be carried by using other signaling or messages. This is not limited in this application.

**[00215]** In addition, before 1100, that is, before the access network device sends the information 1 and the m pieces of information 2 to the terminal, the access network device may further send indication information to the terminal, where the indication information indicates $N_1$ and $N_2$. In other words, the indication information may not be carried in a same message as the information 1 or the m pieces of information 2.

**[00216]** Therefore, when values of $N_1$ and $N_2$ remain unchanged, CBSR may be indicated a plurality of times. Alternatively, it may be understood as that if the values of $N_1$ and $N_2$ remain unchanged, information indicating $N_1$ and $N_2$ may not need to be carried for each CBSR indication. In the foregoing design, the indication information (that is, the information indicating $N_1$ and $N_2$) may not be bound to the information 1 or the m pieces of information 2 (that is, information indicating the CBSR) for sending, thereby reducing unnecessary signaling overheads.

**[00217]** 1120. The terminal determines a PMI based on the information 1 and the m pieces of information 2.

**[00218]** For example, the terminal determines the m of the Q spatial-domain vector groups based on the information 1, and determines, based on the m pieces of information 2, the n spatial-domain vectors that correspond to each of the m spatial-domain vector groups and are not used for PMI calculation, that is, determines, based on the information 1 and the m pieces of information 2, spatial-domain vectors in the spatial-domain vector set that are not used for PMI calculation, which are m*n spatial-domain vectors in total, and then does not use any one of the m*n spatial-domain vectors when calculating the PMI, that is, does not use, when calculating the PMI, precoding associated with any one of the m*n spatial-domain vectors. Optionally, the terminal may further determine the PMI with reference to the information 3.

**[00219]** 1130. The terminal sends the PMI to the access network device. Correspondingly, the access network device receives the PMI from the terminal.

**[00220]** In conclusion, according to the method provided in the embodiment shown in FIG. 11, the number (for example, m) of spatial-domain vector groups that need to be selected and the

number (for example, n) of spatial-domain vectors that need to be selected in the selected spatial-domain vector group are fixed, so that the number of spatial-domain vectors that are not selected can be fixed, thereby effectively reducing signaling overheads for indicating CBSR. In addition, the access network device may further send the information 3 to the terminal, to indicate a maximum allowed amplitude of a spatial-domain vector used for PMI calculation, so that codebook performance can be further improved.

**[00221]** To reduce signaling overheads for indicating CBSR and improve communication performance, this application further provides a channel state information reporting method. As shown in FIG. 12, the method may specifically include the following steps.

**[00222]** 1200. An access network device determines information A and information B.

**[00223]** The information A indicates whether each of $N_1*O_1$ spatial-domain vector groups includes a spatial-domain vector that is not used for PMI calculation, each of the $N_1*O_1$ spatial-domain vector groups includes $N_2*O_2$ spatial-domain vectors in a second dimension in a spatial-domain vector set, the information B indicates whether each of $N_2*O_2$ spatial-domain vector groups includes a spatial-domain vector that is not used for PMI calculation, and each of the $N_2*O_2$ spatial-domain vector groups includes $N_1*O_1$ spatial-domain vectors in a first dimension in the spatial-domain vector set. For related descriptions of the spatial-domain vector set, refer to related content in the embodiment shown in FIG. 6. The spatial-domain vector set includes $N_1*N_2*O_1*O_2$ spatial-domain vectors, $O_1$ represents an oversampling factor in the first dimension, $O_2$ represents an oversampling factor in the second dimension, $N_1$ represents the number of antenna ports in the first dimension, $N_2$ represents the number of antenna ports in the second dimension, and $O_1$, $O_2$, $N_1$, and $N_2$ are all positive integers.

**[00224]** For example, the information A includes $N_1*O_1$ bits, and the $N_1*O_1$ bits ordered from start to end are associated with the $N_1*O_1$ spatial-domain vector groups in a first order. The first order is $a_0, a_1, \dots, a_{N_1O_1-2}, a_{N_1O_1-1}$, and $a_0, a_1, \dots, a_{N_1O_1-2}, a_{N_1O_1-1}$ are in one-to-one correspondence with the $N_1*O_1$ spatial-domain vector groups. The information B includes $N_2*O_2$ bits. The $N_2*O_2$ bits ordered from start to end are associated with the $N_2*O_2$ spatial-domain vector groups in a second order. The second order is $b_0, b_1, \dots, b_{N_2O_2-2}, b_{N_2O_2-1}$, and $b_0, b_1, \dots, b_{N_2O_2-2}, b_{N_2O_2-1}$ are in one-to-one correspondence with the $N_2*O_2$ spatial-domain vector groups.

**[00225]** In an optional embodiment, assuming that the first dimension represents a horizontal direction, and the second dimension represents a vertical direction, that each of the $N_1*O_1$ spatial-domain vector groups includes $N_2*O_2$ spatial-domain vectors in the second dimension in the spatial-domain vector set may be understood as that the spatial-domain vectors in the spatial-domain vector set are grouped by column, and all spatial-domain vectors in each column form one

spatial-domain vector group; and that each of the $N_2*O_2$ spatial-domain vector groups includes $N_1*O_1$ spatial-domain vectors in the first dimension in the spatial-domain vector set may be understood as that the spatial-domain vectors in the spatial-domain vector set are grouped by row, and all spatial-domain vectors in each row form one spatial-domain vector group. Further, determining is performed on the $N_1*O_1$ spatial-domain vector groups sequentially in the order of $a_0, a_1, \dots, a_{N_1O_1-2}, a_{N_1O_1-1}$, that is, an order of columns from left to right. If a spatial-domain vector group includes a spatial-domain vector that is not used for PMI calculation, a value of a bit corresponding to the spatial-domain vector group in which the spatial-domain vector is located is 0. If a spatial-domain vector group does not include a spatial-domain vector that is not used for PMI calculation, that is, all spatial-domain vectors included in the spatial-domain vector group can be used for PMI calculation, a value of a bit corresponding to the spatial-domain vector group in which the spatial-domain vector is located is 1. Determining is performed on the $N_2*O_2$ spatial-domain vector groups sequentially in the order of $b_0, b_1, \dots, b_{N_2O_2-2}, b_{N_2O_2-1}$, that is, an order of rows from bottom to top. If a spatial-domain vector group includes a spatial-domain vector that is not used for PMI calculation, a value of a bit corresponding to the spatial-domain vector group in which the spatial-domain vector is located is 0. If a spatial-domain vector group does not include a spatial-domain vector that is not used for PMI calculation, that is, all spatial-domain vectors included in the spatial-domain vector group can be used for PMI calculation, a value of a bit corresponding to the spatial-domain vector group in which the spatial-domain vector is located is 1.

**[00226]** For example, as shown in FIG. 13A and FIG. 13B, if $N_1=4$, $N_2=2$, $O_1=2$, and $O_2=2$, the spatial-domain vector set includes 32 spatial-domain vectors in total; and spatial-domain vectors corresponding to black circles are not used for PMI calculation. Assuming that the first dimension is the horizontal direction and the second dimension is the vertical direction, $N_1*O_1=8$, the information A includes 8 bits, the 8 bits ordered from start to end are associated with eight spatial-domain vector groups in an order of $a_0, a_1, \dots, a_6, a_7$, that is, an order from left to right in the figure, and values of the 8 bits are 01101101; and $N_2*O_2=4$, the information B includes 4 bits, the 4 bits ordered from start to end are associated with four spatial-domain vector groups in an order of $b_0, b_1, b_2, b_3$, that is, an order from bottom to top in the figure, and values of the 4 bits are 0001.

**[00227]** In addition, in a possible implementation, the access network device may further send information C and/or information D to the terminal, where the information C indicates a maximum allowed amplitude coefficient corresponding to each of the $N_1*O_1$ spatial-domain vector groups, and the information D indicates a maximum allowed amplitude coefficient corresponding to each of the $N_2*O_2$ spatial-domain vector groups. A maximum allowed amplitude coefficient corresponding to a spatial-domain vector group may be understood as a minimum value of

maximum allowed amplitude coefficients corresponding to spatial-domain vectors in the spatial-domain vector group. Alternatively, spatial-domain vectors in each spatial-domain vector group may correspond to a same maximum allowed amplitude coefficient; in this case, a maximum allowed amplitude coefficient corresponding to a spatial-domain vector group may be understood as a maximum allowed amplitude coefficient corresponding to each spatial-domain vector in the spatial-domain vector group.

**[00228]** In another possible implementation, the access network device may further send information C and/or information D to the terminal, where the information C indicates a maximum allowed amplitude coefficient corresponding to each spatial-domain vector in each of the $N_1*O_1$ spatial-domain vector groups, or the information D indicates a maximum allowed amplitude coefficient corresponding to each spatial-domain vector in each of the $N_2*O_2$ spatial-domain vector groups.

**[00229]** 1210. The access network device sends the information A and the information B to the terminal. Correspondingly, the terminal receives the information A and the information B from the access network device.

**[00230]** For example, the access network device sends RRC signaling to the terminal, where the RRC signaling includes the information A and the information B. In addition, the information A and the information B may alternatively be carried by using other signaling or messages. This is not limited in this application.

**[00231]** In addition, before 1200, the access network device may further send indication information to the terminal, where the indication information indicates $N_1$ and $N_2$. In other words, the indication information may not be carried in a same message as the information A or the information B.

**[00232]** Therefore, when values of $N_1$ and $N_2$ remain unchanged, CBSR may be indicated a plurality of times. Alternatively, it may be understood as that if the values of $N_1$ and $N_2$ remain unchanged, information indicating $N_1$ and $N_2$ may not need to be carried for each CBSR indication. In the foregoing design, the indication information (that is, the information indicating $N_1$ and $N_2$) may not be bound to the information A or the information B (that is, information indicating the CBSR) for sending, thereby reducing unnecessary signaling overheads.

**[00233]** 1220. The terminal determines a PMI based on the information A and the information B.

**[00234]** For example, the terminal determines, in the $N_1*O_1$ spatial-domain vector groups based on the information A, one or more spatial-domain vector groups including a spatial-domain vector that is not used for PMI calculation, and determines, in the $N_2*O_2$ spatial-domain vector groups based on the information B, one or more spatial-domain vector groups including a spatial-domain

vector that is not used for PMI calculation, to obtain two-dimensional coordinates of one or more spatial-domain vectors that are not used for PMI calculation, and does not use, when calculating the PMI, any one of the one or more spatial-domain vectors that are not used for PMI calculation, that is, does not use, when calculating the PMI, precoding associated with any one of the one or more spatial-domain vectors that are not used for PMI calculation. Optionally, the terminal may further determine the PMI based on the information C and/or the information D.

**[00235]** 1230. The terminal sends the PMI to the access network device. Correspondingly, the access network device receives the PMI from the terminal.

**[00236]** In conclusion, according to the method provided in the embodiment shown in FIG. 12, two-dimensional coordinates of one or more spatial-domain vectors in the spatial-domain vector set that are not used for PMI calculation can be determined by using two bitmaps, that is, the information A and the information B, thereby effectively reducing signaling overheads for indicating CBSR. In addition, the access network device may further send the information C and/or the information D to the terminal, to indicate a maximum allowed amplitude of a spatial-domain vector used for PMI calculation, so that codebook performance can be further improved.

**[00237]** To reduce signaling overheads for indicating CBSR and improve communication performance, this application further provides a channel state information reporting method. The method may specifically include the following two modes:

**[00238]** Mode A: A large number of spatial-domain vectors in the spatial-domain vector set are available spatial-domain vectors, where the available spatial-domain vectors are spatial-domain vectors that can be used for PMI calculation, for example, the number of available spatial-domain vectors is greater than $(\frac{N_1*N_2*O_1*O_2}{2})$.

**[00239]** If only one spatial-domain vector is not used for PMI calculation, the spatial-domain vector may be specifically indicated by using $\lceil \log_2 N_1 * O_1 \rceil + \lceil \log_2 N_2 * O_2 \rceil$ bits. For example, if $N_1$=8, $N_2$=8, $O_1$=4, and $O_2$=4, $\lceil \log_2 N_1 * O_1 \rceil + \lceil \log_2 N_2 * O_2 \rceil$=10.

**[00240]** If two spatial-domain vectors are not used for PMI calculation, a first spatial-domain vector that is not used for PMI calculation may be indicated by using $\lceil \log_2 N_1 * O_1 \rceil + \lceil \log_2 N_2 * O_2 \rceil$ bits, and a second spatial-domain vector that is not used for PMI calculation is indicated based on an offset (offset) relative to the previous spatial-domain vector that is not used for PMI calculation. Assuming that the offset is specified to follow an order of the first dimension prior to the second dimension (for example, the first dimension is the horizontal direction, and the second dimension is the vertical direction), a maximum offset is $N_1*N_2*O_1*O_2$–1, and the second spatial-domain vector that is not used for PMI calculation may be indicated by using $\lceil \log_2(N_1 * N_2 * O_1 * O_2 - 1) \rceil$ bits. For example, if $N_1$=8, $N_2$=8, $O_1$=4, and $O_2$=4, $\lceil \log_2 N_1 * O_1 \rceil + \lceil \log_2 N_2 * O_2 \rceil + \lceil \log_2(N_1 * N_2 * O_1 * O_2 - 1) \rceil$ =10+10=20 bits.

**[00241]** Similarly, if n spatial-domain vectors are not used for PMI calculation, the n spatial-domain vectors may be indicated by using $(\log_2 N_1 * O_1 + \log_2 N_2 * O_2)+\log_2(N_1 * N_2 * O_1 * O_2 - 1)+\ldots+\log_2(N_1 * N_2 * O_1 * O_2 - n + 1)$ bits, where n≤100.

**[00242]** For example, if 100 spatial-domain vectors are not used for PMI calculation, signaling overheads are 1000 bits in total, fewer than 1024 bits.

**[00243]** If n>100, CBSR may continue to be indicated by using $N_1*N_2*O_1*O_2$ bits.

**[00244]** Mode B: A large number of spatial-domain vectors in the spatial-domain vector set are unavailable spatial-domain vectors, where the unavailable spatial-domain vectors are spatial-domain vectors that are not used for PMI calculation, for example, the number of unavailable spatial-domain vectors is greater than $(\frac{N1*N2*O1*O2}{2})$. In this case, a manner similar to the mode A may be used.

**[00245]** In addition, the access network device may further send indication information to the terminal, where the indication information indicates $N_1$ and $N_2$. In other words, the indication information may not be carried in a same message as bit information required in the mode A or bit information required in the mode B.

**[00246]** In the foregoing manner, a meaning indicated by signaling is determined based on a mode (that is, the mode A) corresponding to a "large number of available spatial-domain vectors" and a mode (that is, the mode B) corresponding to a "large number of unavailable spatial-domain vectors", so that indication overheads can be reduced when a difference between the numbers of unavailable spatial-domain vectors and available spatial-domain vectors is large.

**[00247]** To reduce signaling overheads for CBSR and improve communication performance, this application further provides a channel state information reporting method. As shown in FIG. 14, the method may specifically include the following steps.

**[00248]** 1400. An access network device determines information X and information Y.

**[00249]** The information X indicates m of Q spatial-domain vector groups. For example, the Q spatial-domain vector groups are determined based on a spatial-domain vector set. For related descriptions of the spatial-domain vector set, refer to related content in the embodiment shown in FIG. 6. The spatial-domain vector set includes $N_1*N_2*O_1*O_2$ spatial-domain vectors, $O_1$ represents an oversampling factor in a first dimension, $O_2$ represents an oversampling factor in a second dimension, $N_1$ represents the number of antenna ports in the first dimension, $N_2$ represents the number of antenna ports in the second dimension, and $O_1$, $O_2$, $N_1$, $N_2$, and Q are all positive integers. Each of the Q spatial-domain vector groups includes S spatial-domain vectors, $Q*S=N_1*N_2*O_1*O_2$, and S is a positive integer.

**[00250]** In an example, $Q=O_1*O_2$, $K=N_1*N_2$, the $O_1*O_2$ spatial-domain vector groups are orthogonal groups, and $N_1*N_2$ spatial-domain vectors in each spatial-domain vector group are

orthogonal. In another example, $Q=N_1*N_2$, $K=O_1*O_2$, and the $N_1*N_2$ spatial-domain vector groups are oversampled spatial-domain vector groups.

**[00251]** The information Y indicates one or more of W spatial-domain vector groups, the W spatial-domain vector groups are determined based on the m spatial-domain vector groups, and spatial-domain vectors included in the one or more of the W spatial-domain vector groups are not used for PMI calculation.

**[00252]** For how to determine the W spatial-domain vector groups based on the m spatial-domain vector groups, refer to the foregoing possible grouping manners A to C. In addition, other grouping manners may alternatively be used. This is not limited in this application.

**[00253]** In some possible embodiments, a grouping manner used for the W spatial-domain vector groups may be predefined in a protocol or preconfigured by using signaling. In this case, a terminal does not need to be further notified of the grouping manner. In some other possible embodiments, the access network device may further determine information Z, and send information Z to the terminal, where the information Z indicates a third grouping manner, and the third grouping manner is one of a plurality of preset grouping manners. The W spatial-domain vector groups are determined based on the third grouping manner and the m spatial-domain vector groups.

**[00254]** For example, as shown in FIG. 10, if Q=8 and m=2, the information X indicates two of eight orthogonal groups, where one orthogonal group is formed by spatial-domain vectors corresponding to eight black circles, and the other orthogonal group is formed by spatial-domain vectors corresponding to eight hatched circles. Further, two spatial-domain vectors belonging to a same oversampled group form one spatial-domain vector group, eight spatial-domain vector groups are obtained in total, and each spatial-domain vector group includes two spatial-domain vectors, that is, each spatial-domain vector group includes one spatial-domain vector corresponding to a black circle and one spatial-domain vector corresponding to a hatched circle, and the two spatial-domain vectors belong to a same oversampled group. The information Y indicates one or more of the eight spatial-domain vector groups, and spatial-domain vectors included in the one or more spatial-domain vector groups indicated by the information Y are not used for PMI calculation.

**[00255]** For another example, as shown in FIG. 15A, if Q=8 and m=4, the information X indicates four of eight oversampled groups, for example, four oversampled groups shown by bold dashed lines in FIG. 15A. Further, the four oversampled groups shown by bold dashed lines may be grouped to determine eight spatial-domain vector groups, and each spatial-domain vector group includes four spatial-domain vectors. As shown in FIG. 15B, the information Y indicates one or more of the eight spatial-domain vector groups, and spatial-domain vectors included in the one or

more spatial-domain vector groups indicated by the information Y are not used for PMI calculation.

**[00256]** In addition, in a possible implementation, the access network device may further send information T to the terminal, where the information T indicates a maximum allowed amplitude coefficient corresponding to each spatial-domain vector in another spatial-domain vector group in the W spatial-domain vector groups other than the one or more spatial-domain vector groups indicated by the information Y.

**[00257]** 1410. The access network device sends the information X and the information Y to the terminal. Correspondingly, the terminal receives the information X and the information Y from the access network device.

**[00258]** For example, the access network device sends RRC signaling to the terminal, where the RRC signaling includes the information X and the information Y. In addition, the information X and the information Y may alternatively be carried by using other signaling or messages. This is not limited in this application.

**[00259]** In addition, before 1400, that is, before the access network device sends the information X and the information Y to the terminal, the access network device may further send indication information to the terminal, where the indication information indicates $N_1$ and $N_2$. In other words, the indication information may not be carried in a same message as the information X or the m pieces of information Y, thereby reducing unnecessary signaling overheads.

**[00260]** 1420. The terminal determines a PMI based on the information X and the information Y.

**[00261]** For example, the terminal determines the m of the Q spatial-domain vector groups based on the information X, and determines, based on the information Y, that the spatial-domain vectors included in the one or more of the W spatial-domain vector groups are not used for PMI calculation. Optionally, the terminal may further determine the PMI with reference to the information T.

**[00262]** 1430. The terminal sends the PMI to the access network device. Correspondingly, the access network device receives the PMI from the terminal.

**[00263]** In conclusion, according to the method provided in the embodiment shown in FIG. 14, the number (for example, m) of spatial-domain vector groups that need to be selected is fixed, the selected spatial-domain vector groups are regrouped, and it is indicated that spatial-domain vectors included in one or more of several regrouped spatial-domain vector groups are not used for PMI calculation, thereby effectively reducing signaling overheads for indicating CBSR. In addition, the access network device may further send the information T to the terminal, to indicate a maximum allowed amplitude of a spatial-domain vector used for PMI calculation, so that codebook performance can be further improved.

**[00264]** It may be understood that, to implement functions in the foregoing embodiments, the terminal and the access network device include corresponding hardware structures and/or software modules for performing the functions. A person skilled in the art should be easily aware that, with reference to units and method steps of examples described in embodiments disclosed in this application, this application can be implemented in a form of hardware or a combination of hardware and computer software. Whether a function is performed by hardware or hardware driven by computer software depends on specific application scenarios and design constraints of the technical solutions.

**[00265]** FIG. 16 and FIG. 17 are structural diagrams of possible communication apparatuses according to embodiments of this application. These communication apparatuses may be configured to implement functions of the terminal or the access network device in the foregoing method embodiments, and therefore can also achieve the beneficial effects of the foregoing method embodiments.

**[00266]** As shown in FIG. 16, a communication apparatus 1600 includes a processing unit 1610 and a transceiver unit 1620. The communication apparatus 1600 is configured to implement functions of the terminal or the access network device in the foregoing method embodiments.

**[00267]** When the communication apparatus 1600 is configured to implement functions of the access network device in the foregoing embodiments:

**[00268]** The processing unit 1610 is configured to determine first information, where the first information indicates one or more of P spatial-domain vector groups, spatial-domain vectors included in the one or more spatial-domain vector groups are not used for precoding matrix indicator PMI calculation, the P spatial-domain vector groups are determined based on a spatial-domain vector set, the spatial-domain vector set includes $N_1*N_2*O_1*O_2$ spatial-domain vectors, $O_1$ represents an oversampling factor in a first dimension, $O_2$ represents an oversampling factor in a second dimension, $N_1$ represents the number of antenna ports in the first dimension, $N_2$ represents the number of antenna ports in the second dimension, each of the P spatial-domain vector groups includes K spatial-domain vectors, $P*K=N_1*N_2*O_1*O_2$, $O_1$, $O_2$, $N_1$, and $N_2$ are all positive integers, and P and K are integers greater than 1.

**[00269]** The transceiver unit 1620 is configured to send the first information to a terminal.

**[00270]** In a possible design, the first information occupies P bits, and the P bits are in one-to-one correspondence with the P spatial-domain vector groups.

**[00271]** In a possible design, a value of a bit in the P bits that corresponds to a part of or all the one or more spatial-domain vector groups is 0, indicating that PMI reporting for precoding corresponding to the part of or all the spatial-domain vector groups is not allowed.

**[00272]** In a possible design, the P spatial-domain vector groups are determined based on a first

grouping manner and the spatial-domain vector set; and

the transceiver unit 1620 is configured to send second information to the terminal, where the second information indicates the first grouping manner, the first grouping manner is one of M preset grouping manners, and M is an integer greater than 1.

**[00273]** In a possible design, the second information occupies $\lceil \log_2 M \rceil$ bits.

**[00274]** In a possible design, the M preset grouping manners include two or more of the following:

each spatial-domain vector group includes $N_1*O_1$ spatial-domain vectors in the first dimension, $P=N_2*O_2$, and $K=N_1*O_1$;

each spatial-domain vector group includes $N_2*O_2$ spatial-domain vectors in the second dimension, $P=N_1*O_1$, and $K=N_2*O_2$; or

each spatial-domain vector group includes $n_1*n_2$ spatial-domain vectors, $n_1$ represents the number of spatial-domain vectors in the first dimension, $n_2$ represents the number of spatial-domain vectors in the second dimension, $N_1*O_1$ is an integer multiple of $n_1$, $N_2*O_2$ is an integer multiple of $n_2$, and $n_1$ and $n_2$ are positive integers.

**[00275]** In a possible design, the first information includes P bits, and the P bits ordered from start to end are associated with the P spatial-domain vector groups in ascending order of maximum spatial-domain vector indexes in the spatial-domain vector groups; or the P bits ordered from start to end are associated with the P spatial-domain vector groups in ascending order of minimum spatial-domain vector indexes in the spatial-domain vector groups.

**[00276]** In a possible design, the transceiver unit 1620 is configured to send third information to the terminal, where the third information indicates a maximum allowed amplitude coefficient corresponding to each of the P spatial-domain vector groups, or the third information indicates a maximum allowed amplitude coefficient corresponding to each of the P spatial-domain vector groups except the one or more spatial-domain vector groups.

**[00277]** In a possible design, the transceiver unit 1620 is configured to send indication information to the terminal before sending the first information to the terminal, where the indication information indicates $N_1$ and $N_2$.

**[00278]** When the communication apparatus 1600 is configured to implement functions of the terminal in the foregoing embodiments:

**[00279]** The transceiver unit 1620 is configured to receive first information from an access network device, where the first information indicates one or more of P spatial-domain vector groups, spatial-domain vectors included in the one or more spatial-domain vector groups are not used for PMI calculation, the P spatial-domain vector groups are determined based on a spatial-domain vector set, the spatial-domain vector set includes $N_1*N_2*O_1*O_2$ spatial-domain vectors,

$O_1$ represents an oversampling factor in a first dimension, $O_2$ represents an oversampling factor in a second dimension, $N_1$ represents the number of antenna ports in the first dimension, $N_2$ represents the number of antenna ports in the second dimension, each of the P spatial-domain vector groups includes K spatial-domain vectors, $P*K=N_1*N_2*O_1*O_2$, $O_1$, $O_2$, $N_1$, and $N_2$ are all positive integers, and P and K are integers greater than 1.

**[00280]** The processing unit 1610 is configured to calculate a PMI based on the first information.

**[00281]** The transceiver unit 1620 is configured to send the PMI to the access network device.

**[00282]** In a possible design, the first information occupies P bits, and the P bits are in one-to-one correspondence with the P spatial-domain vector groups.

**[00283]** In a possible design, a value of a bit in the P bits that corresponds to a part of or all the one or more spatial-domain vector groups is zero 0, indicating that PMI reporting for precoding corresponding to the part of or all the spatial-domain vector groups is not allowed.

**[00284]** In a possible design, the P spatial-domain vector groups are determined based on a first grouping manner and the spatial-domain vector set; and

the transceiver unit 1620 is configured to receive second information sent from the access network device, where the second information indicates the first grouping manner, the first grouping manner is one of M preset grouping manners, and M is an integer greater than 1.

**[00285]** In a possible design, the second information occupies $\lceil \log_2 M \rceil$ bits.

**[00286]** In a possible design, the M preset grouping manners include two or more of the following:

each spatial-domain vector group includes $N_1*O_1$ spatial-domain vectors in the first dimension, $P=N_2*O_2$, and $K=N_1*O_1$;

each spatial-domain vector group includes $N_2*O_2$ spatial-domain vectors in the second dimension, $P=N_1*O_1$, and $K=N_2*O_2$; or

each spatial-domain vector group includes $n_1*n_2$ spatial-domain vectors, $n_1$ represents the number of spatial-domain vectors in the first dimension, $n_2$ represents the number of spatial-domain vectors in the second dimension, $N_1*O_1$ is an integer multiple of $n_1$, $N_2*O_2$ is an integer multiple of $n_2$, and $n_1$ and $n_2$ are positive integers.

**[00287]** In a possible design, the first information includes P bits, and the P bits ordered from start to end are associated with the P spatial-domain vector groups in ascending order of maximum spatial-domain vector indexes in the spatial-domain vector groups; or the P bits ordered from start to end are associated with the P spatial-domain vector groups in ascending order of minimum spatial-domain vector indexes in the spatial-domain vector groups.

**[00288]** In a possible design, the transceiver unit 1620 is configured to receive third information from the access network device, where the third information indicates a maximum allowed

amplitude coefficient corresponding to each of the P spatial-domain vector groups, or the third information indicates a maximum allowed amplitude coefficient corresponding to each of the P spatial-domain vector groups except the one or more spatial-domain vector groups.

**[00289]** In a possible design, the transceiver unit 1620 is configured to receive indication information from the access network device before receiving the first information from the access network device, where the indication information indicates $N_1$ and $N_2$.

**[00290]** When the communication apparatus 1600 is configured to implement functions of the access network device in the foregoing embodiments:

**[00291]** The processing unit 1610 is configured to determine information 1 and m pieces of information 2, where the information 1 indicates m of Q spatial-domain vector groups, the m pieces of information 2 are in one-to-one correspondence with the m spatial-domain vector groups, each piece of information 2 indicates n spatial-domain vectors in a corresponding spatial-domain vector group, the n spatial-domain vectors indicated by each piece of information 2 are not used for PMI calculation, the Q spatial-domain vector groups are determined based on a spatial-domain vector set, the spatial-domain vector set includes $N_1*N_2*O_1*O_2$ spatial-domain vectors, $O_1$ represents an oversampling factor in a first dimension, $O_2$ represents an oversampling factor in a second dimension, $N_1$ represents the number of antenna ports in the first dimension, $N_2$ represents the number of antenna ports in the second dimension, $O_1$, $O_2$, $N_1$, and $N_2$ are all positive integers, each of the Q spatial-domain vector groups includes S spatial-domain vectors, $Q*S=N_1*N_2*O_1*O_2$, and Q, S, m, and n are positive integers.

**[00292]** The transceiver unit 1620 is configured to send the information 1 and the m pieces of information 2 to a terminal.

**[00293]** In a possible design, the information 1 occupies $\lceil \log_2 C_Q^m \rceil$ bits, and the information 2 occupies $\lceil \log_2 C_S^n \rceil$ bits.

**[00294]** In a possible design, $Q=O_1*O_2$, $K=N_1*N_2$, the $O_1*O_2$ spatial-domain vector groups are orthogonal groups, $N_1*N_2$ spatial-domain vectors in each spatial-domain vector group are orthogonal, the information 1 occupies $\lceil \log_2 C_{O_1*O_2}^m \rceil$ bits, and the information 2 occupies $\lceil \log_2 C_{N_1*N_2}^n \rceil$ bits.

**[00295]** In a possible design, $Q=N_1*N_2$, $K=O_1*O_2$, the $N_1*N_2$ spatial-domain vector groups are oversampled spatial-domain vector groups, the information 1 occupies $\lceil \log_2 C_{N_1*N_2}^m \rceil$ bits, and the information 2 occupies $\lceil \log_2 C_{O_1*O_2}^n \rceil$ bits.

**[00296]** In a possible design, the transceiver unit 1620 is configured to send indication information to the terminal before sending the information 1 and the m pieces of information 2 to the terminal, where the indication information indicates $N_1$ and $N_2$.

**[00297]** In a possible design, the transceiver unit 1620 is configured to send information 3 to the terminal, where the information 3 indicates a maximum allowed amplitude coefficient corresponding to each spatial-domain vector in each of the m spatial-domain vector groups, or the information 3 indicates a maximum allowed amplitude coefficient corresponding to each spatial-domain vector in each of the m spatial-domain vector groups except n spatial-domain vectors indicated by corresponding information 2.

**[00298]** When the communication apparatus 1600 is configured to implement functions of the terminal in the foregoing embodiments:

**[00299]** The transceiver unit 1620 is configured to receive information 1 and m pieces of information 2 from an access network device, where the information 1 indicates m of Q spatial-domain vector groups, the m pieces of information 2 are in one-to-one correspondence with the m spatial-domain vector groups, each piece of information 2 indicates n spatial-domain vectors in a corresponding spatial-domain vector group, the n spatial-domain vectors indicated by each piece of information 2 are not used for PMI calculation, the Q spatial-domain vector groups are determined based on a spatial-domain vector set, the spatial-domain vector set includes $N_1*N_2*O_1*O_2$ spatial-domain vectors, $O_1$ represents an oversampling factor in a first dimension, $O_2$ represents an oversampling factor in a second dimension, $N_1$ represents the number of antenna ports in the first dimension, $N_2$ represents the number of antenna ports in the second dimension, $O_1$, $O_2$, $N_1$, and $N_2$ are all positive integers, each of the Q spatial-domain vector groups includes S spatial-domain vectors, $Q*S=N_1*N_2*O_1*O_2$, and Q, S, m, and n are positive integers.

**[00300]** The processing unit 1610 is configured to calculate a PMI based on the information 1 and the m pieces of information 2.

**[00301]** The transceiver unit 1620 is configured to send the PMI to the access network device.

**[00302]** In a possible design, the information 1 occupies $\lceil \log_2 C_Q^m \rceil$ bits, and the information 2 occupies $\lceil \log_2 C_S^n \rceil$ bits.

**[00303]** In a possible design, $Q=O_1*O_2$, $K=N_1*N_2$, the $O_1*O_2$ spatial-domain vector groups are orthogonal groups, $N_1*N_2$ spatial-domain vectors in each spatial-domain vector group are orthogonal, the information 1 occupies $\lceil \log_2 C_{O_1*O_2}^m \rceil$ bits, and the information 2 occupies $\lceil \log_2 C_{N_1*N_2}^n \rceil$ bits.

**[00304]** In a possible design, $Q=N_1*N_2$, $K=O_1*O_2$, the $N_1*N_2$ spatial-domain vector groups are oversampled spatial-domain vector groups, the information 1 occupies $\lceil \log_2 C_{N_1*N_2}^m \rceil$ bits, and the information 2 occupies $\lceil \log_2 C_{O_1*O_2}^n \rceil$ bits.

**[00305]** In a possible design, the transceiver unit 1620 is configured to receive indication information from the access network device before receiving the information 1 and the m pieces

of information 2 from the access network device, where the indication information indicates $N_1$ and $N_2$.

**[00306]** In a possible design, the transceiver unit 1620 is configured to receive information 3 from the access network device, where the information 3 indicates a maximum allowed amplitude coefficient corresponding to each spatial-domain vector in each of the m spatial-domain vector groups, or the information 3 indicates a maximum allowed amplitude coefficient corresponding to each spatial-domain vector in each of the m spatial-domain vector groups except n spatial-domain vectors indicated by corresponding information 2.

**[00307]** When the communication apparatus 1600 is configured to implement functions of the access network device in the foregoing embodiments:

**[00308]** The processing unit 1610 is configured to determine information A and information B, where the information A indicates whether each of $N_1*O_1$ spatial-domain vector groups includes a spatial-domain vector that is not used for PMI calculation, each of the $N_1*O_1$ spatial-domain vector groups includes $N_2*O_2$ spatial-domain vectors in a second dimension in a spatial-domain vector set, the information B indicates whether each of $N_2*O_2$ spatial-domain vector groups includes a spatial-domain vector that is not used for PMI calculation, each of the $N_2*O_2$ spatial-domain vector groups includes $N_1*O_1$ spatial-domain vectors in a first dimension in the spatial-domain vector set, the spatial-domain vector set includes $N_1*N_2*O_1*O_2$ spatial-domain vectors, $O_1$ represents an oversampling factor in the first dimension, $O_2$ represents an oversampling factor in the second dimension, $N_1$ represents the number of antenna ports in the first dimension, $N_2$ represents the number of antenna ports in the second dimension, and $O_1$, $O_2$, $N_1$, and $N_2$ are all positive integers.

**[00309]** The transceiver unit 1620 is configured to send the information A and the information B to a terminal.

**[00310]** In a possible design, the information A includes $N_1*O_1$ bits, and the information B includes $N_2*O_2$ bits.

**[00311]** In a possible design, the transceiver unit 1620 is configured to send information C and/or information D to the terminal, where the information C indicates a maximum allowed amplitude coefficient corresponding to each of the $N_1*O_1$ spatial-domain vector groups, and the information D indicates a maximum allowed amplitude coefficient corresponding to each of the $N_2*O_2$ spatial-domain vector groups.

**[00312]** In a possible design, the transceiver unit 1620 is configured to send indication information to the terminal before sending the information A and the information B to the terminal, where the indication information indicates $N_1$ and $N_2$.

**[00313]** When the communication apparatus 1600 is configured to implement functions of the

terminal in the foregoing embodiments:

**[00314]** The transceiver unit 1620 is configured to receive information A and information B from an access network device, where the information A indicates whether each of $N_1*O_1$ spatial-domain vector groups includes a spatial-domain vector that is not used for PMI calculation, each of the $N_1*O_1$ spatial-domain vector groups includes $N_2*O_2$ spatial-domain vectors in a second dimension in a spatial-domain vector set, the information B indicates whether each of $N_2*O_2$ spatial-domain vector groups includes a spatial-domain vector that is not used for PMI calculation, each of the $N_2*O_2$ spatial-domain vector groups includes $N_1*O_1$ spatial-domain vectors in a first dimension in the spatial-domain vector set, the spatial-domain vector set includes $N_1*N_2*O_1*O_2$ spatial-domain vectors, $O_1$ represents an oversampling factor in the first dimension, $O_2$ represents an oversampling factor in the second dimension, $N_1$ represents the number of antenna ports in the first dimension, $N_2$ represents the number of antenna ports in the second dimension, and $O_1$, $O_2$, $N_1$, and $N_2$ are all positive integers.

**[00315]** The processing unit 1610 is configured to calculate a PMI based on the information A and the information B.

**[00316]** The transceiver unit 1620 is configured to send the PMI to the access network device.

**[00317]** In a possible design, the information A includes $N_1*O_1$ bits, and the information B includes $N_2*O_2$ bits.

**[00318]** In a possible design, the transceiver unit 1620 is configured to receive information C and/or information D from the access network device, where the information C indicates a maximum allowed amplitude coefficient corresponding to each of the $N_1*O_1$ spatial-domain vector groups, and the information D indicates a maximum allowed amplitude coefficient corresponding to each of the $N_2*O_2$ spatial-domain vector groups.

**[00319]** In a possible design, the transceiver unit 1620 is configured to receive indication information from the access network device before receiving the information A and the information B from the access network device, where the indication information indicates $N_1$ and $N_2$.

**[00320]** For more detailed descriptions of the processing unit 1610 and the transceiver unit 1620, directly refer to related descriptions in the foregoing method embodiments. Details are not described herein again.

**[00321]** As shown in FIG. 17, a communication apparatus 1700 includes a processor 1710 and an interface circuit 1720. The processor 1710 and the interface circuit 1720 are coupled to each other. It may be understood that the interface circuit 1720 may be a transceiver or an input/output interface. Optionally, the communication apparatus 1700 may further include a memory 1730, configured to store instructions executed by the processor 1710, input data required by the

processor 1710 to run the instructions, or data generated after the processor 1710 runs the instructions.

**[00322]** The memory 1730 may be integrated into the processor 1710. In a possible case, the communication apparatus 1700 may include at least one processor 1710 integrated with the memory 1730, and may further include another memory.

**[00323]** When the communication apparatus 1700 is configured to implement the method shown in any one of FIG. 6, FIG. 11, FIG. 12, or FIG. 14, the processor 1710 is configured to implement functions of the processing unit 1610, and the interface circuit 1720 is configured to implement functions of the transceiver unit 1620.

**[00324]** It may be understood that the processor in embodiments of this application may be a central processing unit (Central Processing Unit, CPU), or may be another general-purpose processor, a digital signal processor (Digital Signal Processor, DSP), an application-specific integrated circuit (Application-Specific Integrated Circuit, ASIC), a field programmable gate array (Field Programmable Gate Array, FPGA) or another programmable logic device, a transistor logic device, a hardware component, or any combination thereof. The general-purpose processor may be a microprocessor or any regular processor.

**[00325]** This application provides another example of the apparatus. The communication apparatus includes at least one processor and at least one memory. The at least one processor is coupled to the at least one memory. The at least one memory is configured to store instructions. When the instructions are executed by the at least one processor, the communication apparatus is enabled to perform the method in the foregoing embodiments. For example, the communication apparatus includes one processor and one memory. As shown in FIG. 17, the communication apparatus 1700 includes one processor 1710 and one memory 1730. The processor 1710 is coupled to the memory 1730. The memory 1730 stores instructions. When the instructions stored in the memory 1730 are executed by the processor 1710, the communication apparatus 1700 performs the method performed by the terminal or the access network device in the foregoing embodiments.

**[00326]** The method steps in embodiments of this application may be implemented in hardware, or may be implemented in processor-executable software instructions. The software instructions may include a corresponding software module. The software module may be stored in a random access memory, a flash memory, a read-only memory, a programmable read-only memory, an erasable programmable read-only memory, an electrically erasable programmable read-only memory, a register, a hard disk drive, a removable hard disk drive, a CD-ROM, or any other form of storage medium well-known in the art. For example, the storage medium is coupled to the processor, so that the processor can read information from the storage medium and write information into the storage medium. The storage medium may alternatively be a component of

the processor. The processor and the storage medium may be located in an ASIC. In addition, the ASIC may be located in the terminal or the access network device. Alternatively, the processor and the storage medium may exist as discrete components in the terminal or the access network device.

**[00327]** The foregoing embodiments may be all or partly implemented by software, hardware, firmware, or any combination thereof. When software is used for implementation, the embodiments may be all or partly implemented in a form of a computer program product. The computer program product includes one or more computer programs or instructions. When the computer programs or the instructions are loaded and executed on a computer, the procedures or functions in embodiments of this application are all or partly executed. The computer may be a general-purpose computer, a dedicated computer, a computer network, a network device, user equipment, or another programmable apparatus. The computer programs or the instructions may be stored in a computer-readable storage medium, or may be transmitted from a computer-readable storage medium to another computer-readable storage medium. For example, the computer programs or the instructions may be transmitted from a website, computer, server, or data center to another website, computer, server, or data center in a wired or wireless manner. The computer-readable storage medium may be any usable medium that can be accessed by the computer, or a data storage device, for example, a server or a data center, integrating one or more usable media. The usable medium may be a magnetic medium, for example, a floppy disk, a hard disk drive, or a magnetic tape; or may be an optical medium, for example, a digital video disc; or may be a semiconductor medium, for example, a solid-state drive. The computer-readable storage medium may be a volatile or non-volatile storage medium, or include both.

**[00328]** In embodiments of this application, unless otherwise specified or a logic conflict occurs, terms and/or descriptions in different embodiments are consistent and may be mutually referenced, and technical features in different embodiments may be combined based on an internal logical relationship thereof to form new embodiments.

**[00329]** In this application, "at least one" means one or more, and "a plurality of" means two or more. The term "and/or" describes an association relationship between associated objects and represents that three relationships may exist. For example, A and/or B may represent the following three cases: Only A exists, both A and B exist, and only B exists, where A and B may be singular or plural. In text descriptions of this application, the character "/" represents an "or" relationship between associated objects. In formulas of this application, the character "/" represents a "division" relationship between associated objects. The expression "including at least one of A, B, and C" may represent as follows: including A; including B; including C; including A and B; including A and C; including B and C; or including A, B, and C.

**[00330]** It may be understood that various numbers in embodiments of this application are

merely used for differentiation for ease of description, but are not intended to limit the scope of embodiments of this application. Sequence numbers of the foregoing processes do not mean a particular execution sequence, and the execution sequence of the processes should be determined based on functions and internal logic of the processes.

# CLAIMS

1. A channel state information reporting method, comprising:

determining first information, wherein the first information indicates one or more of P spatial-domain vector groups, spatial-domain vectors comprised in the one or more spatial-domain vector groups are not used for precoding matrix indicator PMI calculation, the P spatial-domain vector groups are determined based on a part of or all spatial-domain vectors in a spatial-domain vector set, the spatial-domain vector set comprises $N_1*N_2*O_1*O_2$ spatial-domain vectors, $O_1$ represents an oversampling factor in a first dimension, $O_2$ represents an oversampling factor in a second dimension, $N_1$ represents a number of antenna ports in the first dimension, $N_2$ represents a number of antenna ports in the second dimension, each of the P spatial-domain vector groups comprises K spatial-domain vectors, $P*K=N_1*N_2*O_1*O_2$, $O_1$, $O_2$, $N_1$, and $N_2$ are all positive integers, and P and K are both integers greater than 1; and

sending the first information to a terminal.

2. The method according to claim 1, wherein the first information occupies P bits, and the P bits are in one-to-one correspondence with the P spatial-domain vector groups.

3. The method according to claim 2, wherein a value of a bit in the P bits that corresponds to a part of or all the one or more spatial-domain vector groups is 0, indicating that PMI reporting for precoding corresponding to the part of or all the spatial-domain vector groups is not allowed.

4. The method according to claim 2 or 3, wherein the P bits ordered from start to end are associated with the P spatial-domain vector groups in ascending order of maximum spatial-domain vector indexes in the spatial-domain vector groups; or the P bits ordered from start to end are associated with the P spatial-domain vector groups in ascending order of minimum spatial-domain vector indexes in the spatial-domain vector groups.

5. The method according to any one of claims 1 to 4, wherein the P spatial-domain vector groups are determined based on a first grouping manner and the spatial-domain vector set; and

the method further comprises:

sending second information to the terminal, wherein the second information indicates the first grouping manner, the first grouping manner is one of M preset grouping manners, and M is an integer greater than 1.

6. The method according to claim 5, wherein the second information occupies $\lceil \log_2 M \rceil$ bits.

7. The method according to claim 5 or 6, wherein the M preset grouping manners comprise one or more of the following:

each spatial-domain vector group comprises $N_1*O_1$ spatial-domain vectors in the first dimension, $P=N_2*O_2$, and $K=N_1*O_1$;

each spatial-domain vector group comprises $N_2*O_2$ spatial-domain vectors in the second dimension, $P=N_1*O_1$, and $K=N_2*O_2$; or

each spatial-domain vector group comprises $n_1*n_2$ spatial-domain vectors, $n_1$ represents a number of spatial-domain vectors in the first dimension, $n_2$ represents a number of spatial-domain vectors in the second dimension, $N_1*O_1$ is an integer multiple of $n_1$, $N_2*O_2$ is an integer multiple of $n_2$, and $n_1$ and $n_2$ are positive integers.

8. The method according to claim 5 or 6, wherein the M preset grouping manners comprise one or more of the following:

each spatial-domain vector group comprises $N_1$ spatial-domain vectors in the first dimension, $P=N_2$, and $K=N_1$;

each spatial-domain vector group comprises $N_2$ spatial-domain vectors in the second dimension, $P=N_1$, and $K=N_2$; or

each spatial-domain vector group comprises $n_1*n_2$ spatial-domain vectors, $n_1$ represents a number of spatial-domain vectors in the first dimension, $n_2$ represents a number of spatial-domain vectors in the second dimension, $N_1$ is an integer multiple of $n_1$, $N_2$ is an integer multiple of $n_2$, and $n_1$ and $n_2$ are positive integers.

9. The method according to claim 7 or 8, wherein $n_1=2$ and $n_2=2$; or $n_1=1$ and $n_2=4$; or $n_1=4$ and $n_2=1$; or $n_1=1$ and $n_2=1$.

10. The method according to claim 7 or 8, wherein a first value group corresponds to at least one second value group, the first value group is formed by a value of $N_1$ and a value of $N_2$, and the second value group is formed by a value of $n_1$ and a value of $n_2$.

11. The method according to claim 10, wherein there is at least one first value group for which no corresponding second value group is configured.

12. The method according to any one of claims 1 to 11, further comprising:

sending third information to the terminal, wherein the third information indicates a maximum allowed amplitude coefficient corresponding to each of the P spatial-domain vector groups, or the third information indicates a maximum allowed amplitude coefficient corresponding to each of the P spatial-domain vector groups except the one or more spatial-domain vector groups.

13. The method according to any one of claims 1 to 12, wherein before the sending the first information to the terminal, the method further comprises:

sending indication information to the terminal, wherein the indication information indicates $N_1$ and $N_2$.

14. A channel state information reporting method, comprising:

receiving first information from an access network device, wherein the first information indicates one or more of P spatial-domain vector groups, spatial-domain vectors comprised in the

one or more spatial-domain vector groups are not used for PMI calculation, the P spatial-domain vector groups are determined based on a part of or all spatial-domain vectors in a spatial-domain vector set, the spatial-domain vector set comprises $N_1*N_2*O_1*O_2$ spatial-domain vectors, $O_1$ represents an oversampling factor in a first dimension, $O_2$ represents an oversampling factor in a second dimension, $N_1$ represents a number of antenna ports in the first dimension, $N_2$ represents a number of antenna ports in the second dimension, each of the P spatial-domain vector groups comprises K spatial-domain vectors, $P*K=N_1*N_2*O_1*O_2$, $O_1$, $O_2$, $N_1$, and $N_2$ are all positive integers, and P and K are both integers greater than 1;

calculating a PMI based on the first information; and

sending the PMI to the access network device.

15. The method according to claim 14, wherein the first information occupies P bits, and the P bits are in one-to-one correspondence with the P spatial-domain vector groups.

16. The method according to claim 15, wherein a value of a bit in the P bits that corresponds to a part of or all the one or more spatial-domain vector groups is 0, indicating that PMI reporting for precoding corresponding to the part of or all the spatial-domain vector groups is not allowed.

17. The method according to claim 15 or 16, wherein the P bits ordered from start to end are associated with the P spatial-domain vector groups in ascending order of maximum spatial-domain vector indexes in the spatial-domain vector groups; or the P bits ordered from start to end are associated with the P spatial-domain vector groups in ascending order of minimum spatial-domain vector indexes in the spatial-domain vector groups.

18. The method according to any one of claims 14 to 17, wherein the P spatial-domain vector groups are determined based on a first grouping manner and the spatial-domain vector set; and

the method further comprises:

receiving second information sent from the access network device, wherein the second information indicates the first grouping manner, the first grouping manner is one of M preset grouping manners, and M is an integer greater than 1.

19. The method according to claim 18, wherein the second information occupies $\lceil \log_2 M \rceil$ bits.

20. The method according to claim 18 or 19, wherein the M preset grouping manners comprise one or more of the following:

each spatial-domain vector group comprises $N_1*O_1$ spatial-domain vectors in the first dimension, $P=N_2*O_2$, and $K=N_1*O_1$;

each spatial-domain vector group comprises $N_2*O_2$ spatial-domain vectors in the second dimension, $P=N_1*O_1$, and $K=N_2*O_2$; or

each spatial-domain vector group comprises $n_1*n_2$ spatial-domain vectors, $n_1$ represents a

number of spatial-domain vectors in the first dimension, $n_2$ represents a number of spatial-domain vectors in the second dimension, $N_1*O_1$ is an integer multiple of $n_1$, $N_2*O_2$ is an integer multiple of $n_2$, and $n_1$ and $n_2$ are positive integers.

21. The method according to claim 18 or 19, wherein the M preset grouping manners comprise one or more of the following:

each spatial-domain vector group comprises $N_1$ spatial-domain vectors in the first dimension, $P=N_2$, and $K=N_1$;

each spatial-domain vector group comprises $N_2$ spatial-domain vectors in the second dimension, $P=N_1$, and $K=N_2$; or

each spatial-domain vector group comprises $n_1*n_2$ spatial-domain vectors, $n_1$ represents a number of spatial-domain vectors in the first dimension, $n_2$ represents a number of spatial-domain vectors in the second dimension, $N_1$ is an integer multiple of $n_1$, $N_2$ is an integer multiple of $n_2$, and $n_1$ and $n_2$ are positive integers.

22. The method according to claim 20 or 21, wherein $n_1=2$ and $n_2=2$; or $n_1=1$ and $n_2=4$; or $n_1=4$ and $n_2=1$; or $n_1=1$ and $n_2=1$.

23. The method according to claim 20 or 21, wherein a first value group corresponds to at least one second value group, the first value group is formed by a value of $N_1$ and a value of $N_2$, and the second value group is formed by a value of $n_1$ and a value of $n_2$.

24. The method according to claim 23, wherein there is at least one first value group for which no corresponding second value group is configured.

25. The method according to any one of claims 14 to 24, further comprising:

receiving third information from the access network device, wherein the third information indicates a maximum allowed amplitude coefficient corresponding to each of the P spatial-domain vector groups, or the third information indicates a maximum allowed amplitude coefficient corresponding to each of the P spatial-domain vector groups except the one or more spatial-domain vector groups.

26. The method according to any one of claims 14 to 25, wherein before the receiving the first information from the access network device, the method further comprises:

receiving indication information from the access network device, wherein the indication information indicates $N_1$ and $N_2$.

27. A communication apparatus, comprising a module configured to perform the method according to any one of claims 1 to 26.

28. A communication apparatus, wherein the communication apparatus comprises at least one processor, and the at least one processor is configured to perform the method according to any one of claims 1 to 26.

29. A computer-readable storage medium, wherein the computer-readable storage medium comprises a program, and when the program is run, the method according to any one of claims 1 to 26 is performed.

30. A computer program product, wherein the computer program product comprises a program or instructions, and when the program or the instructions are executed, the method according to any one of claims 1 to 26 is performed.