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INFORMATION TRANSMISSION METHOD AND APPARATUS

Abstract

This application relates to the field of communication technologies, and provides an information transmission method and an apparatus, to reduce a PAPR of a PPDU for transmission in a 320 MHz bandwidth. The information transmission method includes: A transmit device generates a PPDU of a 320 MHz bandwidth, where some or all fields of the PPDU are rotated in the 320 MHz bandwidth based on a rotation factor sequence, the 320 MHz bandwidth includes sixteen 20 MHz sub-channels, the rotation factor sequence includes 16 rotation factors, and each 20 MHz sub-channel corresponds to one rotation factor. The transmit device sends the PPDU. For example, the rotation factor sequence may be [1, 1, 1, 1, 1, -1, 1, 1, -1, -1, -1, 1, 1, -1, 1, -1].

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS [0001] This application is a continuation of U.S. patent application Ser. No. 18/340,567, filed on Jun. 23, 2023, which is a continuation of International Application No. PCT/CN2021/135140, filed on Dec. 2, 2021, which claims priority to Chinese Patent Application No. 202011569822.3, filed on Dec. 26, 2020. All of the aforementioned patent applications are hereby incorporated by reference in their entireties.

TECHNICAL FIELD

[0002] This application relates to the field of communication technologies, and in particular, to an information transmission method and an apparatus.

BACKGROUND ART

[0003] An orthogonal frequency division multiplexing (OFDM) technology is a multi-carrier modulation technology. The OFDM technology has advantages of high spectral efficiency, anti-multipath fading, and the like, but it also has a disadvantage of a high peak to average power ratio (PAPR). Because superposition of a plurality of sub-carriers in OFDM leads to a large peak signal, a high power amplifier requires a large linear dynamic range. This increases costs of the high power amplifier and also reduces efficiency of the high power amplifier. If a peak value exceeds a linear dynamic range of the high power amplifier, in-band distortion and out-of-band dispersion are caused. Therefore, PAPR reduction is a key technology to an OFDM system and has great significance.

[0004] Currently, the Institute of Electrical and Electronics Engineers (IEEE) is discussing a next-generation 802.11be standard after 802.11ax. Compared with the previous 802.11ax standard, the 802.11be standard supports extremely high throughput (EHT) data transmission. The 802.11be standard supports a maximum transmission bandwidth of 320 MHz. A PAPR problem is more serious for the 320 MHz bandwidth. Therefore, how to reduce a PAPR for the 320 MHz bandwidth is an urgent problem to be resolved.

SUMMARY

[0005] This application provides an information transmission method and apparatus, to reduce a PAPR for a 320 MHz bandwidth.

[0006] According to a first aspect, an information transmission method is provided, including: A transmit device generates a physical layer protocol data unit (PPDU) of a 320 MHz bandwidth, where some or all fields of the PPDU are rotated in the 320 MHz bandwidth based on a rotation factor sequence, the 320 MHz bandwidth includes sixteen 20 MHz sub-channels, the rotation factor sequence includes 16 rotation factors, and each 20 MHz sub-channel corresponds to one rotation factor. The transmit device sends the PPDU. Based on the foregoing technical solution, the some or all fields of the 320 MHz PPDU are rotated in the 320 MHz bandwidth based on the rotation factor sequence. Accordingly, PAPRs of some or all fields of a PPDU of a large bandwidth can be reduced based on the rotation factor sequence.

[0007] In a possible design, all the fields of the PPDU are transmitted in a non-HT duplicate mode.

[0008] In a possible design, all the fields of the PPDU are rotated based on the rotation factor sequence.

[0009] In a possible design, the some fields of the PPDU are duplicated and transmitted on a per-20

MHz sub-channel basis.

[0010] In a possible design, the some fields of the PPDU are rotated based on the rotation factor sequence.

[0011] In a possible design, the some fields of the PPDU include one or more of the following fields: an L-STF, an L-LTF, an L-SIG, an RL-SIG, a U-SIG, or an EHT-SIG.

[0012] In a possible design, the rotation factor sequence is a target sequence. Alternatively, the rotation factor sequence is a sequence obtained by performing a target operation on the target sequence. The target operation includes one or more of the following: overall negation, reverse sequence arrangement, or alternative negation. Based on this design, the rotation factor sequence provided in this application can more effectively reduce a PAPR of a PPDU of a 320 MHz bandwidth than a rotation factor sequence [1, -1, -1, -1, 1, -1, -1, -1, -1, 1, 1, 1, -1, 1, 1, 1] provided in a related technology.

[0013] Optionally, the target sequence is one of the following: [0014] [1, 1, 1, 1, 1, -1, -1, -1, 1, 1, -1, 1, -1]; [0015] [1, 1, 1, -1, -1, -1, 1, -1, -1, 1, 1, -1, 1, -1, 1]; [0016] [1, 1, 1, 1, -1, -1, -1, 1, -1, 1, -1, -1, 1, 1, -1]; [0017] [1, 1, 1, 1, 1, -1, 1, -1, -1, 1, 1, 1, -1, -1]; [0018] [1, 1, 1, 1, -1, 1, -1, 1, 1, -1, 1, 1, -1, -1]; [0019] [1, 1, 1, 1, 1, -1, -1, 1, -1, 1, -1, -1, 1, -1, -1]; or [0020] [1, 1, 1, -1, -1, 1, -1, -1, -1, 1, -1, 1, 1, -1, 1].

[0021] In a possible design, the rotation factor sequence is a target sequence. Alternatively, the rotation factor sequence is a sequence obtained by performing overall negation on the target sequence. Based on this design, the rotation factor sequence provided in this application can more effectively reduce a PAPR of a PPDU of a 320 MHz bandwidth than a rotation factor sequence [1, -1, -1, -1, 1, -1, -1, -1, -1, 1, 1, 1, -1, 1, 1, 1] provided in a related technology. In addition, the rotation factor sequence provided in this design does not affect a related channel smoothing operation performed by a receive device on content of an 80 MHz sub-channel.

[0022] Optionally, the target sequence is one of the following: [0023] [1, -1, -1, 1, -1, -1, -1, 1, -1, -1, -1, -1, 1, 1, 1]; or [0024] [1, -1, -1, -1, 1, 1, 1, -1, 1, 1, 1, -1, 1, 1, 1].

[0025] According to a second aspect, an information transmission method is provided, including: A receive device receives a PPDU of a 320 MHz bandwidth, where some or all fields of the PPDU are rotated in the 320 MHz bandwidth based on a rotation factor sequence, the 320 MHz bandwidth includes sixteen 20 MHz sub-channels, the rotation factor sequence includes 16 rotation factors, and each 20 MHz sub-channel corresponds to one rotation factor. The receive device parses the PPDU. Based on the foregoing technical solution, the some or all fields of the 320 MHz PPDU are rotated in the 320 MHz bandwidth based on the rotation factor sequence. Accordingly, PAPRs of some or all fields of a PPDU of a large bandwidth can be reduced based on the rotation factor sequence.

[0026] In a possible design, the parsing the PPDU includes: performing rotation recovery on the some or all fields of the PPDU in the 320 MHz bandwidth based on a rotation recovery factor sequence corresponding to the rotation factor sequence, to obtain a PPDU before rotation. Rotation recovery factors included in the rotation recovery factor sequence are in a one-to-one correspondence with the rotation factors in the rotation factor sequence.

[0027] In a possible design, all the fields of the PPDU are received in a non-HT duplicate mode.

[0028] In a possible design, all the fields of the PPDU are rotated based on the rotation factor sequence.

[0029] In a possible design, the some fields of the PPDU are received on a per-20 MHz sub-channel basis.

[0030] In a possible design, the some fields of the PPDU are rotated based on the rotation factor sequence.

[0031] In a possible design, the some fields of the PPDU include one or more of the following fields: an L-STF, an L-LTF, an L-SIG, an RL-SIG, a U-SIG, or an EHT-SIG.

[0032] In a possible design, the rotation factor sequence is a target sequence. Alternatively, the

rotation factor sequence is a sequence obtained by performing a target operation on the target sequence. The target operation includes one or more of the following: overall negation, reverse sequence arrangement, or alternative negation. Based on this design, the rotation factor sequence provided in this application can more effectively reduce a PAPR of a PPDU of a 320 MHz bandwidth than a rotation factor sequence [1, -1, -1, -1, 1, -1, -1, -1, -1, 1, 1, 1, -1, 1, 1, 1] provided in a related technology.

[0033] Optionally, the target sequence is one of the following: [0034] [1, 1, 1, 1, 1, -1, -1, -1, 1, 1, -1, 1, -1]; [0035] [1, 1, 1, -1, -1, -1, 1, -1, -1, 1, 1, -1, 1, -1, 1]; [0036] [1, 1, 1, 1, -1, -1, -1, 1, -1, 1, -1, -1, 1, 1, -1]; [0037] [1, 1, 1, 1, 1, -1, 1, -1, -1, 1, 1, 1, -1, -1]; [0038] [1, 1, 1, 1, -1, 1, -1, 1, 1, -1, 1, 1, -1, -1]; [0039] [1, 1, 1, 1, 1, -1, -1, 1, -1, 1, -1, -1, 1, -1, -1]; or [0040] [1, 1, 1, -1, -1, 1, -1, -1, -1, 1, -1, 1, 1, -1, 1].

[0041] In a possible design, the rotation factor sequence is a target sequence. Alternatively, the rotation factor sequence is a sequence obtained by performing overall negation on the target sequence. Based on this design, the rotation factor sequence provided in this application can more effectively reduce a PAPR of a PPDU of a 320 MHz bandwidth than a rotation factor sequence [1, -1, -1, -1, 1, -1, -1, -1, -1, 1, 1, 1, -1, 1, 1, 1] provided in a related technology. In addition, the rotation factor sequence provided in this design does not affect a related channel smoothing operation performed by a receive device on content of an 80 MHz sub-channel.

[0042] Optionally, the target sequence is one of the following: [0043] [1, -1, -1, 1, -1, -1, -1, 1, -1, -1, -1, -1, 1, 1, 1]; or [0044] [1, -1, -1, -1, 1, 1, 1, -1, 1, 1, 1, -1, 1, 1, 1].

[0045] According to a third aspect, an information transmission method is provided, including: A transmit device generates a PPDU of a 320 MHz bandwidth, where subcarriers that are in the 320 MHz bandwidth and that carry some or all fields of the PPDU are rotated based on a rotation factor. The transmit device sends the PPDU. Based on the foregoing technical solution, the subcarriers that are in the 320 MHz bandwidth and that carry the some or all fields of the PPDU are rotated based on the rotation factor. Accordingly, PAPRs of some or all fields of a PPDU of a large bandwidth can be reduced.

[0046] In a possible design, all the fields of the PPDU are transmitted in a non-HT duplicate mode.

[0047] In a possible design, the subcarriers that carry all the fields of the PPDU are rotated based on a rotation factor sequence.

[0048] In a possible design, the some fields of the PPDU are duplicated and transmitted on a per-20 MHz sub-channel basis.

[0049] In a possible design, the subcarriers that carry the some fields of the PPDU are rotated based on the rotation factor sequence.

[0050] In a possible design, for a correspondence between a subcarrier and a rotation factor, refer to any one of the following Formula (1-1) to Formula (9-1).

[0051] According to a fourth aspect, an information transmission method is provided, including: A receive device receives a PPDU of a 320 MHz bandwidth, where subcarriers that are in the 320 MHz bandwidth and that carry some or all fields of the PPDU are rotated based on a rotation factor. The receive device parses the PPDU. Based on the foregoing technical solution, the subcarriers that are in the 320 MHz bandwidth and that carry the some or all fields of the PPDU are rotated based on the rotation factor. Accordingly, PAPRs of some or all fields of a PPDU of a large bandwidth can be reduced.

[0052] In a possible design, the parsing the PPDU includes: performing, based on a rotation recovery factor, rotation recovery on the subcarriers that carry the some or all fields of the PPDU, to obtain a PPDU before rotation. A product of the rotation factor of the subcarriers and the rotation recovery factor of the subcarriers is 1.

[0053] In a possible design, all the fields of the PPDU are received in a non-HT duplicate mode.

[0054] In a possible design, the subcarriers that carry all the fields of the PPDU are rotated based on a rotation factor sequence.

[0055] In a possible design, the some fields of the PPDU are received on a per-20 MHz sub-channel basis.

[0056] In a possible design, the subcarriers that carry the some fields of the PPDU are rotated based on the rotation factor sequence.

[0057] In a possible design, for a correspondence between a subcarrier and a rotation factor, refer to any one of the following Formula (1-1) to Formula (9-1).

[0058] According to a fifth aspect, a communication apparatus is provided, including a processing module and a communication module. The processing module is configured to generate a PPDU of a 320 MHz bandwidth. Some or all fields of the PPDU are rotated in the 320 MHz bandwidth based on a rotation factor sequence. The 320 MHz bandwidth includes sixteen 20 MHz sub-channels. The rotation factor sequence includes 16 rotation factors. Each 20 MHz sub-channel corresponds to one rotation factor. The communication module is configured to send the PPDU.

[0059] In a possible design, all the fields of the PPDU are transmitted in a non-HT duplicate mode.

[0060] In a possible design, all the fields of the PPDU are rotated based on the rotation factor sequence.

[0061] In a possible design, the some fields of the PPDU are duplicated and transmitted on a per-20 MHz sub-channel basis.

[0062] In a possible design, the some fields of the PPDU are rotated based on the rotation factor sequence.

[0063] In a possible design, the some fields of the PPDU include one or more of the following fields: an L-STF, an L-LTF, an L-SIG, an RL-SIG, a U-SIG, or an EHT-SIG.

[0064] In a possible design, the rotation factor sequence is a target sequence. Alternatively, the rotation factor sequence is a sequence obtained by performing a target operation on the target sequence. The target operation includes one or more of the following: overall negation, reverse sequence arrangement, or alternative negation.

[0065] Optionally, the target sequence is one of the following: [0066] [1, 1, 1, 1, 1, -1, -1, -1, 1, 1, -1, 1, -1]; [0067] [1, 1, 1, -1, -1, -1, 1, -1, -1, 1, 1, -1, 1, -1, 1]; [0068] [1, 1, 1, 1, -1, -1, -1, 1, -1, 1, -1, -1, 1, -1]; [0069] [1, 1, 1, -1, 1, -1, -1, 1, 1, 1, -1, -1]; [0070] [1, 1, 1, 1, -1, 1, -1, 1, 1, -1, 1, -1, -1]; [0071] [1, 1, 1, 1, 1, -1, -1, 1, -1, 1, -1, -1, 1, -1, -1]; or [0072] [1, 1, 1, -1, -1, 1, -1, -1, -1, 1, -1, 1, 1, -1, 1].

[0073] In a possible design, the rotation factor sequence is a target sequence. Alternatively, the rotation factor sequence is a sequence obtained by performing overall negation on the target sequence.

[0074] Optionally, the target sequence is one of the following: [0075] [1, -1, -1, -1, 1, -1, -1, -1, 1, -1, -1, -1, 1, 1, 1]; or [0076] [1, -1, -1, -1, -1, 1, 1, 1, -1, 1, 1, 1, -1, 1, 1].

[0077] According to a sixth aspect, a communication apparatus is provided, including a processing module and a communication module. The communication module is configured to receive a PPDU of a 320 MHz bandwidth. Some or all fields of the PPDU are rotated in the 320 MHz bandwidth based on a rotation factor sequence. The 320 MHz bandwidth includes sixteen 20 MHz sub-channels. The rotation factor sequence includes 16 rotation factors. Each 20 MHz sub-channel corresponds to one rotation factor. The processing module is configured to parse the PPDU.

[0078] In a possible design, the processing module is specifically configured to perform rotation recovery on the some or all fields of the PPDU in the 320 MHz bandwidth based on a rotation recovery factor sequence corresponding to the rotation factor sequence, to obtain a PPDU before rotation. Rotation recovery factors included in the rotation recovery factor sequence are in a one-to-one correspondence with the rotation factors in the rotation factor sequence.

[0079] In a possible design, all the fields of the PPDU are received in a non-HT duplicate mode.

[0080] In a possible design, all the fields of the PPDU are rotated based on the rotation factor sequence.

[0081] In a possible design, the some fields of the PPDU are received on a per-20 MHz sub-

channel basis.

[0082] In a possible design, the some fields of the PPDU are rotated based on the rotation factor sequence.

[0083] In a possible design, the some fields of the PPDU include one or more of the following fields: an L-STF, an L-LTF, an L-SIG, an RL-SIG, a U-SIG, or an EHT-SIG.

[0084] In a possible design, the rotation factor sequence is a target sequence. Alternatively, the rotation factor sequence is a sequence obtained by performing a target operation on the target sequence. The target operation includes one or more of the following: overall negation, reverse sequence arrangement, or alternative negation.

[0085] Optionally, the target sequence is one of the following: [0086] [1, 1, 1, -1, 1, 1, -1, -1, -1, 1, 1, -1, 1, -1]; [0087] [1, 1, 1, -1, -1, -1, -1, 1, -1, -1, 1, 1, -1, 1, -1, 1]; [0088] [1, 1, 1, 1, -1, -1, -1, -1, 1, -1, 1, -1, 1, 1, -1, 1]; [0089] [1, 1, 1, 1, 1, -1, 1, -1, 1, -1, -1, 1, 1, 1, -1, -1]; [0090] [1, 1, 1, 1, -1, 1, -1, 1, -1, 1, 1, -1, 1, 1, -1, -1]; [0091] [1, 1, 1, 1, 1, -1, -1, -1, 1, -1, 1, -1, -1, 1, -1, -1]; or [0092] [1, 1, 1, -1, -1, -1, 1, -1, -1, -1, 1, -1, 1, 1, -1, 1].

[0093] In a possible design, the rotation factor sequence is a target sequence. Alternatively, the rotation factor sequence is a sequence obtained by performing overall negation on the target sequence.

[0094] Optionally, the target sequence is one of the following: [0095] [1, -1, -1, -1, 1, -1, -1, -1, 1, -1, -1, -1, 1, 1, 1]; or [0096] [1, -1, -1, -1, -1, 1, 1, 1, -1, 1, 1, 1, -1, 1, 1].

[0097] According to a seventh aspect, a communication apparatus is provided, including a processing module and a communication module. The processing module is configured to generate a PPDU of a 320 MHz bandwidth. Subcarriers that are in the 320 MHz bandwidth and that carry some or all fields of the PPDU are rotated based on a rotation factor. The communication module is configured to send the PPDU.

[0098] In a possible design, all the fields of the PPDU are transmitted in a non-HT duplicate mode.

[0099] In a possible design, the subcarriers that carry all the fields of the PPDU are rotated based on a rotation factor sequence.

[0100] In a possible design, the some fields of the PPDU are duplicated and transmitted on a per-20 MHz sub-channel basis.

[0101] In a possible design, the subcarriers that carry the some fields of the PPDU are rotated based on the rotation factor sequence.

[0102] In a possible design, for a correspondence between a subcarrier and a rotation factor, refer to any one of the following Formula (1-1) to Formula (9-1).

[0103] According to an eighth aspect, a communication apparatus is provided, including a processing module and a communication module. The communication module is configured to receive a PPDU of a 320 MHz bandwidth. Subcarriers that are in the 320 MHz bandwidth and that carry some or all fields of the PPDU are rotated based on a rotation factor. The processing module is configured to parse the PPDU.

[0104] In a possible design, the processing module is specifically configured to perform, based on a rotation recovery factor, rotation recovery on the subcarriers that carry the some or all fields of the PPDU, to obtain a PPDU before rotation. A product of the rotation factor of the subcarriers and the rotation recovery factor of the subcarriers is 1.

[0105] In a possible design, all the fields of the PPDU are received in a non-HT duplicate mode.

[0106] In a possible design, the subcarriers that carry all the fields of the PPDU are rotated based on a rotation factor sequence.

[0107] In a possible design, the some fields of the PPDU are received on a per-20 MHz sub-channel basis.

[0108] In a possible design, the subcarriers that carry the some fields of the PPDU are rotated based on the rotation factor sequence.

[0109] In a possible design, for a correspondence between a subcarrier and a rotation factor, refer

to any one of the following Formula (1-1) to Formula (9-1).

[0110] According to a ninth aspect, a communication apparatus is provided, including a processor and a transceiver. The processor is configured to perform the generating operation in the method according to the first or third aspect, the transceiver is configured to perform the sending operation in the method according to the first or third aspect.

[0111] According to a tenth aspect, a communication apparatus is provided, including a processor and a transceiver. The processor is configured to perform the parsing operation in the method according to the second or fourth aspect, the transceiver is configured to perform the receiving operation in the method according to the second or fourth aspect.

[0112] According to an eleventh aspect, a computer-readable storage medium is provided. The computer-readable storage medium stores instructions. When the instructions are run on a computer, the computer is enabled to perform the information transmission method according to any one of the first to fourth aspects or the possible implementations of the first to fourth aspects.

[0113] According to a twelfth aspect, a computer program product including instructions is provided. When the computer program product runs on a computer, the computer is enabled to perform the information transmission method according to any one of the first to fourth aspects or the possible implementations of the first to fourth aspects.

[0114] According to a thirteenth aspect, a chip is provided, including a processing circuit and a transceiver pin. The processing circuit is configured to perform the generating operation in the method according to the first or third aspect. The transceiver pin is configured to perform the sending operation in the method according to the first or third aspect.

[0115] According to a fourteenth aspect, a chip is provided, including a processing circuit and a transceiver pin. The processing circuit is configured to perform the parsing operation in the method according to the second or fourth aspect. The transceiver pin is configured to perform the receiving operation in the method according to the second or fourth aspect.

[0116] It may be understood that any communication apparatus, chip, computer storage medium, or computer program product provided above is configured to perform the corresponding method provided above. Therefore, for beneficial effect that can be achieved by the communication apparatus, chip, computer storage medium, or computer program product, refer to beneficial effect in the corresponding method provided above. Details are not described herein again.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0117] FIG. 1 is a schematic diagram of a structure of a communication system according to an embodiment of this application;

[0118] FIG. 2 is a schematic diagram of a frame structure of a PPDU according to an embodiment of this application;

[0119] FIG. 3 is a schematic diagram of distribution of a channel of a 320 MHz bandwidth according to an embodiment of this application;

[0120] FIG. 4 is a schematic diagram of a frame structure of an EHT PPDU according to an embodiment of this application;

[0121] FIG. 5 is a flowchart of an information transmission method according to an embodiment of this application;

[0122] FIG. 6 is a schematic diagram of a simulation result of a PAPR according to an embodiment of this application;

[0123] FIG. 7 is a schematic diagram of a simulation result of another PAPR according to an embodiment of this application;

[0124] FIG. 8 is a schematic diagram of a simulation result of still another PAPR according to an

embodiment of this application;

[0125] FIG. **9** is a schematic diagram of a simulation result of yet another PAPR according to an embodiment of this application;

[0126] FIG. **10** is a schematic diagram of a simulation result of still yet another PAPR according to an embodiment of this application;

[0127] FIG. **11** is a schematic diagram of a simulation result of a further PAPR according to an embodiment of this application;

[0128] FIG. **12** is a schematic diagram of a structure of a communication apparatus according to an embodiment of this application; and

[0129] FIG. **13** is a schematic diagram of a structure of another communication apparatus according to an embodiment of this application.

DETAILED DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

[0130] In descriptions of this application, unless otherwise specified, “/” means “or”. For example, A/B may represent A or B. A term “and/or” in this specification describes only an association relationship between associated objects and indicates that there may be three relationships. For example, A and/or B may represent the following three cases: Only A exists, both A and B exist, and only B exists. In addition, “at least one” means one or more, and “a plurality of” means two or more. Terms such as “first” and “second” do not limit a quantity and an execution sequence, and the terms such as “first” and “second” do not indicate a definite difference.

[0131] In this application, the word such as “example” or “for example” is used to represent giving an example, an illustration, or a description. Any embodiment or design scheme described as “an example” or “for example” in this application should not be explained as being more preferred or having more advantages than another embodiment or design scheme. Exactly, use of the word “an example” or “for example” or the like is intended to present a relative concept in a specific manner.

[0132] It should be understood that embodiments of this application may be applied to various communication systems, for example, a global system for mobile communication (GSM), a code division multiple access (CDMA) system, a wideband code division multiple access (WCDMA) system, a general packet radio service (GPRS), a long term evolution (LTE) system, an LTE frequency division duplex (FDD) system, an LTE time division duplex (TDD) system, a universal mobile telecommunication system (UMTS), a worldwide interoperability for microwave access (WiMAX) communication system, a future 5G communication system, or a system complying with an IEEE 802.11 standard. For example, the IEEE 802.11 standard includes but is not limited to the 802.11be standard or a next-generation 802.11 standard.

[0133] The following embodiments are mainly described from a perspective of a communication system complying with the 802.11 standard. Application scenarios of the technical solutions of this application include: communication between an access point (access point, AP) and a station (STA), communication between APs, and communication between STAs, and the like.

[0134] The access point maybe an access point used by a terminal device (such as a mobile phone) to access a wired (or wireless) network, and is mainly deployed at home, in a building, and in a campus. A typical coverage radius is dozens of meters to hundreds of meters. Certainly, the access point may alternatively be deployed outdoors. The access point is equivalent to a bridge that connects the wired network and the wireless network. A main function of the access point is to connect various wireless network clients together and then connect the wireless network to the Ethernet. Specifically, the access point may be a terminal device (for example, a mobile phone) or a network device (for example, a router) with a wireless-fidelity (Wi-Fi) chip. The access point maybe a device that supports the 802.11be standard. Alternatively, the access point may be a device that supports a plurality of wireless local area network (WLAN) standards of the 802.11 family such as the 802.11ax standard, the 802.11ac standard, the 802.11n standard, the 802.11g standard, the 802.11b standard, and the 802.11a standard. The access point in this application may be a high-efficiency (HE) AP, an extremely high throughput (EHT) AP, or an access point applicable to a

future generation Wi-Fi standard.

[0135] The station may be a wireless communication chip, a wireless sensor, a wireless communication terminal, or the like, and may also be referred to as user equipment. For example, the station may be a mobile phone, a tablet computer, a set-top box, a smart television set, a smart wearable device, a vehicle-mounted communication device, a computer, or the like that supports a Wi-Fi communication function. Optionally, the station may support the 802.11be standard. The station may also support a plurality of wireless local area network (WLAN) standards of the 802.11 family such as the 802.11be standard, the 802.11ax standard, the 802.11ac standard, the 802.11n standard, the 802.11g standard, the 802.11b standard, and the 802.11a standard.

[0136] For example, the access point and the station may be devices used in an Internet of vehicles, Internet of things nodes, sensors, or the like in an Internet of things (Internet of things, IoT), smart cameras, smart remote controls, smart water or electricity meters, or the like in a smart home, or sensors in a smart city.

[0137] In an embodiment of this application, communication between an AP and a STA is used as an example for description. As shown in FIG. 1, an AP performs wireless communication with a STA 1 and a STA 2. It should be understood that a method described in embodiments of this application is also applicable to communication between APs, communication between STAs, and the like.

[0138] A structure of each of the AP and the STA in embodiments of this application may include a media access control (MAC) layer and a physical (PHY) layer. The AP and the STA may perform information transmission by using a physical layer protocol data unit (PPDU). In addition, a frame structure of the PPDU varies with a wireless communication protocol used by the AP and the STA.

[0139] For example, when a wireless communication protocol used by the AP and the STA is 802.11a, as shown in FIG. 2, a frame structure of the PPDU includes a legacy short training field (L-STF), a legacy long training field (L-LTF), a legacy signal field (L-SIG), and a data field (data). It should be noted that the L-STF, the L-LTF, and the L-SIG in the foregoing fields may be referred to as legacy preambles.

[0140] It should be noted that the frame structure of the PPDU in 802.11a constitutes no limitation on embodiments of this application. In other words, the frame structure of the PPDU provided in this embodiment of this application may be the same as or different from a frame structure shown in FIG. 2.

[0141] 802.11a is the first-generation Wi-Fi standard that uses an OFDM modulation scheme. The standard supports a maximum system bandwidth of 20 MHz and includes 52 OFDM subcarriers, among which 48 subcarriers are used to transmit data and 4 subcarriers are pilot subcarriers (pilot carrier). A maximum transmission rate is only 54 Mbit/s. Therefore, a mode of sending data according to the 802.11a standard is referred to as non-high throughput transmission (Non-HT transmission).

[0142] Subsequently, the 802.11n standard was developed, which greatly improves the maximum Wi-Fi transmission rate. Therefore, the 802.11n standard is also referred to as the high throughput (HT) WLAN standard. The standard maybe compatible with the previous-generation 802.11a standard. In other words, an HT device may communicate with a non-HT device in a non-HT mode. Because a maximum bandwidth supported by the 802.11n standard is 40 MHz, when a signal is sent in the non-HT mode, simultaneously sending the signal on two 20 MHz channels causes a high PAPR. Therefore, in the 802.11 standard, phase rotation by 90 degrees is performed on subcarriers in a 20 MHz channel with a higher frequency. In other words, each subcarrier in an upper half of the bandwidth is multiplied by a unit imaginary number j .

[0143] The subsequent 802.11ac and 802.11ax standards further expand bandwidths to 80 MHz and 160 MHz. The next-generation standards are still compatible with a conventional 802.11a device. Therefore, data may be simultaneously sent on more 20 MHz sub-channels in the non-HT mode. To reduce a high PAPR caused by simultaneously sending a same signal on a plurality of channels, the

standards separately define a rotation coefficient corresponding to a carrier on each 20 MHz sub-channel in 80 MHz and 160 MHz. Specifically, when the 80 MHz bandwidth is used for sending, rotation coefficients corresponding to four 20 MHz sub-channels are respectively 1, -1, -1, and -1. When the 160 MHz bandwidth is used for sending, rotation coefficients corresponding to eight 20 MHz sub-channels are respectively 1, -1, -1, -1, 1, -1, -1, and -1.

[0144] The next-generation 802.11 EHT standard supports a maximum bandwidth of 320 MHz. In the new standard, to be compatible with a conventional device, some management frames, such as RTS, CTS, and NDPA frames, are still sent in the non-HT mode. For the 320 MHz bandwidth, rotation coefficients corresponding to subcarriers on sixteen 20 MHz sub-channels when the non-HT sending mode is used need to be designed in the industry. In addition, because the next-generation 802.11 standard supports channel puncturing, some sub-channels in the 320 MHz bandwidth maybe punctured and do not send data. This brings more difficulties to design of a rotation coefficient for the 320 MHz bandwidth.

[0145] For example, channel distribution of a 320 MHz bandwidth maybe shown in FIG. 3. The 320 MHz channel maybe divided into sixteen 20 MHz channels. The sixteen 20 MHz channels may be sequentially numbered from a high frequency to a low frequency, or may be sequentially numbered from a low frequency to a high frequency. For example, in FIG. 3, a channel 1 may be used as a primary 20 MHz channel, and a channel 2 may be used as a secondary 20 MHz channel. The channel 1 and the channel 2 may be aggregated as a primary 40 MHz channel. A channel 3 and a channel 4 may be aggregated as a secondary 40 MHz channel. The channel 1 to the channel 4 may be aggregated as a primary 80 MHz channel. A channel 5 to a channel 8 maybe aggregated as a secondary 80 MHz channel. The channel 1 to the channel 8 may be aggregated as a primary 160 MHz channel. A channel 9 to a channel 16 may be aggregated as a secondary 160 MHz channel. It should be noted that the primary 20 MHz channel is not necessarily a 20 MHz channel located at the beginning. For example, the channel 3 maybe used as the primary 20 MHz channel, the channel 4 maybe used as the secondary 20 MHz channel, the channel 3 and the channel 4 may be aggregated as the primary 40 MHz channel, the channel 1 and the channel 2 may be aggregated as the secondary 40 MHz channel, the channel 1 to the channel 4 may be aggregated as the primary 80 MHz channel, the channel 5 to the channel 8 may be aggregated as the secondary 80 MHz channel, the channel 1 to the channel 8 may be aggregated as the primary 160 MHz channel, and the channel 9 to the channel 16 may be aggregated as the secondary 160 MHz channel. The secondary channel may alternatively have another name, for example, a slave channel or an auxiliary channel. This embodiment of this application is not limited thereto.

[0146] As shown in FIG. 4, a frame structure of an extreme high throughput (extremely high throughput, EHT) PPDU in the 802.11be standard may include an L-STF, an L-LTF, an L-SIG, a repeated L-SIG (repeated L-SIG, RL-SIG), a universal signal field (U-SIG), an EHT-SIG, an EHT-STF, an EHT-LTF, a data field, and a data packet extension (PE) field.

[0147] The L-STF, the L-LTF, the L-SIG, the RL-SIG, and the U-SIG included in the EHT PPDU are duplicated and transmitted on a per-20 MHz sub-channel basis.

[0148] A non-HT duplicate transmission mode indicates that all fields of a PPDU in a non-HT format are duplicated and transmitted on a per-20 MHz sub-channel basis in a bandwidth greater than 20 MHz. A mode in which some fields of the PPDU are duplicated and transmitted on a per-20 MHz sub-channel basis is different from the non-HT duplicate transmission mode. For example, in the non-HT duplicate transmission mode, some fields of the EHT PPDU are duplicated and transmitted on a per-20 MHz sub-channel basis, which has the following features: (1) A rate of the L-SIG field in the EHT PPDU is a fixed value, and a value of a length is set in a special manner to distinguish between protocol versions. (2) For the EHT PPDU, four subcarriers -28, -27, 27, and 28 of the L-SIG and the RL-SIG on each 20 MHz sub-channel are no longer 0, but are fixed values [-1, -1, -1, 1]. (3) For the EHT PPDU, subcarriers -28, -27, 27, and 28 of the U-SIG and the EHT-SIG on each 20 MHz channel are no longer 0, but are used to transmit additional information.

[0149] Because the L-STF, the L-LTF, the L-SIG, the RL-SIG, and the U-SIG included in the EHT PPDU are duplicated and transmitted on a per-20 MHz sub-channel basis, an EHT pre-modulation field of the EHT PPDU also has a high PAPR. Therefore, to reduce PAPRs of these fields, a rotation factor sequence [1, -1, -1, -1, 1, -1, -1, -1, -1, 1, 1, 1, -1, 1, 1, 1] is provided in a related technology. However, the rotation factor sequence cannot effectively reduce PAPRs of these fields.

[0150] It can be learned that a solution that can effectively reduce PAPRs of some fields or all fields of a PPDU of a 320 MHz bandwidth is urgently needed in the industry.

[0151] In this case, an embodiment of this application provides an information transmission method. As shown in FIG. 5, the method includes the following steps.

[0152] **S101:** A transmit device generates a PPDU of a 320 MHz bandwidth.

[0153] In a possible design, the 320 MHz bandwidth maybe a 320 MHz bandwidth in a non-puncturing pattern. In this case, a transmission bandwidth actually used by the transmit device is 320 MHz.

[0154] In another possible design, the 320 MHz bandwidth may be a 320 MHz bandwidth in a puncturing pattern. The 320 MHz bandwidth is also referred to as a nominal 320 MHz bandwidth. In this case, a transmission bandwidth actually used by the transmit device is less than 320 MHz.

[0155] The PPDU may be a PPDU in a non-HT format, an EHT PPDU, or a PPDU of another type. This is not limited in this embodiment of this application.

[0156] In this embodiment of this application, the PPDU may use any one of a plurality of modulation schemes, for example, a binary phase shift keying (BPSK) modulation scheme, a quadrature phase shift keying (QPSK) modulation scheme, a 16 quadrature amplitude modulation (QAM) scheme, or a 64 QAM modulation scheme.

[0157] Optionally, all fields of the PPDU maybe duplicated and transmitted in a non-HT mode on the foregoing 320 MHz bandwidth.

[0158] For example, the PPDU is a clear to send (CTS) frame, a request to send (RTS) frame, or a null data packet announcement (NDPA) frame, and all the fields (including a preamble field and a data field) of the PPDU are duplicated and transmitted in the non-HT mode.

[0159] Optionally, some fields of the PPDU may be duplicated and transmitted on a per-20 MHz sub-channel basis in the foregoing 320 MHz bandwidth. For example, the some fields of the PPDU may be pre-modulation fields. The pre-modulation field is used to carry information that can be interpreted by all devices. For example, for a target receive end, the target receive end may obtain information such as a coding and modulation scheme and a length of a subsequent field of the PPDU based on the pre-modulation field of the PPDU, to facilitate interpretation of subsequent data. A device other than the target receive end may learn, based on the pre-modulation field of the PPDU, information about occupation of a channel by another person and estimated occupation duration, to properly back off, thereby avoiding congestion.

[0160] For example, the some fields of the PPDU maybe one or more of the following fields: an L-STF, an L-LTF, an L-SIG, an RL-SIG, a U-SIG, or an EHT-SIG. It should be understood that, with evolution of wireless technologies, the some fields of the PPDU may further include a new field included in a PPDU in a next-generation format.

[0161] For example, the PPDU is an EHT PPDU, and an L-STF, an L-LTF, an L-SIG, an RL-SIG, a U-SIG, and an EHT-SIG included in the PPDU are duplicated and transmitted on a per-20 MHz sub-channel basis in the 320 MHz bandwidth.

[0162] The following describes two manners for reducing a PAPR of the PPDU of the 320 MHz bandwidth. It should be understood that Manner 1 is described from a perspective of a frequency band (for example, 20 MHz), and Manner 2 is described from a perspective of a subcarrier. Manner 1 and Manner 2 are consistent in ideas.

[0163] Manner 1: The some or all fields of the PPDU are rotated in the 320 MHz bandwidth based on a rotation factor sequence. The 320 MHz bandwidth may include n X MHz sub-channels, and

the rotation factor sequence may include n rotation factors. Each rotation factor corresponds to one X MHz sub-channel. For example, X MHz may be 20 MHz, 40 MHz, or the like. This is not limited.

[0164] It should be understood that one or more of the n X MHz sub-channels maybe punctured. In other words, one or more of the n X MHz sub-channels may not be used to carry a signal. Based on this, the foregoing 320 MHz bandwidth is a 320 MHz bandwidth in the puncturing pattern.

[0165] For example, the 320 MHz bandwidth may include sixteen 20 MHz sub-channels, and the rotation factor sequence includes 16 rotation factors. Each rotation factor may correspond to one 20 MHz sub-channel. It should be understood that when the 320 MHz bandwidth is in the puncturing pattern, one or more 20 MHz sub-channels of the sixteen 20 MHz sub-channels are punctured, and a rotation factor corresponding to a punctured 20 MHz sub-channel in the rotation factor sequence is not used.

[0166] That the some or all fields of the PPDU are rotated in the 320 MHz bandwidth based on a rotation factor sequence may include: The some fields of the PPDU are rotated in the 320 MHz bandwidth based on the rotation factor sequence, and fields other than the some fields are not rotated in the 320 MHz bandwidth based on the rotation factor sequence. Alternatively, all the fields of the PPDU are rotated in the 320 MHz bandwidth based on the rotation factor sequence.

[0167] Alternatively, that the some or all fields of the PPDU are rotated in the 320 MHz bandwidth based on a rotation factor sequence may be understood as follows: Each field in the some or all fields of the PPDU is rotated in the 320 MHz bandwidth based on the rotation factor sequence. In other words, each field in the some fields of the PPDU is rotated in the sixteen 20 MHz sub-channels based on the rotation factor sequence. Alternatively, each field in all the fields of the PPDU are rotated in the sixteen 20 MHz sub-channels based on the rotation factor sequence.

[0168] Optionally, a field that is in the PPDU and that needs to be rotated based on the rotation factor sequence may be a field that is duplicated and transmitted on a per-20 MHz sub-channel basis in the 320 MHz bandwidth. For example, if all the fields of the PPDU are duplicated and transmitted in a non-HT mode on a per-20 MHz sub-channel basis in the 320 MHz bandwidth, all the fields of the PPDU are rotated on a per-20 MHz sub-channel basis in the 320 MHz bandwidth based on the rotation factor sequence. For another example, if the some fields of the PPDU are duplicated and transmitted on a per-20 MHz sub-channel basis in the 320 MHz bandwidth, the some fields of the PPDU are rotated in the 320 MHz bandwidth based on the rotation factor sequence.

[0169] Optionally, when the transmit device generates the PPDU of the 320 MHz bandwidth, for the some or all fields of the PPDU, a frequency-domain signal corresponding to the some or all fields carried on each of the n X MHz sub-channels included in the 320 MHz bandwidth may be multiplied by a rotation factor corresponding to the Y MHz sub-channel, to obtain products of frequency-domain signals corresponding to the some or all fields and the rotation factor sequence. Then, inverse fast Fourier transform (inverse fast Fourier transform, IFFT) is performed on the products to obtain time-domain signals corresponding to the some or all fields.

[0170] For example, it is assumed that frequency-domain signals corresponding to the some or all fields are $[X_1, X_2, \dots, X_n]$, and the n rotation factors are $[K_1, K_2, \dots, K_n]$. X_1 to X_n respectively represent frequency-domain signals corresponding to the n X MHz sub-channels, and K_1 to K_n respectively represent rotation factors corresponding to the n X MHz sub-channels. In this case, the products of the frequency-domain signals corresponding to the some or all fields and the rotation factor sequence maybe represented as $[X_1 \times K_1, X_2 \times K_2, \dots, X_n \times K_n]$. The time-domain signals corresponding to the some or all fields maybe represented as $\text{IFFT}[X_1 \times K_1, X_2 \times K_2, \dots, X_n \times K_n]$.

[0171] Correspondingly, during calculation of a PAPR of the some or all fields based on the time-domain signals corresponding to the some or all fields, oversampling may be performed on the time-domain signals corresponding to the some or all fields, to obtain analog domain signals. For

example, five-times oversampling is performed. It is assumed that a time-domain signal obtained by oversampling is S_i , a PAPR may be calculated according to the following formula. In the formula, \max represents obtaining a maximum value, and mean represents an averaging operation.

$$[00001] \text{PAPR} = 10 \log_{10} \left(\frac{\max(S_i^2)}{\text{mean}(S_i^2)} \right)$$

[0172] In this embodiment of this application, if a field carried on an X MHz sub-channel is multiplied by a non-1 rotation factor, the field on the X MHz sub-channel is rotated.

[0173] Optionally, a value range of a rotation factor in the rotation factor sequence may be 1, -1, j, or -j. A rotation angle corresponding to the rotation factor 1 is 0 degrees. A rotation angle corresponding to the rotation factor -1 is 180 degrees. A rotation angle corresponding to the rotation factor j is 90 degrees. A rotation angle corresponding to the rotation factor -j is -90 degrees. It should be understood that the value range of the rotation factor may be limited to a set {1, -1, j, -j}. This facilitates simple implementation of the device and reduces complexity of the device.

[0174] Optionally, in a scenario in which X MHz is 20 MHz, one of the following designs may be used for the rotation factor sequence:

[0175] Design 1: The rotation factor sequence may be a target sequence. Alternatively, the rotation factor sequence may be a sequence obtained by performing a target operation on the target sequence. The target operation may be one or more of the following: overall negation, reverse sequence arrangement, or alternative negation.

[0176] Optionally, based on Design 1, the target sequence is one of the following: [0177] [1, 1, 1, 1, 1, -1, 1, 1, -1, -1, -1, 1, 1, -1, 1, -1]; [0178] [1, 1, 1, -1, 1, -1, 1, -1, -1, 1, 1, 1, -1, -1]; [0179] [1, 1, 1, 1, -1, 1, -1, 1, -1, 1, 1, -1, 1, 1, -1, -1]; [0180] [1, 1, 1, 1, 1, -1, 1, -1, 1, -1, -1, 1, 1, 1, -1, -1]; [0181] [1, 1, 1, 1, 1, -1, 1, -1, 1, -1, 1, 1, -1, 1, 1, -1]; [0182] [1, 1, 1, 1, 1, -1, -1, -1, 1, -1, 1, -1, -1, 1, -1, -1]; or [0183] [1, 1, 1, -1, -1, -1, 1, -1, -1, -1, 1, -1, 1, 1, -1, 1].

[0184] The overall negation indicates performing a negation operation on each element in the sequence. For example, it is assumed that an original sequence is [1, -1, 1, 1, 1], and a sequence obtained after overall negation is performed on the sequence is [-1, 1, -1, -1].

[0185] The reverse sequence arrangement indicates that elements in the sequence that are originally arranged from a most significant bit to a least significant bit are rearranged from the least significant bit to the most significant bit. For example, it is assumed that an original sequence is [1, -1, 1, 1, 1], and a sequence obtained after reverse sequence arrangement is performed on the sequence is [1, 1, 1, -1, 1].

[0186] The alternative negation has two implementations: Implementation 1: A negation operation is performed on an element of each even item in the sequence. For example, it is assumed that an original sequence is [1, -1, 1, 1, 1], and a sequence obtained after alternative negation is performed on even items in the sequence is [1, 1, 1, -1, 1]. Implementation 2: A negation operation is performed on an element of each odd item in the sequence. For example, it is assumed that an original sequence is [1, -1, 1, 1, 1], and a sequence obtained after alternative negation is performed on odd items in the sequence is [-1, -1, -1, 1, -1].

[0187] It should be understood that alternative negation is first performed on even items in a sequence, and then overall negation is performed on the even items, which is equivalent to performing negation on odd items in the sequence.

[0188] Design 2: The rotation factor sequence maybe a target sequence. Alternatively, the rotation factor sequence may be a sequence obtained by performing overall negation on the target sequence.

[0189] Optionally, based on Design 2, the target sequence is one of the following: [0190] [1, -1, -1, -1, 1, -1, -1, 1, -1, -1, -1, -1, 1, 1, 1]; or [0191] [1, -1, -1, -1, -1, 1, 1, 1, -1, 1, 1, 1, -1, 1, 1].

[0192] It should be understood that, for an 80 MHz bandwidth, rotation coefficients of four 20

Rotation factor sequences whose sequence numbers are 50 to 56 are obtained by performing the target operation on a rotation factor sequence whose sequence number is 49. A rotation factor sequence whose sequence number is 58 is obtained by performing overall negation on a rotation factor sequence whose sequence number is 57. A rotation factor sequence whose sequence number is 60 is obtained by performing overall negation on a rotation factor sequence whose sequence number is 59.

[0195] It should be understood that a sequence obtained after overall negation, alternative negation, and/or reverse sequence arrangement are/is performed on the target sequence has same effect in reducing a PAPR as that of the target sequence.

[0196] For example, Table 2 shows a simulation result of the rotation factor sequences whose sequence numbers are 1, 9, 17, 25, 33, 41, 49, 57, and 59 in Table 1 and a rotation factor sequence [1, -1, -1, -1, 1, -1, -1, -1, -1, 1, 1, 1, -1, 1, 1, 1] provided by a related technology.

[0197] For the rotation factor sequences whose sequence numbers are 1, 9, 17, 25, 33, 41, 49, 57, 59 in Table 1 and the rotation factor sequence [1, -1, -1, -1, 1, -1, -1, -1, -1, 1, 1, 1, -1, 1, 1, 1] provided by the related technology, a second column in Table 2 provides a median value of a PAPR when each rotation factor sequence is applied to a PPDU of a 320 MHz bandwidth in the non-puncturing pattern. A third column in Table 2 provides a median value of a worst PAPR when each rotation factor sequence is applied to a PPDU of a 320 MHz bandwidth in a 20 MHz bandwidth mode. A fourth column in Table 2 provides a median value of a worst PAPR when each rotation factor sequence is applied to a PPDU of a 320 MHz bandwidth in a 40 MHz bandwidth mode. It should be understood that the median value of the PAPR is a median value of a plurality of PAPRs calculated through simulation when the PPDU carries random content by using the BPSK modulation scheme.

[0198] For the 320 MHz bandwidth, there are sixteen 20 MHz puncturing patterns. Therefore, for the 20 MHz bandwidth mode, the worst PAPR is a worst PAPR in 16 PAPRs respectively corresponding to the sixteen 20 MHz puncturing patterns.

[0199] For the 320 MHz bandwidth, there are eight 40 MHz puncturing patterns. Therefore, for the 40 MHz bandwidth mode, the worst PAPR is a worst PAPR in eight PAPRs respectively corresponding to the eight 40 MHz puncturing patterns.

TABLE-US-00002

| TABLE 2 | PAPR No | 20 MHz | 40 MHz |
|------------|--------------------------------|-----------------|---------|
| (unit: dB) | puncturing | puncturing | |
| puncturing | Rotation factor sequence | 12.1476 | 13.3110 |
| | Rotation factor sequence whose | 9.1057 | 10.8747 |
| | sequence number is 1 | Rotation factor | |
| | sequence whose | 9.2655 | 10.8955 |
| | sequence number is 9 | Rotation factor | |
| | sequence whose | 9.4477 | 10.9448 |
| | sequence number is 17 | Rotation factor | |
| | sequence whose | 9.4399 | 11.1188 |
| | sequence number is 25 | Rotation factor | |
| | sequence whose | 9.4388 | 11.0922 |
| | sequence number is 33 | Rotation factor | |
| | sequence whose | 9.6246 | 11.2212 |
| | sequence number is 41 | Rotation factor | |
| | sequence whose | 9.4233 | 11.0954 |
| | sequence number is 49 | Rotation factor | |
| | sequence whose | 10.5908 | 12.1216 |
| | sequence number is 57 | Rotation factor | |
| | sequence whose | 10.6002 | 11.9446 |
| | sequence number is 59 | | |

[0200] It should be understood that a larger PAPR value of a PPDU indicates worse effect of a rotation factor sequence in reducing a PAPR. It can be learned that the rotation factor sequence provided in embodiments of this application can more effectively reduce a PAPR than the rotation factor sequence provided in the related technology.

[0201] With reference to the accompanying drawings, the following compares the rotation factor sequences whose sequence numbers are 1 and 57 with the rotation factor sequence in the related technology. FIG. 6 to FIG. 11 are schematic diagrams of PAPR simulation results. As shown in FIG. 6 to FIG. 11, a horizontal coordinate is a PAPR, and a vertical coordinate is a corresponding cumulative distribution function (CDF). Therefore, FIG. 6 to FIG. 11 may show probability distribution characteristics of PAPRs corresponding to different rotation factor sequences.

[0202] As shown in FIG. 6 to FIG. 11, Seq1 represents a rotation factor sequence whose sequence

number is 1, Seq57 represents a rotation factor sequence whose sequence number is 57, and prior art seq is the rotation factor sequence [1, -1, -1, -1, 1, -1, -1, -1, -1, 1, 1, 1, -1, 1, 1, 1] provided in the related technology.

[0203] FIG. 6 shows a simulation result for a PPDU using the BPSK modulation scheme and of a non-punctured 320 MHz bandwidth. FIG. 7 shows a simulation result for a PPDU using the QPSK modulation scheme and of a non-punctured 320 MHz bandwidth. FIG. 8 shows a simulation result for a PPDU using the BPSK modulation scheme and of a 320 MHz bandwidth in a 20 MHz puncturing pattern. FIG. 9 shows a simulation result for a PPDU using the QPSK modulation scheme and of a 320 MHz bandwidth in a 20 MHz puncturing pattern. FIG. 10 shows a simulation result for a PPDU using the BPSK modulation scheme and of a 320 MHz bandwidth in a 40 MHz puncturing pattern. FIG. 11 shows a simulation result for a PPDU using the QPSK modulation scheme and of a 320 MHz bandwidth in a 40 MHz puncturing pattern.

[0204] For the rotation factor sequences whose sequence numbers are 1 and 57 and the rotation factor sequence in the related technology, it can be seen from FIG. 6 to FIG. 11 that the rotation factor sequence whose sequence number is 1 can most effectively reduce a PAPR of the PPDU of the 320 MHz bandwidth, and the rotation factor sequence whose sequence number is 57 can secondly effectively reduce a PAPR of the PPDU of the 320 MHz bandwidth. The rotation factor sequence provided in the related technology cannot effectively reduce a PAPR of the PPDU of the 320 MHz bandwidth.

[0205] Manner 2: Subcarriers that are in the 320 MHz bandwidth and that are used to carry the some fields or all fields of the PPDU are rotated based on rotation factors.

[0206] Optionally, in a scenario in which all the fields of the PPDU are duplicated and transmitted in the non-HT mode, subcarriers that carry all the fields of the PPDU are rotated based on rotation factors.

[0207] Optionally, in a scenario in which the some fields of the PPDU are duplicated and transmitted on a per-20 MHz sub-channel basis, subcarriers that carry the some fields of the PPDU are rotated based on rotation factors.

[0208] For example, for a correspondence between a subcarrier and a rotation factor, refer to Table 1. In Table 1, a first rotation factor in a rotation factor sequence corresponds to a subcarrier meeting $k < -448$. A second rotation factor corresponds to a subcarrier meeting $-448 \leq k < -384$. A third rotation factor corresponds to a subcarrier meeting $-384 \leq k < -320$. A fourth rotation factor corresponds to a subcarrier meeting $-320 \leq k < -256$. A fifth rotation factor corresponds to a subcarrier meeting $-256 \leq k < -192$. A sixth rotation factor corresponds to a subcarrier meeting $-192 \leq k < -128$. A seventh rotation factor corresponds to a subcarrier meeting $-128 \leq k < -64$. An eighth rotation factor corresponds to a subcarrier meeting $-64 \leq k < 0$. A ninth rotation factor corresponds to a subcarrier meeting $0 \leq k < 64$. A tenth rotation factor corresponds to a subcarrier meeting $64 \leq k < 128$. An eleventh rotation factor corresponds to a subcarrier meeting $128 \leq k < 192$. A twelfth rotation factor corresponds to a subcarrier meeting $192 \leq k < 256$. A thirteenth rotation factor corresponds to a subcarrier meeting $256 \leq k < 320$. A fourteenth rotation factor corresponds to a subcarrier meeting $320 \leq k < 384$. A fifteenth rotation factor corresponds to a subcarrier meeting $384 \leq k < 448$. A sixteenth rotation factor corresponds to a subcarrier meeting $k \geq 448$. k is a number of a subcarrier.

[0209] It should be understood that the correspondence between the subcarrier and the rotation factor may be represented in a formula manner in addition to a table manner.

[0210] The following describes an example in which some rotation factor sequences in Table 1 are represented by using formulas. It should be understood that, other rotation factor sequences in Table 1 may also be represented by referring to the following formula. The following formulas are merely examples, and variations of the following formulas also fall within the protection scope of embodiments of this application.

[0211] For example, for the rotation factor sequence whose sequence number is 1 in Table 1, the

correspondence between the subcarrier and the rotation factor may be shown in Formula (1-1).

$$\begin{aligned}
 &1, \quad k < -448 \\
 &1, \quad -448 \leq k < -384 \\
 &1, \quad -384 \leq k < -320 \\
 &1, \quad -320 \leq k < -256 \\
 &1, \quad -256 \leq k < -192 \\
 &-1, \quad -192 \leq k < -128 \\
 &1, \quad -128 \leq k < -64 \\
 [00002] \quad k, 320\text{MHz} = \{ &1, \quad -64 \leq k < 0 \\
 &-1, \quad 0 \leq k < 64 \\
 &-1, \quad 64 \leq k < 128 \\
 &-1, \quad 128 \leq k < 192 \\
 &1, \quad 192 \leq k < 256 \\
 &1, \quad 256 \leq k < 320 \\
 &-1, \quad 320 \leq k < 384 \\
 &1, \quad 384 \leq k < 448 \\
 &-1, \quad k \geq 448
 \end{aligned} \quad (1-1)$$

[0212] Optionally, the foregoing Formula (1-1) may be transformed into Formula (1-2).

$$\begin{aligned}
 &1, \quad k < -192 \\
 &-1, \quad -192 \leq k < -128 \\
 &1, \quad -128 \leq k < 0 \\
 [00003] \quad k, 320\text{MHz} = \{ &-1, \quad 0 \leq k < 192 \\
 &1, \quad 192 \leq k < 320 \\
 &-1, \quad 320 \leq k < 384 \\
 &1, \quad 384 \leq k < 448 \\
 &-1, \quad k \geq 448
 \end{aligned} \quad (1-2)$$

[0213] Y.sub.k,320 MHz represents a rotation factor corresponding to a subcarrier numbered k in the 320 MHz bandwidth.

[0214] For example, for the rotation factor sequence whose sequence number is 9 in Table 1, the correspondence between the subcarrier and the rotation factor may be shown in Formula (2-1).

$$\begin{aligned}
& 1, \quad k < -448 \\
& 1, \quad -448 \leq k < -384 \\
& 1, \quad -384 \leq k < -320 \\
& -1, \quad -320 \leq k < -256 \\
& -1, \quad -256 \leq k < -192 \\
& -1, \quad -192 \leq k < -128 \\
& -1, \quad -128 \leq k < -64 \\
[00004] \quad k, 320\text{MHz} = \{ & 1, \quad -64 \leq k < 0 \\
& -1, \quad 0 \leq k < 64 \\
& -1, \quad 64 \leq k < 128 \\
& 1, \quad 128 \leq k < 192 \\
& 1, \quad 192 \leq k < 256 \\
& -1, \quad 256 \leq k < 320 \\
& 1, \quad 320 \leq k < 384 \\
& -1, \quad 384 \leq k < 448 \\
& 1, \quad k \geq 448
\end{aligned} \quad (2 - 1)$$

[0215] Optionally, the foregoing Formula (2-1) may be transformed into the following Formula (2-2).

$$\begin{aligned}
& 1, \quad k < -320 \\
& -1, \quad -320 \leq k < -64 \\
& 1, \quad -64 \leq k < 0 \\
& -1, \quad 0 \leq k < 128 \\
[00005] \quad k, 320\text{MHz} = \{ & 1, \quad 128 \leq k < 256 \\
& -1, \quad 256 \leq k < 320 \\
& 1, \quad 320 \leq k < 384 \\
& -1, \quad 384 \leq k < 448 \\
& 1, \quad k \geq 448
\end{aligned} \quad (2 - 2)$$

[0216] For example, for the rotation factor sequence whose sequence number is 17 in Table 1, the correspondence between the subcarrier and the rotation factor may be shown in Formula (3-1).

$$\begin{aligned}
& 1, \quad k < -448 \\
& 1, \quad -448 \leq k < -384 \\
& 1, \quad 384 \leq k < -320 \\
& 1, \quad -320 \leq k < -256 \\
& -1, \quad -256 \leq k < -192 \\
& -1, \quad -192 \leq k < -128 \\
& -1, \quad -128 \leq k < -64 \\
[00006] \quad k, 320\text{MHz} = \{ & -1, \quad -64 \leq k < 0 \\
& 1, \quad 0 \leq k < 64 \\
& -1, \quad 64 \leq k < 128 \\
& 1, \quad 128 \leq k < 192 \\
& -1, \quad 192 \leq k < 256 \\
& -1, \quad 256 \leq k < 320 \\
& 1, \quad 320 \leq k < 384 \\
& 1, \quad 384 \leq k < 448 \\
& -1, \quad k \geq 448
\end{aligned} \quad (3 - 1)$$

[0217] Optionally, the foregoing Formula (3-1) may be transformed into the following Formula (3-2).

$$\begin{aligned}
& 1, \quad k < -256 \\
& -1, \quad -256 \leq k < 0 \\
& 1, \quad 0 \leq k < 64 \\
[00007] \quad k, 320\text{MHz} = \{ & -1, \quad 64 \leq k < 128 \\
& 1, \quad 128 \leq k < 192 \\
& -1, \quad 192 \leq k < 320 \\
& 1, \quad 320 \leq k < 448 \\
& -1, \quad k \geq 448
\end{aligned} \quad (3 - 2)$$

[0218] For example, for the rotation factor sequence whose sequence number is 25 in Table 1, the correspondence between the subcarrier and the rotation factor may be shown in Formula (4-1).

$$\begin{aligned}
& 1, \quad k < -448 \\
& 1, \quad -448 \leq k < -384 \\
& 1, \quad -384 \leq k < -320 \\
& 1, \quad -320 \leq k < -256 \\
& 1, \quad -256 \leq k < -192 \\
& -1, \quad -192 \leq k < -128 \\
& 1, \quad -128 \leq k < -64 \\
[00008] \quad k, 320\text{MHz} = \{ & -1, \quad -64 \leq k < 0 \\
& 1, \quad 0 \leq k < 64 \\
& -1, \quad 64 \leq k < 128 \\
& -1, \quad 128 \leq k < 192 \\
& 1, \quad 192 \leq k < 256 \\
& 1, \quad 256 \leq k < 320 \\
& 1, \quad 320 \leq k < 384 \\
& -1, \quad 384 \leq k < 448 \\
& -1, \quad k \geq 448
\end{aligned} \quad (4 - 1)$$

[0219] Optionally, the foregoing Formula (4-1) maybe transformed into the following Formula (4-2).

$$\begin{aligned}
& 1, \quad k < -192 \\
& -1, \quad -192 \leq k < -128 \\
& 1, \quad -128 \leq k < -64 \\
[00009] \quad k, 320\text{MHz} = \{ & -1, \quad -64 \leq k < 0 \\
& 1, \quad 0 \leq k < 64 \\
& -1, \quad 64 \leq k < 192 \\
& 1, \quad 192 \leq k < 384 \\
& -1, \quad k \geq 384
\end{aligned} \quad (4 - 2)$$

[0220] For example, for the rotation factor sequence whose sequence number is 33 in Table 1, the correspondence between the subcarrier and the rotation factor may be shown in Formula (5-1).

$$\begin{aligned}
& 1, \quad k < -448 \\
& 1, \quad -448 \leq k < -384 \\
& 1, \quad -384 \leq k < -320 \\
& 1, \quad -320 \leq k < -256 \\
& -1, \quad -256 \leq k < -192 \\
& 1, \quad -192 \leq k < -128 \\
& -1, \quad -128 \leq k < -64 \\
[00010] \quad k, 320\text{MHz} = \{ & 1, \quad -64 \leq k < 0 \\
& -1, \quad 0 \leq k < 64 \\
& 1, \quad 64 \leq k < 128 \\
& 1, \quad 128 \leq k < 192 \\
& -1, \quad 192 \leq k < 256 \\
& 1, \quad 256 \leq k < 320 \\
& 1, \quad 320 \leq k < 384 \\
& -1, \quad 384 \leq k < 448 \\
& -1, \quad k \geq 448
\end{aligned} \quad (5 - 1)$$

[0221] Optionally, the foregoing Formula (5-1) maybe transformed into the following Formula (5-1).

$$\begin{aligned}
& 1, \quad k < -256 \\
& -1, \quad -256 \leq k < -192 \\
& 1, \quad -192 \leq k < -128 \\
& -1, \quad -128 \leq k < -64 \\
[00011] \quad k, 320\text{MHz} = \{ & 1, \quad -64 \leq k < 0 \\
& -1, \quad 0 \leq k < 64 \\
& 1, \quad 64 \leq k < 192 \\
& -1, \quad 192 \leq k < 256 \\
& 1, \quad 256 \leq k < 384 \\
& -1, \quad k \geq 384
\end{aligned} \quad (5 - 2)$$

[0222] For example, for the rotation factor sequence whose sequence number is 41 in Table 1, the correspondence between the subcarrier and the rotation factor may be shown in Formula (6-1).

$$\begin{aligned}
& 1, \quad k < -448 \\
& 1, \quad -448 \leq k < -384 \\
& 1, \quad -384 \leq k < -320 \\
& 1, \quad -320 \leq k < -256 \\
& 1, \quad -256 \leq k < -192 \\
& -1, \quad -192 \leq k < -128 \\
& -1, \quad -128 \leq k < -64 \\
[00012] \quad k, 320\text{MHz} = \{ & -1, \quad -64 \leq k < 0 \\
& 1, \quad 0 \leq k < 64 \\
& -1, \quad 64 \leq k < 128 \\
& 1, \quad 128 \leq k < 192 \\
& -1, \quad 192 \leq k < 256 \\
& -1, \quad 256 \leq k < 320 \\
& 1, \quad 320 \leq k < 384 \\
& -1, \quad 384 \leq k < 448 \\
& -1, \quad k \geq 448
\end{aligned} \quad (6 - 1)$$

[0223] Optionally, the foregoing Formula (6-1) maybe transformed into the following Formula (6-2).

$$\begin{aligned}
& 1, \quad k < -192 \\
& -1, \quad -192 \leq k < 0 \\
& 1, \quad 0 \leq k < 64 \\
[00013] \quad k, 320\text{MHz} = \{ & -1, \quad 64 \leq k < 128 \\
& 1, \quad 128 \leq k < 192 \\
& -1, \quad 192 \leq k < 320 \\
& 1, \quad 320 \leq k < 384 \\
& -1, \quad k \geq 384
\end{aligned} \quad (6 - 2)$$

[0224] For example, for the rotation factor sequence whose sequence number is 49 in Table 1, the correspondence between the subcarrier and the rotation factor may be shown in Formula (7-1).

$$\begin{aligned}
& 1, \quad k < -448 \\
& 1, \quad -448 \leq k < -384 \\
& 1, \quad -384 \leq k < -320 \\
& -1, \quad -320 \leq k < -256 \\
& -1, \quad -256 \leq k < -192 \\
& -1, \quad -192 \leq k < -128 \\
& 1, \quad -128 \leq k < -64 \\
[00014] \quad k, 320\text{MHz} = \{ & -1, \quad -64 \leq k < 0 \\
& -1, \quad 0 \leq k < 64 \\
& -1, \quad 64 \leq k < 128 \\
& 1, \quad 128 \leq k < 192 \\
& -1, \quad 192 \leq k < 256 \\
& 1, \quad 256 \leq k < 320 \\
& 1, \quad 320 \leq k < 384 \\
& -1, \quad 384 \leq k < 448 \\
& 1, \quad k \geq 448
\end{aligned} \quad (7 - 1)$$

[0225] Optionally, the foregoing Formula (7-1) maybe transformed into the following Formula (7-2).

$$\begin{aligned}
& 1, \quad k < -320 \\
& -1, \quad -320 \leq k < -128 \\
& 1, \quad -128 \leq k < -64 \\
& -1, \quad -64 \leq k < 128 \\
[00015] \quad k, 320\text{MHz} = \{ & 1, \quad 128 \leq k < 192 \\
& -1, \quad 192 \leq k < 256 \\
& 1, \quad 256 \leq k < 384 \\
& -1, \quad 384 \leq k < 448 \\
& 1, \quad k \geq 448
\end{aligned} \quad (7 - 2)$$

[0226] For example, for the rotation factor sequence whose sequence number is 57 in Table 1, the correspondence between the subcarrier and the rotation factor may be shown in Formula (8-1).

$$\begin{aligned}
& 1, \quad k < -448 \\
& -1, \quad -448 \leq k < -384 \\
& -1, \quad -384 \leq k < -320 \\
& -1, \quad -320 \leq k < -256 \\
& 1, \quad -256 \leq k < -192 \\
& -1, \quad -192 \leq k < -128 \\
& -1, \quad -128 \leq k < -64 \\
[00016] \quad k, 320\text{MHz} = \{ & -1, \quad -64 \leq k < 0 \\
& 1, \quad 0 \leq k < 64 \\
& -1, \quad 64 \leq k < 128 \\
& -1, \quad 128 \leq k < 192 \\
& -1, \quad 192 \leq k < 256 \\
& -1, \quad 256 \leq k < 320 \\
& 1, \quad 320 \leq k < 384 \\
& 1, \quad 384 \leq k < 448 \\
& 1, \quad k \geq 448
\end{aligned} \quad (8 - 1)$$

[0227] Optionally, the foregoing Formula (8-1) maybe transformed into the following Formula (8-2).

$$\begin{aligned}
& 1, \quad k < -448 \\
& -1, \quad -448 \leq k < -256 \\
& 1, \quad -256 \leq k < -192 \\
[00017] \quad k, 320\text{MHz} = \{ & -1, \quad -192 \leq k < 0 \\
& 1, \quad 0 \leq k < 64 \\
& -1, \quad 64 \leq k < 320 \\
& 1, \quad k \geq 320
\end{aligned} \quad (8 - 2)$$

[0228] For example, for the rotation factor sequence whose sequence number is 59 in Table 1, the correspondence between the subcarrier and the rotation factor may be shown in Formula (9-1).

$$\begin{aligned}
& 1, \quad k < -448 \\
& -1, \quad -448 \leq k < -384 \\
& -1, \quad -384 \leq k < -320 \\
& -1, \quad -320 \leq k < -256 \\
& -1, \quad -256 \leq k < -192 \\
& 1, \quad -192 \leq k < -128 \\
& 1, \quad -128 \leq k < -64 \\
[00018] \quad k, 320\text{MHz} = \{ & 1, \quad -64 \leq k < 0 \\
& -1, \quad 0 \leq k < 64 \\
& 1, \quad 64 \leq k < 128 \\
& 1, \quad 128 \leq k < 192 \\
& 1, \quad 192 \leq k < 256 \\
& -1, \quad 256 \leq k < 320 \\
& 1, \quad 320 \leq k < 384 \\
& 1, \quad 384 \leq k < 448 \\
& 1, \quad k \geq 448
\end{aligned} \quad (9 - 1)$$

[0229] Optionally, the foregoing Formula (9-1) maybe transformed into the following Formula (9-2).

$$\begin{aligned}
& 1, \quad k < -448 \\
& -1, \quad -448 \leq k < -192 \\
& 1, \quad -192 \leq k < 0 \\
[00019] \quad k, 320\text{MHz} = \{ & -1, \quad 0 \leq k < 64 \\
& 1, \quad 64 \leq k < 256 \\
& -1, \quad 256 \leq k < 320 \\
& 1, \quad k \geq 320
\end{aligned} \quad (9 - 2)$$

[0230] **S102:** The transmit device sends the PPDU to the receive device. Correspondingly, the receive device receives the PPDU sent by the transmit device.

[0231] Optionally, when all the fields of the PPDU are transmitted in a non-HT duplicate mode, the receive end receives all the fields of the PPDU in the non-HT duplicate mode.

[0232] Optionally, when the some fields of the PPDU are duplicated and transmitted on a per-20 MHz sub-channel basis, the receive end receives the some fields of the PPDU on a per-20 MHz sub-channel basis. It should be understood that, for a field that is in the PPDU and that is not duplicated and transmitted on a per-20 MHz sub-channel basis, the receive end receives the field through the 320 MHz bandwidth.

[0233] **S103:** The receive device parses the PPDU.

[0234] In a possible implementation, the receive device may perform rotation recovery on the some or all fields of the received PPDU in the 320 MHz bandwidth and based on a rotation recovery factor sequence corresponding to the rotation factor sequence, to obtain a PPDU before rotation.

[0235] The rotation factors in the rotation factor sequence are in a one-to-one correspondence with rotation recovery factors in the rotation recovery factor sequence. In addition, a product of a rotation factor and a corresponding rotation recovery factor is 1.

[0236] For example, when a rotation factor corresponding to a 20 MHz sub-channel used by the transmit device is 1, a rotation recovery factor corresponding to the receive device during rotation recovery may be 1. When a rotation factor corresponding to a 20 MHz sub-channel used by the transmit device is -1, a rotation recovery factor corresponding to the receive device during rotation

recovery may be -1 . When a rotation factor corresponding to a 20 MHz sub-channel used by the transmit device is $-j$, a rotation recovery factor corresponding to the receive device during rotation recovery may be j . When a rotation factor corresponding to a 20 MHz sub-channel used by the transmit device is j , a rotation recovery factor corresponding to the receive device during rotation recovery may be $-j$.

[0237] In another possible implementation, the receive device may perform, based on a rotation recovery factor, rotation recovery on the subcarriers that carry the some or all fields of the PPDU, to obtain a PPDU before rotation. A product of the rotation factor of the subcarriers and the rotation recovery factor of the subcarriers is 1.

[0238] For example, for each subcarrier in the 320 MHz bandwidth, the receive device may also perform rotation recovery on the subcarrier by multiplying the subcarrier by the rotation recovery factor. When a rotation factor corresponding to the subcarrier used by the transmit device is 1, a rotation recovery factor corresponding to the receive device during rotation recovery may be 1. When a rotation factor corresponding to the subcarrier used by the transmit device is -1 , a rotation recovery factor corresponding to the receive device during rotation recovery may be -1 . When a rotation factor corresponding to the subcarrier used by the transmit device is $-j$, a rotation recovery factor corresponding to the receive device during rotation recovery may be j . When a rotation factor corresponding to the subcarrier used by the transmit device is j , a rotation recovery factor corresponding to the receive device during rotation recovery may be $-j$.

[0239] In another possible implementation, the receive device directly uses a rotation factor as a part of a channel, and removes the rotation factor through channel estimation and channel equalization to obtain the PPDU before rotation.

[0240] Based on the rotation factor sequence provided in this embodiment of this application, the PAPR of the PPDU of the 320 MHz bandwidth can be effectively reduced.

[0241] The foregoing mainly describes the solutions provided in embodiments of this application from the perspective of the methods. It may be understood that, to implement the foregoing functions, the communication apparatus includes a corresponding hardware structure and/or software module for performing each function. A person skilled in the art should easily be aware that, in combination with units and algorithm steps of the examples described in embodiments disclosed in this specification, this application may be implemented by hardware or a combination of hardware and computer software. Whether a function is performed by hardware or hardware driven by computer software depends on particular applications and design constraints of technical solutions. A person skilled in the art may use different methods to implement the described functions for each particular application, but it should not be considered that the implementation goes beyond the scope of this application.

[0242] In embodiments of this application, the apparatus maybe divided into functional modules based on the foregoing method examples. For example, each functional module may be obtained through division based on each corresponding function, or two or more functions may be integrated into one functional module. The integrated module may be implemented in a form of hardware, or may be implemented in a form of a software functional module. In embodiments of this application, module division is an example, and is merely a logical function division. In actual implementation, another division manner maybe used. An example in which each functional module is obtained through division based on each corresponding function is used below for description.

[0243] FIG. 12 shows a communication apparatus according to an embodiment of this application. The communication apparatus includes a processing module **101** and a communication module **102**. It should be understood that when the communication apparatus is a transmit device, or the communication apparatus is applied to a transmit device, the communication apparatus has any function of the transmit device in the foregoing method. When the communication apparatus is a receive device, or the communication apparatus is applied to a receive device, the communication

apparatus has any function of the receive device in the foregoing method.

[0244] For example, the communication apparatus is a transmit device, or the communication apparatus is applied to a transmit device. The processing module **101** is configured to perform the step **S101** in FIG. 5, and the communication module **102** is configured to perform the step **S102** in FIG. 5.

[0245] For example, the communication apparatus is a receive device, or the communication apparatus is applied to a receive device. The communication module **102** is configured to perform the step **S102** in FIG. 5, and the processing module **101** is configured to perform the step **S103** in FIG. 5.

[0246] The following describes a possible product form of the communication apparatus. It should be understood that all forms of products having features of the communication apparatus fall within the protection scope of this application. It should be further understood that the following description is merely an example, and does not limit a product form of the communication apparatus in embodiments of this application.

[0247] FIG. **13** is a diagram of a structure of a possible product form of a communication apparatus according to an embodiment of this application.

[0248] In a possible product form, the communication apparatus in this embodiment of this application may be a communication device, and the communication device includes a processor **201** and a transceiver **202**. Optionally, the communication device further includes a memory **203**.

[0249] When the communication apparatus is a transmit device, the processor **201** is configured to perform the step **S101** in FIG. 5, and the transceiver **202** is configured to perform the step **S102** in FIG. 5.

[0250] When the communication apparatus is a receive device, the transceiver **202** is configured to perform the step **S102** in FIG. 5, and the processor **201** is configured to perform the step **S103** in FIG. 5.

[0251] As a possible product form, the communication apparatus described in embodiments of this application may be implemented by using a chip. The chip includes a processing circuit **201** and a transceiver pin **202**. Optionally, the chip may further include a storage medium **203**.

[0252] In another possible product form, the communication apparatus described in this embodiment of this application may alternatively be implemented by using the following circuit or component: one or more field programmable gate arrays (FPGA), a programmable logic device (PLD), a controller, a state machine, gate logic, a discrete hardware component, any other suitable circuits, or any combination of circuits that can perform various functions described in this application.

[0253] Optionally, an embodiment of this application further provides a computer-readable storage medium. The computer-readable storage medium stores computer instructions. When the computer instructions are run on a computer, the computer is enabled to perform the communication method in the foregoing method embodiments.

[0254] Optionally, an embodiment of this application further provides a computer program product including computer instructions. When the computer instructions are run on a computer, the computer is enabled to perform the communication method in the foregoing method embodiments.

[0255] It should be understood that the computer 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 instructions may be transmitted from a website, computer, server, or data center to another website, computer, server, or data center in a wired (for example, a coaxial cable, an optical fiber, or a digital subscriber line) or wireless (for example, infrared, radio, or microwave) manner. The computer-readable storage medium may be any usable medium accessible by a computer, or a data storage device, such as 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, or a magnetic tape), an optical medium, a semiconductor

medium (for example, a solid-state drive), or the like.

[0256] The foregoing descriptions about implementations allow a person skilled in the art to understand that, for the purpose of convenient and brief description, division of the foregoing functional modules is taken as an example for illustration. In actual application, the foregoing functions can be allocated to different modules and implemented according to a requirement, that is, an inner structure of an apparatus is divided into different functional modules to implement all or some of the functions described above.

[0257] It should be understood that the apparatus and method disclosed in the several embodiments provided in this application may be implemented in other manners. For example, the described apparatus embodiment is merely an example. For example, the module or division into the units is merely logical function division and may be other division in actual implementation. For example, a plurality of units or components may be combined or integrated into another apparatus, or some features may be ignored or not performed. In addition, the displayed or discussed mutual couplings or direct couplings or communication connections may be implemented by using some interfaces. The indirect couplings or communication connections between the apparatuses or units may be implemented in electronic, mechanical, or other forms.

[0258] The units described as separate parts may or may not be physically separate, and parts displayed as units may be one or more physical units, may be located in one place, or may be distributed on different places. Some or all of the units may be selected based on actual requirements to achieve the objectives of the solutions of embodiments.

[0259] In addition, functional units in embodiments of this application may be integrated into one processing unit, each of the units may exist alone physically, or two or more units are integrated into one unit. The integrated unit may be implemented in a form of hardware, or may be implemented in a form of a software functional unit.

[0260] When the integrated unit is implemented in the form of a software functional unit and sold or used as an independent product, the integrated unit may be stored in a readable storage medium. Based on such an understanding, the technical solutions of embodiments of this application essentially, or the part contributing to the conventional technology, or all or some of the technical solutions may be implemented in the form of a software product. The software product is stored in a storage medium and includes several instructions for instructing a device (which may be a single-chip microcomputer, a chip or the like) or a processor (processor) to perform all or some of the steps of the methods described in embodiments of this application.

[0261] The foregoing descriptions are merely specific implementations of this application, but are not intended to limit the protection scope of this application. Any variation or replacement within the technical scope disclosed in this application shall fall within the protection scope of this application. Therefore, the protection scope of this application shall be subject to the protection scope of the claims.

Claims

1. A method, comprising: receiving a physical layer protocol data unit (PPDU) of a 320 MHz bandwidth, wherein some or all fields of the PPDU are rotated in the 320 MHz bandwidth based on a rotation factor sequence, the 320 MHz bandwidth comprises sixteen 20 MHz sub-channels, the rotation factor sequence comprises sixteen rotation factors, and each 20 MHz sub-channel corresponds to one rotation factor; and parsing the PPDU.
2. The method according to claim 1, wherein parsing the PPDU comprises: performing rotation recovery on the some or all fields of the PPDU in the 320 MHz bandwidth based on a rotation recovery factor sequence corresponding to the rotation factor sequence, to obtain a PPDU before rotation.
3. The method according to claim 1, wherein the rotation factor sequence is [1, -1, -1, -1, 1, -1,

-1, -1, 1, -1, -1, -1, -1, 1, 1, 1].

4. The method according to claim 1, for the rotation factor sequence, the correspondence between a

$$1, \quad k < -448$$

$$-1, \quad -448 \leq k < -256$$

$$1, \quad -256 \leq k < -192$$

subcarrier and the rotation factor is shown as the following: $k_{320M} = \{$

$$-1, \quad -192 \leq k < 0$$

$$1, \quad 0 \leq k < 64$$

$$-1, \quad 64 \leq k < 320$$

$$1, \quad k \geq 320$$

5. The method according to claim 1, wherein the PPDU is a non-high throughput (HT) PPDU, and the all fields of the non-HT PPDU are received on a per-20 MHz sub-channel basis.

6. The method according to claim 5, wherein all fields of the non-HT PPDU are rotated.

7. The method according to claim 5, wherein all fields of the non-HT PPDU comprise a legacy short training field (L-STF), a legacy long training field (L-LTF), a legacy signal (L-SIG) field, and a data field.

8. The method according to claim 1, wherein the PPDU is an extremely high throughput (EHT) PPDU, and some fields of the EHT PPDU are received on a per-20 MHz sub-channel basis.

9. The method according to claim 8, wherein some fields of the EHT PPDU are rotated.

10. The method according to claim 8, wherein some fields of the EHT PPDU comprise one or more of the following fields: a legacy short training field (L-STF), a legacy long training field (L-LTF), a legacy signal field (L-SIG field), a repeated legacy signal field (RL-SIG field), or a universal signal field (U-SIG field), or an extremely high throughput signal field (EHT-SIG field).

11. The method according to claim 10, wherein a rate of the L-SIG field is a fixed value, and a value of a length indicated by L-SIG field is set in a preset manner to distinguish between protocol versions.

12. The method according to claim 10, wherein the L-SIG field carries fixed values [-1, -1, -1, 1] on four subcarriers -28, -27, 27, and 28 of each 20 MHz sub-channel, and the RL-SIG field carries fixed values [-1, -1, -1, 1] on four subcarriers -28, -27, 27, and 28 of each 20 MHz sub-channel.

13. The method according to claim 10, wherein the U-SIG field transmits additional information on four subcarriers -28, -27, 27, and 28 of each 20 MHz sub-channel.

14. The method according to claim 10, wherein the EHT-SIG field transmits additional information on four subcarriers -28, -27, 27, and 28 of each 20 MHz sub-channel.

15. An apparatus, comprising: at least one processor; and a transceiver, wherein the at least one processor and the transceiver communicate with each other through an internal connection; and wherein the transceiver is configured to receive a physical layer protocol data unit (PPDU) of a 320 MHz bandwidth, wherein some or all fields of the PPDU are rotated in the 320 MHz bandwidth based on a rotation factor sequence, the 320 MHz bandwidth comprises sixteen 20 MHz sub-channels, the rotation factor sequence comprises 16 rotation factors, and each 20 MHz sub-channel corresponds to one rotation factor; and wherein the at least one processor is configured to parse the PPDU.

16. The apparatus according to claim 15, wherein the at least one processor is further configured to: perform rotation recovery on the some or all fields of the PPDU in the 320 MHz bandwidth based on a rotation recovery factor sequence corresponding to the rotation factor sequence, to obtain a PPDU before rotation.

17. The apparatus according to claim 15, wherein the rotation factor sequence is [1, -1, -1, -1, 1, -1, -1, 1, -1, -1, -1, -1, 1, 1, 1].

18. The apparatus according to claim 15, wherein for the rotation factor sequence, the correspondence between a subcarrier and the rotation factor is shown as the following:

$$k, 320M = \begin{cases} 1, & k < -448 \\ -1, & -448 \leq k < -256 \\ 1, & -256 \leq k < -192 \\ -1, & -192 \leq k < 0 \\ 1, & 0 \leq k < 64 \\ -1, & 64 \leq k < 320 \\ 1, & k \geq 320 \end{cases}.$$

- 19.** The apparatus according to claim 15, wherein the PPDU is a non-high throughput (HT) PPDU, and all fields of the non-HT PPDU are received on a per-20 MHz sub-channel basis.
 - 20.** The apparatus according to claim 19, wherein all fields of the non-HT PPDU are rotated.
 - 21.** The apparatus according to claim 20, wherein all fields of the non-HT PPDU comprise a legacy short training field (L-STF), a legacy long training field (L-LTF), a legacy signal field (L-SIG field), and a data field.
 - 22.** The apparatus according to claim 15, wherein the PPDU is an extremely high throughput (EHT_PPDU, and some fields of the EHT PPDU are received on a per-20 MHz sub-channel basis.
 - 23.** The apparatus according to claim 22, wherein some fields of the EHT PPDU are rotated.
 - 24.** The apparatus according to claim 23, wherein some fields of the EHT PPDU comprise one or more of the following fields: a legacy short training field (L-STF), a legacy long training field (L-LTF), a legacy signal field (L-SIG field), a repeated legacy signal field (RL-SIG field), or a universal signal field (U-SIG field), or an extremely high throughput signal field (EHT-SIG field).
 - 25.** The apparatus according to claim 24, wherein a rate of the L-SIG field is a fixed value, and a value of a length indicated by L-SIG field is set in a preset manner to distinguish between protocol versions.
 - 26.** The apparatus according to claim 24, wherein the L-SIG field carries fixed values $[-1, -1, -1, 1]$ on four subcarriers $-28, -27, 27,$ and 28 of each 20 MHz sub-channel, and the RL-SIG field carries fixed values $[-1, -1, -1, 1]$ on four subcarriers $-28, -27, 27,$ and 28 of each 20 MHz sub-channel.
 - 27.** The apparatus according to claim 24, wherein the U-SIG field transmits additional information on four subcarriers $-28, -27, 27,$ and 28 of each 20 MHz sub-channel.
 - 28.** The apparatus according to claim 24, wherein the EHT-SIG field transmits additional information on four subcarriers $-28, -27, 27,$ and 28 of each 20 MHz sub-channel.
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