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(54) **METHOD, DEVICE AND SYSTEM FOR TRANSMITTING CHANNEL INFORMATION**

VERFAHREN, VORRICHTUNG UND SYSTEM ZUR ÜBERTRAGUNG VON
KANALINFORMATIONEN

PROCÉDÉ, DISPOSITIF ET SYSTÈME DE TRANSMISSION D'INFORMATIONS DE CANAL

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Description**FIELD OF THE INVENTION**

[0001] The present invention relates to the field of radio communication, and in particular, to a method for obtaining channel information, a method for transmitting channel information, a beamformer, a beamformee, and a system.

BACKGROUND OF THE INVENTION

[0002] In a radio communication system, the use of the MIMO (Multiple-Input Multiple-Output, MIMO) technology and the beamforming (beamforming) technology makes channel information indispensable. A beamformer (beamformer) obtains channel information by using feedback from a beamformee (beamformee), and uses the channel information as a reference for subsequent data transmission.

[0003] In the prior art, the process of obtaining the channel information by the beamformer is as follows: The beamformer transmits an NDPA (Null Data Packet Announcement, null data packet announcement) and an NDP (Null Data Packet, null data packet) to a beamformee to request the channel information; after receiving the NDPA and the NDP, the beamformee estimates the channel between the beamformer and the beamformee, and transmits the channel information to the beamformer according to a rule. When the beamformer obtains multi-user channel information, for beamformees other than the first one, a Sounding Poll frame may be transmitted to instruct the other beamformees to feed back their channel information.

[0004] The beamformer, before transmitting data each time, obtains a TXOP (Transmission opportunity) in a contention mode, and then transmits data within the duration corresponding to the TXOP. When the beamformer requests the channel information within the duration of a TXOP, if the channel information obtained by the beamformee fails to be completely transmitted before the duration of the TXOP ends, the beamformee may feed back a null feedback (Null Feedback) frame to notify the beamformer that the channel information cannot be fed back currently and the cause thereof, and meanwhile, the beamformee discards the estimated channel information. If the beamformer still needs the channel information, the beamformer can only retransmit a channel estimation request after obtaining a TXOP again, and the beamformee performs channel estimation again and then transmits the channel information to the beamformer.

[0005] US20100208781 discloses a method for wireless communications, comprising: transmitting a start frame containing information regarding parallel multiple-input multiple-output (MIMO) transmissions in a transmit opportunity; and transmitting one or more parallel MIMO streams in accordance with the information contained in

the start frame.

[0006] WO2011035207 discloses methods and apparatuses are proposed for supporting one or more user-dependent channel state information (CSI) feedback rates in a downlink spatial division multiple access (SDMA) system. For certain aspects, an access point (AP) may receive a channel evolution feedback from one or more stations and send a request for CSI to the stations whose CSI values need to be updated. For certain aspects, the AP may poll the stations for updated CSI values. For certain aspects, deterministic back-off timers may be assigned to the stations indicating when to send their CSI feedback. The proposed methods may improve system performance.

[0007] During the implementation of the present invention, the inventor finds that the prior art has at least the following disadvantages:

[0008] The beamformer repeatedly transmits the NDPA and the NDP to request the channel information, causing a low efficiency and a waste of resources. In addition, the beamformee repeatedly performs channel estimation, causing a power waste.

SUMMARY OF THE INVENTION

[0009] Embodiments of the present invention provide a method for obtaining channel information, a method for transmitting channel information, a beamformer, a beamformee, and a system.

[0010] In one aspect, an embodiment of the present invention provides a method for obtaining channel information, including:

transmitting, by a beamformer, a request for obtaining channel information to a beamformee within a duration of a current first transmission opportunity, TXOP;

if the beamformer determines that the duration of the current first TXOP is insufficient for receiving the channel information, if the beamformer obtains a second TXOP within a validity period of the channel information, transmitting, by the beamformer, a channel information indication frame to the beamformee to request the channel information within a duration of the second TXOP, and receiving, by the beamformer, the channel information transmitted by the beamformee.

[0011] In addition, an embodiment of the present invention provides another method for obtaining channel information, including:

receiving, by a beamformee, a request for obtaining channel information, wherein the request is transmitted by a beamformer within a duration of a current first transmission opportunity, TXOP; performing, by the beamformee, channel estimation to obtain the channel information;

if the beamformer determines that the duration of the current first TXOP is insufficient for receiving the channel information, if the beamformer obtains a second TXOP within a validity period of the channel information, receiving, by the beamformee, a channel information indication frame transmitted by the beamformer within a duration of the second TXOP; and transmitting, by the beamformee, the channel information to the beamformer.

[0012] In still another aspect, an embodiment of the present invention provides a beamformer, including a transmitting module and a receiving module; where:

the transmitting module is configured to transmit a request for obtaining channel information to a beamformee within a duration of a current first transmission opportunity, TXOP; if the beamformer determines that the duration of the current first TXOP is insufficient for receiving the channel information, if the beamformer obtains a second TXOP within a validity period of the channel information, transmit a channel information indication frame to the beamformee to request the channel information within a duration of the second TXOP; and the receiving module is configured to receive the channel information transmitted by the beamformee.

[0013] In yet another aspect, an embodiment of the present invention provides a beamformee, including:

a receiving module, configured to receive a request for obtaining channel information, wherein the request is transmitted by a beamformer within a duration of a current first transmission opportunity TXOP; a channel estimation module, configured to perform channel estimation to obtain the channel information; if the beamformer determines that the duration of the current first TXOP is insufficient for receiving the channel information, if the beamformer obtains a second TXOP within a validity period of the channel information, the receiving module is further configured to receive a channel information indication frame transmitted by the beamformer within a duration of the second TXOP; and a transmitting module, configured to transmit the channel information to the beamformer.

[0014] In still yet another aspect, an embodiment of the present invention provides a system for transmitting channel information, including any one of the above beamformers and any one of the above beamformees.

[0015] The method for obtaining channel information, the method for transmitting channel information, the beamformer, the beamformee, and the system provided in the embodiments of the present invention produce the

following beneficial effects:

[0016] The beamformer transmits the channel information indication frame to request the channel information again, and receives the channel information or channel information segments transmitted by the beamformee, which prevents the beamformer from repeatedly transmitting an NDPA and an NDP to request the channel information, improves the efficiency, and saves the signaling resources. In addition, the beamformee prevents repeated channel estimation and reduces power consumption.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017]

FIG. 1 is a schematic flow chart of obtaining channel information using an NDPA and an NDP according to an embodiment of the present invention;

FIG. 2a is a flow chart of a method for obtaining channel information according to an embodiment of the present invention;

FIG. 2b is a flow chart of another method for obtaining channel information according to an embodiment of the present invention;

FIG. 3 is a schematic flow chart of obtaining channel information within a new TXOP of a beamformer by using Sounding Poll in a single-user scenario according to an embodiment of the present invention;

FIG. 4 is a schematic flow chart of obtaining channel information within a new TXOP of a beamformer by using Sounding Poll in a multiple-user scenario according to an embodiment of the present invention;

FIG. 5 is a flow chart of a method for transmitting channel information according to an embodiment of the present invention;

FIG. 6 is a schematic flow chart of transmitting channel information within a new TXOP of a beamformee in a multiple-user scenario according to an embodiment of the present invention;

FIG. 7 is a schematic flow chart of transmitting channel information segments within a new TXOP of a beamformee in a multiple-user scenario according to an embodiment of the present invention;

FIG. 8 is a flow chart of another method for transmitting channel information according to an embodiment of the present invention;

FIG. 9 is a schematic flow chart of transmitting channel information segments within a new TXOP of a beamformer in a multiple-user scenario according to an embodiment of the present invention;

FIG. 10 is a structural diagram of a beamformer according to an embodiment of the present invention;

FIG. 11 is a structural diagram of another beamformer according to an embodiment of the present invention;

FIG. 12 is a structural diagram of a beamformee according to an embodiment of the present invention;

FIG. 13 is a structural diagram of another beam-formee according to an embodiment of the present invention; and

FIG. 14 is a structural diagram of a system for transmitting channel information according to an embodiment of the present invention.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0018] To make the objectives, technical solutions, and advantages of the present invention clearer, the following further describes the embodiments of the present invention in detail with reference to the accompanying drawings.

[0019] Embodiments of the present invention relate to the beamforming technology, and may be applied in a wireless local area network system. The device using the beamforming technology may be a STA (Station, station). The STA includes, but is not limited to, a mobile phone terminal, a laptop computer, and an AP (Access Point, access point). When a STA uses the beamforming technology to transmit data, the STA may be referred to as a beamformer (beamformer); when a STA uses the beamforming technology to receive data, the STA may be referred to as a beamformee (beamformee).

[0020] The embodiments of the present invention may be applied to a radio communication system for obtaining the right to use a channel based on the contention mode. The device that first obtains the right to use the channel through contention may first use the channel to transmit data. The obtained right to use the channel through contention may be referred to as a transmission opportunity TXOP. After a device obtains the TXOP through contention, the duration corresponding to the TXOP may be set. Different durations may be set for different TXOPs, for example, 4 ms or 5 ms. At any time point within the duration of the TXOP, the device can transmit data. If the TXOP ends, the device can no longer use the channel, and can only obtain the right to use the channel through contention again. The embodiments of the present invention involve the TXOP in several occasions. For ease of description, different TXOPs may be referred to as a first TXOP, a second TXOP, and a third TXOP. The "first", "second", and "third" are only used to distinguish different TXOPs and do not represent a time sequence of the TXOPs and is irrelevant to the time when the TXOPs are obtained. In addition, the "first", "second", and "third" are described only for the devices in a radio communication system, regardless of whether the devices are beamformers or beamformees.

[0021] In the embodiments of the present invention, the beamformer may transmit an NDPA and an NDP to the beamformee to request to obtain the channel information. After receiving the NDPA and the NDP, the beamformee estimates the channel between the beamformer and the beamformee, and transmits the obtained channel information (Channel Information) to the beamformer. This process may be referred to as channel

sounding, as shown in FIG. 1. FIG. 1 is a single-user Channel Sounding process, referring to channel information transmission between a beamformer and a beamformee. The channel information obtaining involved in the embodiments of the present invention may also be a multiple-user Channel Sounding process, referring to that a beamformer obtains the channel information from multiple beamformees.

[0022] Referring to FIG. 2a, this embodiment provides a method for obtaining channel information, including the following steps:

201. A beamformer transmits a request for obtaining channel information to a beamformee within the duration of a current first transmission opportunity TXOP.

202. The beamformer receives a null feedback frame transmitted by the beamformee within the duration of the current first TXOP; within the validity period of the channel information, if the beamformer obtains a second TXOP, transmits, within the duration of the second TXOP, a channel information indication frame to the beamformee to request the channel information, and receives the channel information transmitted by the beamformee.

[0023] In addition, referring to FIG. 2b, this embodiment provides another method for obtaining channel information, including the following steps:

301. A beamformer transmits a request for obtaining channel information to a beamformee within the duration of a current first transmission opportunity TXOP.

302. The beamformer receives a first channel information segment transmitted by the beamformee within the duration of the first TXOP; if the beamformer obtains a third TXOP, transmits, within the duration of the third TXOP, a channel information indication frame to the beamformee to request the remaining channel information segments, and receives a second channel information segment transmitted by the beamformee.

[0024] The first channel information segment and the second channel information segment are obtained after the beamformee segments the channel information.

[0025] In this embodiment, optionally, the channel information indication frame may include an indication information element, used for identifying the channel information. Specifically, the indication information element may be a Sounding Sequence.

[0026] In this embodiment, the channel information indication frame may be implemented in multiple forms, which include, but are not limited to, Sounding Poll frame, and Beamforming Report Poll frame, which are not limited in the embodiments of the present invention.

[0027] In this embodiment, the obtaining by the beam-

former the second TXOP may be specifically as follows: When the first TXOP ends, the beamformer obtains the right to use the channel, the second TXOP, prior to all other STAs. In this way, the channel information of the beamformee may be obtained by transmitting the channel information indication frame. The obtaining by the beamformer the third TXOP may be specifically as follows: When the first TXOP ends, the beamformer first obtains the right to use the channel, the third TXOP, prior to all other STAs. In this way, the remaining channel information segments may be obtained by transmitting the channel information indication frame.

[0028] Any method for obtaining channel information in the embodiments may be applied to single-user channel information feedback, and may also be applied to multiple-user channel information feedback, for example, two-user channel information feedback or three-user channel information feedback. In a multiple-user scenario, the beamformer may use the above method to request the channel information from any one of the multiple beamformees, which is not detailed herein.

[0029] FIG. 3 is a schematic flow chart of single-user channel information feedback. A beamformer transmits an NDPA and an NDP to a beamformee within the current TXOP to request channel information, and receives a null feedback frame transmitted by the beamformee. After a period of time, the beamformer obtains a new TXOP prior to all other STAs, transmits a Sounding Poll indication frame within the new TXOP to the beamformee to request the previous channel information again, and receives the estimated channel information between the beamformer and the beamformee from the beamformee. The process in FIG. 3, compared with that the beamformer retransmits an NDPA and an NDP in the prior art, saves the time overhead, that is, length (NDPA + NDP + SIFS) - length (Sounding Poll). The "length" indicates the time required for transmitting a frame or a frame interval, and SIFS (Short Inter-Frame Space, short inter-frame space) indicates the frame interval between two adjacent frames.

[0030] FIG. 4 is a schematic flow chart of two-user channel information feedback. A beamformer transmits an NDPA and an NDP within the current TXOP to a beamformee 1 to request channel information 1, and receives the channel information 1 between the beamformer and the beamformee 1 fed back from the beamformee 1. The beamformer transmits a Sounding Poll indication frame to a beamformee 2 within the current TXOP to request channel information 2, and receives a null feedback frame transmitted by the beamformee 2. After a period of time, the beamformer obtains a new TXOP prior to all other STAs, transmits a Sounding Poll indication frame within the new TXOP to the beamformee 2 to request the previous channel information 2 again, and receives the channel information 2 between the beamformer and the beamformee 2 fed back from the beamformee 2.

[0031] The validity period of the channel information involved in the embodiments of the present invention refers to the maximum time during which the beamformer

is capable of effective beamforming by using the channel information. During the validity period, the beamformee stores the channel information. If the validity period expires, the beamformee discards the channel information.

Generally, the validity period of the channel information is a monotonic increasing function of the channel coherence time. The validity period of the channel information may be preconfigured, or may be negotiated between the beamformer and the beamformee. Exemplarily, the validity period of the channel information is longer than the duration of the TXOP. For example, the beamformer and the beamformee may preconfigure the validity period of the channel information to a default value accepted by the two parties, for example, 25 ms, which is, however, not limited in the embodiments of the present invention.

[0032] In another embodiment of the present invention, the method for obtaining channel information may further include:

transmitting, by the beamformer, management signaling to the beamformee, where the management signaling includes an indication information element used for indicating that the beamformer has the capability of receiving the currently requested channel information or channel information segments within a subsequent TXOP. Specifically, the indication information element may be a bit or field newly added in the capability field (capability field) of the management signaling. The indication information element may enable the beamformee to know that the beamformer may wait for the channel information so that the beamformee does not discard the estimated channel information, which prevents the power waste caused by repeated channel information estimation.

[0033] The beamformer having the above capability may use a channel information indication frame within the validity period of the channel information to request the channel information again, or may use the existing method to retransmit the NDPA and the NDP to request the channel information, which is not limited in the embodiments of the present invention.

[0034] According to the method for obtaining channel information in the embodiments, the beamformer transmits the channel information indication frame to request the channel information again, and receives the channel information or channel information segments transmitted by the beamformee, which prevents the beamformer from repeatedly transmitting the NDPA and the NDP to request the channel information, improves the efficiency, and saves the signaling resources.

[0035] In addition, the beamformer may transmit the management signaling to the beamformee to indicate that the beamformer has the capability of receiving the currently requested channel information or channel information segments within a subsequent TXOP, so that the beamformee does not discard the estimated channel

information, which prevents the power waste caused by repeated channel information estimation. The segmentation may further reduce the time overhead.

[0036] Referring to FIG. 5, this embodiment provides a method for transmitting channel information, including the following steps:

501. A beamformee receives a request for obtaining channel information, where the request is transmitted by a beamformer within the duration of a current first transmission opportunity TXOP.

502. The beamformee performs channel estimation to obtain the channel information, and determines that the remaining duration of the first TXOP is insufficient for transmitting the channel information, where the remaining duration of the first TXOP is the duration from the current time to the time when the first TXOP ends.

503. The beamformee transmits a null feedback frame to the beamformer within the remaining duration of the first TXOP; and within the validity period of the channel information, if the beamformee obtains a second TXOP, transmits the channel information to the beamformer within the duration of the second TXOP; or

the beamformee segments the channel information into a first channel information segment and a second channel information segment, transmits the first channel information segment to the beamformer within the remaining duration of the first TXOP, and after the beamformee obtains a third TXOP, transmits the second channel information segment to the beamformer within the duration of the third TXOP. In this embodiment, if the total duration of the channel information exceeds the remaining duration of the first TXOP, the beamformee may select to transmit the channel information by segment, and transmit a channel information segment allowed by the remaining duration of the first TXOP. For example, the channel information is segmented into five segments; when the duration of the current first TXOP only allows transmission of two segments, the beamformee transmits two segments within the duration of the first TXOP, and transmits the remaining three segments within the subsequent third TXOP, thereby reducing the time overhead.

[0037] At least one of the channel information, the first channel information segment, and the second channel information segment is transmitted together with data information to the beamformer.

[0038] Further, in practical applications, in step 502, the channel information of the beamformee may have already been obtained before the request is received. Therefore, the beamformee might no longer need to perform channel estimation to obtain the channel information.

[0039] In this embodiment, the beamformee may obtain the second TXOP and the third TXOP prior to that

all other STAs obtain the TXOP. To be specific, the beamformee obtains the right to use the channel prior to all other STAs so that the beamformee actively transmits the channel information or channel information segments to the beamformer without the need of a request from the beamformer.

[0040] In another embodiment of the present invention, after the beamformee transmits the channel information, the first channel information segment, or the second channel information segment, the method may further include:

receiving, by the beamformee, an acknowledgment ACK frame or a block acknowledgment (BA, Block ACK) frame returned by the beamformer. The ACK and BA are both used to indicate that the beamformer correctly receives the channel information. The difference lies in that the beamformer returns an ACK frame upon receiving a piece of information, for example, returns an ACK frame upon receiving the channel information or one segment; the beamformer returns a BA upon receiving multiple pieces of channel information, for example, returns a BA upon receiving the channel information and data information, or returns a BA upon receiving two segments.

[0041] The above method provided in the embodiments of the present invention may be applied to single-user channel information feedback, or multiple-user channel information feedback. The following uses multiple-user channel information feedback as an example for description.

[0042] FIG. 6 is a flow chart of two-user channel information feedback, where the segmentation mode is not used. A beamformer transmits an NDPA and an NDP within the current TXOP to a beamformee 1 to request channel information 1, and receives the channel information 1 between the beamformer and the beamformee 1 from the beamformee 1. The beamformer transmits a Sounding Poll indication frame to a beamformee 2 within the current TXOP to request channel information 2, and receives a null feedback frame transmitted by the beamformee 2. After a period of time, the beamformee 2 obtains a new TXOP prior to all other STAs, actively transmits, within the new TXOP, the estimated channel information 2 between the beamformer and the beamformee 2, and transmits the channel information 2 and data information to the beamformer. After receiving the channel information 2 and data information, the beamformer returns a BA to the beamformee 2, indicating that the channel information 2 and data information are correctly received. The process illustrated in FIG. 6, compared with that the beamformer retransmits an NDPA and an NDP in the prior art, saves the time overhead, that is, length (NDPA + NDP + SIFS x 2). If the channel information is transmitted separately, instead of being transmitted with the data information, the saved time overhead is length (NDPA + NDP + SIFS) - length (ACK).

[0043] FIG. 7 is a flow chart of two-user channel information feedback, where the segmentation mode is used. A beamformer transmits an NDPA and an NDP within the current TXOP to a beamformee 1 to request channel information 1, and receives the channel information 1 between the beamformer and the beamformee 1 from the beamformee 1. The beamformer transmits a Sounding Poll indication frame to a beamformee 2 within the current TXOP to request channel information 2, and receives a first channel information segment transmitted by the beamformee 2. After a period of time, the beamformee 2 obtains a new TXOP prior to all other STAs, and actively transmits the remaining second channel information segment within the new TXOP; and the beamformer returns an ACK or a BA to the beamformee 2 after receiving the second channel information segment, indicating that the channel information is correctly received. The process illustrated in FIG. 7, compared with that the beamformer retransmits an NDPA and an NDP in the prior art, saves the time overhead, that is, length (NDPA + NDP + SIFS + first segment of the channel information 2) - length (ACK). If the channel information is transmitted with the data information, the saved time overhead is length (NDPA + NDP + SIFS x 2 + first segment of the channel information 2).

[0044] In another embodiment of the present invention, the method may further include:

transmitting, by the beamformee, management signaling to the beamformer, where the management signaling includes an indication information element used for indicating that the beamformee has the capability of storing and transmitting the channel information or the channel information segments currently requested by the beamformer within a subsequent TXOP. Specifically, the indication information element may be a bit or field newly added in the capability field of the management signaling. The indication information element may enable the beamformer to know that the beamformee can store the estimated channel information and to wait for the feedback, so that the beamformer may transmit a channel information indication frame within the validity period of the channel information to request the channel information again, which prevents the beamformer from retransmitting a request using the channel information indication frame when the beamformee does not have the above capability causing a failure to obtain the channel information.

[0045] Of course, the beamformee having the above capability may actively feed back the stored channel information to the beamformer within the validity period of the channel information once the TXOP is obtained, or may use the existing method to for the beamformer to retransmit the NDPA and the NDP and then feed back the channel information, which is not limited in the embodiments of the present invention.

[0046] According to the method for transmitting channel information in the embodiments, the beamformee, if failing to transmit the channel information within the duration of the current first TXOP of the beamformer, transmits the channel information after obtaining the second TXOP, or transmits the first channel information segment within the remaining duration of the first TXOP, and transmits the second channel information segment after obtaining the third TXOP, which prevents the repeated channel estimation of the beamformee and reduces power consumption. In addition, the beamformee actively transmits the channel information to the beamformer, and the beamformer does not need to transmit the channel information indication frame, which saves the signaling resources.

[0047] In addition, the beamformee may transmit the management signaling to the beamformer to indicate that the beamformee has the capability of storing and transmitting the channel information or the channel information segments currently requested by the beamformer within a subsequent TXOP, which prevents the beamformer from retransmitting the NDPA and the NDP, improves the efficiency, and saves the signaling resources. The segmentation may further reduce the time overhead.

[0048] Referring to FIG. 8, this embodiment provides another method for transmitting channel information, including the following steps:

801. A beamformee receives a request for obtaining channel information, where the request is transmitted by a beamformer within the duration of a current first transmission opportunity TXOP.

802. The beamformee performs channel estimation to obtain the channel information, and determines that the remaining duration of the first TXOP is insufficient for transmitting the channel information, where the remaining duration of the first TXOP is the duration from the current time to the time when the first TXOP ends.

803. The beamformee transmits a null feedback frame to the beamformer within the remaining duration of the first TXOP. Within the validity period of the channel information, if the beamformer obtains a second TXOP and transmits a channel information indication frame, the beamformee transmits the channel information to the beamformer; or the beamformee segments the channel information into the first channel information segment and the second channel information segment, transmits the first channel information segment to the beamformer within the remaining duration of the first TXOP, and transmits the second channel information segment to the beamformer after the beamformer obtains a third TXOP and transmits a channel information indication frame.

[0049] At least one of the channel information, the first channel information segment, and the second channel

information segment is transmitted with data information to the beamformer.

[0050] In this embodiment, the beamformer may obtain the second TXOP and the third TXOP prior to that all other STAs obtain the TXOP. To be specific, the beamformer obtains the right to use the channel prior to all other STAs so that the beamformer actively requests to obtain the channel information and transmits the channel information indication frame.

[0051] In another embodiment of the present invention, after the beamformee transmits the channel information, the first channel information segment, or the second channel information segment, the method may further include:

receiving, by the beamformee, an acknowledgment ACK frame or a block acknowledgment BA frame returned by the beamformer.

[0052] The above method provided in the embodiments of the present invention may be applied to single-user channel information feedback, or multiple-user channel information feedback. The following uses multiple-user channel information feedback as an example for description.

[0053] FIG. 9 is a flow chart of two-user channel information feedback, where the segmentation mode is used. A beamformer transmits an NDPA and an NDP within the current TXOP to a beamformee 1 to request channel information 1, and receives the channel information 1 between the beamformer and the beamformee 1 from the beamformee 1. The beamformer transmits a Sounding Poll indication frame to a beamformee 2 within the current TXOP to request channel information 2, and receives a first segment of the channel information 2 transmitted by the beamformee 2. After a period of time, the beamformer obtains a new TXOP prior to all other STAs, and transmits a Sounding Poll indication frame within the new TXOP to request the remaining second segment of the channel information 2; and the beamformee 2 feeds back the second segment of the channel information 2 to the beamformer after receiving the second segment of the channel information 2. The process illustrated in FIG. 9, compared with that the beamformer retransmits the NDPA and the NDP in the prior art, saves the time overhead, that is, length (NDPA + NDP + SIFS) - length (Sounding Poll) + length (first segment of the channel information 2).

[0054] In another embodiment of the present invention, the method may further include:

transmitting, by the beamformee, management signaling to the beamformer, where the management signaling includes an indication information element used for indicating that the beamformee has the capability of storing and transmitting the channel information or the channel information segments currently requested by the beamformer within a subsequent

TXOP. Specifically, the indication information element may be a bit or field newly added in the capability field of the management signaling. The indication information element may enable the beamformer to know that the beamformee can store the estimated channel information and to wait for the channel information feedback, so that the beamformer may transmit a channel information indication frame within the validity period of the channel information to request the channel information again, which prevents the beamformer from retransmitting a request using the channel information indication frame when the beamformee does not have the above capability, causing a failure to obtain the channel information.

[0055] The beamformee having the above capability may feed back the stored channel information to the beamformer within the validity period of the channel information if the beamformer obtains the TXOP and transmits a channel information indication frame, or may use the existing method to wait for the beamformer to retransmit the NDPA and the NDP and then feed back the channel information, which is not limited in the embodiments of the present invention.

[0056] According to the method for transmitting channel information in the embodiments, the beamformee, if failing to transmit the channel information within the duration of the current first TXOP of the beamformer, feeds back the channel information after the beamformer obtains the second TXOP and transmits the channel information indication frame; or segments the channel information into the first channel information segment and the second channel information segment, transmits the first channel information segment within the remaining duration of the first TXOP, and transmits the second channel information segment after the beamformer obtains the third TXOP and transmits the channel information indication frame, which prevents repeated channel estimation of the beamformee and reduces power consumption.

[0057] In addition, the beamformee may transmit the management signaling to the beamformer to indicate that the beamformee has the capability of storing and transmitting the channel information or the channel information segments currently requested by the beamformer within a subsequent TXOP so that the beamformer may request the channel information again by using the channel information indication frame within the validity period of the channel information, which prevents the beamformer from retransmitting the NDPA and the NDP, improves the efficiency, and saves the signaling resources. The segmentation may further reduce the time overhead.

[0058] Based on the above methods, further, in practice, the first TXOP may be insufficient for transmitting the channel information. In this case, the beamformer may determine whether the duration of the TXOP is sufficient and determine whether to request within a subsequent TXOP. Therefore, another embodiment provides a method for obtaining channel information, including the

following steps:

S1101. A beamformer determines that the duration of a current first transmission opportunity TXOP is insufficient for receiving channel information.

S1102. Within the validity period of the channel information, if obtaining a second TXOP, the beamformer transmits a channel information indication frame within the duration of the second TXOP to the beamformee to request the channel information, and receives the channel information transmitted by the beamformee.

[0059] In this embodiment, if the beamformer determines that the duration of the current first transmission opportunity TXOP is insufficient for receiving the channel information and no other data is to be transmitted, the beamformer may select to terminate the TXOP, i.e., to truncate the TXOP.

[0060] The corresponding method for transmitting channel information may be illustrated in the following embodiment, including the following step:

S1202. Within the validity period of the channel information, if obtaining a second TXOP, the beamformee transmits the channel information to the beamformer within the duration of the second TXOP.

[0061] The method for transmitting channel information may also be illustrated in the following embodiment, including the following steps:

[0062] A beamformee feeds back a null feedback frame within the remaining duration of a first TXOP to the beamformer; within the validity period of the channel information, if a beamformer obtains a second TXOP, the beamformee transmits the channel information to the beamformer within the duration of the second TXOP. Alternatively, the validity period of the channel information is long, and the beamformee may obtain a second TXOP. In this case, the beamformee transmits the channel information to the beamformer within the duration of the second TXOP.

[0063] Alternatively, within the validity period of channel information, if obtaining a second TXOP, the beamformee transmits the channel information to the beamformer within the duration of the second TXOP.

[0064] Further, in practical applications, the remaining duration of a current first transmission opportunity TXOP may be insufficient for transmitting the channel information. In this case, the beamformer determines whether the duration of the first TXOP is sufficient and implements the segmentation in the request. In one of the following embodiments, the beamformer controls the progress of the channel information request and transmission.

[0065] In addition, this embodiment provides another method for obtaining channel information, including the following steps:

S2101. A beamformer determines that the remaining duration of the current first transmission opportunity TXOP is insufficient for transmitting channel information.

S2102. The beamformer transmits a request for obtaining channel information segments to a beamformee within the duration of the current first transmission opportunity TXOP.

S2103. The beamformer receives a first channel information segment transmitted by the beamformee within the duration of the first TXOP; if the beamformer obtains a third TXOP, transmits a channel information indication frame within the duration of the third TXOP to the beamformee to request the remaining channel information segments, and receives a second channel information segment transmitted by the beamformee.

[0066] The first channel information segment and the second channel information segment are obtained after the beamformee segments the channel information.

[0067] In this embodiment, if the total duration of the channel information exceeds the remaining duration of the first TXOP, the beamformer may select to transmit a segment request, and request the channel information segment allowed by the remaining duration within the duration of the first TXOP. For example, the channel information may be segmented into five segments; when the duration of the current first TXOP only allows transmission of two segments, the beamformer requests two segments within the duration of the first TXOP, and requests the remaining three segments within the subsequent third TXOP, thereby reducing the time overhead.

[0068] The corresponding method for transmitting channel information may be illustrated in the following embodiment, including the following steps:

S2201. A beamformee receives a request for obtaining channel information segments, where the request is transmitted by a beamformer within the duration of a current first transmission opportunity TXOP.

S2202. The beamformee segments the channel information into the first channel information segment and the second channel information segment, transmits the first channel information segment to the beamformer within the remaining duration of the first TXOP, and transmits the second channel information segment to the beamformer after the beamformer obtains a third TXOP and transmits a channel information indication frame.

[0069] The corresponding method for transmitting channel information may also be illustrated in the following embodiment, including the following steps:

A beamformee receives a request for obtaining channel information segments, where the request is

transmitted by a beamformer within the duration of a current first transmission opportunity TXOP.

[0070] The beamformee transmits a first channel indication segment to the beamformer within the remaining duration of the first TXOP, and the beamformee transmits the second channel information segment to the beamformer within the duration of a third TXOP after the beamformer obtains the third TXOP. Alternatively, the total duration is long, and after the beamformee obtains the third TXOP, the beamformee transmits the second channel information segment to the beamformer within the duration of the third TXOP.

[0071] At least one of the channel information, the first channel information segment, and the second channel information segment is transmitted with data information to the beamformer.

[0072] Referring to FIG. 10, an embodiment of the present invention provides a beamformer, including a transmitting module 1001 and a receiving module 1002.

[0073] The transmitting module 1001 is configured to transmit a request for obtaining channel information to a beamformee within the duration of a current first transmission opportunity TXOP; after the receiving module 1002 receives a null feedback frame, and if the beamformer obtains a second TXOP within the validity period of the channel information, transmit, within the duration of the second TXOP, a channel information indication frame to the beamformee to request the channel information.

[0074] The receiving module 1002 is configured to receive the null feedback frame transmitted by the beamformee within the duration of the first TXOP and receive the channel information transmitted by the beamformee within the duration of the second TXOP.

[0075] Alternatively, referring to FIG. 11, the beamformer includes a transmitting module 1101 and a receiving module 1102.

[0076] The transmitting module 1101 is configured to transmit a request for obtaining channel information to a beamformee within the duration of a current first TXOP; and after the receiving module 1102 receives a first channel information segment, if the beamformer obtains a third TXOP, transmit, within the duration of the third TXOP, a channel information indication frame to the beamformee to request the remaining channel information segments.

[0077] The receiving module 1102 is configured to receive the first channel information segment transmitted by the beamformee within the duration of the first TXOP, and receive a second channel information segment transmitted by the beamformee within the duration of the third TXOP.

[0078] In another embodiment of the present invention, the transmitting module 1001 or the transmitting module 1101 may be further configured to transmit management signaling to the beamformee, where the management signaling includes an indication information element

used for indicating that the beamformer has the capability of receiving the currently requested channel information or channel information segments within a subsequent TXOP.

[0079] According to the embodiments, the beamformer transmits the channel information indication frame to request the channel information again, and receives the channel information or channel information segments transmitted by the beamformee, which prevents the beamformer from repeatedly transmitting the NDPA and the NDP to request the channel information, improves the efficiency, and saves the signaling resources.

[0080] In addition, the beamformer may transmit the management signaling to the beamformee to indicate that the beamformer has the capability of receiving the currently requested channel information or channel information segments within a subsequent TXOP, so that the beamformee does not discard the estimated channel information, which prevents the power waste caused by repeated channel information estimation. The segmentation may further reduce the time overhead.

[0081] Further, in another embodiment, a beamformer determines whether the duration of a TXOP is sufficient and determines whether to request in a subsequent TXOP. Therefore, the beamformer further includes: a determination module, configured to determine whether the remaining duration of a first TXOP is sufficient for transmitting the channel information, where the remaining duration of the first TXOP is the duration from the current time to the time when the first TXOP ends.

[0082] After the determination module is added, the beamformer may achieve the implementation described in the above method embodiments, and functional modules in the beamformer implement the processes and functions in the method. The determination module determines that the duration of the current first transmission opportunity TXOP is insufficient for transmitting the channel information. The transmitting module and the receiving module correspondingly implement the process and function of the solution where the beamformer determines whether to make a request in a subsequent TXOP.

[0083] Referring to FIG. 12, this embodiment provides a beamformee 12, including a receiving module 1201, a channel estimation module 1202, and a transmitting module 1203.

[0084] The receiving module 1201 is configured to receive a request for obtaining channel information, where the request is transmitted by a beamformer within the duration of a current first transmission opportunity TXOP.

[0085] The channel estimation module 1202 is configured to, after the receiving module 1201 receives the request, perform channel estimation to obtain the channel information, and determine that the remaining duration of the first TXOP is insufficient for transmitting the channel information, where the remaining duration of the first TXOP is the duration from the current time to the time when the first TXOP ends.

[0086] The transmitting module 1203 is configured to

transmit a null feedback frame to the beamformer within the remaining duration of the first TXOP; within the validity period of the channel information, if the beamformee obtains a second TXOP, transmit, within the duration of the second TXOP, the channel information to the beamformer; or segment the channel information into a first channel information segment and a second channel information segment, transmit the first channel information segment to the beamformer within the remaining duration of the first TXOP, and after the beamformee obtains a third TXOP, transmit the remaining second channel information segment to the beamformer within the duration of the third TXOP.

[0087] In another embodiment of the present invention, the transmitting module 1203 may be configured to transmit at least one of the channel information, the first channel information segment, and the second channel information segment with data information to the beamformer.

[0088] In another embodiment of the present invention, the receiving module 1201 may be configured to receive an acknowledgment ACK frame or a block acknowledgment BA frame returned by the beamformer.

[0089] In another embodiment of the present invention, the transmitting module 1203 is further configured to transmit management signaling to the beamformer, where the management signaling includes an indication information element used for indicating that the beamformee has the capability of storing and transmitting the channel information or the channel information segments currently requested by the beamformer within a subsequent TXOP.

[0090] According to the beamformee provided in this embodiment, the beamformee, if failing to transmit the channel information within the duration of the current first TXOP of the beamformer, transmits the channel information after obtaining the second TXOP, or transmits the first channel information segment within the duration of the first TXOP, and transmits the remaining second channel information segment after obtaining the third TXOP, which prevents repeated channel estimation of the beamformee and reduces power consumption. In addition, the beamformee actively transmits the channel information to the beamformer, and the beamformer does not need to transmit the channel information indication frame, which saves the signaling resources.

[0091] In addition, the beamformee may transmit the management signaling to the beamformer to indicate that the beamformee has the capability of storing and transmitting the channel information or channel information segments currently requested by the beamformer within a subsequent TXOP, which prevents the beamformer from retransmitting the NDPA and the NDP, improves the efficiency, and saves the signaling resources. The segmentation may further reduce the time overhead.

[0092] Referring to FIG. 13, this embodiment provides a beamformee 13, including a receiving module 1301, a channel estimation module 1302, and a transmitting module 1303.

[0093] The receiving module 1301 is configured to receive a request for obtaining channel information, where the request is transmitted by a beamformer within the duration of a current first transmission opportunity TXOP.

5 **[0094]** The channel estimation module 1302 is configured to perform channel estimation to obtain the channel information, and determine that the remaining duration of the first TXOP is insufficient for transmitting the channel information, where the remaining duration of the first TXOP is the duration from the current time to the time when the first TXOP ends.

10 **[0095]** The transmitting module 1303 is configured to transmit a null feedback frame to the beamformer within the remaining duration of the first TXOP; and within the validity period of the channel information, if the beamformer obtains a second TXOP and transmits a channel information indication frame, transmit the channel information to the beamformer; or configured to segment the channel information into a first channel information segment and a second channel information segment, transmit the first channel information segment to the beamformer within the remaining duration of the first TXOP, and transmit the remaining second channel information segment to the beamformer after the beamformer obtains a third TXOP and transmits a channel information indication frame.

15 **[0096]** In another embodiment of the present invention, the transmitting module 1303 may be configured to transmit at least one of the channel information, the first channel information segment, and the second channel information segment with data information to the beamformer.

20 **[0097]** In another embodiment of the present invention, the receiving module 1301 may be configured to receive an acknowledgment ACK frame or a block acknowledgment BA frame returned by the beamformer.

25 **[0098]** In another embodiment of the present invention, the transmitting module 1303 may be further configured to transmit management signaling to the beamformer, where the management signaling includes an indication information element used for indicating that the beamformee has the capability of storing and transmitting the channel information or channel information segments currently requested by the beamformer within a subsequent TXOP.

30 **[0099]** According to the beamformee provided in this embodiment, the beamformee, if failing to transmit the channel information within the duration of the current first TXOP of the beamformer, feeds back the channel information after the beamformer obtains the second TXOP and transmits the channel information indication frame; or segments the channel information into the first channel information segment and the second channel information segment, transmits the first channel information segment within the duration of the first TXOP, and transmits the second channel information segment after the beamformer obtains the third TXOP and transmits the channel information indication frame, which prevents repeated channel estimation of the beamformee and reduces power consumption.

er consumption.

[0100] In addition, the beamformee may transmit the management signaling to the beamformer to indicate that the beamformee has the capability of storing and transmitting the channel information or channel information segments currently requested by the beamformer within a subsequent TXOP, so that the beamformer may request the channel information again by using the channel information indication frame within the validity period of the channel information, which prevents the beamformer from retransmitting the NDPA and the NDP, improves the efficiency, and saves the signaling resources. The segmentation may further reduce the time overhead.

[0101] Further, the beamformee may still perform the implementation where the beamformer controls the progress of the channel information request and transmission. The functional modules correspondingly implement the processes and steps for receiving and transmission in the method embodiments.

[0102] Referring to FIG. 14, this embodiment provides a system for transmitting channel information, including a beamformer 1401 according to any one of the above embodiments, and a beamformee 1402 according to any one of the above embodiments.

[0103] According to the system for transmitting channel information in the embodiments of the present invention, the beamformer transmits the channel information indication frame to request the channel information again, and receives the channel information or channel information segments transmitted by the beamformee, which prevents the beamformer from repeatedly transmitting the NDPA and the NDP to request the channel information, improves the efficiency, and saves the signaling resources. In addition, the beamformee prevents repeated channel estimation and reduces power consumption. The segmentation may further reduce the time overhead.

[0104] In addition, it should be noted that the method, device, and system for transmitting channel information in the embodiments of the present invention provide multiple choices: The beamformee may transmit the channel information within its TXOP, or wait for the channel information indication frame from the beamformer; the beamformer may select to transmit the channel information indication frame within its next TXOP to request the channel information, or select to retransmit the NDPA and the NDP to request the channel information, which is more flexible in the applications.

[0105] It should be finally noted that persons of ordinary skill in the art may understand that all or part of the steps of the methods according to the embodiments may be implemented by a program instructing relevant hardware. The program may be stored in a computer readable storage medium. When the program is run, the processes of the methods according to the embodiments may be executed. The storage medium may be a magnetic disk, an optical disk, a read-only memory (ROM) or a random access memory (RAM).

[0106] Various functional units in the embodiments of the present invention may be integrated in a processing module, or be independent physical entities; or two or more than two functional units may be integrated into a module. The preceding integrated module may be not only implemented in the form of hardware, but also implemented in the form of a software functional module. If the integrated module is implemented in the form of a software functional module and functions as an independent product for sale or use, it may also be stored in a computer readable storage medium. The preceding storage medium may be a read-only memory, a magnetic disk, or an optical disk. The above devices and systems may perform the methods described in the method embodiments.

Claims

1. A method for obtaining channel information, comprising:
 - transmitting, by a beamformer, a request for obtaining channel information to a beamformee within a duration of a current first transmission opportunity, TXOP;
 - if the beamformer determines that the duration of the current first TXOP is insufficient for receiving the channel information and if the beamformer obtains a second TXOP within a validity period of the channel information, transmitting, by the beamformer, a channel information indication frame to the beamformee to request the channel information within a duration of the second TXOP, and
 - receiving, by the beamformer, the channel information transmitted by the beamformee.
2. The method according to claim 1, wherein the channel information indication frame comprises an indication information element used for identifying the channel information.
3. The method according to claim 1, further comprising:
 - transmitting, by the beamformer, management signaling to the beamformee, wherein the management signaling comprises an indication information element used for indicating that the beamformer has a capability of receiving the currently requested channel information within a subsequent TXOP.
4. A method for transmitting channel information, comprising:
 - receiving, by a beamformee, a request for obtaining channel information, wherein the request

- is transmitted by a beamformer within a duration of a current first transmission opportunity, TXOP;
- performing, by the beamformee, channel estimation to obtain the channel information; determining, by the beamformee, if the remaining duration of the current first TXOP is insufficient for transmitting channel information;
- if the beamformee determines that the duration of the current first TXOP is insufficient for transmitting the channel information and if the beamformer obtains a second TXOP within a validity period of the channel information, receiving, by the beamformee, a channel information indication frame transmitted by the beamformer within a duration of the second TXOP; and transmitting, by the beamformee, the channel information to the beamformer.
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- channel information transmitted by the beamformee.
9. The beamformer according to claim 8, wherein:
- the transmitting module is further configured to transmit management signaling to the beamformee, wherein the management signaling comprises an indication information element used for indicating that the beamformer has a capability of receiving the currently requested channel information within a subsequent TXOP.
10. A beamformee (12, 13), comprising:
- a receiving module (1201, 1301), configured to receive a request for obtaining channel information, wherein the request is transmitted by a beamformer within a duration of a current first transmission opportunity, TXOP;
- a channel estimation module (1202, 1302), configured to perform channel estimation to obtain the channel information and to determine if the remaining duration of the first TXOP is insufficient for transmitting channel information;
- if the beamformee determines that the duration of the current first TXOP is insufficient for receiving the channel information and if the beamformer obtains a second TXOP within a validity period of the channel information, the receiving module is further configured to receive a channel information indication frame transmitted by the beamformer within a duration of the second TXOP; and
- a transmitting module, configured to transmit the channel information to the beamformer.
11. The beamformee according to claim 10, wherein the transmitting module is configured to transmit the channel information and data information to the beamformer together.
12. The beamformee according to claim 10, wherein the receiving module is further configured to receive an acknowledgment, ACK, frame or a block acknowledgment, BA, frame returned by the beamformer.
13. The beamformee according to claim 10, wherein the transmitting module is further configured to transmit management signaling to the beamformer, wherein the management signaling comprises an indication information element used for indicating that the beamformee has a capability of storing and transmitting the channel information currently requested by the beamformer within a subsequent TXOP.
5. The method according to claim 4, wherein the channel information and data information are together transmitted to the beamformer.
6. The method according to claim 4, wherein after the beamformee transmits the channel information the method further comprises:
- receiving, by the beamformee, an acknowledgment ACK frame or a block acknowledgment BA frame returned by the beamformer.
7. The method according to claim 4, further comprising:
- transmitting, by the beamformee, management signaling to the beamformer, wherein the management signaling comprises an indication information element used for indicating that the beamformee has a capability of storing and transmitting the channel information currently requested by the beamformer within a subsequent TXOP.
8. A beamformer, comprising a transmitting module and a receiving module, wherein:
- the transmitting module is configured to transmit a request for obtaining channel information to a beamformee within a duration of a current first transmission opportunity, TXOP; if the beamformer determines that the duration of the current first TXOP is insufficient for receiving the channel information and if the beamformer obtains a second TXOP within a validity period of the channel information, transmit a channel information indication frame to the beamformee to request the channel information within a duration of the second TXOP; and the receiving module is configured to receive the

Patentansprüche

1. Verfahren zum Erhalten von Kanalinformationen, das Folgendes umfasst:

Senden einer Anforderung zum Erhalten von Kanalinformationen durch einen "Beamformer" zu einem "Beamformee" innerhalb der Dauer einer aktuellen ersten Sendegelegenheit (transmission opportunity, TXOP);

falls der "Beamformer" bestimmt, dass die Dauer der aktuellen ersten TXOP zum Empfangen der Kanalinformationen unzureichend ist, und falls der "Beamformer" eine zweite TXOP innerhalb einer Gültigkeitszeitspanne der Kanalinformationen erhält, Senden eines Kanalinformationsangaberahmens durch den "Beamformer" zu dem "Beamformee", um die Kanalinformationen innerhalb einer Dauer der zweiten TXOP anzufordern, und
Empfangen der Kanalinformationen, die durch den "Beamformee" gesendet werden, durch den "Beamformer".

2. Verfahren nach Anspruch 1, wobei der Kanalinformationsangaberahmen ein Angabeinformationselement umfasst, das zum Identifizieren der Kanalinformationen verwendet wird.

3. Verfahren nach Anspruch 1, das ferner Folgendes umfasst:

Senden von Managementsignalisierung durch den "Beamformer" zu dem "Beamformee", wobei die Managementsignalisierung ein Angabeinformationselement umfasst, das zum Angeben verwendet wird, dass der "Beamformer" eine Fähigkeit zum Empfangen der aktuell angeforderten Kanalinformationen innerhalb einer nachfolgenden TXOP aufweist.

4. Verfahren zum Senden von Kanalinformationen, das Folgendes umfasst:

Empfangen einer Anforderung zum Erhalten von Kanalinformationen durch einen "Beamformee", wobei die Anforderung durch einen "Beamformer" innerhalb einer Dauer einer aktuellen ersten Sendegelegenheit, TXOP, gesendet wird;

Ausführen von Kanalschätzung durch den "Beamformee", um die Kanalinformationen zu erhalten;

Bestimmen durch den "Beamformee", ob die verbleibende Dauer der aktuellen ersten TXOP zum Senden von Kanalinformationen unzureichend ist;

falls der "Beamformee" bestimmt, dass die Dau-

er der aktuellen ersten TXOP zum Senden der Kanalinformationen unzureichend ist, und falls der "Beamformer" eine zweite TXOP innerhalb einer Gültigkeitszeitspanne der Kanalinformationen erhält, Empfangen durch den "Beamformee" eines durch den "Beamformer" gesendeten Kanalinformationsangaberahmens innerhalb einer Dauer der zweiten TXOP; und
Senden der Kanalinformationen durch den "Beamformee" zu dem "Beamformer".

5. Verfahren nach Anspruch 4, wobei die Kanalinformationen und Dateninformationen gemeinsam zu dem "Beamformer" gesendet werden.

6. Verfahren nach Anspruch 4, wobei das Verfahren, nachdem der "Beamformee" die Kanalinformationen sendet, ferner Folgendes umfasst:

Empfangen durch den "Beamformee" eines Quittungsrahmens (acknowledgment frame, ACK-Rahmen) oder eines Block-Quittungsrahmens (block acknowledgment frame, BA-Rahmen), der durch den "Beamformer" zurückgegeben wird.

7. Verfahren nach Anspruch 4, das ferner Folgendes umfasst:

Senden von Managementsignalisierung durch den "Beamformee" zu dem "Beamformer", wobei die Managementsignalisierung ein Angabeinformationselement umfasst, das verwendet wird zum Angeben, dass der "Beamformee" eine Fähigkeit zum Speichern und Senden der Kanalinformationen, die aktuell durch den "Beamformer" angefordert sind, innerhalb einer nachfolgenden TXOP aufweist.

8. "Beamformer", der ein Sendemodul und ein Empfangsmodul umfasst, wobei:

das Sendemodul konfiguriert ist, eine Anforderung zum Erhalten von Kanalinformationen zu einem "Beamformee" innerhalb einer Dauer einer aktuellen ersten Sendegelegenheit, TXOP, zu senden; falls der "Beamformer" bestimmt, dass die Dauer der aktuellen ersten TXOP zum Empfangen der Kanalinformationen unzureichend ist, und falls der "Beamformer" eine zweite TXOP innerhalb einer Gültigkeitszeitspanne der Kanalinformationen erhält, einen Kanalinformationsangaberahmen zu dem "Beamformee" zu senden, um die Kanalinformationen innerhalb einer Dauer der zweiten TXOP anzufordern; und
das Empfangsmodul konfiguriert ist, die Kanalinformationen, die durch den "Beamformee" ge-

sendet werden, zu empfangen.

9. "Beamformer" nach Anspruch 8, wobei:

das Sendemodul ferner konfiguriert ist, Managementsignalisierung zu dem "Beamformee" zu senden, wobei die Managementsignalisierung ein Angabeinformationselement umfasst, das zum Angeben verwendet wird, dass der "Beamformer" eine Fähigkeit zum Empfangen der aktuell angeforderten Kanalinformationen innerhalb einer nachfolgenden TXOP aufweist.

10. "Beamformee" (12, 13), der Folgendes umfasst:

ein Empfangsmodul (1201, 1301), das konfiguriert ist, eine Anforderung zum Erhalten von Kanalinformationen zu empfangen, wobei die Anforderung durch einen "Beamformer" innerhalb einer Dauer einer aktuellen ersten Sendegelegenheit, TXOP, gesendet wird;

ein Kanalschätzungsmodul (1202, 1302), das konfiguriert ist, Kanalschätzung auszuführen, um die Kanalinformationen zu erhalten, und zu bestimmen, ob die verbleibende Dauer der ersten TXOP zum Senden von Kanalinformationen unzureichend ist;

falls der "Beamformee" bestimmt, dass die Dauer der aktuellen ersten TXOP zum Empfangen der Kanalinformationen unzureichend ist, und falls der "Beamformer" eine zweite TXOP innerhalb einer Gültigkeitszeitspanne der Kanalinformationen erhält, das Empfangsmodul ferner konfiguriert ist, einen Kanalinformationsangaberahmen, der durch den "Beamformer" gesendet wird, innerhalb einer Dauer der zweiten TXOP zu empfangen; und

ein Sendemodul, das konfiguriert ist, die Kanalinformationen zu dem "Beamformer" zu senden.

11. "Beamformee" nach Anspruch 10, wobei das Sendemodul konfiguriert ist, die Kanalinformationen und Dateninformationen gemeinsam zu dem "Beamformer" zu senden.

12. "Beamformee" nach Anspruch 10, wobei das Empfangsmodul ferner konfiguriert ist, einen Quittungsrahmen, ACK-Rahmen, oder einen Blockquittungsrahmen, BA-Rahmen, der durch den "Beamformer" zurückgegeben wird, zu empfangen.

13. "Beamformee" nach Anspruch 10, wobei das Sendemodul ferner konfiguriert ist, Managementsignalisierung zu dem "Beamformer" zu senden, wobei die Managementsignalisierung ein Angabeinformationselement umfasst, das verwendet wird zum Angeben, dass der "Beamformee" eine Fähigkeit zum Speichern und Senden der Kanalinformationen, die

aktuell durch den "Beamformer" angefordert sind, innerhalb einer nachfolgenden TXOP aufweist.

5 Revendications

1. Procédé d'obtention d'informations de canal, comprenant :

l'émission, par un élément de formation de faisceau, d'une demande d'obtention d'informations de canal vers un élément soumis à une formation de faisceau pendant une durée d'une première opportunité d'émission, TXOP (Transmission Opportunity), courante ;

si l'élément de formation de faisceau détermine que la durée de la première TXOP courante est insuffisante pour recevoir les informations de canal et si l'élément de formation de faisceau obtient une seconde TXOP pendant une période de validité des informations de canal, l'émission, par l'élément de formation de faisceau, d'une trame d'indication d'informations de canal vers l'élément soumis à une formation de faisceau afin de demander les informations de canal pendant une durée de la seconde TXOP, et la réception, par l'élément de formation de faisceau, des informations de canal émises par l'élément soumis à une formation de faisceau.

2. Procédé selon la revendication 1, dans lequel la trame d'indication d'informations de canal comprend un élément d'information d'indication utilisé pour identifier les informations de canal.

3. Procédé selon la revendication 1, comprenant en outre :

l'émission, par l'élément de formation de faisceau, d'une signalisation de gestion vers l'élément soumis à une formation de faisceau, dans lequel la signalisation de gestion comprend un élément d'information d'indication utilisé pour indiquer que l'élément de formation de faisceau a la capacité de recevoir les informations de canal demandées à l'instant courant pendant une TXOP suivante.

4. Procédé d'émission d'informations de canal, comprenant :

la réception, par un élément soumis à une formation de faisceau, d'une demande d'obtention d'informations de canal, dans lequel la demande est émise par un élément de formation de faisceau pendant une durée d'une première opportunité d'émission, TXOP, courante ;
l'exécution, par l'élément soumis à une forma-

- tion de faisceau, d'une estimation de canal afin d'obtenir les informations de canal ; la détermination, par l'élément soumis à une formation de faisceau, de si la durée restante de la première TXOP courante est insuffisante pour l'émission d'informations de canal ;
- si l'élément soumis à une formation de faisceau détermine que la durée de la première TXOP courante est insuffisante pour émettre les informations de canal et si l'élément de formation de faisceau obtient une seconde TXOP pendant une période de validité des informations de canal, la réception, par l'élément soumis à une formation de faisceau, d'une trame d'indication d'informations de canal émise par l'élément de formation de faisceau pendant une durée de la seconde TXOP ; et
- l'émission, par l'élément soumis à une formation de faisceau, des informations de canal vers l'élément de formation de faisceau.
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mation de faisceau.

11. Elément soumis à une formation de faisceau selon la revendication 10, dans lequel le module d'émission est configuré pour émettre ensemble les informations de canal et des informations de données vers l'élément de formation de faisceau. 5
12. Elément soumis à une formation de faisceau selon la revendication 10, dans lequel le module de réception est en outre configuré pour recevoir une trame d'accusé de réception, ACK, ou une trame d'accusé de réception de bloc, BA, renvoyée par l'élément de formation de faisceau. 10
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13. Elément soumis à une formation de faisceau selon la revendication 10, dans lequel le module d'émission est en outre configuré pour émettre une signalisation de gestion vers l'élément de formation de faisceau, dans lequel la signalisation de gestion comprend un élément d'information d'indication utilisé pour indiquer que l'élément soumis à une formation de faisceau a la capacité de stocker et d'émettre les informations de canal demandées à l'instant courant par l'élément de formation de faisceau pendant une TXOP suivante. 20
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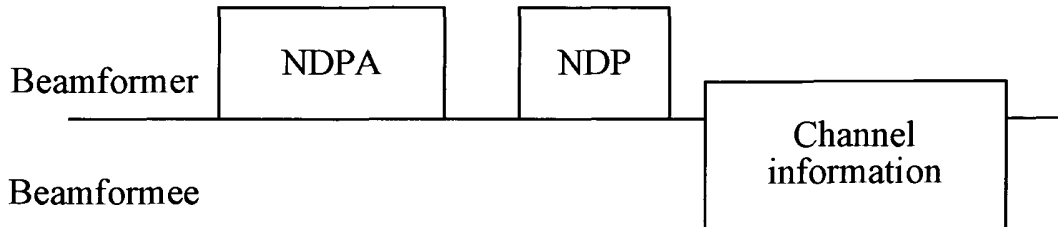


FIG. 1

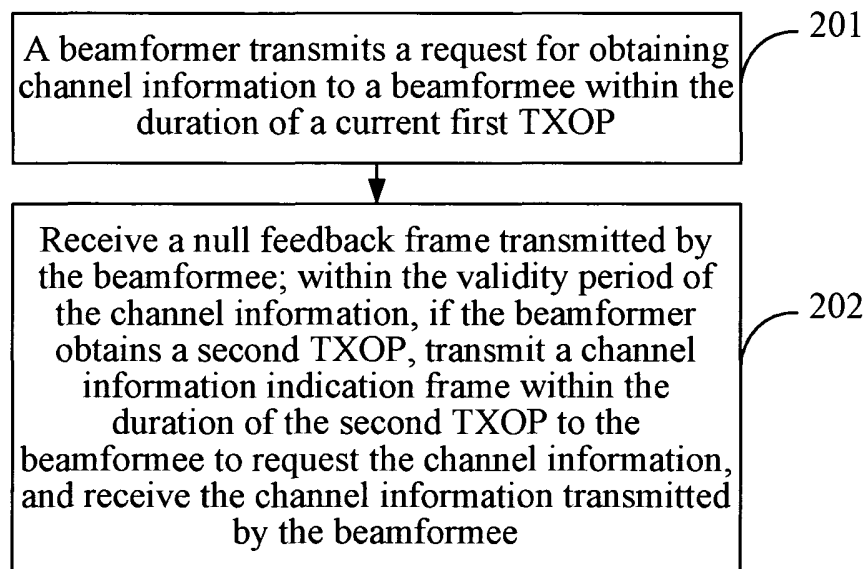


FIG. 2a

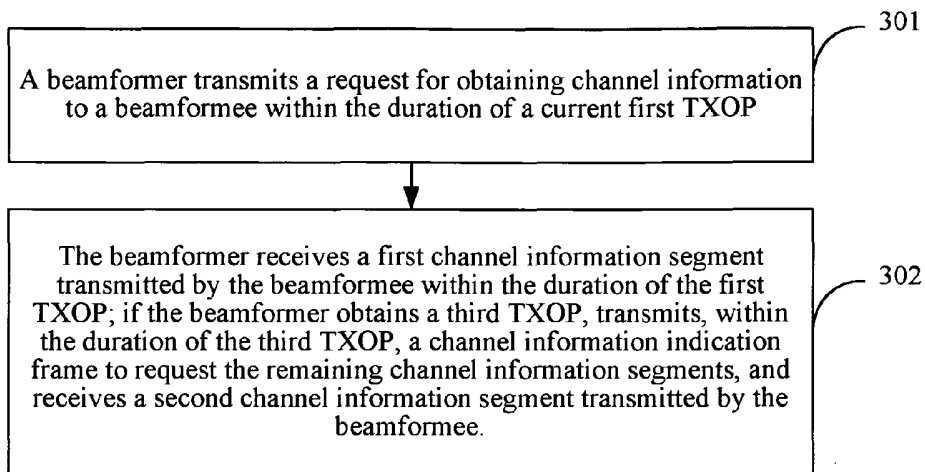


FIG. 2b

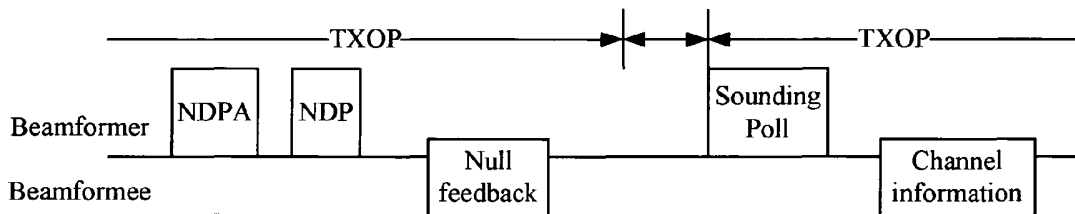


FIG. 3

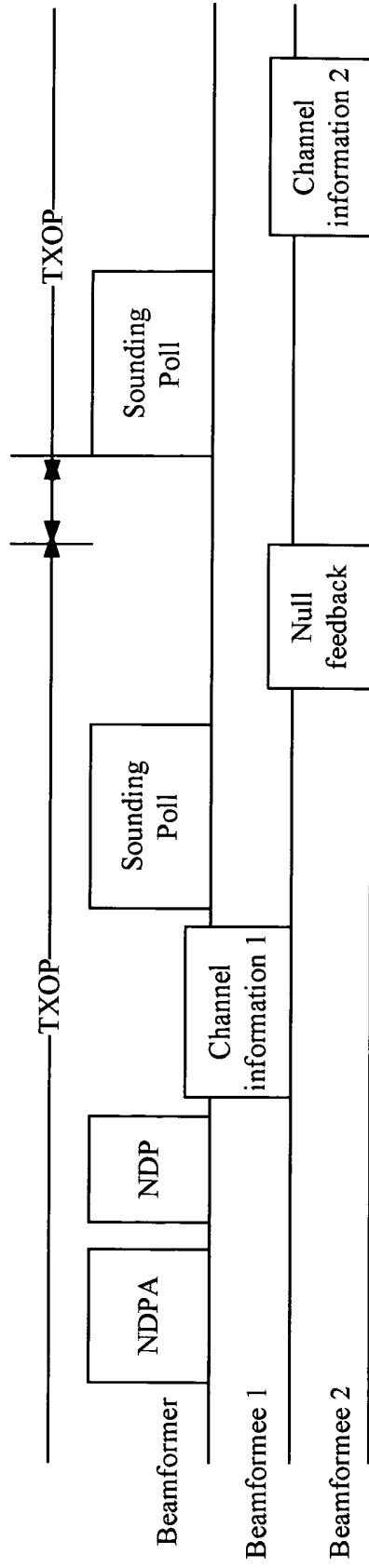


FIG. 4

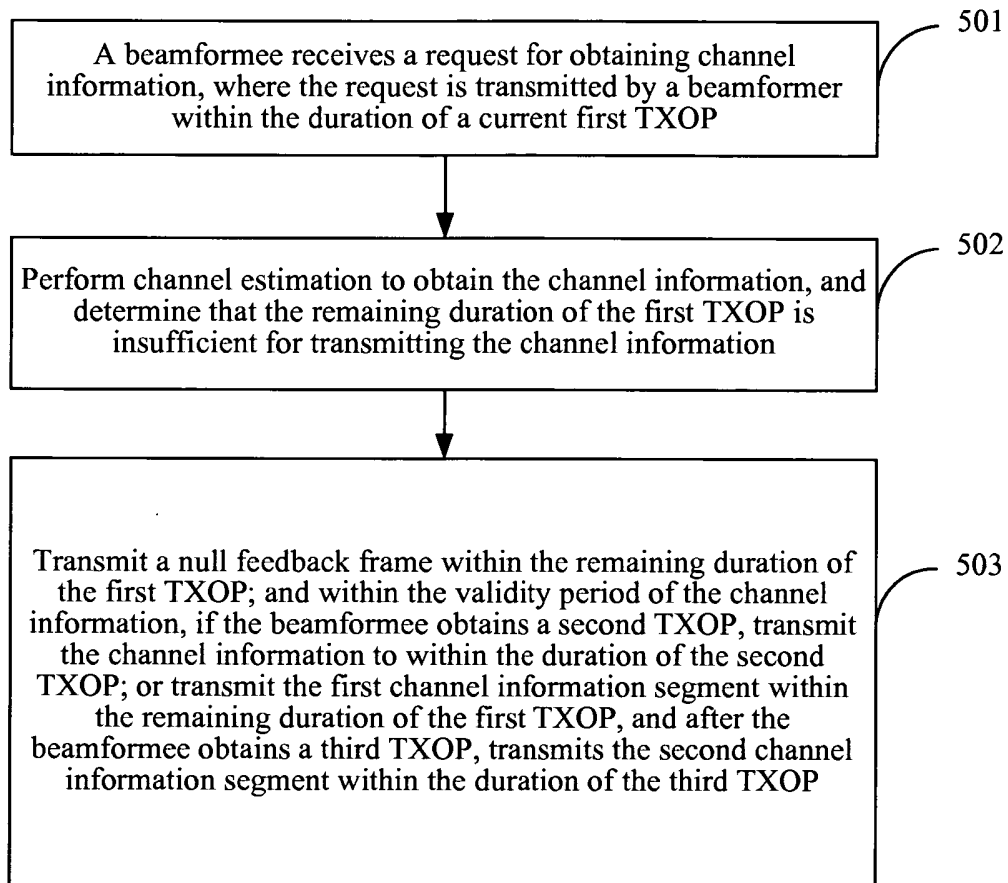


FIG. 5

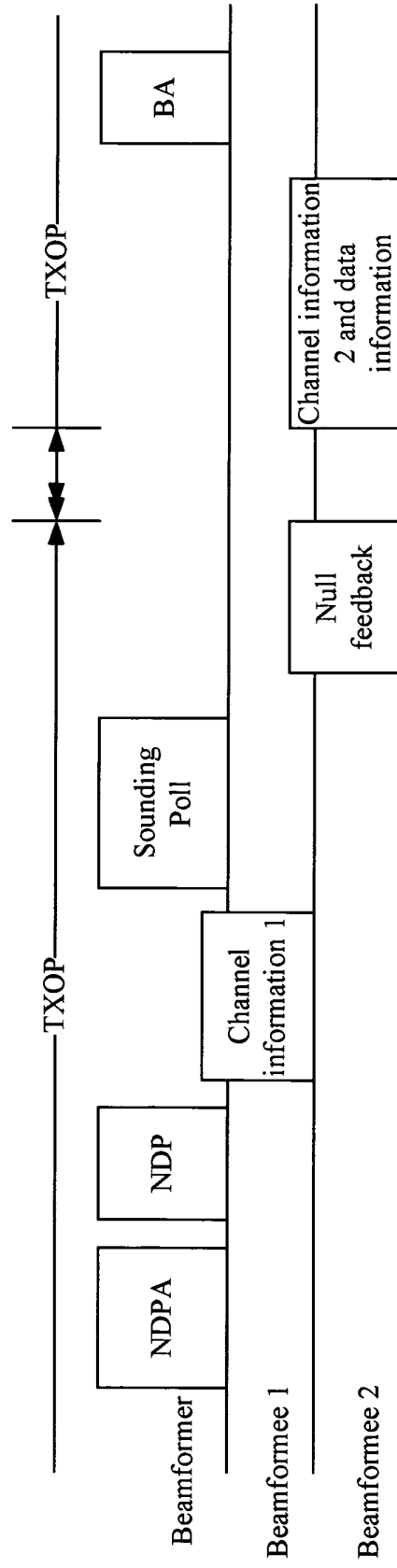


FIG. 6

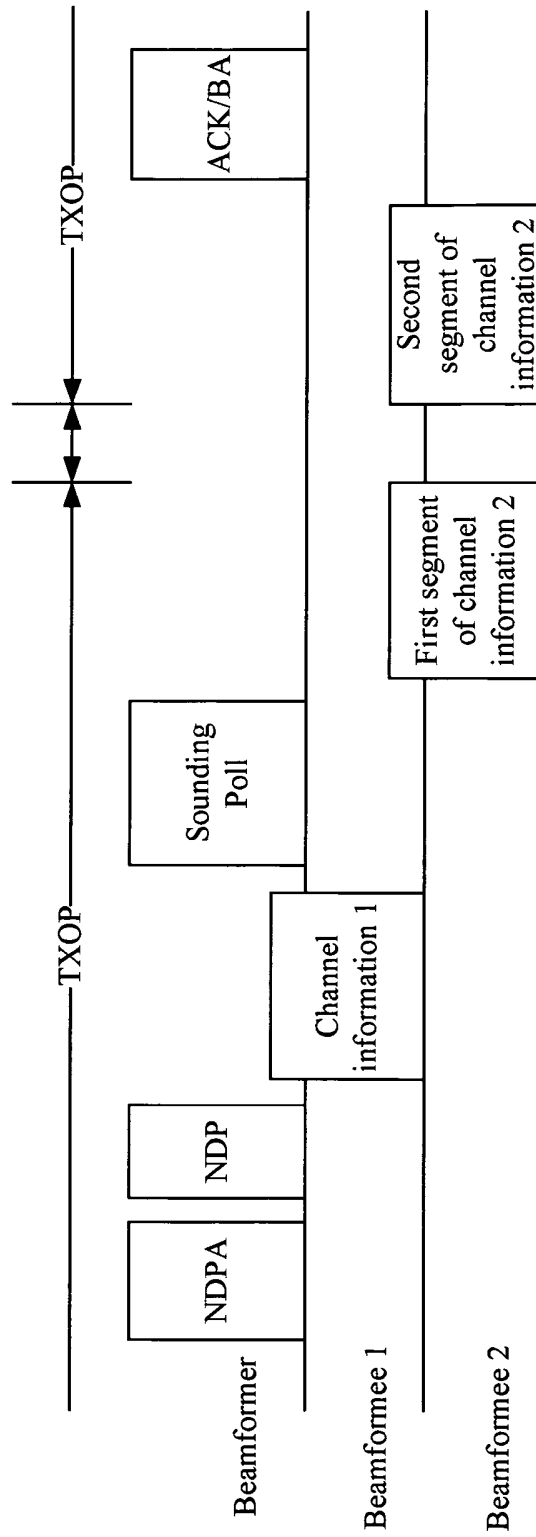


FIG. 7

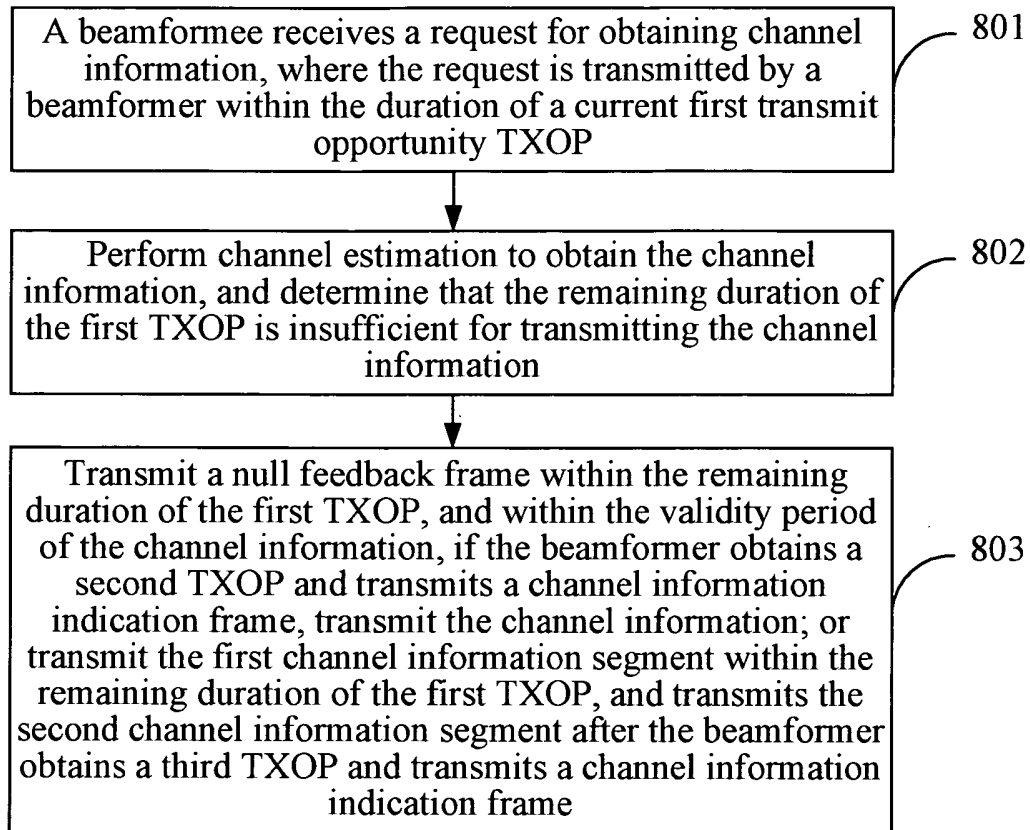


FIG. 8

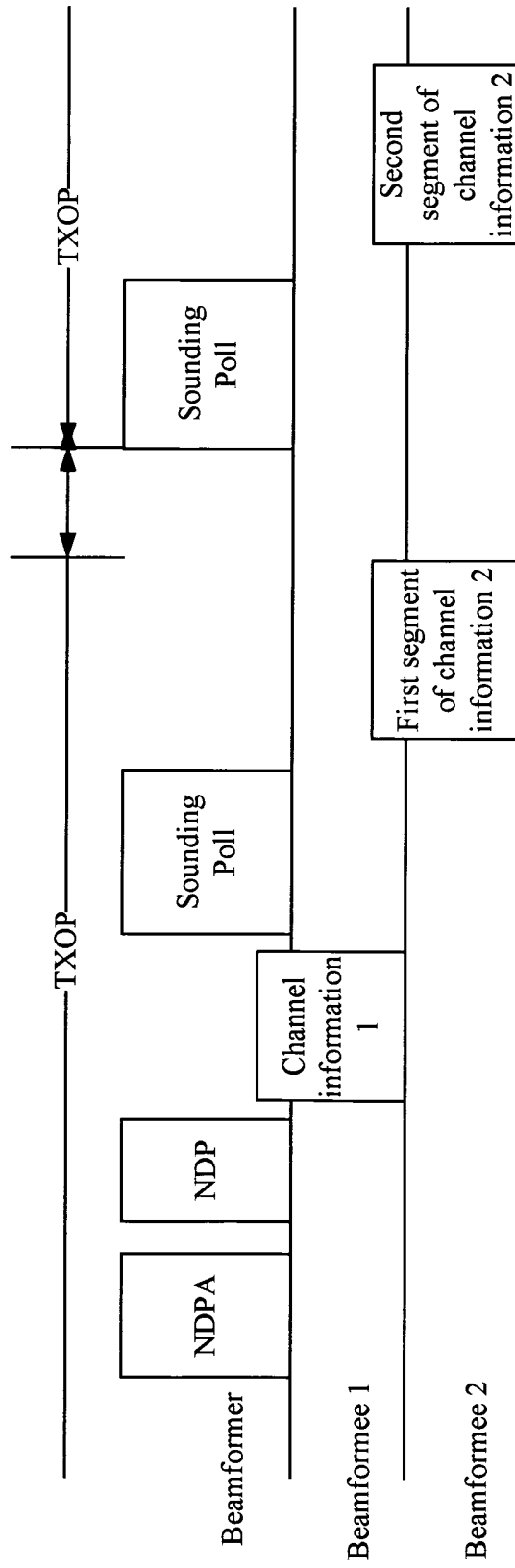


FIG. 9

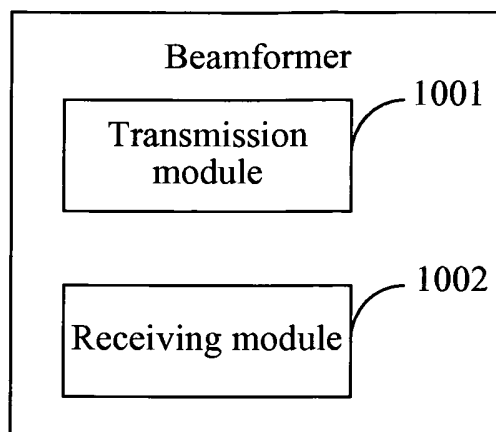


FIG. 10

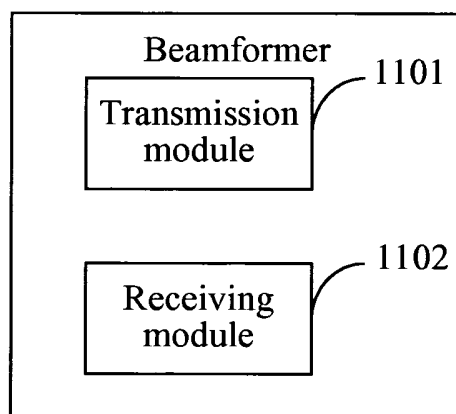


FIG. 11

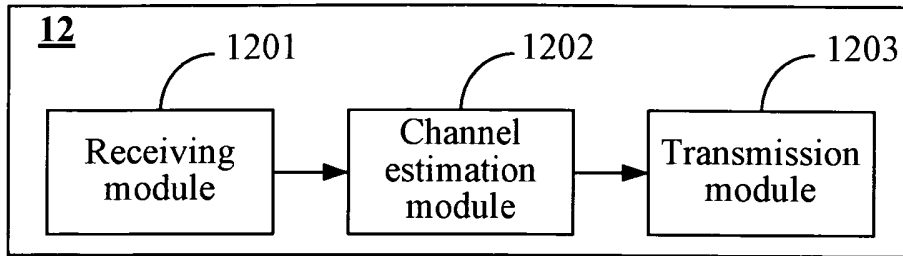


FIG. 12

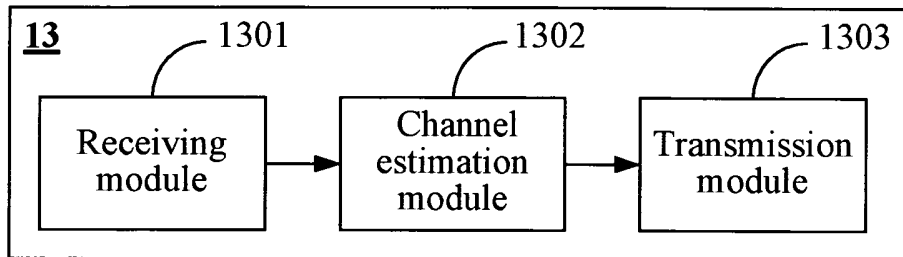


FIG. 13

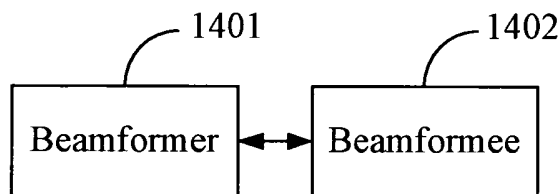


FIG. 14

EP 2 717 522 B1

REFERENCES CITED IN THE DESCRIPTION

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- US 20100208781 A [0005]
- WO 2011035207 A [0006]

ELJÁRÁS, ESZKÖZ ÉS RENDSZER CSATORNA INFORMÁCIÓ TOVÁBBÍTÁSÁRA

SZABADALMI IGÉNYPONTOK

1. Eljárás csatorna információ beszerzésére, amely során:

egy nyalábformálással (*beamformer*) elküldünk egy csatorna információ beszerzésére vonatkozó kérést egy nyalábformázott eszköznek (*beamformee*) az aktuális első adási lehetőség, TXOP, időtartamán belül;

ha a nyalábformáló azt állapítja meg, hogy az aktuális első TXOP időtartama nem elegendő a csatorna információ vételére és ha a nyalábformáló beszerez egy második TXOP-t a csatorna információ érvényességi időtartama alatt, akkor a nyalábformálással továbbítunk egy csatorna információt jelző keretet a nyalábformázott eszköznek a csatorna információnak a második TXOP időtartamán belüli kérelmezése céljából, és

a nyalábformálással fogadjuk a nyalábformázott eszköz által továbbított csatorna információt.

2. Az 1. igénypont szerinti eljárás, ahol a csatorna információt jelző keret tartalmaz egy olyan jelzési információs elemet, melyet a csatorna információ azonosítására használunk.

3. Az 1. igénypont szerinti eljárás, amely során:

a nyalábformálással továbbítunk egy menedzsment jelzést a nyalábformázónak, ahol a menedzsment jelzés olyan jelzési információs elemet tartalmaz, melyet annak jelzésére használunk, hogy a nyalábformáló képes az aktuálisan kért csatorna információ fogadására egy soron következő TXOP időtartamán belül.

4. Eljárás csatorna információ továbbítására, amely során:

egy nyalábformázott eszközzel fogadjuk egy csatorna információ beszerzésére vonatkozó kérést, ahol a kérést egy nyalábformáló továbbította egy aktuális első adási lehetőség, TXOP időtartamán belül;

a nyalábformázott eszközzel csatornabecslést végzünk a csatorna információ beszerzésére;

meghatározzuk a nyalábformázott eszközzel, hogy az aktuális első TXOP hátralévő időtartama kevés-e a csatorna információ továbbítására;

ha a nyalábformázott eszközzel azt állapítjuk meg, hogy az aktuális első TXOP időtartama nem elegendő a csatorna információ továbbítására, és ha a nyalábformáló beszerez egy második TXOP-t a csatorna információ érvényességi időtartamán belül, akkor a nyalábformázott eszközzel a második TXOP időtartamán belül fogadjuk egy a nyalábformáló által továbbított csatorna információt jelző keretet; és

a nyalábformázott eszközzel továbbítjuk a csatorna információt a nyalábformálónak.

5. A 4. igénypont szerinti eljárás, ahol a csatorna információt és az adat információt együtt továbbítjuk a nyalábformálónak.

6. A 4. igénypont szerinti eljárás, ahol miután a nyalábformázott eszköz elküldi a csatorna információt,

öt, az eljárás további lépésében:

a nyalábformázott eszközzel fogadunk egy a nyalábformáló által visszaküldött nyugtázó ACK keretet vagy blokkos nyugtázó BA keretet.

7. A 4. igénypont szerinti eljárás, amelynél további lépésként:

a nyalábformázott eszközzel menedzsment jelzést továbbítunk a nyalábformálóknak, ahol a menedzsment jelzés olyan jelzési információ elemet tartalmaz, melyet annak jelzésére használunk, hogy a nyalábformázott eszköz a soron következő TXOP időtartamán belül képes eltárolni és továbbítani a nyalábformáló által aktuálisan kért csatorna információt.

8. Nyalábformáló, amely tartalmaz adómodult és vevőmodult, ahol

az adómodul úgy van kialakítva, hogy elküld egy csatorna információ beszerzésére vonatkozó kérést egy nyalábformázott eszközhöz egy aktuális első adási lehetőség, TXOP időtartamán belül; ha a nyalábformáló azt állapítja meg, hogy az aktuális első TXOP időtartama nem elégséges a csatorna információ fogadására és ha a nyalábformáló beszerz egy második TXOP-t a csatorna információ érvényességi időtartamán belül, akkor a második TXOP időtartamán belül továbbít egy csatorna információt jelző keretet a nyalábformázott eszközhöz a csatorna információ kérelmezése céljából; és

a vevőmodul úgy van kialakítva, hogy a nyalábformázott eszköz által továbbított csatorna információt fogadja.

9. A 8. igénypont szerinti nyalábformáló, ahol

az adómodul továbbá úgy van kialakítva, hogy menedzsment jelzést továbbít a nyalábformázott eszközhöz, ahol a menedzsment jelzés olyan jelzési információ elemet tartalmaz, melyet annak jelzésére használunk, hogy a nyalábformáló képes az aktuálisan kért csatorna információnak egy soron következő TXOP-n belül történő fogadására.

10. Nyalábformázott eszköz (12, 13), amely tartalmaz:

egy vevőmodult (1201, 1301), amely úgy van kialakítva, hogy csatorna információ beszerzésére vonatkozó kérést fogad, ahol a kérést egy nyalábformáló továbbítja egy aktuális első adási lehetőség, TXOP időtartamán belül;

egy csatornabecslő modult (1202, 1302), amely úgy van kialakítva, hogy csatornabecslést végez a csatorna információ beszerzésére és megállapítja, hogy az első TXOP hátralévő időtartama kevés-e a csatorna információ továbbítására;

ha a nyalábformázott eszköz azt állapítja meg, hogy az aktuális első TXOP időtartama nem elegendő a csatorna információ vételére és ha a nyalábformáló beszerz egy második TXOP-t a csatorna információ érvényességi időtartamán belül, a vevőmodul továbbá úgy van kialakítva, hogy a második TXOP időtartamán belül egy a nyalábformáló által továbbított, csatorna információt jelző keretet fogad; és

egy adómodult, amely a csatorna információnak a nyalábformálóhoz történő továbbítására alkalmasan van kialakítva.

11. A 10. igénypont szerinti nyálábformázott eszköz, ahol az adómodul úgy van kialakítva, hogy a csatorna információt és az adat információt együtt továbbítja a nyálábformálónak.

12. A 10. igénypont szerinti nyálábformázott eszköz, ahol a vevőmodul úgy van kialakítva, hogy egy, a nyálábformáló által visszaküldött nyugtázó, ACK, keretet vagy blokkos nyugtázó, BA, keretet fogad.

13. A 10. igénypont szerinti nyálábformázott eszköz, ahol az adómodul úgy van kialakítva, hogy menedzsment jelzést küld a nyálábformálónak, ahol a menedzsment jelzés olyan jelzési információs elemet tartalmaz, melyet annak jelzésére használ, hogy a nyálábformázott eszköz képes a nyálábformáló által aktuálisan kért csatorna információnak a soron következő TXOP időtartamán belül történő eltárolására és továbbítására.