MULTI-LINK GROUP ADDRESSED TRAFFIC TRANSMISSION METHOD, ~~AND~~ APPARATUS, CHIP SYSTEM, MEDIUM AND SYSTEM

TECHNICAL FIELD

[0001] This application relates to the field of communication technologies, and in particular, to a multi-link group addressed traffic transmission method and an apparatus.

BACKGROUND

[0002] To significantly increase a service transmission rate of a wireless local area network (wireless local area network, WLAN) system, the institute of electrical and electronics engineers (IEEE, Institute of Electrical and Electronics Engineers) 802.11ax standard further adopts an orthogonal frequency division multiple access (OFDMA, Orthogonal Frequency Division Multiplexing) technology based on an existing orthogonal frequency division multiplexing (OFDM, Orthogonal Frequency Division Multiple Access) technology. The OFDMA technology supports multiple nodes to simultaneously send and receive data. This achieves multi-station diversity gains. In addition, the federal communications commission (FCC, Federal Communications Commission) released a new free frequency band of 5925 to 7125 MHz, where the frequency band is referred to as 6 GHz below. Therefore, an operating range of an 802.11ax-compliant device is expanded from 2.4 GHz and 5 GHz to 2.4 GHz, 5 GHz, 6 GHz, and the like.

[0003] IEEE 802.11 next-generation Wi-Fi protocol extremely high throughput (EHT, extremely high throughput) devices need to be forward compatible. Therefore, the devices also support operating spectra of the 802.11ax-compliant device, that is, 2.4 GHz, 5 GHz, and 6 GHz frequency bands. The IEEE 802.11ax next-generation Wi-Fi Protocol EHT device performs channel division based on the latest released free 6 GHz frequency band. A supported bandwidth, for example, 320 MHz, exceeds a maximum bandwidth of 160 MHz supported at 5 GHz.

[0004] A peak throughput for the IEEE 802.11ax next-generation Wi-Fi extremely high throughput device can be increased by using an ultra-large bandwidth, and can also be increased by increasing a quantity of streams, for example, increasing the quantity of streams to 16, through

addressed traffic transmission method according to an embodiment of this application;

[0093] FIG. 6 is a schematic diagram of a multi-link group addressed traffic transmission method 300 according to an embodiment of this application;

[0094] FIG. 7 is a schematic flowchart of a multi-link group addressed traffic transmission method 400 according to an embodiment of this application;

[0095] FIG. 8 is a schematic diagram of a partial virtual bitmap field according to an embodiment of this application;

[0096] FIG. 9 is a schematic diagram of a multi-link group addressed traffic transmission method 500 according to an embodiment of this application;

[0097] FIG. 10 is a schematic diagram of a frame format of a BSSID element according to an embodiment of this application;

[0098] FIG. 11 is a schematic diagram of a structure of a communication apparatus 100 according to an embodiment of this application;

[0099] FIG. 12 is a schematic diagram of a structure of a communication apparatus 200 according to an embodiment of this application;

[00100] FIG. 13 is a schematic diagram of a structure of a communication apparatus 300 according to an embodiment of this application; and

[00101] FIG. 14 is a schematic diagram of a structure of a chip according to an embodiment of this application.

DESCRIPTION OF EMBODIMENTS

[00102] The following clearly ~~and completely~~ describes the technical solutions in embodiments of this application with reference to the accompanying drawings in embodiments of this application.

[00103] To better understand a multi-link group addressed traffic transmission method and a related apparatus that are disclosed in embodiments of this application, related concepts in embodiments of this application are first described.

[00104] 1. Multi-link device

[00105] A wireless communication system applicable to embodiments of this application may be a wireless local area network (Wireless local area network, WLAN) or a cellular network. A

expression (1) is used as an example for subsequent description.

[00144] On one hand, the group addressed traffic may include a group addressed management frame and a group addressed data frame, where a type of the frame is indicated by a type field identifier of a frame control field in a MAC header. On the other hand, the group addressed traffic may be classified into a broadcast traffic and a multicast traffic. In other words, the group addressed traffic sent by the AP is sent to a station associated with the AP or a station MLD associated with the AP in a broadcast or group addressed manner.

[00145] In a same AP MLD, each AP independently sends a group addressed management frame on a link on which the AP works. The AP sends, on the link on which the AP works, a same group addressed data frame to each corresponding STA of a STA MLD associated with the AP. It may be understood that the group addressed management frame is at a link level, and does not need to be received by a conventional station on another link or a STA MLD that has not established an association on the link. This reduces power consumption of a corresponding station. Each AP of the AP MLD sends a same group addressed data frame on each link, so that a station of a single radio (single radio) STA MLD does not lose the group addressed data frame, or a station of a single radio STA MLD does not need to switch a link frequently to receive the group addressed data frame. In an optional implementation, the group addressed traffic indication information indicates whether one AP of the AP MLD has a group addressed traffic. The AP may be the first AP, or may be another AP of the AP MLD other than the first AP. For example, in FIG. 3(c), the first AP is the AP 601-1, and group addressed traffic indication information generated by the AP 601-1 may indicate whether the AP 601-2 of the AP MLD 601 has a group addressed traffic. Alternatively, group addressed traffic indication information generated by the AP 601-1 may indicate whether the AP 601-1 of the AP MLD 601 has a group addressed traffic.

[00146] In another optional implementation, the group addressed traffic indication information indicates whether multiple APs of the AP MLD have a group addressed traffic. The multiple APs may be a part of APs of the AP MLD, or may be all APs of the AP MLD. For example, in FIG. 3(c), the first AP is the AP 601-1, and the AP 601-1 generates group addressed traffic indication information. The group addressed traffic indication information may indicate whether the AP 601-1 of the AP MLD 601 has a group addressed traffic and whether the AP 601-2 has a group addressed traffic. Alternatively, the group addressed traffic indication information may indicate whether the AP 601-1 of the AP MLD 601 has a group addressed traffic, whether the AP 601-2 has

1, an AP MLD explicitly allocates an AID to each AP included in the AP MLD, and the AP MLD allocates the AID to each AP by using association identifier configuration information. In a method 2, an AP MLD implicitly allocates an AID to each AP included in the AP MLD. To be specific, an AID corresponding to a first bit of a part of consecutive bits that are in a partial virtual bitmap field and that correspond to group addressed traffic indication information is predefined. The method may further include two cases. A case 3.1 describes how to predefine an AID corresponding to an AP when the AP of the AP MLD does not work in a multi-BSSID (basic service set identifier) mode. A case 3.2 describes how to allocate the AID to each AP of the AP MLD when one or more APs of the AP MLD work in a multi-BSSID mode. In this case, in a partial virtual bitmap field of a TIM element, AIDs further need to be allocated to multiple APs in a multiple basic service set identifier set. Therefore, the AID allocated to each AP of the AP MLD cannot be the same as AIDs allocated to the multiple APs in the multiple basic service set identifier set. In other words, bits corresponding to each AP of the AP MLD in the partial virtual bitmap field are not repeated with bits corresponding to multiple nontransmitted APs in the multiple basic service set identifier set in the partial virtual bitmap field.

[00244] Method 1: The AP MLD explicitly allocates the AID to each AP included in the AP MLD.

[00245] Optionally, the AID configuration method includes but is not limited to the following steps: A first AP of the AP MLD generates association identifier configuration information, where the association identifier configuration information indicates an association identifier corresponding to each AP of the AP MLD. Specifically, the association identifier configuration information includes one or more pieces of association identifier subconfiguration information, each piece of association identifier subconfiguration information corresponds to one AP, and the association identifier subconfiguration information includes an AID of the AP ~~and an AID of the AP~~. Optionally, the association subconfiguration information may be carried in a subelement or field that stores information about a single AP and that is in an MLD element used for information about one or more APs of the MLD. The first AP sends the association identifier configuration information. Each bit of group addressed traffic indication information indicates whether an AP with an AID corresponding to the bit has a group addressed traffic. The AID of each AP corresponds to each bit of the group addressed traffic indication information.

[00246] The first AP that generates and sends the association identifier configuration

with consecutive association identifiers has a group addressed traffic, the partial virtual bitmap field may not carry bits corresponding to these association identifiers. That is, a quantity of bits of the group addressed traffic indication information in partial virtual bitmap field is reduced by using an offset in the TIM element.

[00289] It is assumed that stations of AIDs corresponding to a bit prior to a largest even byte N_1 and all bits following a smallest byte N_2 in the traffic indication virtual bitmap field have no received downlink traffic, or APs of the corresponding AIDs have no sent group addressed traffic. In this case, the group addressed traffic indication information is all bits starting from byte N_1 of the traffic indication virtual bitmap field and ending at byte N_2.

[00290] To reduce signaling overheads required for sending the offset, in other words, reduce a quantity of bits required for indicating the offset, the offset of second group addressed traffic indication information may be set to $N_1/2$. That is, N_1 is an even byte number.

[00291] In this case, the length field of the TIM element sent by the first AP is $N_2–N_1+1+3$, and an offset of the TIM element is $(1/2)N_1$. Further, a station managed by the first AP in the STA MLD receives the length and the offset, and determines that the group addressed traffic indication information indicates that stations of AIDs corresponding to bits N_1*8 to $((N_2+1)*8–1)$ have no received downlink traffic or APs of the corresponding AIDs have no sent group addressed traffic, determines that APs of AIDs corresponding to all bits of bit 0 to bit $N_1*8–1$ have no group addressed traffics, and determines that APs of AIDs corresponding to bits $(N_2+1)*8$ and all subsequent bits have no group addressed traffic.

[00292] For example, if the offset in the TIM element sent by the first AP is 0 and the length field is 4 bytes (that is, the partial virtual bitmap is 1 byte), the group addressed traffic indication information sent by the first AP is bit 0 to bit 7 in the partial virtual bitmap field. In this way, if an AID of an AP is in a range of AIDs corresponding to bit ~~16~~ 0 to bit ~~23~~7, the first STA may learn, based on values of bit 0 to bit 7, whether APs of AIDs corresponding to bit 0 to bit 7 have a group addressed traffic. If an AID of an AP is not in a range of AIDs corresponding to bit 0 to bit 7, the AP does not send a group addressed traffic to a station associated with the AP or a surrounding station.

[00293] For another example, if the offset sent by the first AP is 1 and the length is 4 bytes (that is, the partial virtual bitmap is 1 byte), the group addressed traffic indication information sent by the first AP is byte 2 in the partial virtual bitmap field, namely, bit 16 to bit 23. In this way, if an

CLAIMS

What is claimed is:

1. A multi-link group addressed traffic transmission method, wherein the method comprises:

generating, by a first access point (AP) of an access point multi-link device (AP MLD), group addressed traffic indication information, wherein the group addressed traffic indication information indicates whether one or more APs of the AP MLD have a group addressed traffic; and

sending, by the first AP, the group addressed traffic indication information.

2. The method according to claim 1, wherein

the group addressed traffic indication information indicates whether each AP of the AP MLD has a group addressed traffic.

3. The method according to claim 1 or 2, wherein

a value of the bit of the group addressed traffic indication information indicates whether the AP corresponding to the bit has a group addressed traffic.

4. The method according to any one of claims 1 to 3, wherein

the group addressed traffic indication information comprises a part of bits in a partial virtual bitmap field in a traffic indication map (TIM) element, wherein the part of bits in the partial virtual bitmap field in the TIM element indicate whether each AP of the AP MLD other than the first AP has a group addressed traffic.

5. The method according to claim 4, wherein

the part of bits in the partial virtual bitmap field in the traffic indication map (TIM) element are consecutive bits.

6. The method according to any one of claims 1 to 5, wherein

an association identifier (AID) corresponding to each bit of the group addressed traffic indication information is different from an AID of a station managed by each AP of the AP MLD; or

an AID corresponding to each bit of the group addressed traffic indication information is different from an AID of a station multilink device (STA MLD) associated with the AP MLD, and multiple stations (STAs) of the STA MLD share one AID.

7. The method according to any one of claims 1 to 3, wherein the group addressed traffic

indication information comprises bit 0 of a bitmap control field in a TIM element, and the bit 0 is used to indicate whether the first AP has a group addressed traffic.

8. The method according to claim 1 or 2, wherein in the group addressed traffic indication information, a quantity of bits corresponding to the AP MLD is a fixed quantity of bits.

9. The method according to claim 4, wherein for the part of bits in the partial virtual bitmap field, one or more bits corresponding to the AP MLD, other than the bits corresponding to the AP of the AP MLD, are set to zero by default; and; the bits corresponding to the AP of the AP MLD do not include the bit corresponding to the first AP.

10. The method according to claim 4, wherein in the partial virtual bitmap fields, one or more bits corresponding to each AP except the first AP in the AP MLD, in ascending order according to the link identifiers of the APs.

11. The method according to claim 4 or 5, wherein in the group addressed traffic indication information, in the partial virtual bitmap field in the TIM element, AIDs corresponding to bits corresponding to the AP MLD, are successively allocated in ascending order or descending order of link identifiers of all APs except the first AP of the AP MLD.

12. The method according to claim 1, wherein the group addressed traffic indication information is carried in a transmit service indication bitmap (DTIM) beacon frame.

13. A multi-link group addressed traffic transmission method, wherein the method comprises:

receiving, by a first station (STA) of a station multi-link device (STA MLD), group addressed traffic indication information from an AP MLD, wherein the group addressed traffic indication information indicates whether one or more APs of the AP MLD have a group addressed traffic;

determining, by the first STA, based on the group addressed traffic indication information, whether the one or more APs have a group addressed traffic14. The method according to claim 13, wherein

the receiving, by a first STA of a STA MLD, group addressed traffic indication information from an AP MLD comprises:

listening to, by the first STA of the STA MLD, group addressed traffic indication information from one AP of the AP MLD.

15. The method according to claim 13 or 14, wherein the group addressed traffic indication information is carried in a delivery traffic indication map (DTIM) beacon frame.

16. The method according to claim 15, wherein the method further comprises:

receiving, by the first STA, a group addressed traffic after the DTIM beacon frame.

17. The method according to any one of claims 13 to 15, wherein

the group addressed traffic indication information comprises a part of bits in a partial virtual bitmap field in a traffic indication map (TIM) element, wherein the part of bits in the partial virtual bitmap field in the TIM element indicate whether each AP of the AP MLD other than the first AP has a group addressed traffic.

18. The method according to claim 17, wherein

the part of bits in the partial virtual bitmap field in the traffic indication map (TIM) element are consecutive bits.

19. The method according to any one of claims 13 to 15, wherein the group addressed traffic indication information comprises bit 0 of a bitmap control field in a TIM element, and the bit 0 is used to indicate whether the first AP has a group addressed traffic.

20. The method according to claim 13 or 14, wherein for the part of bits in the partial virtual bitmap field in the group addressed traffic indication information, a quantity of bits corresponding tothe AP MLD is a fixed quantity of bits.

21. The method according to claim 17, wherein for the part of bits in the partial virtual bitmap field, one or more bits corresponding to the AP MLD, other than the bits corresponding to the AP of the AP MLD, are set to zero by default; and; the bits corresponding to the AP of the AP MLD do not include the bit corresponding to the first AP.

22. The method according to claim 17, wherein in the partial virtual bitmap fields, one or more bits corresponding to each AP except the first AP in the AP MLD, in ascending order according to the link identifiers of the APs.

23. The method according to claim 17 or 18, wherein in the group addressed traffic indication information, in the partial virtual bitmap field in the TIM element, AIDs corresponding to bits corresponding to the AP MLD, are successively allocated in ascending order or descending order of link identifiers of all APs except the first AP of the AP MLD.

24. An access point in an access point multilink device, comprising at least one processor and an interface, wherein the processor and the interface are configured to implement the group addressed service transmission method applicable to multiple links according to any one of claims

1 to 12.

25. A station in a station multilink device, comprising at least one processor and an interface, wherein the processor and the interface are configured to implement the group addressed service transmission method applicable to multiple links according to any one of claims 13 to 23.

26. A chip system, comprising at least one processor and an interface, wherein the processor and the interface are configured to support any access point in an access point multilink device in implementing the group addressed traffic transmission method applicable to multiple links according to any one of claims 1 to 12; or

the processor and the interface are configured to support any station in a station multilink device in implementing the group addressed traffic transmission method applicable to multiple links according to any one of claims 13 to 23.

27. A computer-readable storage medium, configured to store a computer program, wherein when the computer program runs on a computer, the computer is enabled to perform the method according to any one of claims 1 to 12, or perform the method according to any one of claims 13 to 23.

28. An access point multi-link device, wherein the access point multilink device comprises multiple access points, and at least one access point is a first access point (AP) according to claim 24.

29. A station multi-link device, wherein the station multilink device comprises multiple stations, and at least one station is a station according to claim 25.

30. A system, comprising at least one access point in an access point multilink device and at least one station in a station multilink device, wherein the access point is configured to implement the group addressed traffic transmission method applicable to multiple links according to any one of claims 1 to 12, and the station is configured to implement the group addressed traffic transmission method applicable to multiple links according to any one of claims 13 to 23.~~1. A multi-link group addressed traffic transmission method, wherein the method comprises:~~

~~generating, by a first access point AP of an access point multi-link device AP MLD, group addressed traffic indication information, wherein the group addressed traffic indication information indicates whether one or more APs of the AP MLD have a group addressed traffic; and~~

~~sending, by the first AP, the group addressed traffic indication information.~~

~~2. The method according to claim 1, wherein~~

~~the group-addressed traffic indication information indicates whether each AP of the AP MLD has a group addressed traffic.~~

~~3. The method according to claim 1 or 2, wherein~~

~~each bit of the group-addressed traffic indication information corresponds to each AP of the AP MLD; and~~

~~a value of the bit indicates whether the AP corresponding to the bit has a group-addressed traffic.~~

~~4. The method according to any one of claims 1 to 3, wherein~~

~~the group-addressed traffic indication information comprises a part of bits in a partial virtual bitmap field in a traffic indication map TIM element, wherein the part of bits in the partial virtual bitmap field in the TIM element indicate whether each AP of the AP MLD other than the first AP has a group addressed traffic.~~

~~5. The method according to claim 4, wherein~~

~~the part of bits in the partial virtual bitmap field in the traffic indication map TIM element are consecutive bits.~~

~~6. The method according to any one of claims 1 to 5, wherein~~

~~an association identifier AID corresponding to each bit of the group addressed traffic indication information is different from an AID of a station managed by each AP of the AP MLD.~~

~~7. A multi-link group addressed traffic transmission method, wherein the method comprises:~~

~~receiving, by a first station STA of a station multi-link device STA MLD, group addressed traffic indication information from an AP MLD, wherein the group addressed traffic indication information indicates whether one or more APs of the AP MLD have a group addressed traffic.~~

~~8. The method according to claim 7, wherein~~

~~the receiving, by a first STA of a STA MLD, group addressed traffic indication information from an AP MLD comprises:~~

~~listening to, by the first STA of the STA MLD, group addressed traffic indication information from one AP of the AP MLD.~~

~~9. The method according to claim 7 or 8, wherein the group addressed traffic indication information is carried in a delivery traffic indication map DTIM beacon frame.~~

~~10. The method according to claim 9, wherein the method further comprises:~~

receiving, by the first STA, a group addressed traffic after the DTIM beacon frame.

11. An access point of an access point multi-link device, wherein the access point of the access point multi-link device comprises a transceiver and a processor, wherein

the processor is configured to generate group addressed traffic indication information, wherein the group addressed traffic indication information indicates whether one or more APs of the AP MLD have a group addressed traffic; and

the transceiver is configured to send the group addressed traffic indication information.

12. The access point of the access point multi-link device according to claim 11, wherein

the group addressed traffic indication information indicates whether each AP of the AP MLD has a group addressed traffic.

13. The access point of the access point multi-link device according to claim 11 or 12, wherein

each bit of the group addressed traffic indication information corresponds to each AP of the AP MLD; and

a value of the bit indicates whether the AP corresponding to the bit has a group addressed traffic.

14. The access point of the access point multi-link device according to any one of claims 11 to 13, wherein

the group addressed traffic indication information is a part of bits in a partial virtual bitmap field in a traffic indication map TIM element.

15. The access point of the access point multi-link device according to any one of claims 11 to 14, wherein

the group addressed traffic indication information is a part of consecutive bits in the partial virtual bitmap field in the traffic indication map TIM element.

16. The access point of the access point multi-link device according to any one of claims 11 to 15, wherein

an association identifier AID corresponding to each bit of the group addressed traffic indication information is different from an AID of a station managed by each AP of the AP MLD.

17. A station of a station multi-link device, wherein the station of the station multi-link device comprises a transceiver; and

the transceiver is configured to receive group addressed traffic indication information from an AP MLD, wherein the group addressed traffic indication information indicates whether one or

more APs of the AP MLD have a group addressed traffic.

18. The station of the station multi-link device according to claim 17, wherein the station of the station multi-link device works on a primary link; and

that the transceiver receives group addressed traffic indication information from an AP MLD is specifically:

the transceiver is configured to listen to, on the primary link, group addressed traffic indication information from one AP of the AP MLD.

19. The station of the station multi-link device according to claim 17 or 18, wherein

the group addressed traffic indication information is carried in a delivery traffic indication map DTIM beacon frame.

20. The method according to claim 19, wherein

the transceiver is further configured to receive a group addressed traffic after the DTIM beacon frame.

21. A chip system, comprising at least one processor and an interface, wherein

the processor is configured to generate group addressed traffic indication information, wherein the group addressed traffic indication information indicates whether one or more APs of an AP MLD have a group addressed traffic; and

the interface is configured to send the group addressed traffic indication information.

22. A chip system, comprising at least one processor and an interface, wherein

the interface is configured to receive group addressed traffic indication information from an AP MLD, wherein the group addressed traffic indication information indicates whether one or more APs of the AP MLD have a group addressed traffic.

23. A computer-readable storage medium, configured to store a computer program, wherein when the computer program runs on a computer, the computer is enabled to perform the method according to any one of claims 1 to 6, or perform the method according to any one of claims 7 to 10.