[0006] There is thus a need for communication apparatuses and methods that can solve the above mentioned issue. Furthermore, other desirable features and characteristics will become apparent from the subsequent detailed description and the appended claims, taken in conjunction with the accompanying drawings and this background of the disclosure.

SUMMARY

[0007] A non-limiting example facilitates providing communication apparatuses and communication methods for EHT virtualization for MLD devices.

[0008] According to an example of the present disclosure, there is provided an Access Point (AP) included in a plurality of APs affiliated with an AP Multi-link Device (MLD), wherein each of the plurality of APs advertises a Basic Service Set Identifier (BSSID) and provides a link identified by a Link Identifier (ID), the AP comprising: circuitry, which in operation, generates a frame carrying a multi-link element containing information about the AP MLD and the plurality of APs; and a transmitter, which in operation, transmits the frame on a link, the Multi-link element indicating a Link ID of the link on which the frame is transmitted.

[0009] According to another example of the present disclosure, there is provided a non-AP Station (STA) included in a plurality of non-AP STAs affiliated with a non-AP MLD, the non-AP STA comprising: circuitry, which in operation, generates a Probe Request frame carrying a Multi-link element containing a MLD MAC Address of an AP MLD and one or more Link IDs of links affiliated with the AP MLD; and a transmitter, which in operation, transmits the Probe Request frame to request information about the AP MLD and the one or more links of the AP MLD.

[0010] According to another example of the present disclosure, there is provided a communication method comprising: generating a frame at an AP included in a plurality of APs affiliated with an AP MLD, wherein each of the plurality of APs advertises a BSSID and provides a link identified by a Link ID, the frame carrying a multi-link element containing information about the AP MLD and the plurality of APs; and transmitting the frame on a link, the Multi-link element indicating a Link ID of the link on which the frame is transmitted.

[0010a] According to an aspect, the present disclosure refers to an Access Point Multi-Link Device (AP MLD) to which a plurality of access points (APs) belong, comprising:

a first virtual AP that corresponds to a first Basic Service Set Identifier (BSSID) belonging to a first multiple BSSID set for a first channel, the first BSSID being a first transmitted BSSID; and

a second virtual AP that corresponds to a second BSSID belonging to a second multiple BSSID set for a second channel, the second BSSID being a second transmitted BSSID or a second nontransmitted BSSID, and

wherein the first virtual AP advertises a first common Service Set Identifier (SSID) for the first BSSID and the second BSSID over the first channel,

wherein the first virtual AP comprises:

circuitry that generates a frame including an SSID field indicating the first common SSID, a Multi-Link element for the AP MLD and a Multiple BSSID element for another AP MLD, wherein the Multi-Link element includes a MAC address of the AP

MLD, and the Multiple BSSID element includes a non-transmitted BSSID profile of a first non-transmitted BSSID belonging to the first multiple BSSID set; and

a transmitter that transmits the frame on the first channel.

[0010b] According to an aspect, the present disclosure refers to a communication method for an Access Point Multi-Link Device (AP MLD) o which multiple access points (APs) belong, wherein the AP MLD comprises a first virtual AP that corresponds to a first multiple Basic Service Set Identifier (BSSID) belonging to a first multiple BSSID set for a first channel, the first BSSID being a first transmitted BSSID, and comprises a second virtual AP that corresponds to a second BSSID belonging to a second multiple BSSID set for a second channel, the second BSSID being a second transmitted BSSID or a second nontransmitted BSSID, wherein the first virtual AP advertises a first common Service Set Identifier (SSID) for the first BSSID and the second BSSID over the first channel,

wherein the communication method comprises:

a frame generation step of generating, by the first virtual AP, a frame including an SSID field indicating the first common SSID, a Multi-Link element for the AP MLD and a Multiple BSSID element for another AP MLD, wherein the Multi-Link element includes a MAC address of the AP MLD, and the Multiple BSSID element includes a non-transmitted BSSID profile of a first non-transmitted BSSID belonging to the first multiple BSSID set; and

a frame transmission step of transmitting, by the first virtual AP, the frame on the first channel.

[0011] It should be noted that general or specific examples may be implemented as a system, a method, an integrated circuit, a computer program, a storage medium, or any selective combination thereof. Additional benefits and advantages of the

examples in the disclosure will become apparent from the specification and drawings. The benefits and/or advantages may be individually obtained by the various examples and features of the specification and drawings, which need not all be provided in order to obtain one or more of such benefits and/or advantages.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] The accompanying figures where like reference numerals refer to identical or functionally similar elements throughout the separate views and which together with the detailed description below are incorporated in and form part of the specification, serve to illustrate various embodiments and to explain various principles and advantages in accordance with present embodiments.

[0013] FIG. 1 illustrates an implementation of VLANs according to an example.

[0014] FIG. 2 illustrates an implementation of a network according to an example.

[0015] FIG. 3 depicts an illustration of an AP MLD having a Tier 1 virtualization in accordance with various embodiments.

CLAIMS

1. An Access Point Multi-Link Device (AP MLD) to which a plurality of access points (APs) belong, comprising:

a first virtual AP that corresponds to a first Basic Service Set Identifier (BSSID) belonging to a first multiple BSSID set for a first channel, the first BSSID being a first transmitted BSSID; and

a second virtual AP that corresponds to a second BSSID belonging to a second multiple BSSID set for a second channel, the second BSSID being a second transmitted BSSID or a second nontransmitted BSSID, and

wherein the first virtual AP advertises a first common Service Set Identifier (SSID) for the first BSSID and the second BSSID over the first channel,

wherein the first virtual AP comprises:

circuitry that generates a frame including an SSID field indicating the first common SSID, a Multi-Link element for the AP MLD and a Multiple BSSID element for another AP MLD, wherein the Multi-Link element includes a MAC address of the AP MLD, and the Multiple BSSID element includes a non-transmitted BSSID profile of a first non-transmitted BSSID belonging to the first multiple BSSID set; and

a transmitter that transmits the frame on the first channel.

2. The AP MLD according to claim 1, wherein the frame is one of a Beacon frame and a Probe Response frame.

3. The AP MLD according to claim 1, wherein the another AP MLD comprises:

a third virtual AP that corresponds to the first nontransmitted BSSID belonging to the first multiple BSSID set for the first channel; and

a fourth virtual AP that corresponds to another BSSID being either one of the second transmitted BSSID and the second nontransmitted BSSID belonging to the second multiple BSSID set for the second channel,

wherein when the another BSSID is the second transmitted BSSID, the fourth virtual AP advertises a second common SSID for the first nontransmitted BSSID and the second transmitted BSSID over the second channel.

4. The AP MLD according to claim 3, wherein the nontransmitted BSSID profile includes another Multiple BSSID element for the another AP MLD, which is different from the Multiple BSSID element for the AP MLD.

5. The AP MLD according to claim 4, wherein the another Multiple BSSID element included in the nontransmitted BSSID profile includes information regarding the third virtual AP and the fourth virtual AP.

6. The AP MLD according to claim 1, wherein a plurality of virtual APs corresponding to the first multiple BSSID set operate on the first channel and form a first virtual AP set, and a plurality of virtual APs corresponding to the second multiple BSSID set operate on the second channel and form a second virtual AP set.

7. The AP MLD according to claim 1, wherein the Multi-Link element includes a common information field that includes MAC address of the AP MLD and a per-link information field that includes link information of the second virtual AP.

8. The AP MLD according to claim 7, wherein the per-link information field includes a Link ID subfield and a nontransmitted BSSID information field.

9. The AP MLD according to claim 1, comprising

a third virtual AP that corresponds to a third BSSID that is either a third transmitted BSSID or a third nontransmitted BSSID belonging to a third multiple BSSID set for a third channel,

wherein the first virtual AP advertises the first common SSID that is also common for the third BSSID, and in case the third BSSID is the third transmitted BSSID, the third virtual AP advertises the first common SSID over third channel.

10. The AP MLD according to claim 9, wherein the Multi-Link element includes per-link information fields that include link information of the second virtual AP and the third virtual AP.

11. A communication method for an Access Point Multi-Link Device (AP MLD) o which multiple access points (APs) belong, wherein the AP MLD comprises a first virtual AP that corresponds to a first multiple Basic Service Set Identifier (BSSID) belonging to a first multiple BSSID set for a first channel, the first BSSID being a first transmitted BSSID, and comprises a second virtual AP that corresponds to a second BSSID belonging to a second multiple BSSID set for a second channel, the second BSSID being a second transmitted BSSID or a second nontransmitted BSSID, wherein the first virtual AP

advertises a first common Service Set Identifier (SSID) for the first BSSID and the second BSSID over the first channel,

wherein the communication method comprises:

a frame generation step of generating, by the first virtual AP, a frame including an SSID field indicating the first common SSID, a Multi-Link element for the AP MLD and a Multiple BSSID element for another AP MLD, wherein the Multi-Link element includes a MAC address of the AP MLD, and the Multiple BSSID element includes a non-transmitted BSSID profile of a first non-transmitted BSSID belonging to the first multiple BSSID set; and

a frame transmission step of transmitting, by the first virtual AP, the frame on the first channel.

12. The communication method according to claim 11, wherein the frame is one of a Beacon frame and a Probe Response frame.

13. The communication method according to claim 11, wherein the another AP MLD comprises:

a third virtual AP that corresponds to the first nontransmitted BSSID belonging to the first multiple BSSID set for the first channel; and

a fourth virtual AP that corresponds to another BSSID being either one of the second transmitted BSSID and the second nontransmitted BSSID belonging to the second multiple BSSID set for the second channel, and

wherein when the another BSSID is the second transmitted BSSID, the fourth virtual AP advertises a second common SSID for the first nontransmitted BSSID and the second transmitted BSSID over the second channel.

14. The communication method according to claim 14, wherein the nontransmitted BSSID profile includes another Multiple BSSID element for the another AP MLD, which is different from the Multiple BSSID element for the AP MLD.

15. The communication method according to claim 14, wherein the another Multiple BSSID element included in the nontransmitted BSSID profile includes information regarding the third virtual AP and the fourth virtual AP.

16. The communication method according to claim 11, wherein a plurality of virtual APs corresponding to the first multiple BSSID set operate on the first channel and form

a first virtual AP set, and a plurality of virtual APs corresponding to the second multiple BSSID set operate on the second channel and form a second virtual AP set.

17. The communication method according to claim 11, wherein the Multi-Link element includes a common information field that includes MAC address of the AP MLD and a per-link information field that includes link information of the second virtual AP.

18. The communication method according to claim 17, wherein the per-link information field includes a Link ID subfield and a nontransmitted BSSID information field.

19. The communication method according to claim 11,

wherein the AP MLD comprises a third virtual AP that corresponds to a third BSSID that is either a third transmitted BSSID or a third nontransmitted BSSID belonging to a third multiple BSSID set for a third channel, and

wherein the first virtual AP advertises the first common SSID that is also common for the third BSSID, and in case the third BSSID is the third transmitted BSSID, the third virtual AP advertises the first common SSID over third channel.

20. The communication method according to claim 19, wherein the Multi-Link element includes per-link information fields that include link information of the second virtual AP and the third virtual AP.

21. An integrated circuit for an Access Point Multi-Link Device (AP MLD) which multiple access points (APs) belong, wherein the AP MLD comprises a first virtual AP that corresponds to a first multiple Basic Service Set Identifier (BSSID) belonging to a first multiple BSSID set for a first channel, the first BSSID being a first transmitted BSSID, and comprises a second virtual AP that corresponds to a second BSSID belonging to a second multiple BSSID set for a second channel, the second BSSID being a second transmitted BSSID or a second nontransmitted BSSID, wherein the first virtual AP advertises a first common Service Set Identifier (SSID) for the first BSSID and the second BSSID over the first channel,

wherein the integrated circuit controls:

a frame generation step of generating, by the first virtual AP, a frame including an SSID field indicating the first common SSID, a Multi-Link element for the AP MLD and a Multiple BSSID element for another AP MLD, wherein the Multi-Link element

includes a MAC address of the AP MLD, and the Multiple BSSID element includes a non-transmitted BSSID profile of a first non-transmitted BSSID belonging to the first multiple BSSID set; and

a frame transmission step of transmitting, by the first virtual AP, the frame on the first channel.