COMMUNICATION APPARATUS AND COMMUNICATION METHOD FOR MULTI-AP JOINT TRANSMISSION

BACKGROUND

1. TECHNICAL FIELD

[0001] The present disclosure generally relates to communication apparatus and methods for electronic devices and systems, and more particularly relates to joint transmission in multi-AP networks.

2. DESCRIPTION OF RELATED ART

[0002] Wireless networks that communicate via multi-AP joint transmission enable electronic devices to communication in networks with joint transmissions sent to multiple electronic devices. Such networks have advantages over other wireless networks in which wireless communication is limited to a single transmission to one electronic device.

SUMMARY

[0003] One non-limiting and exemplary ~~embodiment~~example facilitates providing joint transmission communication in multi-AP networks. By way of example, this communication includes joint transmission from two or more of an access point (AP) to one or more wireless station (STA).

[0004] In one general aspect, the techniques disclosed here feature an access point (AP). The access point includes circuitry, which, in operation, generates a frame including joint transmission (JT) data and a JT identity that uniquely identifies the JT data; and a transmitter, which, in operation, transmits the frame to one or more other APs that jointly transmit the JT data to a communication apparatus, wherein the circuitry, in operation, generates a JT trigger

frame that includes the JT identity of the JT data, and the transmitter, in operation, transmits the JT trigger frame to the one or more other Aps.~~.~~

[0004a] In another aspect, the present disclosure refers to an access point (AP), comprising: circuitry, which, in operation, generates a frame including joint transmission (JT) data and a JT identity that uniquely identifies the JT data, and a transmitter, which, in operation, transmits the frame to one or more other Aps that jointly transmit the JT data to a communication apparatus, wherein the JT identity is one of a uniquely assigned JT packet ID, a value of a Sequence Number subfield within a Sequence Control field of an encapsulating IEEE 802.11 data frame, or a value of a Sequence Number subfield within a Sequence Control field of a MPDU within the JT Data.

[0004b] In yet another aspect, the present disclosure refers to an access point (AP) comprising circuitry, which, in operation, generates a frame including joint transmission (JT) data and a JT identity that uniquely identifies the JT data, and a transmitter, which, in operation, transmits the frame to one or more other APs that jointly transmit the JT data to a communication apparatus, wherein the JT data is carried as a payload of an IEEE 802.11 Data frame using a four address MAC header format; a MAC header of the IEEE 802.11 Data frame includes a control field that indicates a Sequence Control field of the IEEE 802.11 Data frame to be jointly transmitted; and the JT identifier include a value of a Sequence Number subfield within the Sequence Control field.

[0004c] In yet another aspect, the present disclosure refers to an access point (AP) comprising circuitry, which, in operation, generates a frame including joint transmission (JT) data and a JT identity that uniquely identifies the JT data, and a transmitter, which, in operation, transmits the frame to one or more other APs that jointly transmit the JT data to a communication apparatus, wherein the access point transmits a PHY Protocol Data Unit (PPDU) constructed from the JT data after a fixed duration from an end of a JT Trigger frame.

[0004d] An access point (AP), comprising a receiver, which, in operation, receives from another AP a frame that includes Joint Transmission (JT) data and a JT identity that uniquely identifies the JT data, and local memory that stores the JT data and the JT identity, wherein the receiver further operates to receive from the another AP a JT Trigger frame carrying the JT identity of the JT data; the access point retrieves the JT data with matching JT identity from the local memory and transmits a physical layer protocol data unit (PPDU) constructed from the JT data after a fixed duration from an end of the JT Trigger frame.

[0004e] A communication method comprising, generating, at a first access point (AP), a frame including joint transmission (JT) data and a JT identity that uniquely identifies the JT data, generating, at the first AP, a JP trigger frame that includes the JT identify of the JT data; transmitting, from the first AP, the frame to one or more second APs that jointly transmit the JT data to a communication apparatus, and transmitting, from the first AP, the JT trigger frame to the one or more second Aps.

[0004f] A communication method comprising, receiving, at one or more access points (APs), a frame that is transmitted from another AP and that includes Joint Transmission (JT) data and a JT identity that uniquely identifies the JT data, storing the JT data and the JT identity in local memory, receiving from the another AP a JT Trigger frame carrying the JT identity of the JT data, retrieving the JT data with matching JT identity from the local memory, and transmitting a physical layer protocol data unit (PPDU) constructed from the JT data after a fixed duration from an end of the JT Trigger frame.

[0004g] A communication method comprising, generating, at a first access point (AP), a frame including joint transmission (JT) data and a JT identity that uniquely identifies the JT data, transmitting, from the first AP, the frame to one or more second APs that jointly transmit the JT data to a communication apparatus, and synchronizing PHY and MAC parameters at the

one or more second APs such that the JT data received by the communication apparatus from the one or more second Aps are exactly the same.

[0005] It should be noted that general or specific ~~embodiment~~examples may be implemented as a system, a method, an integrated circuit, a computer program, a storage medium, or any selective combination thereof.

[0006] Additional benefits and advantages of the disclosed ~~embodiment~~examples will become apparent from the specification and drawings. The benefits and/or advantages may be individually obtained by the various ~~embodiment~~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

[0007] 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.

[0008] Figure 1 is a wireless network with a multi-AP system in accordance with an example embodiment.

[0009] Figure 2A is a multi-AP system shown as an enterprise network in accordance with an example embodiment.

[0010] Figure 2B is a multi-AP system shown as a home or office network in accordance with an example embodiment.

[0011] Figure 2C is a multi-AP system shown as a Master-Slave configuration in accordance with an example embodiment.

[0012] Figure 3 is MAC Protocol Data Unit (MPDU) in accordance with an example embodiment.

CLAIMS

What is claimed is:

1. An access point (AP) comprising:

circuitry, which, in operation, generates a frame including joint transmission (JT) data and a JT identity that uniquely identifies the JT data; and

a transmitter, which, in operation, transmits the frame to one or more other APs that jointly transmit the JT data to a communication apparatus,.

wherein the circuity, in operation, generates a JT trigger frame that includes the JT identity of the JT data, and the transmitter, in operation, transmits the JT trigger frame to the one or more other Aps.

~~2. The access point of claim 1, wherein the circuity, in operation, generates a JT trigger frame that includes the JT identity of the JT data, and the transmitter in operation, transmit the JT trigger frame to the one or more other APs.~~

23. The access point of claim 12, wherein the JT trigger frame includes a MAC address of the communication apparatus.

34. The access point of claim 1, wherein the JT data is carried as a payload of an Ethertype 89- 0d frame body.

45. The access point of claim 1, wherein the frame is one of an IEEE 802.11 data frame orand an Ethernet frame.

56. The access point of claim 1, wherein the JT data is one or more MAC Protocol Data Units (MPDU) addressed to the communication apparatus.

~~7. The access point of claim 1, wherein the JT identity is one of a uniquely assigned JT packet ID, a value of a Sequence Number subfield within a Sequence Control field of an encapsulating IEEE 802.11 data frame, and value of a Sequence Number subfield within a Sequence Control field of a MPDU within a JT Data.~~

~~8. The access point of claim 1, wherein JT data has higher layer payload and common fields required by the receiving APs to locally construct one or more MAC Protocol Data Units (MPDU) jointly transmitted to the communication apparatus.~~

~~9. The access point of claim 1, wherein the JT data is carried as a payload of an IEEE 802.11 Data frame using a four address MAC header format; a MAC header of the IEEE 802.11 Data frame includes a control field that indicates a Sequence Control field of the IEEE 802.11 Data frame to be jointly transmitted; and the JT identifier includes a value of a Sequence Number subfield within the Sequence Control field.~~

~~10. The access point of claim 1, wherein the access point negotiates an AP Coordination session with the one or more other APs, the AP Coordination session specifies an AP coordination scheme as Joint Transmission, and the AP Coordination session is identified by a session ID.~~

~~11. The access point of claim 1, wherein the access point transmits a PHY Protocol Data Unit (PPDU) constructed from the JT data after a fixed duration from an end of a JT Trigger frame.~~

6~~12~~. An access point (AP), comprising:

circuitry, which, in operation, generates a frame including joint transmission (JT) data and a JT identity that uniquely identifies the JT data; and

a transmitter, which, in operation, transmits the frame to one or more other Aps that jointly transmit the JT data to a communication apparatus,

wherein the JT identity is one of a uniquely assigned JT packet ID, a value of a Sequence Number subfield within a Sequence Control field of an encapsulating IEEE 802.11 data frame, or a value of a Sequence Number subfield within a Sequence Control field of a MPDU within the JT Data.

~~a receiver, which, in operation, receives from another AP a frame that includes Joint Transmission (JT) data and a JT identity that uniquely identifies the JT data; and~~

~~local memory that stores the JT data and the JT identity.~~

7. The access point of claim 1, wherein the JT data has a higher layer payload and common fields required by the receiving APs to locally construct one or more MAC Protocol Data Units (MPDU) jointly transmitted to the communication apparatus.

8. An access point (AP) comprising:

circuitry, which, in operation, generates a frame including joint transmission (JT) data and a JT identity that uniquely identifies the JT data; and

a transmitter, which, in operation, transmits the frame to one or more other APs that jointly transmit the JT data to a communication apparatus,

wherein the JT data is carried as a payload of an IEEE 802.11 Data frame using a four address MAC header format; a MAC header of the IEEE 802.11 Data frame includes a control field that indicates a Sequence Control field of the IEEE 802.11 Data frame to be jointly transmitted; and the JT identifier include a value of a Sequence Number subfield within the Sequence Control field.

9. The access point of claim 1, wherein the access point negotiates an AP Coordination session with the one or more other APs, the AP Coordination session specifies an AP coordination scheme as Joint Transmission, and the AP Coordination session is identified by a session ID.

10. An access point (AP) comprising:

circuitry, which, in operation, generates a frame including joint transmission (JT) data and a JT identity that uniquely identifies the JT data; and

a transmitter, which, in operation, transmits the frame to one or more other APs that jointly transmit the JT data to a communication apparatus,

wherein the access point transmits a PHY Protocol Data Unit (PPDU) constructed from the JT data after a fixed duration from an end of a JT Trigger frame.

11. An access point (AP), comprising:

a receiver, which, in operation, receives from another AP a frame that includes Joint Transmission (JT) data and a JT identity that uniquely identifies the JT data; and

local memory that stores the JT data and the JT identity,

wherein the receiver further operates to receive from the another AP a JT Trigger frame carrying the JT identity of the JT data; the access point retrieves the JT data with

matching JT identity from the local memory and transmits a physical layer protocol data unit (PPDU) constructed from the JT data after a fixed duration from an end of the JT Trigger frame.

~~13. The access point of claim 12, wherein the receiver further operates to receive from the other AP a JT Trigger frame carrying the JT identity of the JT data; the access point retrieves the JT data with matching JT identity from the memory and transmits a physical layer protocol data unit (PPDU) constructed from the JT data after a fixed duration from an end of the JT Trigger frame.~~

12~~14~~. A communication method comprising:

generating, at a first access point (AP), a frame including joint transmission (JT) data and a JT identity that uniquely identifies the JT data; ~~and~~

generating, at the first AP, a JP trigger frame that includes the JT identify of the JT data;

transmitting, from the first AP, the frame~~.~~ to one or more second APs that jointly transmit the JT data to a communication apparatus; and~~.~~

transmitting, from the first AP, the JT trigger frame to the one or more second APs.

13~~5~~. A communication method comprising:

receiving, at one or more access points (APs), a frame that is transmitted from another AP and that includes Joint Transmission (JT) data and a JT identity that uniquely identifies the JT data; ~~and~~

storing the JT data and the JT identity in local memory;~~.~~

receiving from the another AP a JT Trigger frame carrying the JT identity of the JT data;

retrieving the JT data with matching JT identity from the local memory; and

transmitting a physical layer protocol data unit (PPDU) constructed from the JT data after a fixed duration from an end of the JT Trigger frame.

14~~6~~. The communication method according to claim 13~~15~~ further comprising:

transmitting, from the one or more APs, the JT data jointly to a communication apparatus.

~~17. The communication method according to claim 14 further comprising:~~

~~synchronizing PHY and MAC parameters at the more APs such that the JT data received by the communication apparatus from the more APs are exactly the same.~~

15. A communication method comprising:

generating, at a first access point (AP), a frame including joint transmission (JT) data and a JT identity that uniquely identifies the JT data;

transmitting, from the first AP, the frame to one or more second APs that jointly transmit the JT data to a communication apparatus; and

synchronizing PHY and MAC parameters at the one or more second APs such that the JT data received by the communication apparatus from the one or more second Aps are exactly the same.