System and Method for Response Frame Type indication

~~[0001] This application claims the benefit of U.S. Non-Provisional Application No. 14/040,440 filed on September 27, 2013 by Young Hoon Kwon, et al. and entitled "System and Method for Response Frame Type indication," which claims the benefit of U.S. Provisional Application No. 61/707,559 filed on September 28, 2012 by Young Hoon Kwon, et al. and entitled "System and Method for Response Frame Type indication," both of which are hereby incorporated herein by reference as if reproduced in its entirety.~~

TECHNICAL FIELD

[0002] The present invention relates to the field of network communications, and, in particular embodiments, to a system and method for response frame type indication.

BACKGROUND

[0003] In IEEE 802.11 TGah standard for wireless local area networks (WLANs), the concept of early acknowledgement (ACK) was proposed. A two-bit response frame type indication is added in a signal (SIG) field to indicate whether an immediate response is requested by the sender after a physical layer (PHY) convergence procedure (PLCP) protocol data unit (PPDU). A station (STA), e.g., a wireless communication device, which decodes the SIG field in a received frame correctly, can determine whether to defer channel access based on this indication. The two bits of the SIG field indicate the following type of response frames from the receiver: 00 for an ACK response frame, 01 for a BA response frame, and 10 for a no ACK response frame. The indication 11 can also be used to indicate a data response frame.

by the at least one processor. The programming includes instructions to select a response frame type of a plurality of response frame types predefined in accordance to transmission durations of the response frame types. The response frame types have different transmission durations. The programming at the communications device includes further instructions to indicate, in a current frame scheduled for transmission, the selected response frame type using an indication value predefined for the selected response frame type, and transmit the current frame on an access channel for one or more communication devices.

[0008] In accordance with yet another embodiment, a communication device configured for handling response frame type indication according to response frame duration in a wireless network includes at least one processor and a computer readable storage medium storing programming for execution by the at least one processor. The programming includes instructions to receive, in a current frame transmitted on an access channel, an indication value predefined for a response frame type selected from a plurality of response frame types belonging to a plurality of associated classes of transmission durations. The communications device is further configured to determine that the current frame is intended for another entity other than the communication device, and wait, after end of reception of the current frame, for a time period about equal to a predefined inter-frame and backoff time before contending a wireless medium for transmitting a new frame from the communication device. The programming further configures the device to, upon determining that the indication value is for sending a response frame, wait before transmitting a new frame for a time period about equal to a transmission duration corresponding to the response frame type associated with the indication value.

[0009] The foregoing has outlined rather broadly the features of an embodiment of the present invention in order that the detailed description of the invention that follows may be better understood. Additional features and advantages of embodiments of the invention will be described hereinafter, which form the subject of the claims of the invention. It should be appreciated by those skilled in the art that the conception and specific embodiments disclosed may be readily utilized as a basis for modifying or designing other structures or processes for carrying out the same purposes of the present invention. It should also be realized by those skilled in the art that such equivalent constructions do not depart from the ~~spirit and~~ scope of the invention as set forth in the appended claims.

[0029] While several embodiments have been provided in the present disclosure, it should be understood that the disclosed systems and methods might be embodied in many other specific forms without departing from the spirit or scope of the present disclosure. The present examples are to be considered as illustrative and not restrictive, and the intention is not to be limited to the details given herein. For example, the various elements or components may be combined or integrated in another system or certain features may be omitted, or not implemented.

[0030] In addition, techniques, systems, subsystems, and methods described and illustrated in the various embodiments as discrete or separate may be combined or integrated with other systems, modules, techniques, or methods without departing from the scope of the present disclosure. Other items shown or discussed as coupled or directly coupled or communicating with each other may be indirectly coupled or communicating through some interface, device, or intermediate component whether electrically, mechanically, or otherwise. Other examples of changes, substitutions, and alterations are ascertainable by one skilled in the art and could be made without departing from the ~~spirit and~~ scope disclosed herein.

WHAT IS CLAIMED IS:

1. A method for providing response frame types in a wireless network comprising an access point (AP) and a station, the method comprising:

defining a plurality of response frame types in accordance to transmission durations of the response frame types, wherein the response frame types have different transmission durations;

assigning for the response frame types a plurality of corresponding indication values; and

sharing the response frame types and the corresponding indication values with one or more communication devices configured or scheduled to access a channel of the wireless network.

2. The method of claim 1, wherein the response frame types include a no response type, a physical layer (PHY) header response type, a normal acknowledgement (ACK) size response type, and long or unspecified response type.

3. The method of claim 2, wherein the no response type is assigned a first value, the PHY header response type is assigned a second value, the normal ACK size response type is assigned a third value, and the long or unspecified response type is assigned a fourth value.

4. The method of claim 3, wherein the first value is a two-bits indication value of 00, the second value is a two-bits indication value of 01, the third value is a two-bits indication value of 10, and the fourth value is a two-bits indication value of 11.

5. The method of claim 2, wherein the response frame types further include a normal block ACK (BA) size response type.

6. The method of claim 5, wherien both the normal ACK size response type and the normal BA size response type are assigned a two-bits indication value of 10.

7. A method for response frame type indication according to response frame duration in a wireless network comprising an access point (AP) and a station, the method comprising:

selecting a response frame type of a plurality of response frame types predefined in accordance to transmission durations of the response frame types, wherein the response frame types have different transmission durations;

indicating, in a current frame scheduled for transmission, the selected response frame type using an indication value predefined for the selected response frame type; and

transmitting the current frame on an access channel for one or more communication devices.

8. The method of claim 7, wherein the response frame types include a no response type, a null data packet (NDP) response type, a normal size response type, and long or unspecified response type.

9. The method of claim 8, wherein the no response type is assigned a first value, the NDP response type is assigned a second value, the normal size response type is assigned a third value, and the long or unspecified response type is assigned a fourth value.

10. The method of claim 9, wherein the first value is 0, the second value is 1, the third value is 2, and the fourth value is 3.

11. The method of claim 8, wherein the normal size response type is a normal acknowledgement (ACK) response type or a normal block ACK (BA) response type.

12. The method of claim 11 further comprising indicating in the current frame whether the selected response frame type is the normal ACK response type or the normal BA response type.

13. The method of claim 7, wherein the transmitted current frame comprises a physical layer (PHY) header portion including the indication value predefined for the selected response frame type.

14. The method of claim 13, wherein the selected response frame type is indicated, in the PHY header portion, in a SIG field configured according to a wireless network standard.

15. A method for handling response frame type indication according to response frame duration in a wireless network, the method comprising:

detecting, by a receiver unintended to receive a current frame by a sender of the frame, an indication value in the current frame, the indication value predefined for a response frame type selected from a plurality of response frame types associated with a plurality of classes of transmission durations;

determining that the current frame is intended for another entity other than the receiver; and

upon determining that the indication value is for sending a response frame, waiting before transmitting a new frame for a time period about equal to a transmission duration corresponding to the response frame type associated with the indication value.

16. The method of claim 15, wherein the response frame types include a no response type, a physical layer (PHY) header response type, a normal acknowledgement (ACK) size response type or a normal block ACK (BA) response type, and long or unspecified response type.

17. The method of claim 16, wherein when the response frame type is the no response type, the receiver waits, after the end of reception of the current frame, for a time corresponding to a predefined inter-frame and backoff time before contending the wireless medium for transmitting the new frame.

18. The method of claim 16, wherein when the response frame type is the PHY header response type, the receiver waits, after the end of reception of the current frame, for a time corresponding to about a length of the PHY header response type and a predefined inter-frame and backoff time before contending the wireless medium for transmitting the new frame.

19. The method of claim 16, wherein when the response frame type is the normal ACK size response type or normal BA size response type, the receiver waits, after the end of reception of the current frame, for a time corresponding to about a length of the normal ACK size response type or the normal BA size response type and a predefined inter-frame and backoff time before contending the wireless medium for transmitting the new frame.

20. The method of claim 19 further comprising detecting information or a second indication value in the current frame to determine whether the response frame type is the normal ACK size response type or the normal BA size response type.

21. The method of claim 16, wherein the response frame type is the long or unspecified response type and the indication value is set to 11 in bits, and wherein the receiver waits, after the end of reception of the current frame, for a defined extended time and a predefined inter-frame and backoff time before contending the wireless medium for transmitting the new frame.

22. A communication device configured for providing response frame type indication in a wireless network, the communication device comprising:

at least one processor; and

a computer readable storage medium storing programming for execution by the at least one processor, the programming including instructions to:

select a response frame type of a plurality of response frame types predefined in accordance to transmission durations of the response frame types, wherein the response frame types have different transmission durations;

indicate, in a current frame scheduled for transmission, the selected response frame type using an indication value predefined for the selected response frame type; and

transmit the current frame on an access channel for one or more communication devices.

23. The communication device of claim 22, wherein the response frame types include a no response type, a physical layer (PHY) header response type, an acknowledgement (ACK) size response type, and other packet response type.

24. The communication device of claim 22, wherein the communication device is an access point (AP) or a station (STA), and wherein the one or more communication devices include at least one of a second AP or a second STA.

25. A communication device configured for handling response frame type indication according to response frame duration in a wireless network, the communication device comprising:

at least one processor; and

a computer readable storage medium storing programming for execution by the at least one processor, the programming including instructions to:

receive, in a current frame transmitted on an access channel, an indication value predefined for a response frame type selected from a plurality of response frame types belonging to a plurality of associated classes of transmission durations;

determine that the current frame is intended for another entity other than the communication device; and

wait before transmitting a new frame for a time period about equal to a transmission duration corresponding to the response frame type associated with the indication value.

26. The communication device of claim 25, wherein the response frame types include a no response type, a physical layer (PHY) header response type, an acknowledgement (ACK) size response type, and long or unspecified response type.

27. The method of claim 26, wherein the programming includes further instructions to, when the response frame type is the no response type, waits after the end of reception of the current frame for a time corresponding to a predefined inter-frame and backoff time before contending the wireless medium for transmitting the new frame.

28. The method of claim 26, wherein the programming includes further instructions to ,when the response frame type is the PHY header response type, wait after the end of reception of the current frame for a time corresponding to about a length of the PHY header response type and a predefined inter-frame and backoff time before contending the wireless medium for transmitting the new frame.

29. The method of claim 26, wherein the programming includes further instructions to, when the response frame type is the normal ACK size response type or normal BA size response type, wait after the end of reception of the current frame, for a time corresponding to about a length of the normal ACK size response type or the normal BA size response type and a predefined inter-frame and backoff time before contending the wireless medium for transmitting the new frame.

30. The method of claim 26, wherein the programming includes further instructions to, when the response frame type is the long or unspecified response type and the indication value is set to 11 in bits, wait after the end of reception of the current frame for a defined extended time and a predefined inter-frame and backoff time before contending the wireless medium for transmitting the new frame.

31. The communication device of claim 25, wherein the communication device is an access point (AP) or a station (STA) that is a target for the current frame.

CLAIMS:

1. A method in a wireless network, the method comprising:

identifying response indications each of which associated with a different response frame duration; and

inserting one of the response indications into a signal (SIG) field of a frame to indicate a duration of a response following the frame, the response indication in the SIG field indicating that no immediate response follows the frame when the response indication is set to 00, that a null data packet (NDP) response follows the frame when the response indication is set to 01, that a normal duration response follows the frame when the response indication is set to 10, and that a long duration response follows the frame when the response indication is set to 11, wherein the NDP response is a frame that includes a physical header and excludes a payload.

2. A method comprising:

inserting, in a signal (SIG) field of a frame scheduled for transmission, one of a plurality of response indication values, each of the plurality of response indication values being associated with a different response frame duration; and

transmitting the frame on an access channel for one or more communication devices, the response indication value in the SIG field indicating that no immediate response follows the frame when the response indication value is set to 00, that a null data packet (NDP) response follows the frame when the response indication value is set to 01, that a normal duration response follows the frame when the response indication value is set to 10, and that a long duration response follows the frame when the response indication value is set to 11, wherein the NDP response is a frame that includes a physical header and excludes a payload.

3. The method of claim 2, wherein the transmitted frame comprises a physical layer (PHY) header portion including the response indication value.

4. A method comprising:

detecting, by a receiver unintended to receive a frame by a sender of the frame, a duration of a response following the frame based on a response indication value in a signal (SIG) field of the frame communicated over a channel, the receiver detecting that no immediate response follows the frame when the response indication value is set to 00, that a null data packet (NDP) response follows the frame when the response indication value is set to 01, that a normal duration response follows the frame when the response indication value is set to 10, and that a long duration response follows the frame when the response indication value is set to 11, wherein the NDP response is a frame that includes a physical header and excludes a payload;

determining that the frame is intended for another entity other than the receiver; and

waiting before transmitting a new frame in the channel for a time period corresponding to a transmission duration corresponding to the response indication value.

5. The method of claim 4, wherein when the response indication value in the SIG field indicates that no immediate response follows the frame, the receiver waits, after the end of reception of the frame, for a time corresponding to a predefined inter-frame and backoff time before transmitting the new frame in the channel.

6. The method of claim 4, wherein when the response indication value in the SIG field indicates that the NDP response follows the frame, the receiver waits, after the end of reception of the frame, for a time corresponding to a length of the NDP response and a predefined inter-frame and backoff time before transmitting the new frame in the channel.

7. The method of claim 4, wherein when the response indication value in the SIG field indicates that the normal duration response follows the frame, the receiver waits, after the end of reception of the frame, for a time corresponding to a length of the normal duration response and a predefined inter-frame and backoff time before transmitting the new frame in the channel.

8. The method of claim 7 further comprising detecting information of a second indication value in the frame to determine whether the normal duration response is a normal ACK size response or a normal BA size response.

9. The method of claim 4, wherein when the response indication value in the SIG field indicates that the long duration response follows the frame, the receiver waits, after the end of reception of the frame, for a defined extended time and a predefined inter-frame and backoff time before transmitting the new frame in the channel.

10. A communication device in a wireless network, the communication device comprising:

at least one processor; and

a computer readable storage medium storing programming for execution by the at least one processor, the programming including instructions to:

insert, in a signal (SIG) field of a frame scheduled for transmission one of a plurality of response indication values, each of the plurality of response indication values being associated with a different response frame duration; and

transmit the frame on an access channel for one or more communication devices, the response indication value in the SIG field being set to 00 to indicate that no immediate response follows the frame, set to 01 to indicate that a null data packet (NDP) response follows the frame, set to 10 to indicate that a normal duration response follows the frame, or set to 11 to indicate that a long duration response follows the frame, wherein the NDP response is a frame that includes a physical header and excludes a payload.

11. The communication device of claim 10, wherein the communication device is an access point (AP) or a station (STA), and wherein the one or more communication devices include at least one of a second AP or a second STA.

12. A communication device in a wireless network, the communication device comprising:

at least one processor; and

a computer readable storage medium storing programming for execution by the at least one processor, the programming including instructions to:

detect a duration of a response following a frame based on a response indication value in a signal (SIG) field of the frame transmitted on an access channel, the communications devices detecting that no immediate response follows the frame when the response indication value is set to 00, that a null data packet (NDP) response follows the frame when the response indication value is set to 01, that a normal duration response follows the frame when the response indication value is set to 10, and that a long duration response follows the frame when the response indication value is set to 00, wherein the NDP response is a frame that includes a physical header and excludes a payload;

determine that the frame is intended for another entity other than the communication device; and

wait before transmitting a new frame in the access channel for a time period corresponding to a transmission duration corresponding to the response indication value.

13. The communication device of claim 12, wherein the instructions to wait before transmitting a new frame in the access channel includes further instructions to, when the response indication value in the SIG field indicates that no immediate response follows the frame, wait until after the end of reception of the frame for a time corresponding to a predefined inter-frame and backoff time before transmitting the new frame in the access channel.

14. The communication device of claim 12, wherein the instructions to wait before transmitting a new frame in the access channel includes further instructions to, when the response indication value in the SIG field indicates that the NDP response follows the frame, wait until after the end of reception of the frame for a time corresponding to a length of the NDP response and a predefined inter-frame and backoff time before transmitting the new frame in the access channel.

15. The communication device of claim 12, wherein the instructions to wait before transmitting a new frame in the access channel includes further instructions to, when the response indication value in the SIG field indicates that the normal duration response follows the frame, wait until after the end of reception of the frame, for a time corresponding to a length of the normal duration response and a predefined inter-frame and backoff time before transmitting the new frame in the access channel.

16. The communication device of claim 12, wherein the instructions to wait before transmitting a new frame in the access channel includes further instructions to, when the response indication value in the SIG field indicates that the long duration response follows the frame, wait until after the end of reception of the frame for a defined extended time and a predefined inter-frame and backoff time before transmitting the new frame in the access channel.

17. The communication device of claim 12, wherein the communication device is an access point (AP) or a station (STA) that is a target for the frame.

18. The method of claim 1, further comprising transmitting the frame in a channel.