[0001] WIRELESS COMMUNICATION METHOD AND WLAN FOR SIGNALING DEFERRAL MANAGEMENT MESSAGES

[0002] FIELD OF INVENTION

[0003] The present invention is related to a wireless local area network (WLAN). More particularly, the present invention is related to implementing deferral management strategies in the WLAN.

[0004] BACKGROUND

[0005] A wireless local area network (WLAN), such as for example, (but not limited to), an IEEE 802 WLAN, uses a carrier-sense multiple access/collision avoidance (CSMA/CA) scheme to share a wireless medium (WM) among a plurality of wireless transmit/receive units (WTRUs), (i.e., mobile stations (STAs)). This scheme forces the WTRUs to sense whether or not the WM is idle or busy before transmitting a packet. This is performed using a clear channel assessment (CCA) function. If a WTRU senses that the channel is busy, (later referred to as a WTRU hearing another transmission), the WTRU cannot transmit its packet and has to wait until the channel is idle before trying to win contention of the channel. This is referred to as deferring. By preventing two WTRUs which hear each other from transmitting simultaneously, the CSMA/CA scheme controls the level of interference in the system.

[0006] A low level of interference in a WLAN indirectly improves the capacity of the system as the throughput achieved on each radio link increases as interference decreases. On the other hand, the costs associated with preventing two nodes that hear each other from transmitting simultaneously on the same channel are realized in that scarce spectrum channel resources cannot be reused, thus leading to capacity constraints in systems where multiple base station systems (BSSs) use the same channel.

[0007] In CSMA/CA systems, the determination of whether or not a first WTRU defers to a second WTRU, (where the second WTRU is located at a given path loss from first WTRU), depends on two factors: (1) the transmission power used by the first WTRU; and (2) the reception/deferring thresholds used by

second WTRU. It is therefore possible to control the level of deferral, and thus the capacity, in a WLAN by controlling either one or both of these factors. Two key reception/deferral thresholds may be used in the CCA functions of WTRUs operating in CSMA/CA, which are: (1) the energy detect threshold (EDT), which represents the smallest received signal power for which reception of a packet will be attempted; and (2) the defer threshold (DT), which represents the smallest received signal power for which transmission of a packet by the WTRU will be deferred.

[0008] In summary, it is sometimes better from the point of view of capacity to decrease the transmission power and/or to increase the DT/EDT of WTRUs in co-channel BSSs such that the WTRUs from one of the BSSs do not defer to those of another one of the BSSs, and vice-versa. However, problems may arise if the adjustment of deferral parameters is performed individually at each WTRU without consideration for the effect of this adjustment to other WTRUs. For instance, if a WTRU reduces its transmission power excessively, it can become impossible for other WTRUs in the same BSS to detect the signal from this WTRU above the EDT or DT, and a hidden node situation would arise, resulting in degraded capacity. Hidden nodes phenomena across BSSs may also occur. For the optimization to work properly, coordination between the WTRUs is needed to allow gathering all the required information at the node making the decision on the setting of the deferral parameters. This node could be the WTRU itself or an access point (AP) to which the WTRU is associated. In the latter case, coordination is also needed to allow the AP to communicate the values of the optimal deferral parameters to the concerned WTRU(s).

[0009] SUMMARY

[0010] The present invention is related to a deferral management method which is implemented in a WLAN including an AP and a plurality of WTRUs. The AP sends a deferral management capabilities request message to the WTRUs to determine the deferral management capabilities of the WTRUs, such as maximum transmission power, minimum transmission and/or dynamic range,

minimum and maximum DT/EDT, and different CCA modes. In response, each of the WTRUs sends a deferral management capabilities indicator message to the AP. The AP may also send a deferral management parameter set message to the WTRUs to indicate values for setting deferral management parameters, which include message destination identification, configuration time limit, and transmission power settings. In response, each of the WTRUs may optionally send a deferral management parameter set execution confirmation message to the AP. In an alternative embodiment, the WTRUs may set the values of various deferral management parameters in accordance with a certain rule specified in a deferral management rule message sent by the AP. Optionally, the WTRUs may respond to the AP with a deferral management rule execution confirmation message containing the actual values of the deferral management parameters resulting from the execution of the rule.

[0011] The present invention relates to wireless systems using a CSMA/CA scheme such as for example, (but not limited to), the IEEE 802 family of standards. Deferral management strategies are implemented in a coordinated manner between all WTRUs. In medium and relatively large wireless systems, deferral management strategies can increase the system capacity by factors of more than 500%. One particular example where the present invention applies is within the scope of the IEEE 802.11v standard.

[0012] The present invention provides the mechanisms that enable the WTRUs of a BSS to set their deferral management parameters in a coordinated manner that will ultimately enable deferral management policies to fully capitalize on the potential increase in capacity they can offer.

[0013] BRIEF DESCRIPTION OF THE DRAWINGS

[0014] A more detailed understanding of the invention may be had from the following description, given by way of example and to be understood in conjunction with the accompanying drawings wherein:

[0015] Figure 1 is a signal flow diagram of a deferral management signaling procedure in which an AP defines deferral parameters to be used by a plurality of WTRUs in accordance with the present invention;

[0016] Figure 2 is a signal flow diagram of a deferral management signaling procedure used during WTRU measurements in accordance with the present invention; and

[0017] Figure 3 is a signal flow diagram of a deferral management signaling procedure in which deferral management rules used by at least one WTRU are defined by the AP in accordance with the present invention.

[0018] DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0019] Although the features and elements of the present invention are described in the preferred embodiments in particular combinations, each feature or element can be used alone (without the other features and elements of the preferred embodiments) or in various combinations with or without other features and elements of the present invention.

[0020] When referred to hereafter, the terminology "WTRU" includes but is not limited to a user equipment (UE), mobile station, fixed or mobile subscriber unit, pager, or any other type of device capable of operating in a wireless environment. When referred to hereafter, the terminology "AP" includes but is not limited to a base station, a Node-B, a site controller or any other type of interfacing device in a wireless environment.

[0021] The present invention provides two preferred embodiments for implementing deferral management. In the first embodiment, an AP directly communicates to at least one of its associated WTRUs the values at which these WTRUs should set their deferral management parameters. In the second embodiment, an AP communicates to at least one of its associated WTRUs the rules for calculating and setting their own deferral management parameters.

[0022] There are two preferred signaling procedures for allowing the deferral management parameters of WTRUs to be controlled by an AP on an individual basis. The first signaling procedure allows the AP to indicate to at

least one WTRU the deferral parameters that the at least one WTRU should use. The second signaling procedure allows an AP to collect measurements from at least one WTRU that are relevant for the determination of the deferral parameters that the at least one WTRU should use.

[0023] Figure 1 is a flow diagram of the first signaling procedure which is implemented in a wireless communication system, (e.g., WLAN) 100 including an AP 105 and a plurality of WTRUs 110_1 - 110_N. The AP 105 sends a deferral management capabilities request message 115 to one WTRU or multiple WTRUs to report its deferral management capabilities. The deferral management capabilities request message 115 may be transmitted as a broadcast, multicast or unicast signal. The deferral management capabilities include the following parameters:

1) Maximum transmission power, minimum transmission power and/or dynamic range of the WTRU;

2) Minimum DT/EDT and maximum DT/EDT that the WTRU can use; and

3) Different CCA (Clear Channel Assessment) modes that the WTRU supports.

[0024] A deferral management capabilities indicator message 120 may be sent by the WTRU(s) 110 as a response to the deferral management capabilities request message 115 sent by the AP 105, or may be sent as a stand-alone message. The deferral management capabilities indicator message 120 may be appended to such an association request message or to another message linked to an association / admission control procedure which manages the admission of the WRTU 110 in the WLAN 100.

[0025] A deferral management parameter set message 125 is sent from the AP 105 to one or more of the WTRUs 110 which indicates which values are to be set for its deferral management parameters. The deferral management parameter set message 125 may be transmitted as a broadcast, multicast or unicast signal, and preferably includes the following information:

1) The identification of the WTRU destination for the message is provided. Preferably, the identification would be a medium access control (MAC) address, but any other type of WTRU destination identifier may be used.

2) The time at which the configuration of a deferral management parameter of the WRTU according to a deferral management parameter set message needs to take place. Alternatively, the deferral management parameter set message 125 may indicate the time limit at which the configuration needs to have taken place. The time information can be expressed as a time offset or in absolute terms.

3) The deferral management parameters and the values that the WTRU needs to use. Examples of such parameters are:

a) Transmission power settings in normal operations.

b) Transmission power settings in special operations. Examples of special operations include but are not limited to scanning operations and measurement collecting.

c) DT/EDT settings in normal operations.

d) DT/EDT settings in special operations. Examples of special operations include but are not limited to scanning operations and measurement collecting.

e) CCA mode(s).

[0026] As shown in Figure 1, a deferral management parameter set execution confirmation message 130 may be optionally sent by the WTRU(s) 110 to confirm to the AP 105 that the configuration indicated in a given deferral management parameter set message 125 has taken place. The optional deferral management parameter set execution confirmation message 130 may include any of the parameters specified in the deferral management parameter set message described above or can refer to a transaction identifier that would associate the deferral management parameter set execution confirmation message 130 to the corresponding deferral management parameter set message 125. The reason for specifying the deferral management in the deferral management parameter set execution confirmation message 130 would be to allow the AP 105 to report the

actual parameters that were set according to the deferral management parameter set message 125. For example, if the AP 105 tells the WRTU 110 to set its transmission power to 0 dBm and its EDT to -75 dBm, it is possible that the WRTU 110 lowered its EDT to -75 dBm and also lowered its power but was unable to lower it below 13 dBm. In that case, the WRTU 110 could send a deferral management parameter set execution confirmation message 130 indicating the actual settings of the configuration which could be achieved by providing the same type of information as what can be found in the deferral management parameter set message 125.

[0027] Figure 2 is a flow diagram of the second signaling procedure which is implemented in a wireless communication system 200 including an AP 205 and a plurality of WTRUs 210_1 - 210_N. The second signaling procedure allows the AP 205 to collect measurements from WTRU(s) 210 that are relevant for the determination of the deferral parameters that WTRU(s) 210 should use. Relevant measurements include, but are not limited to:

1) Signal strength (or average thereof) of packets that a WTRU receive from other specific WTRUs.

2) Number and total duration of packets received by a WTRU that originate from other specific WTRUs.

[0028] This signaling procedure compensates for the possibility that the deferral management parameters that are optimal in terms of providing capacity during normal operations may not be optimal when the WTRU 210 needs to perform measurements, such as during the scanning period. For instance, in a particular situation where it is desirable that a given WTRU 210 increase its DT/EDT in normal operations, a high DT/EDT might impair the ability of the WTRU 210 from accurately measuring certain metrics such as channel occupancy. To prevent such an impairment, the AP 205 indicates, as part of a measurement request, which deferral management parameter a WTRU should use when collecting measurements.

[0029] As shown in Figure 2, a measurement request message 215 is sent by the AP 205 to the WTRU(s) 210 which indicates what type of measurement

the WTRUs 210 are to perform and which deferral management parameter, (e.g., DT/EDT, CCA mode, or the like), should be used when collecting the requested measurement. A measurement report message 220 is sent by the WTRU(s) 210 to the AP 205 which indicates the results of the measurement and which deferral management parameters, (e.g., DT/EDT, CCA mode, or the like), were actually used to collect the reported measurement. The messages 215 and 220 may be used separately or together. The deferral management parameters used during measurement may be different than those requested by the AP 205 in the measurement request message 215. Using the measurements collected from its associated WTRUs 210, the AP 205 can perform calculations and determine the optimum deferral parameters to use for each WTRU 210. For instance, one possible strategy is to set the EDT of a given WTRU 210 to the smallest signal strength, (minus a margin), of packets that this WTRU 210 receives from other WTRUs 210 in the same BSS.

[0030] As explained earlier, there is a need for the deferral management to be performed in a coordinated manner across all WTRUs in order for the system to fully capitalize on the capacity gain that can be achieved by deferral management. Previously, signaling mechanisms were presented which allow an AP to actively determine the values and set the deferral management parameters of each of its associated WTRU in a direct fashion. This strategy ensures that the deferral management parameter settings for each WTRU are coherent since they are calculated at a central location, (i.e., the AP). On the other hand, this centralized scheme relies on the fact that the AP collects a significant amount of measurements and signaling from the WTRUs. For example, for an AP to be able to determine the DT/EDT value a WTRU should use such that the WTRU does not defer to a given co-channel extra-BSS WTRU, the AP may need to determine the signal strength of packets that the WTRU receives from the extra-BSS WTRU.

[0031] An alternative scheme that reduces the amount of signaling needed in the system is to have each WTRU responsible for determining and setting the values of their deferral management parameters, but to have the AP set the

guidelines or rules that WTRUs have to follow when determining the values and setting their deferral management parameters. Such a scheme provides consistency between the deferral management strategy used by each WTRU while relieving the system from some of the signaling between the WTRU and the AP.

[0032] Figure 3 shows a signaling procedure which is implemented in a wireless communication system 300 including an AP 305 and a plurality of WTRUs 310_1 - 310_N. The AP 305 sends a deferral management rule message 315 to at least one WTRU 310 that specifies a certain rule that the WTRU 310 has to follow for the determination of the values to use for its deferral management parameters. Optionally, after having calculated the proper setting of the deferral management parameters according to the rule sent by the AP 305, the WTRU 310 may respond to the AP 305 with a deferral management rule execution confirmation message 320 containing the actual value(s) of the deferral management parameter(s) resulting from the execution of the rule. This information can be subsequently used by the AP 305 when sending deferral management rule messages 315 to other WTRUs 310.

[0033] The information that has to be conveyed to the WTRU 310 by the AP 305 depends to some extent on the rule that the AP 305 wants enforced. Below are examples of generic but novel rules that can be used as well as the input parameters the AP 305 would typically have to provide to enable the WTRU 310 to implement the rule.

[0034] The first rule specifies which WTRUs are to be deferred to by the WTRU(s) 310. This rule tells the WTRU(s) 310 that it should set its DT/EDT to the highest possible value such that it can hear a certain set of WTRUs. In one embodiment, the AP 305 could choose the set of WTRUs to be all WTRUs in the BSS. That would imply that the WTRUs 310 would set their DT/EDT parameters as high as possible while still ensuring that they hear all WTRUs in their BSS.

[0035] In the preferred embodiment, the rules the WTRU 310 needs to follow and the list of the WTRUs the WTRU 310 needs to defer to can be included

in a single message, but could also be conveyed in two separate messages in another embodiment. The message could also specify a margin M that the WTRU 310 should use when determining the value of the parameter. For example, if the WTRU 310 determines that the maximum value at which it would hear all its neighbors is DT/EDT of -85 dBm, a margin of 3 dB would imply that the WTRU 310 would have to set its DT/EDT parameter to -85dBm – margin = -88dBm.

[0036] This rule could be summarized by the following equation:

$$DT/EDT_{WTRU} = \min_function\,(\max DT/EDT_1, \max DT/EDT_2, \ldots \max DT/EDT_N) - M \quad \text{Equation (1)}$$

where max DT/EDT_n is the maximum DT/EDT required to hear $WTRU_n$, where n is a WRTU identifier and M represents the margin, all of these values being provided by the AP 305.

[0037] Another preferred rule specifies to the WTRU 310 the set of WTRUs by which it needs to be heard. This rule tells the WTRU 310 that it should set its transmission power to the lowest possible value that ensures it will be heard by a certain set of WTRUs.

[0038] In one embodiment, the AP 305 chooses the set of WTRUs to include all WTRUs in the BSS. That would imply that the WTRUs 310 would set their transmission power at the lowest possible value that ensures that it is heard by all WTRUs in their BSS.

[0039] In the preferred embodiment, the rules the WTRUs 310 need to follow and the list of the WTRUs the WTRU 310 needs to ensure it is heard by would be included in a single message but could also be conveyed in two separate messages in another embodiment. The message could also specify the DT/EDT value used by each of the WTRUs needing to hear the WTRU 310. The message could also include a margin that the WTRU 310 should use when determining the value of the transmission power parameter. For example, if the WTRU 310 determines that a power 8 dBm would allow it to be heard by hear all the WTRUs specified in the list provided from the AP 305, a margin of 3 dB would imply that the WTRU 310 would set its transmission power to 8 dBm + margin =

11dBm. The message could also specify the minimum transmission rate the WTRU 310 should not go beyond while reducing its transmission power.

[0040] This rule could be summarized by the following equations:

Tx_Power_{WTRU} = max_function(min_function(min Tx_Power_1, min Tx_Power_2, ... min Tx_Power_N) +M), min Tx_Power_{RATE}) Equation (2)

where min Tx_Power_i= DT/EDT value of $WTRU_i$ + pathloss between $WTRU_i$ and WTRU and min Tx_Power_{RATE} is the minimum transmission power to achieve desired transmission rate, and min Tx_Power_n is the minimum transmission power required to be heard by $WTRU_n$ where n is a WRTU identifier.

[0041] Embodiments

1. A deferral management method implemented in a wireless local area network (WLAN) including an access point (AP) and a plurality of wireless transmit/receive units (WTRUs), the method comprising:

(a) the AP sending a deferral management capabilities request message to at least one of the WTRUs to report the deferral management capabilities of the AP; and

(b) each of the at least one of the WTRUs sending a deferral management capabilities indicator message to the AP in response to the deferral management capabilities request.

2. The method of embodiment 1 further comprising:

(c) the AP sending a deferral management parameter set message to the at least one of the WTRUs to indicate values for setting deferral management parameters; and

(d) each of the at least one of the WTRUs sending a deferral management parameter set execution confirmation message to the AP in response to the deferral management parameter set message.

3. The method of embodiment 1 wherein the deferral management capabilities request message is transmitted as a broadcast signal.

4. The method of embodiment 1 wherein the deferral management capabilities request message is transmitted as a multicast signal.

5. The method of embodiment 1 wherein the deferral management capabilities request message is transmitted as a unicast signal.

6. The method of embodiment 1 wherein the deferral management capabilities indicated by the deferral management capabilities indicator message includes at least one of maximum transmission power of the WTRU, minimum transmission of the WTRU and dynamic range of the WTRU.

7. The method of embodiment 1 wherein the deferral management capabilities indicated by the deferral management capabilities indicator message includes at least one of minimum and maximum defer threshold (DT)/energy detect threshold (EDT) that the WTRU can use.

8. The method of embodiment 1 wherein the deferral management capabilities indicated by the deferral management capabilities indicator message includes different clear channel assessment (CCA) modes that the WTRU supports.

9. The method of embodiment 2 wherein the deferral management parameter set message is transmitted as a broadcast signal.

10. The method of embodiment 2 wherein the deferral management parameter set message is transmitted as a multicast signal.

11. The method of embodiment 2 wherein the deferral management parameter set message is transmitted as a unicast signal.

12. The method of embodiment 2 wherein the deferral management parameter set message includes a medium access control (MAC) address of the WTRU to which the deferral management parameter set message is destined.

13. The method of embodiment 2 wherein the deferral management parameter set message includes time information indicating when the deferral management parameters need to be configured.

14. The method of embodiment 2 wherein the deferral management parameter set message includes parameters including transmission power settings.

15. The method of embodiment 2 wherein the deferral management parameter set message includes parameters including defer threshold (DT)/energy detect threshold (EDT) settings.

16. The method of embodiment 2 wherein the deferral management parameter set message includes at least one clear channel assessment (CCA) mode parameter.

17. A deferral management method implemented in a wireless local area network (WLAN) including an access point (AP) and a plurality of wireless transmit/receive units (WTRUs), the method comprising:

(a) the AP sending a measurement request message to at least one of the WTRUs which indicates what type of measurement the WTRU is to perform and which deferral management parameter should be used when collecting the requested measurement; and

(b) each of the at least one of the WTRUs sending a measurement report message to the AP which indicates the results of the measurement and which deferral management parameters were actually used to collect the measurement.

18. A deferral management method implemented in a wireless local area network (WLAN) including an access point (AP) and a plurality of wireless transmit/receive units (WTRUs), the method comprising:

the AP sending a deferral management rule message to at least one of the WTRUs which specifies a certain rule which the at least one of the WTRUs must follow to determine values of deferral management parameters, wherein the certain rule specifies which of the WTRUs are to be deferred to by the at least one of the WTRUs by adjusting a defer threshold (DT)/energy detect threshold (EDT) parameter setting to a highest possible value such that the at least one of the WTRUs can hear selected ones of the WTRUs.

19. The method of embodiment 18 wherein the selected ones of the WTRUs are all located in the same base station system (BSS).

20. A deferral management method implemented in a wireless local area network (WLAN) including an access point (AP) and a plurality of wireless transmit/receive units (WTRUs), the method comprising:

the AP sending a deferral management rule message to at least one of the WTRUs which specifies a certain rule which the at least one of the WTRUs must follow to determine values of deferral management parameters, wherein the certain rule specifies which of the WTRUs are to be deferred to by the at least one of the WTRUs by adjusting a defer threshold (DT)/energy detect threshold (EDT) parameter setting to a highest possible value at which the at least one of the WTRUs can hear selected ones of the WTRUs minus a margin M specified by the certain rule.

21. The method of embodiment 20 wherein the margin M is 3db and the highest possible value of the DT/EDT parameter is -85 dBm, resulting in setting the value of the DT/EDT parameter to -88 dBm.

22. The method of embodiment 20 further comprising:

the at least one WTRU calculating the proper values of the deferral management parameters according to the certain rule; and

the at least one WTRU sending a deferral management rule execution confirmation message to the AP containing the actual values of the deferral management parameters resulting from the execution of the certain rule.

23. A deferral management method implemented in a wireless local area network (WLAN) including an access point (AP) and a plurality of wireless transmit/receive units (WTRUs), the method comprising:

the AP sending a deferral management rule message to at least one of the WTRUs which specifies a certain rule which the at least one of the WTRUs must follow to determine values of deferral management parameters, wherein the certain rule specifies which of the WTRUs are to be deferred to by the at least one of the WTRUs by setting transmission power at a lowest possible value that ensures that the at least one of the WTRUs is heard by selected ones of the WTRUs.

24. The method of embodiment 23 wherein the deferral management rule message includes a margin M that the at least one of the WTRUs should use when determining the value of the transmission power.

25. The method of 24 wherein the margin is 3 dB and the minimum transmission power is 8 dBm, resulting in setting the value of the transmission power to 11 dBm.

26. The method of embodiment 23 wherein the deferral management rule message specifies a minimum transmission rate that the at least one of the WTRUs should not exceed when setting the transmission power.

27. The method of embodiment 23 further comprising:

the at least one WTRU calculating the proper values of the deferral management parameters according to the certain rule; and

the at least one WTRU sending a deferral management rule execution confirmation message to the AP containing the actual values of the deferral management parameters resulting from the execution of the certain rule.

28. A wireless local area network (WLAN) comprising:

an access point (AP); and

a plurality of wireless transmit/receive units (WTRUs) wherein the AP sends a deferral management capabilities request message to at least one of the WTRUs to report its deferral management capabilities, and each of the at least one of the WTRUs sends a deferral management capabilities indicator message to the AP in response to the deferral management capabilities request.

29. The WLAN of embodiment 28 wherein the AP sends a deferral management parameter set message to the at least one of the WTRUs to indicate values for setting deferral management parameters, and each of the at least one of the WTRUs sends a deferral management parameter set execution confirmation message to the AP in response to the deferral management parameter set message.

30. The WLAN of embodiment 28 wherein the deferral management capabilities request message is transmitted as a broadcast signal.

31. The WLAN of embodiment 28 wherein the deferral management capabilities request message is transmitted as a multicast signal.

32. The WLAN of embodiment 28 wherein the deferral management capabilities request message is transmitted as a unicast signal.

33. The WLAN of embodiment 28 wherein the deferral management capabilities indicated by the deferral management capabilities indicator message includes at least one of maximum transmission power of the WTRU, minimum transmission of the WTRU and dynamic range of the WTRU.

34. The WLAN of embodiment 28 wherein the deferral management capabilities indicated by the deferral management capabilities indicator message includes at least one of minimum and maximum defer threshold (DT)/energy detect threshold (EDT) that the WTRU can use.

35. The WLAN of embodiment 28 wherein the deferral management capabilities indicated by the deferral management capabilities indicator message includes different clear channel assessment (CCA) modes that the WTRU supports.

36. The WLAN of embodiment 29 wherein the deferral management parameter set message is transmitted as a broadcast signal.

37. The WLAN of embodiment 29 wherein the deferral management parameter set message is transmitted as a multicast signal.

38. The WLAN of embodiment 29 wherein the deferral management parameter set message is transmitted as a unicast signal.

39. The WLAN of embodiment 29 wherein the deferral management parameter set message includes a medium access control (MAC) address of the WTRU to which the deferral management parameter set message is destined.

40. The WLAN of embodiment 29 wherein the deferral management parameter set message includes time information indicating when the deferral management parameters need to be configured.

41. The WLAN of embodiment 29 wherein the deferral management parameter set message includes parameters including transmission power settings.

42. The WLAN of embodiment 29 wherein the deferral management parameter set message includes parameters including defer threshold (DT)/energy detect threshold (EDT) settings.

43. The WLAN of embodiment 29 wherein the deferral management parameter set message includes at least one clear channel assessment (CCA) mode parameter.

44. A wireless local area network (WLAN) comprising:

an access point (AP); and

a plurality of wireless transmit/receive units (WTRUs), wherein the AP sends a measurement request message to at least one of the WTRUs which indicates what type of measurement the WTRU is to perform and which deferral management parameter should be used when collecting the requested measurement, and each of the at least one of the WTRUs sends a measurement report message to the AP which indicates the results of the measurement and which deferral management parameters were actually used to collect the measurement.

45. A wireless local area network (WLAN) comprising:

an access point (AP); and

a plurality of wireless transmit/receive units (WTRUs), wherein the AP sends a deferral management rule message to at least one of the WTRUs which specifies a certain rule which the at least one of the WTRUs must follow to determine values of deferral management parameters, the certain rule specifying which of the WTRUs are to be deferred to by the at least one of the WTRUs by adjusting a defer threshold (DT)/energy detect threshold (EDT) parameter setting to a highest possible value such that the at least one of the WTRUs can hear selected ones of the WTRUs.

46. The WLAN of embodiment 45 wherein the selected ones of the WTRUs are all located in the same base station system (BSS).

47. The WLAN of embodiment 45 wherein the at least one WTRU calculates the proper values of the deferral management parameters according to the certain rule, and the at least one WTRU sending a deferral management rule execution confirmation message to the AP containing the actual values of the deferral management parameters resulting from the execution of the certain rule.

48. A wireless local area network (WLAN) comprising:

an access point (AP); and

a plurality of wireless transmit/receive units (WTRUs), wherein the AP sends a deferral management rule message to at least one of the WTRUs which specifies a certain rule which the at least one of the WTRUs must follow to determine values of deferral management parameters, the certain rule specifying which of the WTRUs are to be deferred to by the at least one of the WTRUs by adjusting a defer threshold (DT)/energy detect threshold (EDT) parameter setting to a highest possible value at which the at least one of the WTRUs can hear selected ones of the WTRUs minus a margin M specified by the certain rule.

49. The WLAN of embodiment 48 wherein the margin M is 3db and the highest possible value of the DT/EDT parameter is -85 dBm, resulting in setting the value of the DT/EDT parameter to -88 dBm.

50. The WLAN of embodiment 48 wherein the at least one WTRU calculates the proper values of the deferral management parameters according to the certain rule, and the at least one WTRU sending a deferral management rule execution confirmation message to the AP containing the actual values of the deferral management parameters resulting from the execution of the certain rule.

51. A wireless local area network (WLAN) comprising:

an access point (AP); and

a plurality of wireless transmit/receive units (WTRUs), wherein the AP sends a deferral management rule message to at least one of the WTRUs which specifies a certain rule which the at least one of the WTRUs must follow to determine values of deferral management parameters, the certain rule specifying which of the WTRUs are to be deferred to by the at least one of the WTRUs by setting transmission power at a lowest possible value that ensures that the at least one of the WTRUs is heard by selected ones of the WTRUs.

52. The WLAN of embodiment 51 wherein the deferral management rule message includes a margin M that the at least one of the WTRUs should use when determining the value of the transmission power.

53. The WLAN of 52 wherein the margin is 3 dB and the minimum transmission power is 8 dBm, resulting in setting the value of the transmission power to 11 dBm.

54. The WLAN of embodiment 51 wherein the deferral management rule message specifies a minimum transmission rate that the at least one of the WTRUs should not exceed when setting the transmission power.

55. The WLAN of embodiment 51 wherein the at least one WTRU calculates the proper values of the deferral management parameters according to the certain rule, and the at least one WTRU sending a deferral management rule execution confirmation message to the AP containing the actual values of the deferral management parameters resulting from the execution of the certain rule.

[0042] Although the features and elements of the present invention are described in the preferred embodiments in particular combinations, each feature or element can be used alone or in various combinations with or without other features and elements of the present invention.

* * *

CLAIMS

What is claimed is:

1. A deferral management method implemented in a wireless local area network (WLAN) including an access point (AP) and a plurality of wireless transmit/receive units (WTRUs), the method comprising:

(a) the AP sending a deferral management capabilities request message to at least one of the WTRUs to report the deferral management capabilities of the AP; and

(b) each of the at least one of the WTRUs sending a deferral management capabilities indicator message to the AP in response to the deferral management capabilities request.

2. The method of claim 1 further comprising:

(c) the AP sending a deferral management parameter set message to the at least one of the WTRUs to indicate values for setting deferral management parameters; and

(d) each of the at least one of the WTRUs sending a deferral management parameter set execution confirmation message to the AP in response to the deferral management parameter set message.

3. The method of claim 1 wherein the deferral management capabilities request message is transmitted as a broadcast signal.

4. The method of claim 1 wherein the deferral management capabilities request message is transmitted as a multicast signal.

5. The method of claim 1 wherein the deferral management capabilities request message is transmitted as a unicast signal.

6. The method of claim 1 wherein the deferral management capabilities indicated by the deferral management capabilities indicator message includes at least one of maximum transmission power of the WTRU, minimum transmission of the WTRU and dynamic range of the WTRU.

7. The method of claim 1 wherein the deferral management capabilities indicated by the deferral management capabilities indicator message includes at least one of minimum and maximum defer threshold (DT)/energy detect threshold (EDT) that the WTRU can use.

8. The method of claim 1 wherein the deferral management capabilities indicated by the deferral management capabilities indicator message includes different clear channel assessment (CCA) modes that the WTRU supports.

9. The method of claim 2 wherein the deferral management parameter set message is transmitted as a broadcast signal.

10. The method of claim 2 wherein the deferral management parameter set message is transmitted as a multicast signal.

11. The method of claim 2 wherein the deferral management parameter set message is transmitted as a unicast signal.

12. The method of claim 2 wherein the deferral management parameter set message includes a medium access control (MAC) address of the WTRU to which the deferral management parameter set message is destined.

13. The method of claim 2 wherein the deferral management parameter set message includes time information indicating when the deferral management parameters need to be configured.

14. The method of claim 2 wherein the deferral management parameter set message includes parameters including transmission power settings.

15. The method of claim 2 wherein the deferral management parameter set message includes parameters including defer threshold (DT)/energy detect threshold (EDT) settings.

16. The method of claim 2 wherein the deferral management parameter set message includes at least one clear channel assessment (CCA) mode parameter.

17. A deferral management method implemented in a wireless local area network (WLAN) including an access point (AP) and a plurality of wireless transmit/receive units (WTRUs), the method comprising:

(a) the AP sending a measurement request message to at least one of the WTRUs which indicates what type of measurement the WTRU is to perform and which deferral management parameter should be used when collecting the requested measurement; and

(b) each of the at least one of the WTRUs sending a measurement report message to the AP which indicates the results of the measurement and which deferral management parameters were actually used to collect the measurement.

18. A deferral management method implemented in a wireless local area network (WLAN) including an access point (AP) and a plurality of wireless transmit/receive units (WTRUs), the method comprising:

the AP sending a deferral management rule message to at least one of the WTRUs which specifies a certain rule which the at least one of the WTRUs must follow to determine values of deferral management parameters, wherein the certain rule specifies which of the WTRUs are to be deferred to by the at least one of the WTRUs by adjusting a defer threshold (DT)/energy detect threshold (EDT)

parameter setting to a highest possible value such that the at least one of the WTRUs can hear selected ones of the WTRUs.

19. The method of claim 18 wherein the selected ones of the WTRUs are all located in the same base station system (BSS).

20. A deferral management method implemented in a wireless local area network (WLAN) including an access point (AP) and a plurality of wireless transmit/receive units (WTRUs), the method comprising:

the AP sending a deferral management rule message to at least one of the WTRUs which specifies a certain rule which the at least one of the WTRUs must follow to determine values of deferral management parameters, wherein the certain rule specifies which of the WTRUs are to be deferred to by the at least one of the WTRUs by adjusting a defer threshold (DT)/energy detect threshold (EDT) parameter setting to a highest possible value at which the at least one of the WTRUs can hear selected ones of the WTRUs minus a margin M specified by the certain rule.

21. The method of claim 20 wherein the margin M is 3db and the highest possible value of the DT/EDT parameter is -85 dBm, resulting in setting the value of the DT/EDT parameter to -88 dBm.

22. The method of claim 20 further comprising:

the at least one WTRU calculating the proper values of the deferral management parameters according to the certain rule; and

the at least one WTRU sending a deferral management rule execution confirmation message to the AP containing the actual values of the deferral management parameters resulting from the execution of the certain rule.

23. A deferral management method implemented in a wireless local area network (WLAN) including an access point (AP) and a plurality of wireless transmit/receive units (WTRUs), the method comprising:

the AP sending a deferral management rule message to at least one of the WTRUs which specifies a certain rule which the at least one of the WTRUs must follow to determine values of deferral management parameters, wherein the certain rule specifies which of the WTRUs are to be deferred to by the at least one of the WTRUs by setting transmission power at a lowest possible value that ensures that the at least one of the WTRUs is heard by selected ones of the WTRUs.

24. The method of claim 23 wherein the deferral management rule message includes a margin M that the at least one of the WTRUs should use when determining the value of the transmission power.

25. The method of 24 wherein the margin is 3 dB and the minimum transmission power is 8 dBm, resulting in setting the value of the transmission power to 11 dBm.

26. The method of claim 23 wherein the deferral management rule message specifies a minimum transmission rate that the at least one of the WTRUs should not exceed when setting the transmission power.

27. The method of claim 23 further comprising:

the at least one WTRU calculating the proper values of the deferral management parameters according to the certain rule; and

the at least one WTRU sending a deferral management rule execution confirmation message to the AP containing the actual values of the deferral management parameters resulting from the execution of the certain rule.

28. A wireless local area network (WLAN) comprising:

an access point (AP); and

a plurality of wireless transmit/receive units (WTRUs) wherein the AP sends a deferral management capabilities request message to at least one of the WTRUs to report its deferral management capabilities, and each of the at least one of the WTRUs sends a deferral management capabilities indicator message to the AP in response to the deferral management capabilities request.

29. The WLAN of claim 28 wherein the AP sends a deferral management parameter set message to the at least one of the WTRUs to indicate values for setting deferral management parameters, and each of the at least one of the WTRUs sends a deferral management parameter set execution confirmation message to the AP in response to the deferral management parameter set message.

30. The WLAN of claim 28 wherein the deferral management capabilities request message is transmitted as a broadcast signal.

31. The WLAN of claim 28 wherein the deferral management capabilities request message is transmitted as a multicast signal.

32. The WLAN of claim 28 wherein the deferral management capabilities request message is transmitted as a unicast signal.

33. The WLAN of claim 28 wherein the deferral management capabilities indicated by the deferral management capabilities indicator message includes at least one of maximum transmission power of the WTRU, minimum transmission of the WTRU and dynamic range of the WTRU.

34. The WLAN of claim 28 wherein the deferral management capabilities indicated by the deferral management capabilities indicator message

includes at least one of minimum and maximum defer threshold (DT)/energy detect threshold (EDT) that the WTRU can use.

35. The WLAN of claim 28 wherein the deferral management capabilities indicated by the deferral management capabilities indicator message includes different clear channel assessment (CCA) modes that the WTRU supports.

36. The WLAN of claim 29 wherein the deferral management parameter set message is transmitted as a broadcast signal.

37. The WLAN of claim 29 wherein the deferral management parameter set message is transmitted as a multicast signal.

38. The WLAN of claim 29 wherein the deferral management parameter set message is transmitted as a unicast signal.

39. The WLAN of claim 29 wherein the deferral management parameter set message includes a medium access control (MAC) address of the WTRU to which the deferral management parameter set message is destined.

40. The WLAN of claim 29 wherein the deferral management parameter set message includes time information indicating when the deferral management parameters need to be configured.

41. The WLAN of claim 29 wherein the deferral management parameter set message includes parameters including transmission power settings.

42. The WLAN of claim 29 wherein the deferral management parameter set message includes parameters including defer threshold (DT)/energy detect threshold (EDT) settings.

43. The WLAN of claim 29 wherein the deferral management parameter set message includes at least one clear channel assessment (CCA) mode parameter.

44. A wireless local area network (WLAN) comprising:

an access point (AP); and

a plurality of wireless transmit/receive units (WTRUs), wherein the AP sends a measurement request message to at least one of the WTRUs which indicates what type of measurement the WTRU is to perform and which deferral management parameter should be used when collecting the requested measurement, and each of the at least one of the WTRUs sends a measurement report message to the AP which indicates the results of the measurement and which deferral management parameters were actually used to collect the measurement.

45. A wireless local area network (WLAN) comprising:

an access point (AP); and

a plurality of wireless transmit/receive units (WTRUs), wherein the AP sends a deferral management rule message to at least one of the WTRUs which specifies a certain rule which the at least one of the WTRUs must follow to determine values of deferral management parameters, the certain rule specifying which of the WTRUs are to be deferred to by the at least one of the WTRUs by adjusting a defer threshold (DT)/energy detect threshold (EDT) parameter setting to a highest possible value such that the at least one of the WTRUs can hear selected ones of the WTRUs.

46. The WLAN of claim 45 wherein the selected ones of the WTRUs are all located in the same base station system (BSS).

47. The WLAN of claim 45 wherein the at least one WTRU calculates the proper values of the deferral management parameters according to the

certain rule, and the at least one WTRU sending a deferral management rule execution confirmation message to the AP containing the actual values of the deferral management parameters resulting from the execution of the certain rule.

48. A wireless local area network (WLAN) comprising:

an access point (AP); and

a plurality of wireless transmit/receive units (WTRUs), wherein the AP sends a deferral management rule message to at least one of the WTRUs which specifies a certain rule which the at least one of the WTRUs must follow to determine values of deferral management parameters, the certain rule specifying which of the WTRUs are to be deferred to by the at least one of the WTRUs by adjusting a defer threshold (DT)/energy detect threshold (EDT) parameter setting to a highest possible value at which the at least one of the WTRUs can hear selected ones of the WTRUs minus a margin M specified by the certain rule.

49. The WLAN of claim 48 wherein the margin M is 3db and the highest possible value of the DT/EDT parameter is -85 dBm, resulting in setting the value of the DT/EDT parameter to -88 dBm.

50. The WLAN of claim 48 wherein the at least one WTRU calculates the proper values of the deferral management parameters according to the certain rule, and the at least one WTRU sending a deferral management rule execution confirmation message to the AP containing the actual values of the deferral management parameters resulting from the execution of the certain rule.

51. A wireless local area network (WLAN) comprising:

an access point (AP); and

a plurality of wireless transmit/receive units (WTRUs), wherein the AP sends a deferral management rule message to at least one of the WTRUs which specifies a certain rule which the at least one of the WTRUs must follow to determine values of deferral management parameters, the certain rule specifying

which of the WTRUs are to be deferred to by the at least one of the WTRUs by setting transmission power at a lowest possible value that ensures that the at least one of the WTRUs is heard by selected ones of the WTRUs.

52. The WLAN of claim 51 wherein the deferral management rule message includes a margin M that the at least one of the WTRUs should use when determining the value of the transmission power.

53. The WLAN of 52 wherein the margin is 3 dB and the minimum transmission power is 8 dBm, resulting in setting the value of the transmission power to 11 dBm.

54. The WLAN of claim 51 wherein the deferral management rule message specifies a minimum transmission rate that the at least one of the WTRUs should not exceed when setting the transmission power.

55. The WLAN of claim 51 wherein the at least one WTRU calculates the proper values of the deferral management parameters according to the certain rule, and the at least one WTRU sending a deferral management rule execution confirmation message to the AP containing the actual values of the deferral management parameters resulting from the execution of the certain rule.