[0001] METHOD AND SYSTEM FOR DELIVERY OF ASSISTANCE DATA

[0002] FIELD OF INVENTION

[0003] The present invention relates to wireless communication systems. More particularly, the present invention relates to delivery of assistance data to wireless transmit/receive units (WTRUs).

[0004] BACKGROUND

[0005] Referring initially to Figure 1, there is shown a conventional wireless communication system 100. The system 100 includes at least one wireless transmit/receive unit (WTRU) 102, an access point 104, and at least one system controller 106 for controlling and otherwise managing communications within the system 100. Typically, in wireless local area network (WLAN) type systems, the network may be deployed as shown in Figure 2.

[0006] In Figure 2, the wireless network 200 comprises a system controller 206, a plurality of access points 214, 216, and a plurality of WTRUs 212, 218. WTRUs 212, 218 are grouped with there respective access points 214, 216. These groupings are commonly referred to as basic service sets (BSSs) 220, 222. A plurality of BSSs 220, 222 are typically connected via a distribution system (DS) 224 wherein a plurality of BSSs are commonly referred to as an extended service set (ESS). The access points 214, 216 are preferably connected to the system controller 206 over a network 219.

[0007] Generally, assistance data is data provided, or otherwise accessible at a particular access point, to WTRUs associated with the particular access point. Typically, assistance data may include any type of data relating to any type of information related to access points neighboring the particular access point (i.e. access points whose respective coverage areas are adjacent to the coverage area of the particular access point). Providing assistance data facilitates ring/handover of WTRUs by providing essential information regarding finding/identifying neighboring access points.

[0008] By way of example, assistance data may include information regarding neighboring access points such as operational frequency of neighboring

WTRUs and access points, access modes [e.g. 802.11 Frequency Hopping Spread Spectrum (FHSS)/Direct Sequence Spread Spectrum (DSSS), 802.11a, 802.11b High Rate Direct Sequence Spread Spectrum (HR-DSSS), etc.], timing, system configuration information regarding neighboring basic service sets (BSSs) [e.g. ready to send (RTS)/clear to send (CTS), Point Coordination Function (PCF), Wired Equivalent Privacy (WEP), etc.].

[0009] Currently, assistance data is transmitted using point-to-point (i.e. unicast) signaling. In 802.xx type systems, for example, the assistance data is provided in the form of an Information Element (IE) containing neighbor information. The IE is incorporated into the existing Probe Response frame. The Probe Response frame is typically sent by an access point as a reply to a Probe Request management frame sent by a WTRU when the WTRU is attempting to discover neighboring BSSs. This arrangement is inefficient, however, in that transmitting assistance data using point-to-point signaling results in significant amounts of network traffic thereby significantly increasing the likelihood of significant delays not only with respect to transmission/reception of the assistance data, but also with respect to transmissions/receptions generally.

[0010] It would therefore be desirable to provide a method and system for providing WTRUs with assistance data without the limitations discussed above.

[0011] SUMMARY

[0012] The present invention is a method and system for providing assistance data to wireless transmit/receive units (WTRUs). The assistance data includes information regarding an access point's neighboring access points. The assistance data is transmitted to WTRUs using multicast and/or broadcast type signaling and facilitates ring and handover of WTRUs from one access point to another.

[0012a] According to the first aspect of the present invention, there is provided an access point (AP) configured to provide assistance data relating to neighboring access points (APs), the AP comprising: a processor configured to: obtain neighbor information relating to a neighboring AP; generate assistance data based on the neighbor information; and broadcast a beacon that includes an indicator that indicates a presence of assistance data in the beacon on a condition that the indicator is filled, wherein the assistance data is included in an extended beacon frame and includes channel information, and wherein the indicator indicates an absence of assistance data in the beacon on a condition that the indicator is empty.

[0012b] According to a second aspect of the present invention, there is provided a wireless transmit/receive unit (WTRU) configured to receive assistance data relating to neighboring access points (AP)s, the WTRU comprising: a processor configured to receive a beacon, from an AP, wherein the beacon includes an indicator that indicates a presence of assistance data in the beacon on a condition that the indicator is filled, wherein the assistance data is included in an extended beacon frame and includes channel information, and wherein the indicator indicates an absence of assistance data in the beacon on a condition that the indicator is empty.

[0012c] According to third aspect of the present invention, there is provided a a method for providing assistance data relating to neighboring access points (AP)s to a wireless transmit/receive unit (WTRU), the method comprising:obtaining neighbor information relating to a neighboring AP; generating assistance data based on the neighbor information; and broadcasting a beacon that includes an indicator that indicates a presence of assistance data in the beacon on a condition that the indicator is filled, wherein the assistance data is included in an extended beacon frame and includes channel information, and wherein the indicator indicates an absence of assistance data in the beacon on a condition that the indicator is empty.

[0012d] According to a fourth aspect of the present invention, there is provided a method for receiving from an access point (AP) assistance data relating to neighboring access points (APs), the method comprising: receiving a beacon that includes an indicator that indicates a presence of assistance data in the beacon on a condition that the indicator is filled, wherein the assistance data is included in an extended beacon frame and includes channel information, and wherein the indicator indicates an absence of assistance data in the beacon on a condition that the indicator is empty.

[0012e] According to a fifth aspect of the present invention, there is provided an access point (AP) configured to provide assistance data relating to neighboring access points (APs), the AP comprising: a processor configured to obtain neighbor information relating to a neighboring AP and to periodically broadcast a message that includes an indicator that indicates a presence of assistance data in the message

on a condition that the indicator is filled, wherein the assistance data includes a number of neighbor APs, identities (IDs) of each neighbor AP, timing information, and information relating to the access mode of each AP.

[0012f] According to a sixth aspect of the present invention, there is provided a wireless transmit/receive unit (WTRU) configured to receive assistance data relating to neighboring access points (AP)s, the WTRU comprising: a receiver configured to periodically receive a message that includes an indicator that indicates a presence of assistance data in the message on a condition that the indicator is filled, wherein the assistance data includes a number of neighbor APs, identities (IDs) of each neighbor AP, timing information, and information relating to the access mode of each AP.

[0013] BRIEF DESCRIPTION OF THE DRAWING(S)

[0014] Figure 1 is a block diagram of a conventional wireless

communication system.

[0015] Figure 2 is a block diagram of a conventional wireless communication system having a plurality of access points and a plurality of WTRUs.

[0016] Figure 3 is a block diagram of a wireless communication system in accordance with the present invention.

[0017] Figure 4 is a diagram of neighbor information being transmitted by an access point at a predetermined multiple of the time period with which the access point is transmitting its beacons.

[0018] Figure 5 is a diagram of neighbor information being transmitted along with a beacon in the form of an extended beacon at a predetermined multiple of the time period with which the access point transmits its regular beacons.

[0019] DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT(S)

[0020] 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.

[0021] Herein, a wireless transmit/receive unit (WTRU) includes but is not limited to a user equipment, mobile station, fixed or mobile subscriber unit, pager, or any other type of device capable of operating in a wireless environment. When referred to herein, an access point includes but is not limited to a base station, Node-B, site controller, access point or any other type of interfacing device in a wireless environment. Herein, the term handover includes changing access points while a WTRU is actively receiving/sending data and the term ring includes changing access points while a WTRU is not actively receiving/sending data. The present invention applies equally to both scenarios and the terms handover and ring may be used interchangeably herein such that both terms refer generically to situations where a WTRU affiliated or otherwise operating with a first access point becomes affiliated with a second access point and the

affiliation with the first access point is eventually terminated.

[0022] Generally, in the present invention, access points obtain assistance data using OAM, inter-access point signaling, scanning, commanding WTRUs to scan, or a combination thereof and transmit this information as a single message to a plurality of WTRUs. Once obtained, an access point may also share neighbor information with other access points allowing those access points to also transmit the information to WTRUs.

[0023] Referring now to Figure 3, there is shown a wireless communication system 300. The system 300 includes at least one extended service set (ESS). For purposes of describing the present invention, however, two ESSs 336, 338 are shown in Figure 3. The first ESS 336 is configured in accordance with the present invention and includes a system controller 302, plurality of access points 304, 306, 308, and plurality of WTRUs 310, 312, 314. Of course, the first ESS 336 could be configured with a single access point, where appropriate, in which case it may be referred to as a BSS. The overall coverage area of the first ESS 336 is outlined in bold and includes coverage areas, 324, 326, 328. The second ESS 338 also includes a system controller 316, a plurality of access points 318, 320, 322, and a plurality of WTRUs (not shown). The overall coverage area of the second ESS 338 includes coverage areas 330, 332, 334.

[0024] In the present invention, the access points 304, 306, 308 of the first ESS 336 each include processors 340, 342, 344 for obtaining assistance data and providing it to their respective WTRUs. The assistance data facilitates handover and ring of WTRUs. It is noted that only the first ESS 336 is shown configured in accordance with the present invention purely for simplicity in describing the invention. Of course, any number of access points regardless of their affiliation with an ESS or BSS may be configured in accordance with the present invention.

[0025] The assistance data (i.e. neighbor list or neighbor information) is preferably obtained by operation and maintenance (OAM), proprietary signaling between access points (i.e. inter-access point signaling), active/passive scanning of channels other than the one being used by the scanning access point, and/or measurement reports from WTRUs. The method used for obtaining neighbor information may vary depending on the neighboring access point for which

information is sought.

[0026] For example, in Figure 3, when access point 304 is seeking information regarding access points 306 and 308 within the same ESS 336 of the access point 304, it may be preferable to use inter-access point signaling and/or may be preferable because, for example, access points 304, 306, 308 share a common system controller 302 allowing neighbor information regarding access points 306, 308 to be provided to access point 304 via at controller 302. Inter-access point signaling may be preferable because, for example, while direct connections between access points 304, 306, 308 are shown for simplicity, a distribution network as shown in Figure 2 is typically provided between the access points 304, 306, 308 that make up an ESS 336. The distribution network provides direct wired connections over which inter-access point signaling may efficiently be performed. When using inter-access point signaling, Inter-Access Point Protocol (IAPP) may be used.

[0027] As mentioned above, other options are also available for the access point 304 to obtain neighbor information from neighboring access points 306, 308. For example, access point 304 may command WTRUs 310 to scan channels other than the one being used by access point 304 to obtain neighbor information for any detected channels and report back the information. The access point 304 may also scan for other channels itself. Where the access point 304 is scanning, such scanning may be done independently of or together with any scanning being done by the WTRU 310. In this embodiment, a quality metric, such as received power, may be used to choose between measurements obtained by the access point 304 versus measurements obtained by the WTRU 310 for the same channel.

[0028] Where the access point 304 is obtaining information regarding a neighboring access point 318 that happens to be outside of access point's 304 ESS 336, it may be preferable to obtain the information via scanning. As discussed above, the access point 304 may perform the scanning (either passively or actively) itself or command the WTRUs 310 to perform the scanning (either passively or actively) and report back. Of course, access point 304 is not limited to using scanning for obtaining neighbor information regarding access point 318. The access point 304 may also obtain information regarding access point 318

using and inter-access point signaling.

[0029] The processor 340 of access point 304 is preferably configured to obtain the neighbor information as described above. Of course, more than one processor may be used, as desired. The information obtained by processor 340 may be stored in memory 350, as needed. Further, the processor(s) 340 of the access point 304 is also configured to provide the neighbor information as explained below.

[0030] It is noted that the various methods described above may be used in combination where appropriate. For example, when an access point 304 initially comes on-line, and it does not have a neighbor information defined through it can itself scan the surroundings and/or command a few of its WTRUs 310 to scan as well. Once the access point 304 has the results of this scan, it can then use this information to inform other access points 306, 308 within its ESS 336 about the discovery. This will minimize the amount of scanning (which may cause some small disruption in traffic) performed by these access points 306, 308. This arrangement may be particularly helpful where access point 304 is seeking neighbor information from an access point 318 outside ESS 324 because access point's 304 information likely will not include access points 318, 320, 322 outside of ESS 324. It is also noted that in a preferred embodiment, the access point 304 should, after startup and discovery of the neighbor information, periodically scan (or ask one of its WTRUs to scan) to see if the neighbor information situation has changed.

[0031] The neighbor information obtained by access point 304 is preferably periodically broadcast or multicast to WTRUs 310 operating within the coverage area 336 of access point 304. Referring now to Figure 4, using WLANs as an example, access points and WTRUs operating within a particular BSS all transmit and receive using a single channel (i.e. frequency). As shown in Figure 4, the access point periodically transmits a beacon 402 on its respective channel. The time period in which the beacon is transmitted is typically referred to as a beacon frame. The beacon 402 is typically transmitted approximately every 100ms. Although possible, it is typically not necessary for an access point to

transmit the neighbor information it has obtained to its WTRUs at each beacon. Therefore, in a preferred embodiment, access points are configured to transmit their neighbor information at a predetermined multiple of the time period between which the access points transmit their beacons 402. The multiple may be set as desired and is preferably a function of the degree of mobility of WTRUs affiliated with their respective access point.

[0032] By way of example, in Figure 4, neighbor information 406 is shown being transmitted by an access point at a particular multiple of the beacon interval. The particular access point that is transmitting the neighbor information 406 shares the channel with the WTRUs with which it is affiliated. Therefore, in a beacon interval where neighbor information is being transmitted, once the access point has completed transmission of its beacon 402, it waits a certain amount of time until it can gain access to the channel again. This amount of time is typically referred to as a contention phase 404 because the access point is contending with its respective WTRUs for access to the channel. Once the access point gains access to the channel, it transmits the neighbor information 406 wherein information about neighboring access points is provided, as explained above, to WTRUs affiliated with the access point.

[0033] The neighbor information 406 may be transmitted as a multicast message(s) to a predetermined group(s) of WTRUs affiliated with the access point that is transmitting the neighbor information 406. In another embodiment, the neighbor information 406 may be broadcast to all WTRUs affiliated with the transmitting access point. It is noted that the WTRUs, in parallel with the access points' efforts to provide them with neighbor information 406, may also use point-to-point probe requests and/or scanning of channels. The WTRUs may implement such techniques as a backup and/or complement to receiving such information from the access point.

[0034] The neighbor information 406 is preferably transmitted using a management type frame (i.e. during a time period wherein system management information is transmitted). The management type frame that is used, in one embodiment, is preferably the same as that which is used in the prior art when WTRUs obtain neighbor information using point-to-point signaling. Further, the

associated procedures implemented in a WTRU after it receives neighbor information 406 are the same as that of a point-to-point message, with the exception of the WTRU's acknowledgement.

[0035] Referring now to Figure 5, another embodiment of the present invention is shown. In this embodiment, the typical beacon signal is configured with an extra bit wherein the extra bit indicates the presence/absence of neighbor information. The beacons 502 transmitted in a regular beacon frame are shown with the signaling bit 506 being empty. The beacons 502 are transmitted as normal in a regular beacon frame by an access point according to a predetermined schedule. The periodicity with which the neighbor information is sent is a predetermined multiple of the time period between which the beacons 502 are being transmitted, as discussed above. When it is time for the neighbor information to be transmitted by an access point to its respective WTRUs, the neighbor information 508 is added to the beacon 502 and transmitted along with it in an extended beacon frame 504. In this scenario the signaling bit 506 of the beacon 502 is solid to reflect the fact that the bit is set such that it indicates neighbor information 508 is present within the extended beacon frame 504. In a preferred embodiment, the neighbor information 508 is added to the beacon 502 as an Information Element (IE). As discussed above, the neighbor information 508 includes information that assists WTRUs in efficiently handing over from one access point to a neighboring access point.

[0036] It is important to note that the present invention may be implemented in any type of wireless communication system. By way of example, the present invention may be implemented in wireless local area networks (WLAN), wireless personal area networks (WPAN), wireless metropolitan area networks (WMAN) or any other type of wireless communication systems/networks. Further, 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. An access point (AP) configured to provide assistance data relating to neighboring access points (APs), the AP comprising:

a processor configured to:

obtain neighbor information relating to a neighboring AP;

generate assistance data based on the neighbor information; and

broadcast a beacon that includes an indicator that indicates a presence of assistance data in the beacon on a condition that the indicator is filled, wherein the assistance data is included in an extended beacon frame and includes channel information, and wherein the indicator indicates an absence of assistance data in the beacon on a condition that the indicator is empty.

2. The AP of claim 1 wherein the processor is configured to include, in the extended beacon frame, information relating to at least one access mode associated with the neighboring AP.

3. The AP of claim 2 wherein the processor is configured to broadcast information related to at least one access mode, and wherein the at least one access mode includes an Institute of Electrical and Electronics Engineers (IEEE) 802.11 access mode.

4. The AP of claim 2 wherein the processor is configured to broadcast

information related to at least one access mode, and wherein the at least one access mode includes an Institute of Electrical and Electronics Engineers (IEEE) 802.xx high rate direct sequence spread spectrum (HR-DSSS) mode.

5. The AP of claim 1 wherein the channel information includes a channel on which the neighboring AP is found.

6. The AP of claim 1 wherein the processor is configured to obtain neighbor information relating to the neighboring AP via neighbor information from at least one wireless transmit/receive unit (WTRU) associated with the AP.

7. The AP of claim 1 wherein the processor is further configured to:

request neighbor information data from the neighboring AP; and

receive neighbor information data from the neighboring AP.

8. The AP of claim 1 wherein the processor is further configured to:

receive neighbor information from the neighboring AP.

9. The AP of claim 1 wherein the processor is configured to obtain neighbor information that includes quality metrics.

10. The AP of claim 1 wherein the processor is configured to obtain assistance data from wireless transmit/receive units (WTRUs) operating within

a physically overlapping area of a basic service set (BSS).

11. The AP of claim 1 wherein the indicator is a one bit indicator in length.

12. A wireless transmit/receive unit (WTRU) configured to receive assistance data relating to neighboring access points (AP)s, the WTRU comprising:

a processor configured to receive a beacon, from an AP, wherein the beacon includes an indicator that indicates a presence of assistance data in the beacon on a condition that the indicator is filled, wherein the assistance data is included in an extended beacon frame and includes channel information, and wherein the indicator indicates an absence of assistance data in the beacon on a condition that the indicator is empty.

13. The WTRU of claim 12 wherein the processor is configured to include, in the extended beacon frame, information relating to at least one access mode associated with a neighboring AP.

14. The WTRU of claim 13 wherein the processor is configured to receive information related to an access mode, and wherein the access mode includes an Institute of Electrical and Electronics Engineers (IEEE) 802.11 access mode.

15. The WTRU of claim 13 wherein the processor is configured to receive information related to an access mode, and wherein the access mode

includes an Institute of Electrical and Electronics Engineers (IEEE) 802.xx high rate direct sequence spread spectrum (HR-DSSS) mode.

16. The WTRU of claim 12 wherein the processor is further configured to:

receive a request to provide neighbor information from the AP; and

transmit neighbor information to the AP.

17. The WTRU of claim 12 wherein the processor is further configured to:

request additional neighbor information from a second WTRU; and

receive the additional neighbor information in response to the request.

18. The WTRU of claim 12, wherein the processor is configured to receive an indicator that is a one bit indicator in length.

19. A method for providing assistance data relating to neighboring access points (AP)s to a wireless transmit/receive unit (WTRU), the method comprising:

obtaining neighbor information relating to a neighboring AP;

generating assistance data based on the neighbor information; and

broadcasting a beacon that includes an indicator that indicates a

presence of assistance data in the beacon on a condition that the indicator is filled, wherein the assistance data is included in an extended beacon frame and includes channel information, and wherein the indicator indicates an absence of assistance data in the beacon on a condition that the indicator is empty.

20. The method of claim 19 wherein the extended beacon frame includes information relating to at least one access mode associated with the neighboring AP.

21. The method of claim 20 wherein the at least one access mode is an Institute of Electrical and Electronics Engineers (IEEE) 802.11 access mode.

22. The method of claim 20 wherein the at least one access mode includes an Institute of Electrical and Electronics Engineers (IEEE) 802.xx high rate direction sequence spread spectrum (HR-DSSS) access mode.

23. The method of claim 19 wherein the channel information includes a channel on which the neighboring AP is found.

24. The method of claim 19 wherein obtaining neighbor information relating to the neighboring AP includes:

receiving neighbor information from at least one WTRU associated with the AP.

25. The method of claim 19 wherein obtaining neighbor information relating to the neighboring AP includes:

requesting neighbor information data from the neighboring AP; and

receiving neighbor information data from neighboring AP.

26. The method of claim 19 wherein obtaining neighbor information includes:

receiving neighbor information from the neighboring AP.

27. The method of claim 19 wherein the indicator is a one bit indicator in length.

28. A method for receiving from an access point (AP) assistance data relating to neighboring access points (APs), the method comprising:

receiving a beacon that includes an indicator that indicates a presence of assistance data in the beacon on a condition that the indicator is filled, wherein the assistance data is included in an extended beacon frame and includes channel information, and wherein the indicator indicates an absence of assistance data in the beacon on a condition that the indicator is empty.

29. The method of claim 28 wherein the extended beacon frame

includes information relating to at least one access mode associated with the neighboring AP.

30. The method of claim 29 wherein the at least one access mode is an Institute of Electrical and Electronics Engineers (IEEE) 802.11 access mode.

31. The method of claim 29 wherein the at least one access mode includes an Institute of Electrical and Electronics Engineers (IEEE) 802.xx high rate direction sequence spread spectrum (HR-DSSS) access mode.

32. The method of claim 28 wherein the channel information includes a channel on which the neighboring AP is found.

33. The method of claim 28 wherein obtaining neighbor information relating to the neighboring AP includes:

receiving neighbor information from at least one wireless transmit/receive unit (WTRU) associated with the AP.

34. The method of claim 28 wherein obtaining neighbor information relating to the neighboring AP includes:

requesting neighbor information data from the neighboring AP; and

receiving neighbor information data from the neighboring AP.

35. The method of claim 28 wherein obtaining neighbor information for assisting data includes:

receiving neighbor information from the neighboring AP.

36. The method of claim 28 wherein the indicator is a one bit indicator in length.

37. An access point (AP) configured to provide assistance data relating to neighboring access points (APs), the AP comprising:

a processor configured to obtain neighbor information relating to a neighboring AP and to periodically broadcast a message that includes an indicator that indicates a presence of assistance data in the message on a condition that the indicator is filled, wherein the assistance data includes a number of neighbor APs, identities (IDs) of each neighbor AP, timing information, and information relating to the access mode of each AP.

38. A wireless transmit/receive unit (WTRU) configured to receive assistance data relating to neighboring access points (AP)s, the WTRU comprising:

a receiver configured to periodically receive a message that includes an indicator that indicates a presence of assistance data in the message on a condition that the indicator is filled, wherein the assistance data

includes a number of neighbor APs, identities (IDs) of each neighbor AP, timing information, and information relating to the access mode of each AP.