

(51) International Patent Classification:
H04W 36/08 (2009.01)(21) International Application Number:
PCT/KR2009/003334(22) International Filing Date:
22 June 2009 (22.06.2009)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
10-2008-0059576 24 June 2008 (24.06.2008) KR(71) Applicant (for all designated States except US): **ELECTRONICS AND TELECOMMUNICATIONS RESEARCH INSTITUTE** [KR/KR]; 161, Gajeong-dong, Yuseong-gu, Daejeon 305-350 (KR).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **JEON, Hong Seok** [KR/KR]; 202, 397-29, Doryong-dong, Yuseong-gu, Daejeon 305-340 (KR). **JEE, Junghoon** [KR/KR]; 304-1704, Yeolmae-maeul Apt., Jijok-dong, Yuseong-gu, Daejeon 305-330 (KR). **PARK, Chang Min** [KR/KR]; 104-1004, Hanmaroo Apt., Dunsan-dong, Seo-gu, Daejeon 302-120 (KR).(74) Agent: **YOU ME PATENT AND LAW FIRM**; Seolim Bldg., 649-10, Yoksam-dong, Kangnam-ku, Seoul 135-080 (KR).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

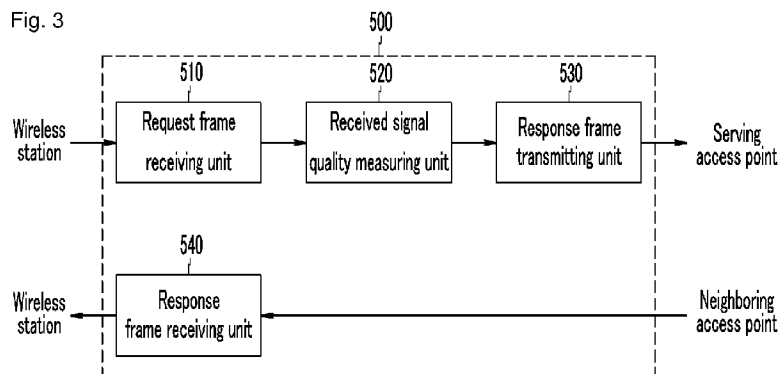
(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— without international search report and to be republished upon receipt of that report (Rule 48.2(g))

(54) Title: METHOD AND SYSTEM FOR REDUCING BACKGROUND SCANNING DELAY IN WIRELESS COMMUNICATION SYSTEM

Fig. 3



(57) Abstract: Disclosed is a background scanning delay reducing method and system in a wireless communication system. A wireless station transmits a frame that is required for measuring radio quality to a neighboring access point without standing by for a Beacon and a Probe Response frame from the neighboring access point on a channel used by the neighboring access point, and returns to a serving access station.

Description

METHOD AND SYSTEM FOR REDUCING BACKGROUND SCANNING DELAY IN WIRELESS COMMUNICATION SYSTEM

Technical Field

- [1] The present invention relates to a method and system for reducing a background scanning delay in a wireless communication system.

Background Art

- [2] For a background scanning operation, a wireless station first switches its current channel (hereinafter a serving channel) used by a currently connected access point(hereinafter a serving access point) to other channels (hereinafter neighboring channels) used by access points (hereinafter neighboring access points) which neighbor on the serving access point. The wireless station receives Beacon or a Probe Response frames from the neighboring access points over the neighboring channels and thus they can collect information of the neighboring access points by measuring received signal quality through the received frames. Once scanning neighboring access points is completed, the wireless station switches back to its serving channel and maintains a connection with the serving access point.
- [3] During the background scanning operation, the wireless station is unable to receive data from the serving access point. This is because the serving access point transmits the data on the serving channel while the wireless station stays on the neighboring channel in order to receive the Beacon or the Probe Response frame.
- [4] There is a method in which the background scanning operation is split into multiple sub-phases in order to reduce data loss during the background scanning operation. However, the long time interval between the sub-phases can make the information from a previous sub-phase out-of-date by the time of a last sub-phase. Therefore, it is meaningless to compare information from a first background scanning phase with information from a second background scanning phase executed after the wireless station is moved.
- [5] Further, another well-known method, SyncScan, requires a time synchronization between the wireless station and access points. Also, when there are multiple access points on the same neighbor channel, it is hard to guarantee receiving of all Beacon messages from the access points.
- [6] The above information disclosed in this Background section is only for enhancement of understanding of the background of the invention and therefore it may contain information that does not form the prior art that is already known in this country to a

person of ordinary skill in the art.

Disclosure of Invention

Technical Problem

- [7] The present invention has been made in an effort to provide a system and method for reducing a background scanning delay without deteriorating data service quality.

Technical Solution

- [8] An exemplary embodiment of the present invention provides a method a wireless station to reduce a background scanning delay including: transmitting a background scan request frame to a serving access point, and receiving a background scan response frame from the serving access point; broadcasting candidate access point probe request frames to each of neighboring access points, which are near the serving access point, based on the background scan response frame; receiving candidate access point probe response frames through the serving access point, each of the candidate access point probe response frames including received signal quality information measured by a corresponding neighboring access point; and selecting a target access point based on the candidate access point probe response frames.
- [9] Another embodiment of the present invention provides a method for a serving access point to reduce a background scanning delay including: transmitting a background scan response frame in response to a background scan request frame sent from a wireless station; receiving candidate access point probe response frames from neighboring access points in response to candidate access point probe request frames that are transmitted to the neighboring access points by the wireless station; and transmitting the received candidate access point probe response frames to the wireless station.
- [10] Yet another embodiment of the present invention provides a system for reducing a background scanning delay including: a request frame receiving unit for receiving a candidate access point probe request frame broadcasted from a wireless station; a received signal quality measuring unit for measuring received signal quality for the candidate access point probe request frame broadcasted from the wireless station and computing a received signal quality value; a response frame transmitting unit for generating a candidate access point probe response frame including the computed received signal quality value, and transmitting the candidate access point probe response frame to a serving access point to which the wireless station is connected; and a response frame receiving unit for transmitting the candidate access point probe response provided from the response frame transmitting unit to the wireless station.

Advantageous Effects

- [11] According to the present invention, the wireless station transmits a frame, which requests the neighboring access point to measure a link quality, to the neighboring

access point and then returns to the serving access point without waiting for the Beacon or the probe response frame from neighboring access point, thereby reducing a background scanning delay.

Brief Description of Drawings

- [12] FIG. 1 shows a schematic diagram of a wireless communication system according to an exemplary embodiment of the present invention.
- [13] FIG. 2 shows a relational diagram of an identifiable neighboring access point according to an exemplary embodiment of the present invention.
- [14] FIG. 3 shows a configuration diagram of a background scanning delay reducing system according to an exemplary embodiment of the present invention.
- [15] FIG. 4 shows a flowchart of a background scanning delay reducing method according to an exemplary embodiment of the present invention.
- [16] FIG. 5 shows a frame body configuration diagram of a candidate access point probe request frame and a candidate access point probe response frame according to an exemplary embodiment of the present invention.
- [17] FIG. 6 shows a flowchart of a neighboring access point determining method according to an exemplary embodiment of the present invention.
- [18] FIG. 7 shows a flowchart for requesting a background scanning acceptance between a wireless station and a serving access point according to an exemplary embodiment of the present invention.
- [19] FIG. 8 shows a flowchart for a wireless station according to an exemplary embodiment of the present invention to transmit a candidate access point probe request frame to neighboring access points.
- [20] FIG. 9 shows a flowchart for a neighboring access point according to an exemplary embodiment of the present invention to transmit a candidate access point probe response frame to the wireless station.

Mode for the Invention

- [21] In the following detailed description, only certain exemplary embodiments of the present invention have been shown and described, simply by way of illustration. As those skilled in the art would realize, the described embodiments may be modified in various different ways, all without departing from the spirit or scope of the present invention. Accordingly, the drawings and description are to be regarded as illustrative in nature and not restrictive. Like reference numerals designate like elements throughout the specification.
- [22] Throughout the specification, unless explicitly described to the contrary, the word "comprise" and variations such as "comprises" or "comprising" will be understood to imply the inclusion of stated elements but not the exclusion of any other elements. In

the specification, a wireless station may indicate a terminal a mobile station (MS), a mobile terminal (MT), a subscriber station (SS), a portable subscriber station (PSS), user equipment (UE), and an access terminal (AT), and may include partial or entire functions of the MS, MT, SS, PSS, UE, and AT.

- [23] An access point (AP) may indicate a base station (BS), a radio access station (RAS), a nodeB (Node B), a base transceiver station (BTS), and a mobile multihop relay (MMR)-BS, and may include partial or entire functions of the AP, RAS, Node B, BTS, and MMR-BS.
- [24] A background scanning delay described in an exemplary embodiment of the present invention means a period of time during which a wireless station stays on a channel of a neighboring access point in order to receive Beacon or Probe Response frames from the neighboring access points. In the exemplary embodiment of the present invention, a neighbor report method is used to obtain information of neighboring access points over a serving channel used by a serving access point to which the wireless station currently connects. In this instance, the neighbor report method will be described based on the neighbor report method of IEEE 802.11k, and it is not restricted thereto.
- [25] In order to measure the link quality of the neighboring access point, the wireless station does not measure signal strength of Beacon or Probe Response frames received from the neighboring access points. Instead, the wireless station makes use of reports which the neighboring access points produce and transmit to the wireless station via the serving access point. The reports describe measurement of signal strength for frames which the wireless station sent to the neighboring access points. As a result, in order to obtain information on the neighboring access point, the wireless station just transmits frames defined by the exemplary embodiment of the present invention for learning link quality of the neighboring access points without waiting Beacon and a Probe Response frames over the neighbor channel used by the neighboring access point.
- [26] A system and method for reducing a background scanning delay according to an exemplary embodiment of the present invention will now be described with reference to accompanying drawings.
- [27] FIG. 1 shows a schematic diagram of a wireless communication system according to an exemplary embodiment of the present invention.
- [28] As shown in FIG. 1, the wireless communication system includes at least one wireless station 100, a serving access point 200 for providing a service to the associated wireless station, at least one neighboring access point 300 next to the serving access point 200, and a distribution system 400 for connecting the serving access point 200 and the neighboring access point 300. The serving access point 200 and the neighboring access point 300 each form a basic service set, and the basic service set

and the distribution system form an extended service set.

[29] FIG. 1 shows a communication environment based on the IEEE 802.11 standard according to the exemplary embodiment of the present invention, but it is not restricted thereto. That is, the background scanning delay can be reduced in handover between heterogeneous networks (e.g., handover between the WiMAX network and the WiFi network) according to the exemplary embodiment of the present invention.

[30] Next, a relationship between connectable neighboring access points and disconnected neighboring access points from among neighboring access points will be described with reference to FIG. 2. Here, the neighboring access points 300 represent access points next to the serving access point 200 to which the wireless station 100 currently connects.

[31] FIG. 2 shows a relational diagram of an identifiable neighboring access point according to an exemplary embodiment of the present invention.

[32] As shown in FIG. 2, the neighboring access points 300 are classified as candidate access points (CAP) 300' and non-candidate access points (non-CAP) 300". Here, the candidate access point 300' is an access point that the wireless station can connect through a radio at its current position, and indicates an access point with which the wireless station is likely to make an association after disassociation with the current serving access point. The neighboring access points other than the candidate access point 300' are classified as non-candidate access points 300".

[33] A system and method for reducing a background scanning delay according to an exemplary embodiment of the present invention will now be described with reference to FIG. 3 and 4.

[34] FIG. 3 shows a configuration diagram of a background scanning delay reducing system according to an exemplary embodiment of the present invention, and FIG. 4 shows a flowchart of a background scanning delay reducing method according to an exemplary embodiment of the present invention.

[35] As shown in FIG. 3, an access point 500 of the system for reducing a background scanning delay includes a request frame receiving unit 510, a received signal quality measuring unit 520, a response frame transmitting unit 530, and a response frame receiving unit 540. Here, the access point 500 is shown by another reference numeral, which is applied to all the access points including the serving access point 200 and the neighboring access point 300.

[36] The request frame receiving unit 510 receives a candidate access point probe request frame sent from the wireless station 100. The received signal quality measuring unit 520 measures received signal strength for the candidate access point probe request frame received by the request frame receiving unit 510.

[37] The response frame transmitting unit 530 generates a candidate access point probe

response frame including the received signal strength value measured by the received signal quality measuring unit 520 and transmits it to the serving access point 200 to which the wireless station 100 currently connects. The response frame receiving unit 540 receives the candidate access point probe response frame sent from the neighboring access point 300 and forwards the frame to the wireless station 100.

[38] The constituent elements of the access point for reducing the background scan delay are described, and functions as a general access point are not described in the exemplary embodiment of the present invention. A method for reducing a background scanning delay in a communication environment in which an access point including the constituent elements is positioned will now be described referring to FIG. 4.

[39] As shown in FIG. 4, the wireless station 100 transmits a neighbor report request frame to the serving access point 200 which the wireless station 100 is associated with. Then the serving access point 200 returns a neighbor report response frame containing information about the neighboring access points (300-1, 300-2) that are located next to the serving access point 200 (S100). Two neighboring access points (the first neighboring access point 300-1 and the second neighboring access point 300-2) will be exemplified from among neighboring access points in the exemplary embodiment of the present invention, and the number of neighboring access points is not restricted to two. The serving access point 200 transmits a neighbor report response frame to the wireless station 100 (S110), and the wireless station 100 finishes selecting the neighboring access points (S120).

[40] Here, the neighbor report response frame includes information (e.g., channel information used by the neighboring access points) which is about neighboring access points 300-1 and 300-2 and is required for the wireless station 100 to perform a handoff operation. A process for selecting the neighboring access points will be described later with reference to FIG. 6.

[41] The wireless station 100 transmits a background scan request frame to the serving access point 200 so as to gain acceptance on background scanning from the serving access point 200 (S130). The serving access point 200 having received the background scan request frame transmits a background scan response frame to the wireless station 100 in response thereto (S140).

[42] If the serving access point 200 complies with the background scanning request from the wireless station 100, the wireless station 100 recognizes the compliance (S150) and then switch its channel to each of neighbor channel and broadcasts candidate access point (CAP) probe request frames to the neighboring access points 300-1 and 300-2 over the neighbor channels (S160 and S165). The wireless station 100 switches its channel back to a serving channel which the serving access point uses, without waiting for any responses to the candidate access point probe request frames over the neighbor

channels.

- [43] The neighboring access points 300-1 and 300-2 that have received the candidate access point probe request frame measure a received signal quality value for the candidate access point probe request frame (S170). Indication that can be used as the received signal quality value is a received channel power indicator (RCPI) or a received signal to noise indicator (RSNI), and is not restricted thereto.
- [44] The respective neighboring access points load the measured received signal quality value on a candidate access point (CAP) probe response frame and transmit the CAP probe response frame to the wireless station 100 through the serving access point 200 (S180 and S185). The wireless station 100 that has returned to the serving channel of the serving access point 200 receives the candidate access point probe response frames from the neighboring access points 300-1 and 300-2 through the serving access point 200. The wireless station 100 uses neighboring access point addresses included in the candidate access point probe response frames to know which neighboring access points generate the candidate access point probe response frames, and identifies the neighboring access points generating the candidate access point probe response frames as candidate access points (S190).
- [45] Here, a candidate access point probe request frame and a candidate access point probe response frame will be described with reference to FIG. 5.
- [46] FIG. 5 shows configuration diagrams of a candidate access point probe request frame and a candidate access point probe response frame according to an exemplary embodiment of the present invention.
- [47] As shown in FIG. 5, both candidate access point probe request frame and candidate access point probe response frame include wireless station address and serving access point address. The candidate access point probe request frame includes a candidate access point probe request frame body, and the candidate access point probe response frame includes a candidate access point probe response frame body. The candidate access point probe response frame includes a neighboring access point address which is an address of the access point transmitting the candidate access point probe response frame.
- [48] MAC addresses or IP addresses can be used for wireless station address and serving access point address, and is not restricted thereto. Neighboring access point address is an address of the access point generating the candidate access point probe response frame. The neighboring access point address enables the wireless station to know which neighboring access point generates the candidate access point probe response frame.
- [49] The candidate access point probe request frame body includes information about transmission power used when the wireless station 100 transmits a candidate access

point probe request frame and information about maximum transmission power of the wireless station 100. Also, the candidate access point probe request frame may include a Measurement Request frame.

- [50] The Measurement Request frame may be used when a wireless node (including a wireless station and an access point) requests specific measurement operations from another wireless node. The IEEE 802.11k defines fields which are in the Measurement Request frame and specify a measurement operation. The wireless station 100 requests information on the neighboring access points by piggybacking the Measurement Request frame on the candidate access point (CAP) probe request frame.
- [51] The candidate access point probe response frame body includes received signal quality information. Also, when the candidate access point probe request frame includes a Measurement Request frame, the candidate access point probe response frame includes a Measurement Response frame. Here, the candidate access point probe response frame can be used to provide information which is generally included in the Beacon or the Probe Response frames transmitted by neighboring access points. Both Measurement Request frame and Measurement Response frame use the same frame formats and actions as those defined by IEEE 802.11k in the exemplary embodiment of the present invention, but are not restricted thereto.
- [52] The Measurement Request frame and the Measurement Response frame can be used to share information only between wireless nodes (including a wireless station and an access point) which have been successfully associated with each other. Hence, the frames cannot be transmitted between the wireless station 100 and the neighboring access point 300 because they have not yet been associated with each other. However, if the candidate access point probe request frame and the candidate access point probe response frame convey the Measurement Request frame and the Measurement Response frame, the wireless station 100 can request some specific measurement actions from the neighboring access point 300 even though they are not yet associated with each other.
- [53] Referring to FIG. 4, the wireless station 100 selects candidate access points out of the neighboring access points using information included in the candidate access point probe response frame (S190), and decides a target access point (TAP) out of the selected candidate access points (S200). Several methods of the target access point decision have been studied and no detailed description thereof will be provided in the exemplary embodiment of the present invention. The wireless station 100 transmits a Probe Request frame to the first neighboring access point 300-1 which is selected as the target access point (S210), and then receives a Probe Response frame in response thereto (S220).
- [54] The transmitted Probe Request frame and the received Probe Response frame are

used for time synchronization between the wireless station 100 and the first neighboring access point 300-1 that is selected as the target access point by the wireless station 100. When receiving the Probe Response frame from the target access point, the wireless station 100 performs the joining process for time synchronization with the target access point. The joining process will be omitted since it is well known to a skilled person (S230).

[55] A method for determining the neighboring access point of S120 will now be described with reference to FIG. 6. Here, the method for determining the neighboring access point will be described in detail based on the method shown in FIG. 4.

[56] FIG. 6 shows a flowchart of a neighboring access point determining method according to an exemplary embodiment of the present invention.

[57] As shown in FIG. 4 and FIG. 6, regarding the method for determining the neighboring access point, the wireless station 100 transmits a neighbor report request frame to the serving access point 200 so as to request information about the neighboring access points 300-1 and 300-2 from the serving access point 200 (S121). The serving access point 200 transmits a neighbor report response frame to the wireless station 100 in response to the neighbor report request frame provided by the wireless station 100 (S122).

[58] As shown in FIG. 6, the information about neighboring access points is provided in a neighbor report element field of the neighbor report response frame, and the wireless station 100 determines the neighboring access point based on the information about neighboring access points (S123). Here, the information about the neighboring access point includes channel information used by the neighboring access point, a basic service set ID (BSSID), security information, and PHY related information. However, this stage can be omitted when the serving access point 200 does not support the neighbor report method.

[59] A method for requesting and accepting a background scanning operation between the wireless station 100 and the serving access point 200 in S150 of FIG. 4 will be described with reference to FIG. 7.

[60] FIG. 7 is a signal flow diagram illustrating an exemplary process of the present invention for requesting and accepting background scanning operation using service primitives between a wireless station and a serving access point.

[61] As shown in FIG. 7, internal messaging is performed with service primitives newly introduced by the embodiment of the present invention.

[62] Using the exemplary process, both wireless station 100 and serving access point 200 share information related to the background scanning operation, such as a background scanning duration, background scanning iteration, and background scanning interleaving interval. With the shared information, the serving access point 200 can be

aware of the starting point and completion point of the background scanning operation which the wireless station 100 performs, and buffer the packets destined for the wireless station 100 in order to reduce packet loss during the background scanning operation.

- [63] The wireless station 100 and the serving access point 200 respectively include a station management entity (SME) and a MAC layer management entity (MLME). The SME is a layer-independent entity in the layered architecture, and it is responsible to collect status information from respective layers or to set the value of layers-specific parameters. The MLME manages the status information of the MAC layer, and informs the SME of the status information as occasion demands.
- [64] Since the SME and the MLME are known to a person skilled in the art, no detailed description will be provided in the exemplary embodiment of the present invention. For ease of description in the exemplary embodiment of the present invention, a SME and a MLME for the wireless station 100 are respectively denoted as a first SME 410 and a first MLME 420. Similarly, a SME and a MLME for the serving access point 200 are depicted as a second SME 440 and a second MLME 430.
- [65] The first SME 410 of the wireless station 100 determines whether or not to gain acceptance of background scanning from the serving access point 200 before starting the background scanning process. If the first SME 410 of the wireless station 100 determines to gain the acceptance of the background scanning from the serving access point 200, the first SME 410 sets the value of parameters related to the background scanning, such as a background scanning duration, background scanning iteration number, and background scanning interleaving interval (S401), and transmits an MLME background scan request (MLME-BackgroundSCAN.req) message including the parameters related to the background scanning, that is, background scanning specific parameters to the first MLME 420 of the wireless station 100 (S402).
- [66] The first MLME 420 transmits a background scan request frame including the background scanning specific parameters to the serving access point 200 (S403), and the second MLME 430 of the serving access point 200 receives the background scan request frame. The second MLME 430 transmits an MLME background scan indication (MLME-BackgroundSCAN.ind) message including received signal quality for the background scan request frame and the background scanning specific parameters to the second SME 440 (S404).
- [67] The second SME 440 of the serving access point 200 determines whether or not to accept the request for the background scanning of the wireless station 100 upon receiving the MLME background scan indication message (S405). If the serving access point 200 determines to accept the request for background scanning of the wireless station 100, the second SME 440 of the serving access point 200 sets value of a

background scanning start point and obtains information on the background scanning with the background scanning specific parameters included in the background scan request frame (S406). However, if the serving access point 200 determines not to accept the request for background scanning of the wireless station 100, it transmits the background scan response frame which indicates non-permission of the background scan request to the wireless station 100 thereof.

[68] Here, the information on the background scanning includes a background scanning duration, background scanning iteration, and a background scanning interleaving interval. The serving access point 200 obtains the information on the background scanning of the wireless station 100 through background scanning specific parameters in the background scan request frame or new background scanning specific parameters obtained by modifying the background scanning specific parameters.

[69] The second SME 440 transmits an MLME background scan response (MLME-BackgroundSCAN.rsp) message including the received signal quality for the background scan request frame, the background scanning start point and the information on the background scanning to the second MLME 430(S407).

[70] The second MLME 430 transmits a background scan response frame including the received signal quality for the background scan request frame, the background scanning start point and the information on the background scanning to the wireless station 100 (S408), and the first MLME 420 receives the background scan response frame. The first MLME 420 transmits an MLME background scan confirm (MLME-BackgroundSCAN.cfm) message to the first SME 410 (S409). The MLME background scan confirming message is a response to the MLME background scan request. The wireless station 100 having received the MLME background scan confirming message checks to see whether or not the background scanning request is accepted (S410).

[71] According to an exemplary embodiment of the present invention, a method for a wireless station 100 to transmit a candidate access point probe request frame to two neighboring access points (a first access point and a second access point) 300-1 and 300-2 that use different channels respectively will now be described with reference to FIG. 8.

[72] FIG. 8 shows a flowchart for a wireless station to transmit candidate access point probe request frames to neighboring access points according to an exemplary embodiment of the present invention.

[73] The exemplary embodiment of the present invention assumes that the serving access point, the first neighboring access point 300-1 and the second neighboring access point 300-2 each use channel 1, channel 5 and channel 7, respectively. As shown in FIG. 8, the wireless station 100 switches its channel from channel 1 that the serving access

point 200 uses to channel 5 that the first neighboring access point 300-1 (S300) uses, and then broadcasts a candidate access point (CAP) probe request frame over the channel 5 (S310).

[74] Once the wireless station 100 broadcasts the candidate access point probe request frame over the channel 5, it switches its channel to channel 7 that the second neighboring access point 300-2 uses without waiting for any response over the channel 5 thereto (S320), and then broadcasts the candidate access point probe request frame over the channel 7 (S330).

[75] When the wireless station 100 and the serving access point 200 do not support the neighbor report function and thus the wireless station 100 cannot obtain information about channels that the neighboring access points use, the wireless station 100 broadcasts candidate access point probe request frames to its all available channels.

[76] After broadcasting the candidate access point probe request frame over channel 7, the wireless station 100 switches its channel back to the channel 1 that the serving access point 200 (S340) uses, and consecutively the serving access point 200 provides the network access service to the wireless station 100 through the channel 1.

[77] A process for the first neighboring access point 300-1 and the second neighboring access point 300-2 to transmit a candidate access point probe response frame to the wireless station through the serving access point 200 will now be described with reference to FIG. 9.

[78] FIG. 9 shows a flowchart for a neighboring access point to transmit a candidate access point probe response frame to the wireless station according to an exemplary embodiment of the present invention.

[79] As shown in FIG. 9, the first neighboring access point 300-1 and the second neighboring access point 300-2 receive a candidate access point probe request frame from the wireless station 100 and measure received signal quality for the received candidate access point probe request frame. A received channel power indicator, received signal to noise indicator, or other available signal quality variables can represent the received signal quality. The first neighboring access point 300-1 and the second neighboring access point 300-2 transmit candidate access point probe request response frames including the measurement results of the received signal quality to the wireless station 100 through the serving access point 200.

[80] The above-described embodiments can be realized through a program for realizing functions corresponding to the configuration of the embodiments or a recording medium for recording the program in addition to through the above-described device and/or method, which is easily realized by a person skilled in the art.

[81] While this invention has been described in connection with what is presently considered to be practical exemplary embodiments, it is to be understood that the

invention is not limited to the disclosed embodiments, but, on the contrary, is intended to cover various modifications and equivalent arrangements included within the spirit and scope of the appended claims.

Claims

- [1] A method for a wireless station to reduce a background scanning delay, comprising:
transmitting a background scan request frame to a serving access point, and receiving a background scan response frame from the serving access point;
broadcasting a candidate access point probe request frame to each of neighboring access points, which are near the serving access point, based on the background scan response frame;
receiving candidate access point probe response frames through the serving access point, each of the candidate access point probe response frames including received signal quality information measured by a corresponding neighboring access point; and
selecting a target access point based on the candidate access point probe response frames.
- [2] The method of claim 1, wherein
the candidate access point probe request frame includes wireless station's address information, serving access point's address information, and a candidate access point probe request frame body, and the candidate access point probe response frame includes wireless station's address information, serving access point's address information, and a candidate access point probe response frame body.
- [3] The method of claim 1, wherein
the wireless station has a structure of a station management entity (SME) and a MAC layer management entity (MLME), and
the receiving of a background scan response frame further includes:
the SME transmitting a MLME background scan request message to the MLME, the MLME background scan request message including background scanning period information, background scanning interleaving period information, and background scanning repeating number information;
the MLME transmitting the background scan request frame to the serving access point based on the MLME background scan request message;
the MLME receiving the background scan response frame for the background scan request frame from the serving access point; and
the MLME transmitting an MLME background scan confirming message to the SME to notify of finish of a background scanning accepting request.
- [4] The method of claim 1, wherein the method further includes,
before the receiving of a background scan response frame,
transmitting a neighbor report request frame to the serving access point;

receiving a neighbor report response frame from the serving access point in response to the neighbor report request frame; and
selecting a neighboring access point for the serving access point based on the neighbor report response frame.

- [5] The method of claim 4, wherein
the selecting of a neighboring access point selects a neighboring access point based on information on a neighboring access point of a neighbor report element field included in the received neighbor report response frame, the information on the neighboring access point including at least one among channel information used by the neighboring access point, a basic service set ID, security information, and PHY related information.
- [6] The method of claim 1, wherein
the broadcasting of a candidate access point probe request frame includes:
switching the wireless station's current channel from a channel connected to the serving access point to a channel used by a neighboring access point;
broadcasting the candidate access point probe request frame to the switched channel; and
switching the wireless station's current channel from the switched channel to the channel connected to the serving access point.
- [7] A method for a serving access point to reduce a background scanning delay, comprising:
transmitting a background scan response frame to a wireless station in response to a background scan request frame sent from the wireless station;
receiving candidate access point probe response frames from neighboring access points in response to candidate access point probe request frames that are transmitted to the neighboring access points by the wireless station; and
transmitting the received candidate access point probe response frames to the wireless station.
- [8] The method of claim 7, wherein
the serving access point has a structure of a station management entity (SME) and a MAC layer management entity (MLME), and
the transmitting of a background scan response frame includes:
the MLME receiving the background scan request frame from the wireless station;
the MLME transmitting an MLME background scan indicating message to the SME;
the SME determining to accept a background scanning request requested by the wireless station based on the MLME background scan indicating message;

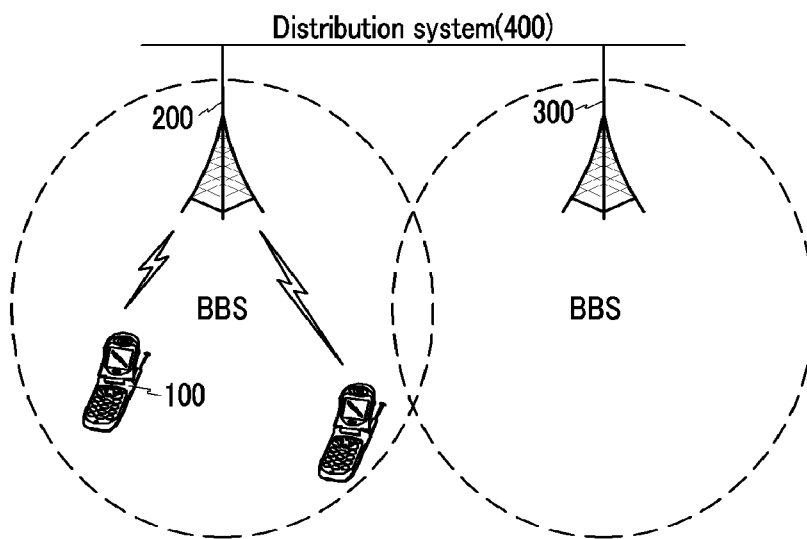
the SME transmitting an MLME background scan response message to the MLME; and

the MLME transmitting the background scan response frame to the wireless station.

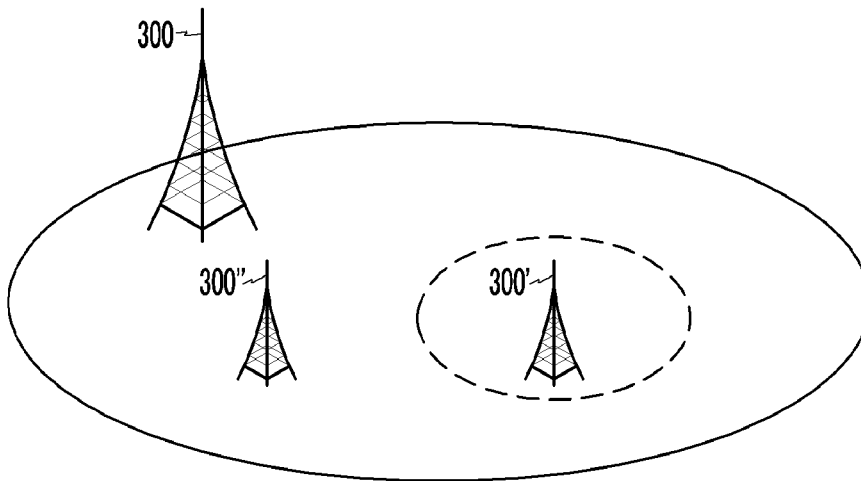
- [9] The method of claim 8, wherein
the background scan response frame includes at least one among received signal quality information for the background scan request frame, background scanning start point information, and information on the background scanning.
- [10] The method of claim 8, wherein
the background scan request frame includes at least one among background scanning duration information, background scanning interleaving interval information, and background scanning iteration number information.
- [11] A system for reducing a background scanning delay, comprising:
a request frame receiving unit for receiving a candidate access point probe request frame broadcasted from a wireless station;
a received signal quality measuring unit for measuring received signal quality for the candidate access point probe request frame broadcasted from the wireless station and computing a received signal quality value;
a response frame transmitting unit for generating a candidate access point probe response frame including the computed received signal quality value, and transmitting the candidate access point probe response frame to a serving access point to which the wireless station is connected; and
a response frame receiving unit for transmitting the candidate access point probe response provided from the response frame transmitting unit to the wireless station.
- [12] The system of claim 11, wherein
the candidate access point probe request frame broadcasted from the wireless station is broadcasted through a channel corresponding to a neighboring access point, or is broadcasted through channels available by the wireless station.
- [13] The system of claim 11, wherein
the candidate access point probe request frame includes at least one among transmit power information that is used when the wireless station transmits the candidate access point probe request frame, the wireless station's maximum transmit power information, and a measurement request frame.
- [14] The system of claim 11, wherein
the candidate access point probe response frame includes at least one among transmit power information of an access point for computing the received signal quality value, a measurement response frame, and information included in a

Beacon or a Probe Response frame.

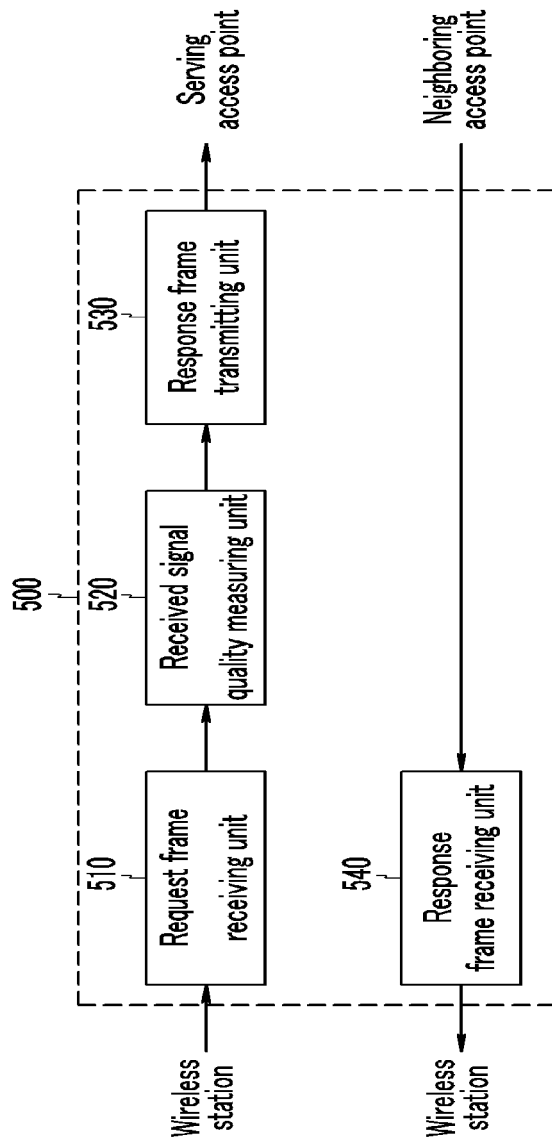
[Fig. 1]



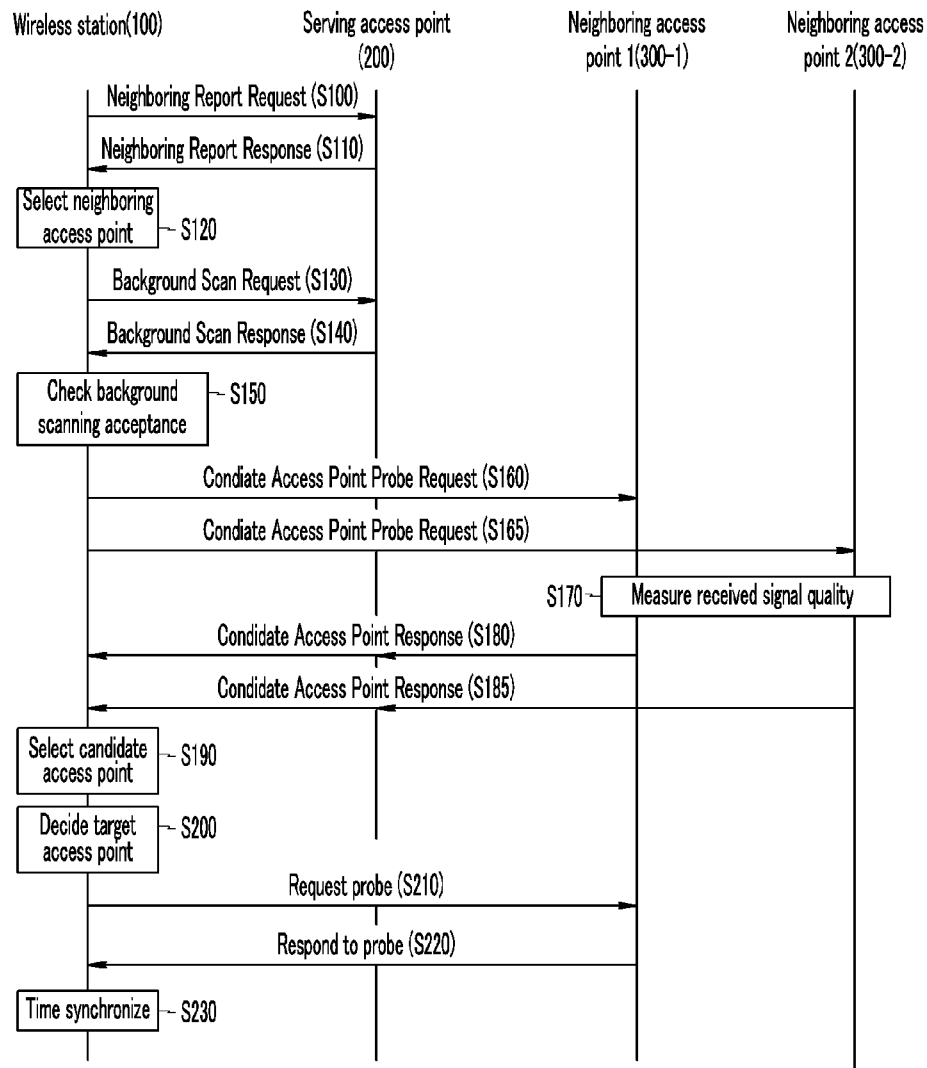
[Fig. 2]



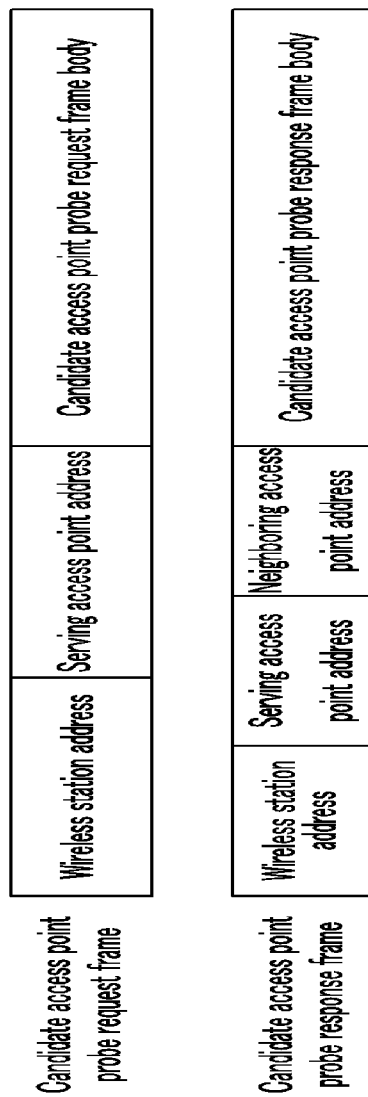
[Fig. 3]



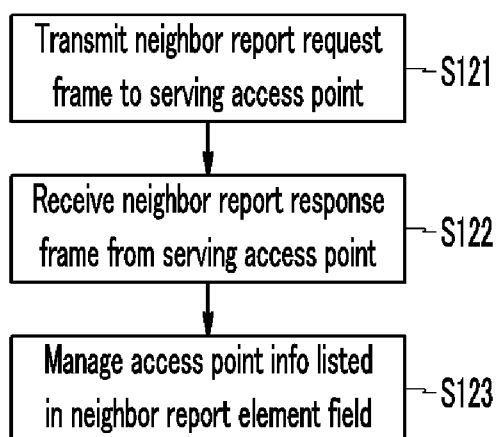
[Fig. 4]



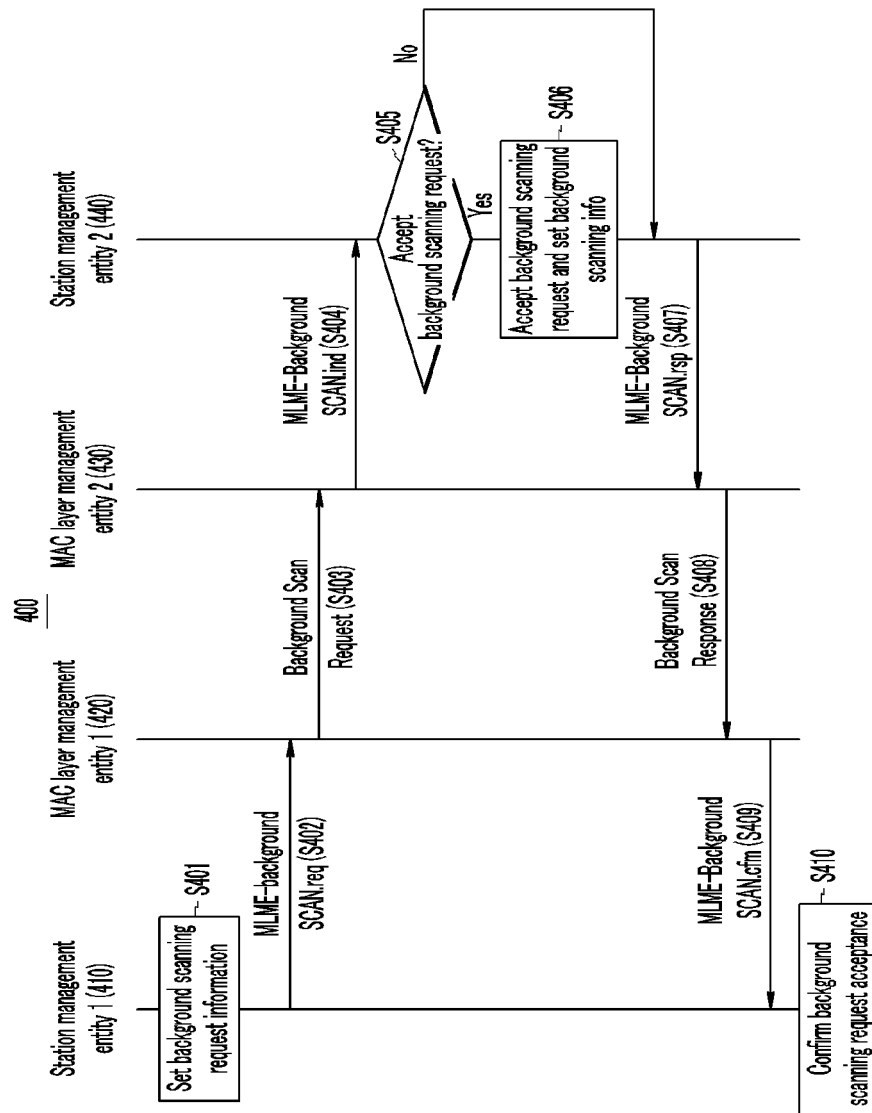
[Fig. 5]



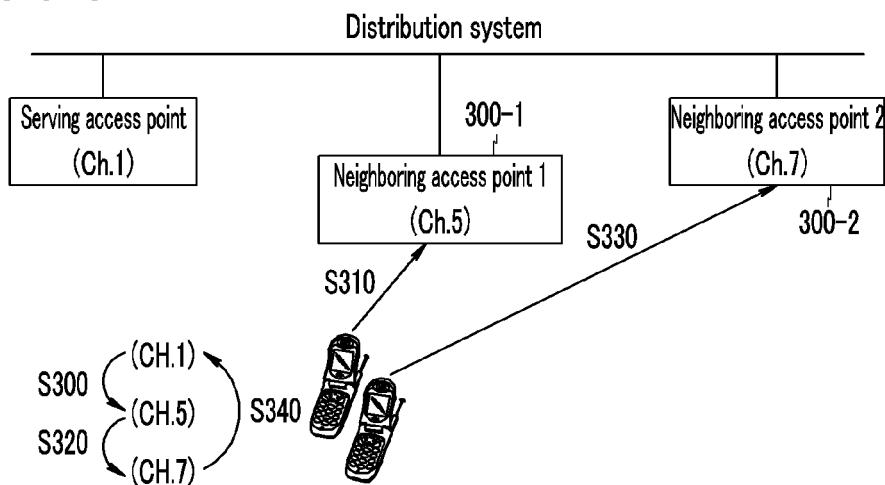
[Fig. 6]



[Fig. 7]



[Fig. 8]



[Fig. 9]

