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(54) **Title**: SYSTEMS AND METHODS TO TRANSMIT CONFIGURATION CHANGE MESSAGES BETWEEN AN ACCESS POINT AND A STATION

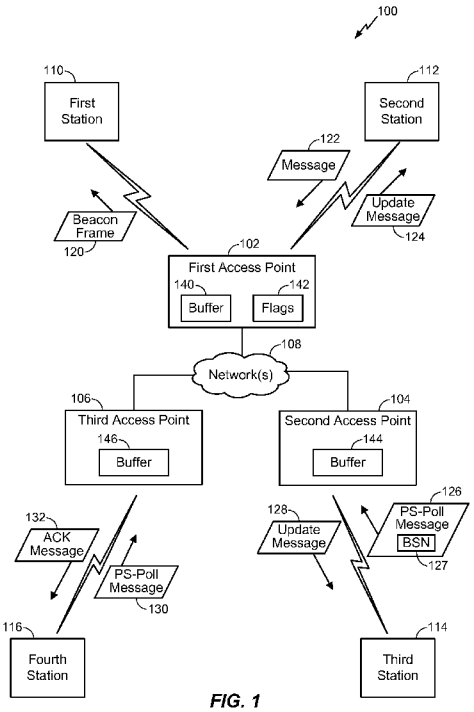

FIG. 1

(57) **Abstract**: A particular method includes transmitting a frame from a station to an access point. The frame includes a beacon sequence number related to a configuration of the access point. The method also includes, in response to transmitting the frame, receiving an update frame from the access point. The update frame indicates at least one change in the configuration of the access point.

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SYSTEMS AND METHODS TO TRANSMIT CONFIGURATION CHANGE MESSAGES BETWEEN AN ACCESS POINT AND A STATION

I. Cross-Reference to Related Applications

[0001] The present application claims priority from commonly owned U.S. Provisional Patent Application No. 61/584,667 filed January 9, 2012, the content of which is expressly incorporated herein by reference in its entirety.

II. Field

[0002] The present disclosure is generally related to transmission of configuration change messages between an access point and a station.

III. Description of Related Art

[0003] In wireless networks, stations (e.g., cell phones, personal digital assistants (PDAs), personal computing devices, laptops, and other computing devices) connect to an access point (e.g., a router) using wireless communication links. The access point may be connected to one or more networks and stations connected to the access point may access networks via the wireless communication links to the access point. The access point may periodically broadcast a beacon frame to stations within a coverage area associated with the access point. The beacon frame is broadcast by the access point in accordance with a beacon interval. The beacon frame may indicate that data intended for one of the stations is stored at the access point. The beacon frame may also indicate a change in the configuration of the access point.

[0004] Each of the stations connected to the access point may operate in synchronous mode or asynchronous mode. A station operating in the synchronous mode is configured to receive the beacon frame from the access point and determine whether the beacon frame indicates that the access point is storing data intended for the station. The station may also determine whether the beacon frame indicates that a configuration change has occurred at the access point. If the beacon frame indicates that the access point is not storing data intended for the station and that no configuration changes have

occurred, the station may transition to a low power mode (e.g., a sleep mode). At a subsequent time prior to broadcasting a next beacon frame, the station transitions out of the low power mode and prepares to receive the next beacon frame. If the beacon frame indicates that a configuration change has been made and/or that the access point is storing data intended for the station, the station may initiate communication with the access point to determine the configuration change and/or to receive the data stored at the access point. If a configuration change has occurred, the station may modify a configuration of the station based on information associated with the configuration change received from the access point. Thus, stations operating in the synchronous mode are able to conserve battery power by transitioning into the low power mode in between transmission of each beacon frame when the station does not need to receive data, and/or configuration change data, from the access point. Because stations operating in the synchronous mode receive each beacon frame, each station receives notification of each configuration change that occurs at the access point and is able to synchronize the configuration of the station with the configuration of the access point.

[0005] Unlike stations operating in the synchronous mode, stations operating in the asynchronous mode may transition into an asynchronous low power mode that may be longer than the beacon interval. Accordingly, stations operating in the asynchronous mode may not receive each beacon frame. If a beacon frame identifying an access point configuration change is transmitted by an access point while a station is in the asynchronous low power mode, the station may not receive notification of the configuration change when the station transitions out of the asynchronous low power mode. Thus, stations operating in the asynchronous mode may remain configured according to out of date access point configuration information.

IV. Summary

[0006] Systems and methods of transmitting configuration change messages between an access point and a station are disclosed. In a particular embodiment, the described techniques may find application in Institute of Electrical and Electronics Engineers (IEEE) 802.11ah compliant devices that may have low duty cycles. To illustrate, a wireless sensor that communicates over an IEEE 802.11ah compliant network may wake up for a relatively short period of time to perform a few measurements,

communicate results of the measurements to a destination via an access point (or communicate the results to the access point), and then sleep for a relatively long period of time. Because the wireless sensor is frequently in a sleep mode to conserve power, the wireless sensor may not be aware of network or system configuration that may have changed while the wireless sensor was in the sleep mode. After waking up, the wireless sensor may require information related to configuration changes from the access point. The disclosed techniques may enable updated configuration information to be communicated between the access point and the low duty cycle wireless sensor.

[0007] In a particular embodiment, a method includes transmitting a frame from a station to an access point. The frame includes a beacon sequence number related to a configuration of the access point. The method also includes, in response to transmitting the frame, receiving an update frame from the access point. The update frame indicates at least one change in the configuration of the access point.

[0008] In another particular embodiment, a method includes receiving a frame from a station at an access point. The frame includes a beacon sequence number identifying a last known configuration of the access point that was known to the station prior to the station entering a low power mode. The method also includes determining whether a current configuration of the access point is identified by the beacon sequence number received from the station in the frame. The method further includes, in response to determining that the current configuration is not identified by the beacon sequence number, transmitting an update frame that indicates at least one difference between the current configuration and the configuration identified by the beacon sequence number.

[0009] In another particular embodiment, a method includes transmitting, from a station to an access point, a frame requesting data for the station that is buffered by the access point. The method also includes, in response to transmitting the frame, receiving an update frame from the access point indicating at least one change in a configuration of the access point.

[0010] In another particular embodiment, a method includes receiving a frame from a station at an access point. The access point includes a flags register that stores information associated with stations that operate in an asynchronous mode. The method

further includes determining whether the station operates in the asynchronous mode. The method also includes, in response to determining that the station operates in the asynchronous mode, determining information stored at the flags register that is associated with the station indicates that an update frame is to be transmitted to the station. The method further includes, in response to determining that the information indicates that an update frame is to be transmitted to the station, transmitting the update frame to the station. The update frame indicates at least one change in a configuration of the access point.

[0011] In another particular embodiment, a method includes transmitting a frame from a station to an access point. The method also includes, in response to transmitting the frame, receiving an acknowledgement frame including an updated beacon sequence number related to an updated configuration of the access point. The method further includes determining whether a last known configuration of the access point is identified by the updated beacon sequence number. The method also includes, in response to determining that the last known configuration of the access point is not identified by the updated beacon number, transmitting an update request frame to the access point.

[0012] In another particular embodiment, a method includes receiving a frame from a station at an access point. The method further includes, in response to receiving the frame, transmitting an acknowledgement frame including an updated beacon sequence number related to an updated configuration of the access point.

[0013] In a particular embodiment, an apparatus includes a processor and a memory storing instructions executable by the processor. The instructions are executable to initiate transmission of a frame from a station to an access point. The frame includes a beacon sequence number related to a configuration of the access point. The instructions are further executable, in response to transmission of the frame, to detect receipt of an update frame from the access point indicating at least one change in the configuration of the access point.

[0014] In another particular embodiment, an apparatus includes a processor and a memory storing instructions executable by the processor. The instructions are

executable to detect receipt of a frame from a station at an access point. The instructions are further executable, in response to receiving the frame, to initiate transmission of an acknowledgement frame including an updated beacon sequence number related to an updated configuration of the access point.

[0015] In a particular embodiment, an apparatus includes means for receiving a frame from a station at an access point. The frame includes a beacon sequence number identifying a last known configuration of the access point that was known to the station prior to the station entering a low power mode. The apparatus also includes means for determining whether a current configuration of the access point is identified by the beacon sequence number received from the station in the frame. The apparatus further includes means for transmitting an update frame that indicates at least one difference between the current configuration and the configuration identified by the beacon sequence number in response to determining that the current configuration is not identified by the beacon sequence number.

[0016] In another particular embodiment, an apparatus includes means for transmitting a frame from a station to an access point. The apparatus also includes means for receiving an acknowledgement frame including an updated beacon sequence number related to an updated configuration of the access point in response to the frame. The apparatus further includes means for determining whether a last known configuration of the access point is identified by the updated beacon sequence number. The means for transmitting is further configured to transmit an update request frame to the access point in response to determining that the last known configuration of the access point is not identified by the updated beacon number.

[0017] In a particular embodiment, a non-transitory computer-readable medium includes program code that, when executed by a processor, causes the processor to initiate transmission of a frame from a station to an access point. The frame includes a beacon sequence number related to a configuration of the access point. The program code is executable to cause the processor, in response to transmission of the frame, to detect receipt of an update frame from the access point indicating at least one change in the configuration of the access point.

[0018] In a particular embodiment, a non-transitory computer-readable medium includes program code that, when executed by a processor, causes the processor to detect receipt of a frame from a station at an access point. The instructions are also executable to cause the processor, in response to receiving the frame, to initiate transmission of an acknowledgement frame including an updated beacon sequence number related to an updated configuration of the access point.

[0019] One advantage provided by at least one of the described embodiments includes an ability to efficiently and accurately provide current network/system configuration (i.e., access point configuration) to low power stations.

[0020] Other aspects, advantages, and features of the present disclosure will become apparent after review of the entire application, including the following sections: Brief Description of the Drawings, Detailed Description, and the Claims.

V. Brief Description of the Drawings

[0021] FIG. 1 is a diagram of a particular embodiment of a system operable to transmit configuration change messages between an access point and a station;

[0022] FIG. 2 is a diagram of particular embodiment of a method of transmitting configuration change messages between an access point and a station in the system of FIG. 1;

[0023] FIG. 3 is a diagram of another embodiment of a method of transmitting configuration change messages between an access point and a station in the system of FIG. 1;

[0024] FIG. 4 is a diagram of another embodiment of a method of transmitting configuration change messages between an access point and a station in the system of FIG. 1;

[0025] FIG. 5 is a block diagram of a particular embodiment of a station operable to transmit configuration change messages to an access point according to FIGs. 1-4; and

[0026] FIG. 6 is a block diagram of a particular embodiment of an access point operable to transmit configuration change messages to a station according to FIGs. 1-4.

VI. Detailed Description

[0027] Referring to FIG. 1, a diagram of a particular embodiment of a system operable to transmit configuration change messages between access points and stations is shown and generally designated 100. The system 100 includes access points 102, 104, and 106. Each of the access points 102, 104, 106 may be connected to one or more stations and to one or more networks 108. The access points 102, 104, 106 may be connected to the one or more networks 108 via wired or wireless connections.

[0028] As shown in FIG. 1, a first access point 102 is connected to a first station 110 via a first wireless communication link and to a second station 112 via a second wireless communication link. A second access point 104 is connected to a third station 114 via a third wireless communication link, and a third access point 106 is connected to a fourth station 116 via a fourth wireless communication link. Each of the wireless communication links may be established according to one or more wireless communication protocols (e.g., an Institute of Electrical and Electronics Engineers (IEEE) 802.11ah compliant protocol).

[0029] In a particular embodiment, a station may transmit a frame to an access point. The frame may request data for the station that is buffered by the access point (e.g., data for the station that was received and/or buffered by the access point while the station was in low power mode). For example, the frame may be a power save polling (PS-Poll) frame, which may be shorter in length than a probe request frame. Alternately, or in addition, the frame may be a trigger frame that causes the access point to send the data to the station. In a particular embodiment, the frame may include uplink data sent from the station to the access point. Upon receiving the frame, the access point may determine whether a flag stored in a register of the access point (e.g., a flag register) associated with the station indicates that an update frame is to be transmitted to the station. In response to determining that the flag indicates that an update frame is to be transmitted to the station, the access device may transmit the update frame to the station. In a particular embodiment, the update frame may indicate at least one change in a

configuration of the access point. The station may receive the update frame and is thus aware of a current configuration of the access point and may communicate with the access point based on the current configuration.

[0030] To illustrate, the first station 110 may operate in a synchronous mode and the second station 112 may operate in an asynchronous mode. As shown in FIG. 1, the first access point 102 includes a buffer 140 and a flags register 142. At a first time, the first access point 102 may receive first data from one of the one or more networks 108. The first access point 102 may determine that an intended recipient of the first data is the first station 110 and may store the first data in the buffer 140. At the first time, the first station 110 may be in a low power mode. At a subsequent time, after the first station 110 has transitioned out of the low power mode, the first access point 102 may broadcast a beacon frame 120 and the first station 110 may receive the beacon frame 120. The first station 110 may determine that the beacon frame 120 indicates that the first data intended for the first station 110 is stored in the buffer 140 of the first access point 102. The first station 110 may also determine that the beacon frame 120 indicates that a configuration change has occurred at the first access point 102 prior to the broadcast of the beacon frame 120 and subsequent to the broadcast of a previous beacon frame (i.e., while the first station 110 was in sleep mode). The first station 110 may modify a configuration of the first station 110 based on the information included in the beacon frame 120.

[0031] The flags register 142 of the first access point 102 may store information associated with stations that are connected to the first access point 102 and that are operating in the asynchronous mode. For example, an entry in the flags register 142 may be associated with the second station 112. The first access point 102 may set the entry in the flags register 142 associated with the second station 112 to a first value in response to determining that the second station 112 has not communicated with the first access point 102 since the change in the configuration of the first access point 102 occurred. In a particular embodiment, the first access point 102 may be configured to set entries in the flags register 142 to the first value in response to significant changes made to the configuration of the first access point 102, while non-significant configuration changes would not cause the first access point 102 to set the entries in the

flags register 142 to the first value. In a particular embodiment, whether a configuration change is "significant" may be defined in a standard (e.g., IEEE 802.11ah) and the first access point 102 may be configured to identify the significant configuration changes defined in the standard.

[0032] When the first access point 102 broadcasts the beacon frame 120, the second station 112 may be operating in the asynchronous low power mode and may not receive the configuration change notification indicated in the beacon frame 120. Because the second station 112 did not receive the beacon frame 120, a configuration of the second station 112 may be out of synch with the configuration of the first access point 102. In response to transitioning out of the asynchronous low power mode, the second station 112 may transmit a message 122 to the first access point 102. In a particular embodiment, the message 122 is a power save poll (PS-Poll) frame. Alternately, the frame may be a trigger frame that causes the first access point 102 to send data to the second station 112 (e.g., data for the second station 112 that was received and/or buffered by the first access point 102 while the second station 112 was in low power mode). In a particular embodiment, the frame may include uplink data sent from the second station 112 to the first access point 102.

[0033] In response to receiving the message 122 (e.g., the PS-Poll frame), the first access point 102 may determine whether the second station 112 operates in the asynchronous mode. In response to determining that the second station 112 operates in the asynchronous mode, the first access point 102 may determine whether the entry for the second station 112 in the flags register 142 is set to the first value, indicating that the second station 112 has not communicated with the first access point 102 since the change in the configuration of the first access point 102 occurred. When the entry in the flags register 142 is set to the first value, the first access point 102 transmits an update message 124 to the second station 112.

[0034] In a particular embodiment, the update message 124 may include information that identifies one or more parameter values in the current configuration of the first access point 102 that differ in value from the one or more parameter values in a previous configuration of the first access point 102. In another embodiment, the update message 124 may include information that identifies all of or a predetermined set of

parameter values associated with the configuration of the first access point 102. In yet another embodiment, the update message 124 may include information that indicates that the configuration of the first access point 102 has changed. The second station 112 may modify its configuration based on the information included in the update message 124 in response to receiving the update message 124.

[0035] In another embodiment, the update message 124 may be an acknowledgement (ACK) frame that includes an update bit. A first value of the update bit may indicate that the first access point 102 does not have data to send to the second station 112. A second value of the update bit may indicate that the first access point 102 has data to send to the second station 112. The data may include information associated with the configuration change at the first access point 102. Alternatively, or in addition, the data may include information received from a network (e.g., one of the networks 108) that is intended for the second station 112 and that is stored in the buffer 140. In response to determining that the update bit included in the acknowledgement message (e.g., the update message 124) is set to the first value, the second station 112 may transition into the asynchronous low power mode. In response to determining that the update bit included in the acknowledgement message (e.g., the update message 124) is set to the second value, the second station 112 may refrain from transitioning into the asynchronous low power mode until after the second station 112 receives the data from the first access point 102.

[0036] In a particular embodiment, the update message 124 may be a frame that is compatible with IEEE 802.11ah wireless networks, such as one or more frames defined in the IEEE 802.11ah standard, one or more modified update frames, a probe response frame, a channel change frame, an extended channel switch announcement (ECSA) frame, an operating mode change frame, a very high throughput (VHT) operating mode notification frame, another frame, or a combination thereof.

[0037] In a particular embodiment, the second access point 104 includes a buffer 144. The buffer 144 of the second access point 104 may operate as described with reference to the buffer 140 of the first access point 102. For example, the second access point 104 may receive second data addressed to the third station 114 via the networks 108. The third station 114 may operate in the asynchronous mode. The second access point 104

may store the second data in the buffer 144 until the third station 114 transmits a message to the second access point 104 indicating that the third station 114 is ready to receive the data.

[0038] By setting a value of an entry in a flags register associated with the third station 114 to the first value in response to changing the configuration of the second access point 104, the second access point 104 is able to determine whether the third station 114 was in the asynchronous low power mode when a beacon frame indicating the configuration change at the second access point 104 was broadcast. Thus, in response to receiving a PS-Poll message from the third station 114, the second access point 104 is able to automatically determine whether the third station 114 has received notification of the configuration change and, if not, automatically transmit an update message 124 including information that identifies the configuration change to the third station 114.

[0039] In another particular embodiment, a station communicating with an access point may transmit a frame to the access point. The frame may request data for the station that is buffered by the access point (e.g., data for the station that was received and/or buffered by the access point while the station was in low power mode). For example, the frame may be a power save polling (PS-Poll) frame. Alternately, or in addition, the frame may be a trigger frame that causes the access point to send the data to the station. In a particular embodiment, the frame may include uplink data sent from the station to the access point. The frame may include a beacon sequence number related to a configuration of the access point (i.e., a last known configuration of the access point that was known to the station prior to the station entering a low power mode). The access point may receive the frame and may determine that the beacon sequence number included in the frame corresponds to an 'old' configuration of the access point (i.e., not a current configuration of the access point). The access point may then transmit an update frame that indicates at least one difference between the current configuration and the old configuration identified by the received beacon sequence number. In an alternate embodiment, the access point may schedule transmission of the update frame to the station (e.g., during a period when the station is not in a sleep mode or a power-save mode) and may transmit the update frame during the scheduled time. Thus, the access point may refrain from transmitting the update frame to the station

until the station exits the sleep mode or the power-save mode. In yet another alternate embodiment, the access point may transmit an acknowledgement (ACK) frame including information, such as an update bit field, that notifies the station that an update frame is available (i.e., a current configuration is available). When the station receives the acknowledgement frame, the station may transmit an update request frame to the access point, and the access point may then transmit the update frame to the station.

[0040] To illustrate, the second access point 104 may be configured to communicate with the third station 114 via a wireless communication link. A configuration change may occur at the second access point 104 while the third station 114 is in the asynchronous low power mode, as described with reference to FIGs. 2-3. In a particular embodiment, the configuration change is associated with a channel configuration. For example, the second access point 104 may determine that a channel used by the second access point 104 to communicate with the third station 114 and other stations (not shown) may need to be temporarily quiet (i.e., no traffic). The second access point 104 may modify its configuration information to indicate that the channel is to be quiet. In a particular embodiment, the second access point 104 may change a current transmission or operating channel, may change an operation mode, or any combination thereof. For example, the channel change may be a channel switch or an extended channel switch. As another example, the operation mode change may include modification of enhanced distribution channel access (EDCA) parameters, modification of a quiet information element, modification of a direct sequence spread spectrum (DSSS) parameter set, modification of a contention-free (CF) parameter set, modification of a frequency-hopping (FH) parameter set, modification of a high-throughput (HT) operation element, or any combination thereof.

[0041] In response to modifying the configuration, the second access point 104 may modify (e.g., increment or decrement) a beacon sequence number that identifies a current configuration of the second access point 104. For example, prior to modifying the configuration of the second access point 104 to indicate that the channel is to be quiet, the beacon sequence number may have a value of X. In response to modifying the configuration, the second access point 104 may modify the beacon sequence number to a value of X+1 (e.g., an increment).

[0042] Prior to the change of configuration at the second access point 104, the third station 114 may have transitioned into the asynchronous low power mode. The third station 114 may store information indicating that the beacon sequence number associated with the second access point 104 has a value of X. The value of X stored at the third station 114 represents or corresponds to the last configuration of the second access point 104 that was known to the third station 114 prior to transitioning into the asynchronous low power mode. The third station 114 is unable to detect that the configuration of the second access point 104 has changed while the third station 114 is in the asynchronous low power mode. When the third station 114 transitions out of the asynchronous low power mode, the beacon sequence number stored at the third station 114 indicates that the configuration of the second access point 104 is the configuration associated with the beacon sequence number value of X. When the third station 114 transitions out of the asynchronous low power mode, the current beacon sequence number stored at the second access point 104 has a value of X+1.

[0043] When the third station 114 transitions out of the asynchronous low power mode, the third station 114 transmits a message to the second access point 104. The message may include a PS-Poll message 126 requesting data for the third station 114 that is buffered by the second access point 104. Alternately, or in addition, the message may include a trigger frame that causes the access point to send the data to the station. In a particular embodiment, the message may include uplink data sent from the third station 114 to the second access point 104. In a particular embodiment, the PS-Poll message 126 may include the beacon sequence number 127 that is stored at the third station 114 (e.g., the beacon sequence number having a value of X). The PS-Poll message 126 may be received by the second access point 104.

[0044] In response to receiving the PS-Poll message 126 from the third station 114, the second access point 104 may determine whether the beacon sequence number 127 included in the PS-Poll message 126 (e.g., the beacon sequence number having a value of X) identifies the current beacon sequence number stored at the second access point 104 (e.g., the beacon sequence number having a value of X+1). In response to determining that the beacon sequence number 127 included in the PS-Poll message 126 does not identify the current beacon sequence number stored at the second access point

104, the second access point 104 may transmit an update message 128 to the third station 114. The update message 128 may be similar to the update message 124 and may include information similar to the information included in the update message 124.

[0045] For example, the update message 128 may include information that identifies one or more parameter values in the current configuration of the second access point 104 that differ in value from the one or more parameter values in a previous configuration of the second access point 104. In another embodiment, the update message 128 may include information that identifies all of or a predetermined set of parameter values associated with the configuration of the second access point 104. In yet another embodiment, the update message 128 may include information that indicates that the configuration of the second access point 104 has changed. In response to receiving the update message 128, the third station 114 may modify its configuration based on the information included in the update message 128.

[0046] In another particular embodiment, the second access point 104 may transmit an acknowledgement frame (not shown) to the third station 114 instead of or in addition to transmitting the update message 128. The acknowledgement frame may include an update bit (e.g., a flag). In a particular embodiment, the update bit may indicate whether the beacon sequence number 127 stored at the third station 114 identifies the current beacon sequence number stored at the second access point 104. For example, a first value of the update bit may indicate that the beacon sequence number 127 stored at the third station 114 matches the current beacon sequence number stored at the second access point 104. A second value of the update bit may indicate that the beacon sequence number 127 stored at the third station 114 does not match the current beacon sequence number stored at the second access point 104.

[0047] In another particular embodiment, the update bit may indicate that the second access point 104 has data to send to the third station 114. For example, a first value of the update bit may indicate that the second access point 104 does not have data to send to the third station 114. A second value of the update bit may indicate that the second access point 104 has data to send to the third station 114. In a particular embodiment, the data may be related to the configuration change at the second access point 104. In another embodiment, the data may be related either to the configuration change at the

second access point 104 or may include data received from a network (e.g., one of the networks 108) that is intended for the third station 114.

[0048] The third station 114 may receive the acknowledgement frame and determine whether the update bit is set to the first value or the second value. When the update bit is set to the first value, the third station 114 may determine that the second access point 104 does not have data to send to the third station 114, and the third station 114 may transition back into the asynchronous low power mode. In a particular embodiment, when the update bit is set to the second value, the third station 114 may delay transitioning back into the asynchronous low power mode until after the third station 114 receives the data from the access point 104. In another embodiment, the third station 114 may transmit an update request message (not shown) to the second access point 104 indicating that the third station 114 is ready to receive the data from the second access point 104. The second access point 104 may transmit an update message (e.g., the update message 128) in response to receiving the update request from the third station 114. In a particular embodiment, the update message may include the configuration change data as described with reference to the update messages 124 and 128. Alternatively, or in addition, the update message may include data received from a network (e.g., one of the networks 108) that is intended for the third station 114.

[0049] By receiving the beacon sequence number 127 stored at the third station 114 in the PS-Poll message 126, the second access point 104 is able to determine whether the third station 114 was in the asynchronous low power mode when a beacon frame indicating a configuration change at the second access point 104 was broadcast by the second access point 104. Thus, the second access point 104 is able to automatically transmit the update message 128 including information that identifies the configuration change to the third station 114 in response to receiving the PS-Poll message 126.

[0050] In particular embodiment, a station may transmit a frame (e.g., a PS-Poll frame, a trigger frame, a frame requesting buffered data, and/or a frame including uplink data) to an access point and may receive an acknowledgement frame including an updated beacon sequence number related to an updated configuration of the access point in response to the frame. The station may determine whether a last known configuration of the access point is identified by the updated sequence number. If the last known

configuration of the access point is not identified by the received updated beacon sequence number, the station may transmit an update request frame to the access point. The access point may transmit an update frame to the station, the update frame indicating at least one change in the last known configuration of the access point that was known by the station.

[0051] As illustrated, the fourth station 116 may operate in the asynchronous mode and transition into the asynchronous low power mode. While the fourth station 116 is in the asynchronous low power mode, a configuration of the third access point 106 may be modified. Subsequent to the modification of the configuration of the third access point 106, the fourth station 116 may transition out of the asynchronous low power mode and transmit a PS-Poll message 130 to the third access point 106. The third access point 106 may receive the PS-Poll message 130 and transmit an acknowledgement message 132 to the fourth station 116. The acknowledgement message 132 may include a current beacon sequence number that identifies the current configuration of the third access point 106.

[0052] In response to receiving the acknowledgement message 132, the fourth station 116 may determine whether a beacon sequence number stored at the fourth station 116 corresponds to the configuration identified by the current beacon sequence number included in the acknowledgement message 132. When the beacon sequence number stored at the fourth station 116 matches the current beacon sequence number included in the acknowledgement message 132, the fourth station 116 may determine that the fourth station 116 is aware of the current configuration of the third access point 106. When the beacon sequence number stored at the fourth station 116 does not match the current beacon sequence number included in the acknowledgement message 132, the fourth station 116 may determine that the fourth station 116 is not aware of the current configuration of the third access point 106 and that the fourth station 116 needs to modify its configuration. In response to determining that the beacon sequence number stored at the fourth station 116 does not match the current beacon sequence number included in the acknowledgement message 132, the fourth station 116 may transmit an update request message (not shown) to the third access point 106.

[0053] In response to receiving the update request message at the third access point 106, the third access point 106 may transmit an update message (not shown). The update message transmitted by the third access point 106 may be similar to the update message 128 described above.

[0054] In a particular embodiment, the third access point 106 includes a buffer 146. The buffer 146 of the third access point 106 may operate as described with reference to the buffer 140 of the first access point 102. For example, the third access point 106 may receive third data addressed to the fourth station 116 via the networks 108. The fourth station 116 may operate in the asynchronous mode. The third access point 106 may store the third data in the buffer 146 until the fourth station 116 transmits a message to the third access point 106 indicating that the fourth station 116 is ready to receive the data.

[0055] By receiving the current beacon sequence number stored at the third access point 106 in the acknowledgement message 132, the fourth station 116 is able to determine whether the fourth station 116 was in the asynchronous low power mode when a configuration change at the third access point 106 occurred. Thus, the fourth station 116 is able to automatically transmit the update request message to the third access point 106 and the third access point 106 is able to transmit the update message (not shown) that includes information that identifies the configuration change to the access point 106.

[0056] Referring to FIG. 2, a diagram of a particular embodiment of a method of transmitting configuration change messages between access points and stations is disclosed and generally designated 200. In FIG. 2, a station 202 and an access point 204 are shown. In a particular embodiment, the access point 204 may be the second access point 104 of FIG. 1. As shown in FIG. 2, the access point 204 may store a current beacon sequence number (e.g., access point beacon sequence number (AP-BSN)) 208. The current beacon sequence number 208 may identify a current configuration of the access point 204. In a particular embodiment, the station 202 may store a beacon sequence number (e.g., station beacon sequence number (S-BSN)) 206. The station beacon sequence number 206 may identify a last known configuration of the access point 204 that is known to the station 202.

[0057] At a first time, the station beacon sequence number 206 may be set to a value of X and the current beacon sequence number 208 may be set to a value of X. The station 202 may enter an asynchronous low power mode, at 210. While the station 202 is in the asynchronous low power mode, the access point 204 may modify a configuration of the access point 204, at 212, and the current beacon sequence number 208 may be incremented to X+1. Because the station 202 is in the asynchronous low power mode, the station 202 may not receive a notification (e.g., a beacon frame, an update message, etc.) that the configuration of the access point 204 has changed.

[0058] At 214, the station 202 may transition out of the asynchronous low power mode. Subsequently, the station 202 transmits a PS-Poll message 218 to the access point 204, at 216. The PS-Poll message 218 may include the station beacon sequence number 206 stored at the station 202. At 222, the access point 204 may receive the PS-Poll message 218 from the station 202 and determine whether the station beacon sequence number 206 corresponds to the current beacon sequence number 208 stored at the access point 204.

[0059] In response to determining that the station beacon sequence number 206 does not correspond to the current beacon sequence number 208, the access point 204 may transmit an update frame 234 (e.g., the update message 128), at 224. The update frame 234 may include update data 236. In a particular embodiment, the update data 236 may include information that identifies one or more parameter values in the current configuration of the access point 204 that differ in value from the one or more parameter values in a previous configuration of the access point 204 (e.g., the configuration identified by the station beacon sequence number 206 stored at the station 202). In another embodiment, the update data 236 may include information that identifies all of or a predetermined set of parameter values associated with the configuration of the access point 204. In yet another embodiment, the update data 236 may include other information that indicates that the configuration of the access point 204 has changed. In response to receiving the update frame 234, the station 202 may modify its configuration (not shown) based on the update data 236 included in the update frame 234.

[0060] In an alternative embodiment, the access point 204 may transmit an acknowledgement frame 228 to the station 202 in response to determining that the station beacon sequence number 206 does not correspond to the current beacon sequence number 208, at 226. The acknowledgement frame 228 may include an update bit 230 (e.g., a flag) that indicates whether the station beacon sequence number 206 stored at the station 202 corresponds to the current beacon sequence number 208 stored at the access point 204. For example, a first value of the update bit 230 may indicate that the station beacon sequence number 206 stored at the station 202 matches the current beacon sequence number 208 stored at the access point 204. A second value of the update bit 230 may indicate that the station beacon sequence number 206 stored at the third station 114 does not match the current beacon sequence number 208 stored at the second access point 104.

[0061] At 232, the station 202 may receive the acknowledgement frame 228 and determine whether the update bit 230 is set to the first value or the second value. When the update bit 230 is set to the first value, the station 202 may determine that the current configuration of the access point 204 is the configuration identified by the station beacon sequence number 206 stored at the station 202. When the update bit 230 is set to the second value, the station 202 may determine that the current configuration of the access point 204 is not the configuration corresponding to the station beacon sequence number 206 stored at the station 202. In response to determining that the update bit 230 is set to the second value, the station 202 may transmit an update request message 240 to the access point 204, at 238. The update request message 240 may request that the access point 204 transmit an update message (e.g., one of the update messages 124, 128). At 224, the third access point 106 may transmit the update frame 234 in response to receiving the update request frame 234 at the access point 204. The update frame 234 may be similar to the update messages 124, 128 described with reference to FIG. 1.

[0062] Alternately, in response to the update bit 230 having the second value, the station 202 may remain in an active state (i.e., a state other than an asynchronous low power state or off state) to await transmission of the update frame 234 from the access point 204, and the access point 204 may automatically transmit the update frame 234 after transmitting the acknowledgement frame 228.

[0063] Referring to FIG. 3, a diagram of another embodiment of a method of transmitting configuration change messages between an access point and a station is disclosed and generally designated 300. In FIG. 3, a station 302 and an access point 304 are shown. The access point 304 includes a flags register 306. The flags register 306 may be the flags register 142 of FIG. 1.

[0064] At 308, the station 302 may enter an asynchronous low power mode. While the station 302 is in the asynchronous low power mode, the access point 304 may modify a configuration of the access point 304, at 310. Because the station 302 is in the asynchronous low power mode, the station 302 may not receive a notification (e.g., a beacon frame, an update message, etc.) that the configuration of the access point 304 has changed. At 312, the access point 304 may initialize one or more entries in the flags register 306 to a value that indicates that station(s) associated with the one or more entries (e.g., including the station 302) may not have received notification of the configuration change, as explained with reference to FIG. 1.

[0065] At 314, the station 302 may transition out of the asynchronous low power mode. Subsequently, the station 302 transmits a PS-Poll message 318 to the access point 304, at 316. At 320, the access point 304 may receive the PS-Poll message 318 from the station 302 and determine whether the value of the entry in the flags register 306 that is associated with the station 302 indicates that the station 302 did not receive the notification of configuration change of the access point 304. In response to determining that the station 302 did not receive the notification, the access point 304 may transmit an update frame 324 to the station 302, at 322. The update frame 324 may include update data 326, as described above with reference to FIGs. 1 and 2.

[0066] Referring to FIG. 4, a diagram of another embodiment of a method of transmitting configuration change messages between an access point and a station is disclosed and generally designated 400. In FIG. 4, a station 402 and an access point 404 are shown. As shown in FIG. 4, the access point 404 may include a current beacon sequence number 408 (e.g., an access point beacon sequence number (AP-BSN)). The current beacon sequence number 408 may identify a current configuration of the access point 404. In a particular embodiment, the station 402 may include a beacon sequence number 406 (e.g., a station beacon sequence number (S-BSN)). The station beacon

sequence number 406 may identify a last known configuration of the access point 404 that is known to the station 402.

[0067] At a first time, the station beacon sequence number 406 may be set to a value of X and the current beacon sequence number 408 may be set to a value of X. The station 402 may enter an asynchronous low power mode, at 410. While the station 402 is in the asynchronous low power mode, the access point 404 may modify a configuration of the access point 404, at 412, and the current beacon sequence number 408 may be incremented to X+1. Because the station 402 is in the asynchronous low power mode, the station 402 may not receive a notification (e.g., a beacon frame, an update message, etc.) that the configuration of the access point 404 has changed.

[0068] At 414, the station 402 may transition out of the asynchronous low power mode. Subsequently, the station 402 transmits a PS-Poll message 418 to the access point 404, at 416. However, in contrast to the PS-Poll message 218 of FIG. 2, the PS-Poll message 418 may not include the station beacon sequence number 406 stored at the station 402. In response to receiving the PS-Poll message 418, the access point 404 may transmit an acknowledgement frame 422 to the station 402, at 420. The acknowledgement frame 422 may include the current beacon sequence number 408 stored at the access point 404 (shown in FIG. 4 as the AP-BSN 424 in the acknowledgement frame 422). The AP-BSN 424 may identify or correspond to the current configuration of the access point 404.

[0069] At 426, the station 402 may receive the acknowledgement frame 422 and determine whether the station beacon sequence number 406 corresponds to the access point configuration that is identified by the current beacon sequence number 408. When the current beacon sequence number 408 and the station beacon sequence number 406 have the same value, the station 402 may determine that the current configuration of the access point 404 is the configuration identified by the station beacon sequence number 406 stored at the station 402. When the current beacon sequence number 408 and the station beacon sequence number 406 do not have the same value, the station 402 may determine that the current configuration of the access point 404 is not the configuration identified by the station beacon sequence number 406 stored at the station 402.

[0070] In response to determining that the current configuration of the access point 404 is not the configuration identified by the station beacon sequence number 406, the station 402 may transmit an update request frame 430 to the access point 404, at 428. In response to the update request frame 430, the access point may send update data, such as one or more of the update messages 124, 128 described with reference to FIG. 1, to the station 402.

[0071] Referring to FIG. 5, a block diagram of a particular embodiment of a station operable to transmit configuration change messages to an access point according to FIGs. 1-4 is disclosed and generally designated 500. The station 500 includes a processor, such as a processor 510, coupled to a memory 532.

[0072] The memory 532 may be a non-transitory computer readable storage medium that stores data (e.g., representative configuration data 562), instructions, or both. In a particular embodiment, the memory 532 may include instructions 552 that may be executable by the processor 510 to cause the processor 510 to perform one or more functions of the station 500. For example, the instructions 552 may include user applications, an operating system, other executable instructions, or a combination thereof. The instructions may be executable by the processor 510 to cause the processor to perform at least a portion of the functionality described with respect to FIGs. 1-4.

[0073] The station 500 may include a transceiver 550 for sending and receiving signals and/or data packets. For example, the station 500 may function as a transmitter when the station 500 transmits frames (e.g., PS-Poll frames, trigger frames, frames requesting buffered data, frames including uplink data, etc.), update request frames, or any other data to an access point. As another example, the station 500 may function as a receiver when the station 500 receives an acknowledgement frame, an update frame, or any other data from the access point.

[0074] In a particular embodiment, the transceiver 550 may provide means for transmitting a frame (e.g., a PS-Poll frame) from a station to an access point. The transceiver 550 may also provide means for receiving an update frame from the access point indicating at least one change in a configuration of the access point, in response to the frame. The transceiver 550 may also provide means for receiving an

acknowledgement frame including an updated beacon sequence number related to an updated configuration of the access point in response to the frame. In a particular embodiment, the processor 510 may provide means for determining whether a last known configuration of the access point is identified by the updated beacon sequence number.

[0075] FIG. 5 also shows a display controller 526 that may be coupled to the processor 510 and to a display 528. A coder/decoder (CODEC) 534 (e.g., an audio and/or voice CODEC) may be coupled to the processor 510. A speaker 536 and a microphone 538 may be coupled to the CODEC 534. FIG. 5 also indicates that a wireless controller 540 may be coupled to the processor 510 and to the transceiver 550 (via a modem 541) that is coupled to a wireless antenna 542. In a particular embodiment, the processor 510, the display controller 526, the memory 532, the modem 541, the CODEC 534, the wireless controller 540, and the transceiver 550 are included in a system-in-package or system-on-chip device 522.

[0076] In a particular embodiment, an input device 530 and a power supply 544 are coupled to the system-on-chip device 522. Moreover, in a particular embodiment, as illustrated in FIG. 5, the display 528, the input device 530, the speaker 536, the microphone 538, the wireless antenna 542, and the power supply 544 are external to the system-on-chip device 522. However, each of the display 528, the input device 530, the speaker 536, the microphone 538, the wireless antenna 542, and the power supply 544 can be coupled to a component of the system-on-chip device 522, such as an interface or a controller.

[0077] It should be noted that although FIG. 5 depicts a wireless communications device, the processor 510 and the memory 532 may be integrated into other devices, such as a mobile device, a camera, a multimedia player, an entertainment unit, a navigation device, a personal digital assistant (PDA), a fixed location data unit, a computer (e.g., a tablet computer, a laptop computer, a desktop computer, a portable computer, etc.), a media device, a router or gateway device, or another device configured to wirelessly communicate data.

[0078] Referring to FIG. 6, a block diagram of a particular embodiment of an access point operable to transmit configuration change messages to a station according to FIGs. 1-4 is disclosed and generally designated 600. The access point 600 includes a processor, such as a processor 610, coupled to a memory 632.

[0079] The memory 632 may be a non-transitory computer readable storage medium that stores data (e.g., representative configuration data 672), instructions, or both. In a particular embodiment, the memory 632 may also include one or more registers including flags 662 associated with corresponding stations in communication with the access point 600. In a particular embodiment, the flags 662 may indicate that an updated configuration of the access point 600 is to be transmitted to a station.

[0080] In a particular embodiment, the memory 632 may include instructions 652 that may be executable by the processor 610 to cause the processor 610 to perform one or more functions of the access point 600. For example, the instructions 652 may include user applications, an operating system, or other executable instructions, or a combination thereof. The instructions 652 may be executable by the processor 610 to cause the processor 610 to perform at least a portion of the functionality described with respect to any of FIGs. 1-4.

[0081] The access point 600 may include a transceiver 650 for sending and receiving signals and/or data packets. For example, the access point 600 may function as a transmitter when the access point 600 transmits signals and/or packets and may function as a receiver when the access point 600 receives signals and/or packets. To illustrate, the access point 600 may function as a transmitter when the access point 600 transmits an acknowledgement frame, an update frame, or any combination thereof, to a station. The access point 600 may also function as a receiver when the access point 600 receives a frame (e.g., a PS-Poll frame, a trigger frame, a frame requesting data buffered at the access point 600, a frame including uplink data, etc.), an update request, or any combination thereof, from the station.

[0082] FIG. 6 also indicates that a modem 641 and a wireless controller 640 may be coupled to the processor 610 and to the transceiver 650 that is coupled to a wireless antenna 642. In a particular embodiment, the processor 610, the memory 632, the

modem 641, the wireless controller 640, and the transceiver 650 are included in a system-in-package or system-on-chip device 622. In a particular embodiment, a power supply 644 is coupled to the system-on-chip device 622. Moreover, in a particular embodiment, the wireless antenna 642 and the power supply 644 are external to the system-on-chip device 622.

[0083] It should be noted that although FIG. 6 depicts a wireless communications device, the processor 610 and the memory 632 may be integrated into other devices, such as a mobile device, a camera, a multimedia player, an entertainment unit, a navigation device, a personal digital assistant (PDA), a fixed location data unit, a computer (e.g., a tablet computer, a laptop computer, a desktop computer, a portable computer, etc.), a media device, a router or gateway device, or another device configured to wirelessly communicate data.

[0084] In conjunction with the described embodiments, an apparatus is disclosed that includes means for receiving a frame from a station at an access point, the frame including a beacon sequence number identifying a last known configuration of the access point that was known to the station prior to entering a lower power mode. For example, the means for receiving may include a component of the access points 102, 104, and 106 of FIG. 1, the access point 204 of FIG. 2, the access point 304 of FIG. 3, the access point 404 of FIG. 4, or the access point 600 of FIG. 6, the transceiver 650 of FIG. 6, one or more other devices configured to receive a frame, or any combination thereof.

[0085] The apparatus also includes means for determining whether a current configuration of the access point is identified by the beacon sequence number received from the station in the frame. For example, the means for determining may include the processor 610 of FIG. 6, a component of the access points 102, 104, and 106 of FIG. 1, the access point 204 of FIG. 2, the access point 304 of FIG. 3, the access point 404 of FIG. 4, or the access point 600 of FIG. 6, the transceiver 650 of FIG. 6, one or more other devices configured to determine whether a current configuration of the access point is identified by a beacon sequence number, or any combination thereof.

[0086] The apparatus includes means for transmitting an update frame that indicates at least one difference between the current configuration and the configuration identified by the beacon sequence number, in response to determining that the current configuration is not identified by the beacon sequence number. For example the means for transmitting the update frame may include a component of the access points 102, 104, and 106 of FIG. 1, the access point 204 of FIG. 2, the access point 304 of FIG. 3, the access point 404 of FIG. 4, or the access point 600 of FIG. 6, the transceiver 650 of FIG. 6, one or more other devices configured to transmit an update frame, or any combination thereof.

[0087] In conjunction with the described embodiments, an apparatus is disclosed that includes means for transmitting a frame from a station to an access point. For example, the means for transmitting may include a component of the stations 110, 112, 114, and 116 of FIG. 1, the station 202 of FIG. 2, the station 302 of FIG. 3, the station 402 of FIG. 4, or the station 500 of FIG. 5, the transceiver 550 of FIG. 5, one or more other devices configured to transmit a frame, or any combination thereof.

[0088] The apparatus includes means for receiving an acknowledgement frame including an updated beacon sequence number related to an updated configuration of the access point in response to the frame. For example, the means for receiving the acknowledgement frame may include a component of the stations 110, 112, 114, and 116 of FIG. 1, the station 202 of FIG. 2, the station 302 of FIG. 3, the station 402 of FIG. 4, or the station 500 of FIG. 5, the transceiver 550 of FIG. 5, one or more other devices configured to receive an acknowledgement frame, or any combination thereof.

[0089] The apparatus also includes means for determining whether a last known configuration of the access point is identified by the updated beacon sequence number. For example, the means for determining may include the processor 510 of FIG. 5, a component of the stations 110, 112, 114, and 116 of FIG. 1, the station 202 of FIG. 2, the station 302 of FIG. 3, the station 402 of FIG. 4, or the station 500 of FIG. 5, the transceiver 550 of FIG. 5, one or more other devices configured to determine whether a last known configuration of an access point is identified by an updated beacon sequence number, or any combination thereof. The means for transmitting is further configured

to transmit an update frame to the access point in response to determining that a last known configuration of the access point is not identified by an updated beacon number.

[0090] Those of skill would further appreciate that the various illustrative logical blocks, configurations, modules, circuits, and algorithm steps described in connection with the embodiments disclosed herein may be implemented as electronic hardware, computer software, or combinations of both. Various illustrative components, blocks, configurations, modules, circuits, and steps have been described above generally in terms of their functionality. Whether such functionality is implemented as hardware or software depends upon the particular application and design constraints imposed on the overall system. Skilled artisans may implement the described functionality in varying ways for each particular application, but such implementation decisions should not be interpreted as causing a departure from the scope of the present disclosure.

[0091] The steps of a method or algorithm described in connection with the embodiments disclosed herein may be embodied directly in hardware, in a software module executed by a processor, or in a combination of the two. A software module may reside in random access memory (RAM), flash memory, read-only memory (ROM), programmable read-only memory (PROM), erasable programmable read-only memory (EPROM), electrically erasable programmable read-only memory (EEPROM), registers, hard disk, a removable disk, a compact disc read-only memory (CD-ROM), or any other form of non-transitory storage medium. An exemplary storage medium is coupled to the processor such that the processor can read information from, and write information to, the storage medium. In the alternative, the storage medium may be integral to the processor. The processor and the storage medium may reside in an application-specific integrated circuit (ASIC). The ASIC may reside in a computing device or a user terminal (e.g., a mobile phone or a PDA). In the alternative, the processor and the storage medium may reside as discrete components in a computing device or user terminal.

[0092] The previous description of the disclosed embodiments is provided to enable a person skilled in the art to make or use the disclosed embodiments. Various modifications to these embodiments will be readily apparent to those skilled in the art, and the principles defined herein may be applied to other embodiments without

departing from the scope of the disclosure. Thus, the present disclosure is not intended to be limited to the embodiments disclosed herein but is to be accorded the widest scope possible consistent with the principles and novel features as defined by the following claims.

WHAT IS CLAIMED IS:

1. A method comprising:

transmitting a frame from a station to an access point, the frame including a beacon sequence number related to a configuration of the access point; and

in response to transmitting the frame, receiving an update frame from the access point, the update frame indicating at least one change in the configuration of the access point.

2. The method of claim 1, further comprising:

in response to transmitting the frame, receiving an acknowledgement frame including an update bit field, wherein the update bit field indicates that the update frame is available at the access point; and

receiving the update frame from the access point.

3. The method of claim 1, wherein the frame is transmitted to the access point in response to the station transitioning out of a low power mode and wherein the low power mode includes one of a sleep mode and a power off mode.

4. The method of claim 1, wherein the at least one change in the configuration of the access point includes a channel change, an operating mode change, or any combination thereof.

5. The method of claim 4, wherein the channel change includes a channel switch or an extended channel switch.

6. The method of claim 4, wherein the operating mode change includes modification of enhanced distribution channel access (EDCA) parameters, modification of a quiet information element, modification of a direct sequence spread spectrum (DSSS) parameter set, modification of a contention-free (CF) parameter set, modification of a frequency-hopping (FH) parameter set, modification of a high-throughput (HT) operation element, or any combination thereof.

7. A method comprising:

receiving a frame from a station at an access point, the frame including a beacon sequence number identifying a last known configuration of the access point that was known to the station prior to the station entering a low power mode;

determining whether a current configuration of the access point is identified by the beacon sequence number received from the station in the frame; and

in response to determining that the current configuration is not identified by the beacon sequence number, transmitting an update frame that indicates at least one difference between the current configuration and the configuration identified by the beacon sequence number.

8. The method of claim 7, further comprising:

in response to determining that the current configuration is not identified by the beacon sequence number, scheduling transmission of the update frame to the station during a scheduled transmission time; and

transmitting the update frame to the station during the scheduled transmission time, wherein the scheduled transmission time is a time when the station is not in a sleep mode and is not in a power off mode.

9. The method of claim 7, further comprising:

in response to determining that the current configuration is not identified by the beacon sequence number, transmitting an acknowledgement frame including an update bit field, wherein the update bit field indicates that the update frame is available at the access point; and

transmitting the update frame to the station.

10. The method of claim 7, wherein the update frame is an expanded channel switch announcement frame indicating a channel change of the access point.

11. The method of claim 7, wherein the update frame is a very high-throughput (VHT) notification frame indicating an operating mode change of the access point.

12. A method comprising:

transmitting, from a station to an access point, a frame requesting data for the station that is buffered by the access point; and

in response to transmitting the frame, receiving an update frame from the access point indicating at least one change in a configuration of the access point.

13. The method of claim 12, wherein the frame comprises a power save polling (PS-Poll) frame.

14. The method of claim 12, wherein the frame comprises a trigger frame that causes the access point to send the data to the station.

15. The method of claim 12, wherein the frame includes uplink data sent from the station to the access point.

16. The method of claim 12, wherein the at least one change in the configuration occurred while the station was operating in a low power mode and wherein the low power mode includes one of a sleep mode and a power off mode.

17. The method of claim 16, wherein the at least one change in the configuration of the access point includes a channel change, an operation mode change, or any combination thereof.

18. A method comprising:

receiving a frame from a station at an access point, wherein the access point includes a flags register that stores information associated with stations that operate in an asynchronous mode;

determining whether the station operates in the asynchronous mode;

in response to determining that the station operates in the asynchronous mode, determining whether information stored at the flags register that is associated with the station indicates that an update frame is to be transmitted to the station; and

in response to determining that the information indicates that an update frame is to be transmitted to the station, transmitting the update frame to the station, wherein the update frame indicates at least one change in a configuration of the access point.

19. The method of claim 18, wherein the update frame includes a beacon sequence number related to the configuration of the access point.

20. The method of claim 19, further comprising:

in response to determining that the information indicates that an update frame is to be transmitted to the station, transmitting an acknowledgement frame to the station.

21. The method of claim 18, further comprising clearing a flag corresponding to the information after transmitting the update frame to the station.

22. The method of claim 18, further comprising refraining from transmitting the update frame to the station until the station exits a sleep mode or a power-save mode.

23. A method comprising:

transmitting a frame from a station to an access point;

in response to transmitting the frame, receiving an acknowledgement frame including an updated beacon sequence number related to an updated configuration of the access point;

determining whether a last known configuration of the access point is identified by the updated beacon sequence number; and

in response to determining that the last known configuration of the access point is not identified by the updated beacon number, transmitting an update request frame to the access point.

24. The method of claim 23, further comprising receiving an update frame from the access point indicating at least one change in the last known configuration of the access point.

25. A method comprising:

receiving a frame from a station at an access point; and

in response to receiving the frame, transmitting an acknowledgement frame including an updated beacon sequence number related to an updated configuration of the access point.

26. The method of claim 25, further comprising:

in response to transmitting the acknowledgement frame, receiving an update request frame from the station; and

transmitting an update frame to the station indicating at least one change in a last known configuration of the access point that was known by the station.

27. An apparatus comprising:

a processor; and

a memory storing instructions executable by the processor to:

initiate transmission of a frame from a station to an access point, the frame including a beacon sequence number related to a configuration of the access point; and

in response to transmission of the frame, detect receipt of an update frame from the access point indicating at least one change in the configuration of the access point.

28. The apparatus of claim 27, wherein the instructions are further executable by the processor to:

in response to transmission of the frame, detect receipt of an acknowledgement frame including an update bit field, wherein the update bit field indicates that the update frame is available at the access point;

initiate transmission of an update request frame to the access point; and

in response to transmission of the update request frame, detect receipt of the update frame from the access point.

29. The apparatus of claim 27, wherein the at least one change in the configuration of the access point includes a channel change, an operating mode change, or any combination thereof.

30. The apparatus of claim 27, wherein the processor is integrated into a mobile device, a camera, a multimedia player, an entertainment unit, a navigation device, a personal digital assistant (PDA), a portable computer, or any combination thereof.

31. An apparatus comprising:

a processor; and

a memory storing instructions executable by the processor to:

detect receipt of a frame from a station at an access point; and

in response to receiving the frame, initiate transmission of an acknowledgement frame including an updated beacon sequence number related to an updated configuration of the access point.

32. The apparatus of claim 31, wherein the instructions are further executable by the processor to:

in response to transmission of the acknowledgement frame, detect receipt of an update request frame from the station; and

initiate transmission of an update frame to the station indicating at least one change in a last known configuration of the access point that was known by the station.

33. An apparatus comprising:

means for receiving a frame from a station at an access point, the frame including a beacon sequence number identifying a last known configuration of the access point that was known to the station prior to the station entering a low power mode;

means for determining whether a current configuration of the access point is identified by the beacon sequence number received from the station in the frame; and

means for transmitting an update frame that indicates at least one difference between the current configuration and the configuration identified by the beacon sequence number, in response to determining that the current configuration is not identified by the beacon sequence number.

34. An apparatus comprising:

means for transmitting a frame from a station to an access point;

means for receiving an acknowledgement frame including an updated beacon sequence number related to an updated configuration of the access point in response to the frame; and

means for determining whether a last known configuration of the access point is identified by the updated beacon sequence number,

wherein the means for transmitting is further configured to transmit an update request frame to the access point in response to determining that the last known configuration of the access point is not identified by the updated beacon number.

35. A non-transitory computer-readable medium including program code that, when executed by a processor, causes the processor to:

initiate transmission of a frame from a station to an access point, the frame including a beacon sequence number related to a configuration of the access point; and

in response to transmission of the frame, detect receipt of an update frame from the access point indicating at least one change in the configuration of the access point.

36. The non-transitory computer-readable medium of claim 35, further comprising program code that, when executed by the processor, causes the processor to:

in response to transmission of the frame, detect receipt of an acknowledgement frame including an update bit field, wherein the update bit field indicates that the update frame is available at the access point;

initiate transmission of an update request frame to the access point; and

in response to transmission of the update request frame, detect receipt of the update frame from the access point.

37. The non-transitory computer-readable medium of claim 35, wherein the at least one change in the configuration of the access point includes a channel change, an operating mode change, or any combination thereof.

38. A non-transitory computer-readable medium comprising program code that, when executed by a processor, causes the processor to:

detect receipt of a frame from a station at an access point; and

in response to receiving the frame, initiate transmission of an acknowledgement frame including an updated beacon sequence number related to an updated configuration of the access point.

39. The non-transitory computer-readable medium of claim 38, further comprising program code that, when executed by the processor, causes the processor to:

in response to transmission of the acknowledgement frame, detect receipt of an update request frame from the station; and

initiate transmission of an update frame to the station indicating at least one change in a last known configuration of the access point that was known by the station.

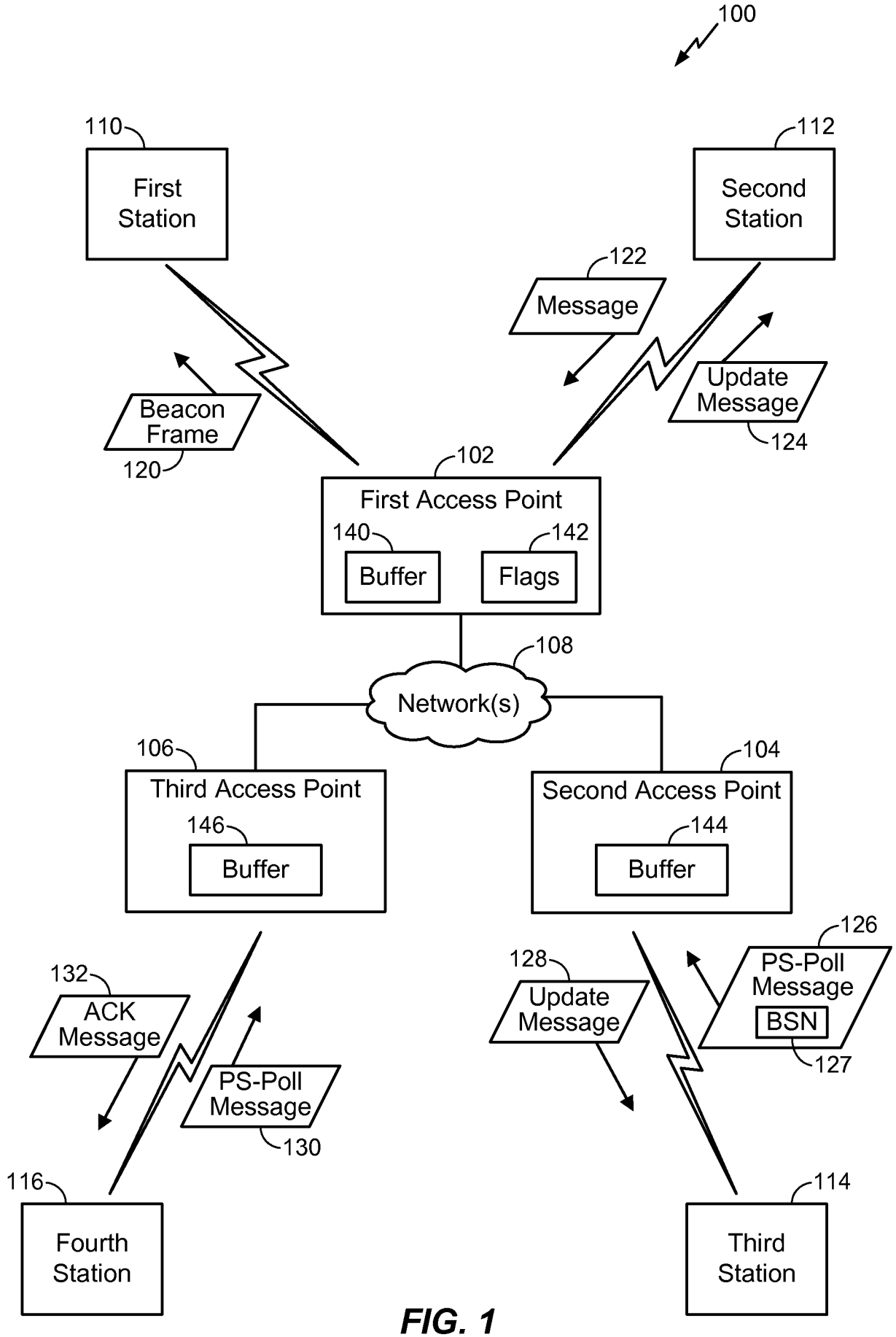
100
110
First Station
112
Second Station
122
Message
Beacon Frame
120
Update Message
124
102
First Access Point
140
Buffer
142
Flags
108
Network(s)
106
Third Access Point
146
Buffer
104
Second Access Point
144
Buffer
126
PS-Poll Message
BSN
127
128
Update Message
132
ACK Message
PS-Poll Message
130
116
Fourth Station
114
Third Station

FIG. 1

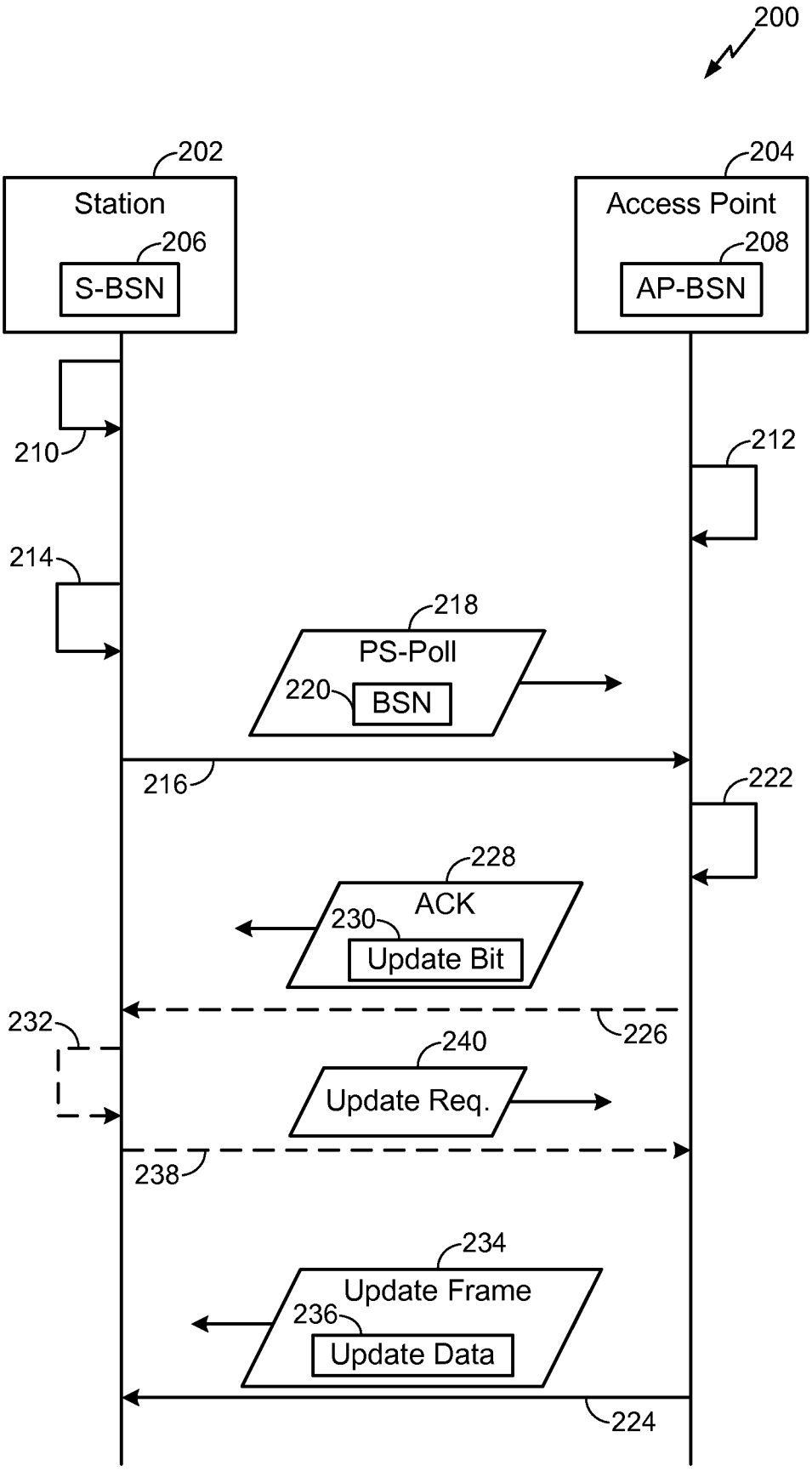
200
202
Station
206
S-BSN
204
Access Point
208
AP-BSN
210
212
214
218
PS-Poll
220
BSN
216
222
228
ACK
230
Update Bit
232
226
240
Update Req.
238
234
Update Frame
236
Update Data
224

FIG. 2

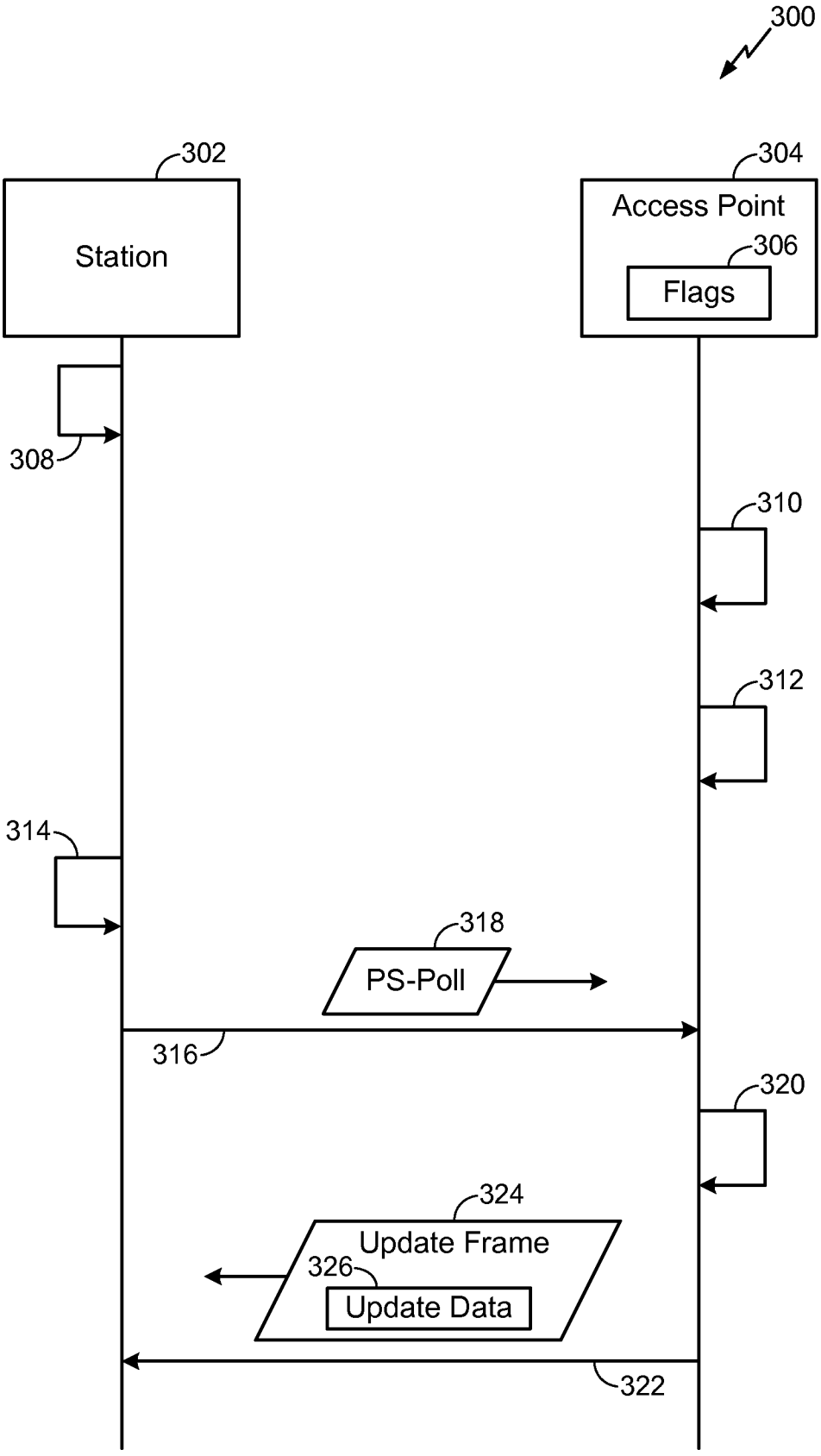
300
302
Station
304
Access Point
306
Flags
308
310
312
314
318
PS-Poll
316
320
324
Update Frame
326
Update Data
322

FIG. 3

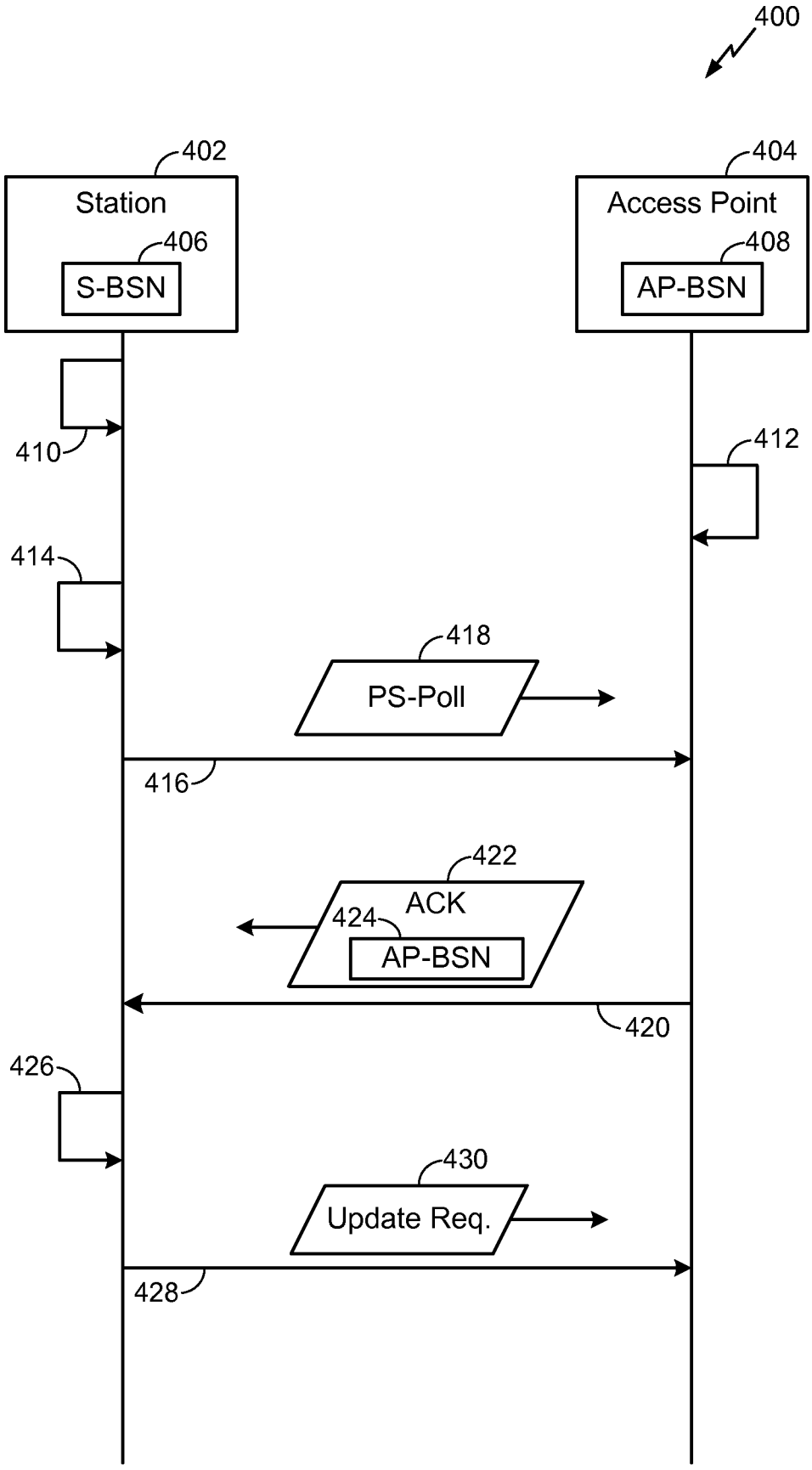
400
402
Station
406
S-BSN
404
Access Point
408
AP-BSN
410
412
414
418
PS-Poll
416
422
ACK
424
AP-BSN
420
426
430
Update Req.
428

FIG. 4

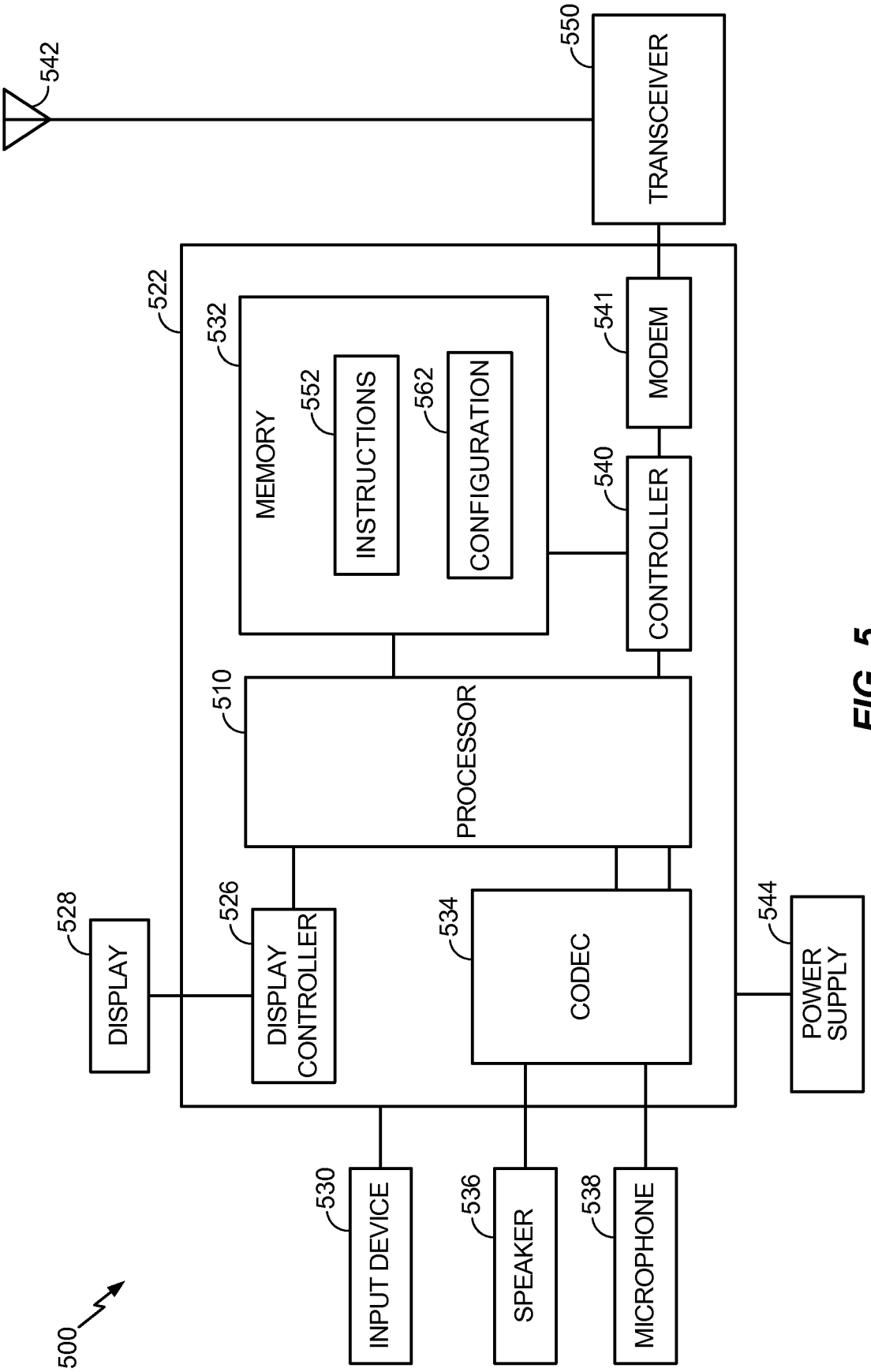
542
550
TRANSCEIVER
522
532
MEMORY
552
INSTRUCTIONS
562
CONFIGURATION
541
MODEM
540
CONTROLLER
510
PROCESSOR
528
DISPLAY
526
DISPLAY CONTROLLER
534
CODEC
544
POWER SUPPLY
530
INPUT DEVICE
536
SPEAKER
538
MICROPHONE
500

FIG. 5

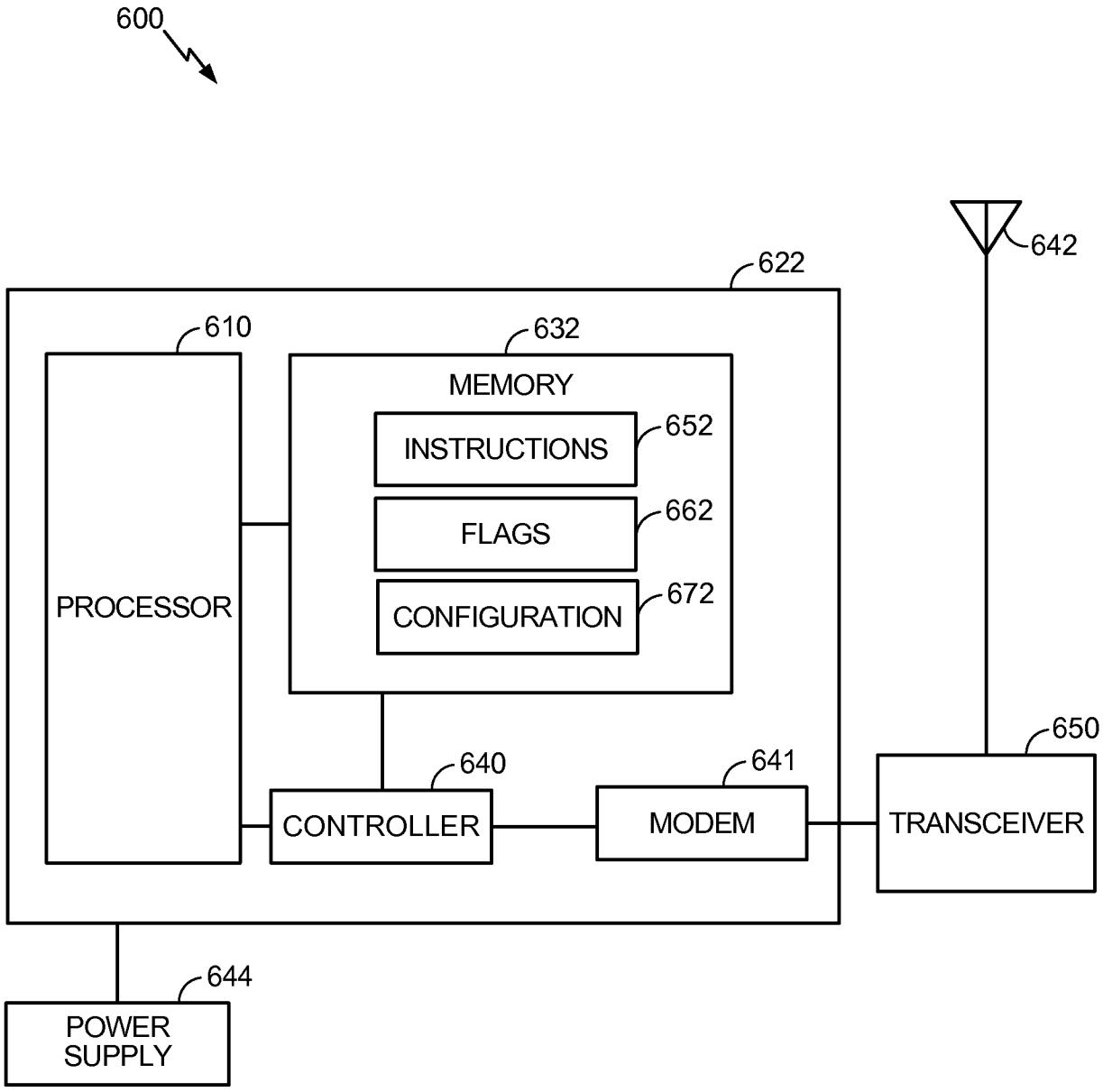
600
642
622
610
632
MEMORY
652
INSTRUCTIONS
662
FLAGS
672
CONFIGURATION
PROCESSOR
640
641
650
CONTROLLER
MODEM
TRANSCEIVER
644
POWER SUPPLY

FIG. 6

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(74) **Agent**: **BELADI, Sayed H.**; Attn: International IP Administration, 5775 Morehouse Drive, San Diego, CA 92121-1714 (US).

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(84) **Designated States** *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, 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, RS, SE, SI, SK, SM,

[Continued on next page]

(54) **Title**: SYSTEMS AND METHODS TO TRANSMIT CONFIGURATION CHANGE MESSAGES BETWEEN AN ACCESS POINT AND A STATION

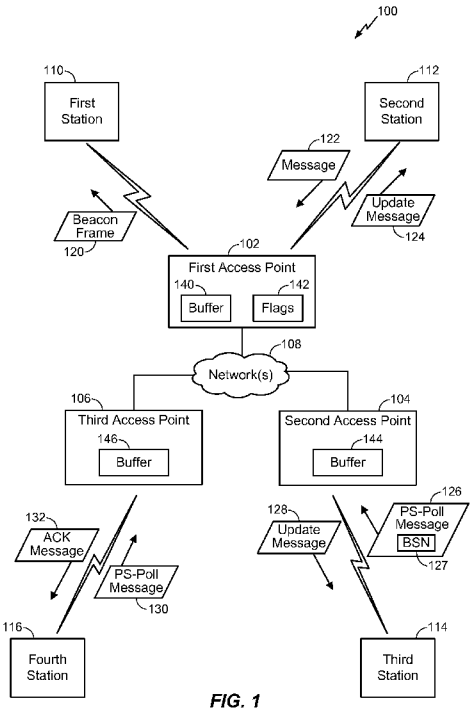

FIG. 1

(57) **Abstract**: A particular method includes transmitting a frame from a station to an access point. The frame includes a beacon sequence number related to a configuration of the access point. The method also includes, in response to transmitting the frame, receiving an update frame from the access point. The update frame indicates at least one change in the configuration of the access point.

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TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

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INTERNATIONAL SEARCH REPORT

International application No
PCT/US2013/020857

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04W24/02
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B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H04W

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2008/133476 A1 (LG ELECTRONICS INC [KR]; FISCHER PATRICK [FR]; FEUILLETTE REMI [FR]) 6 November 2008 (2008-11-06) paragraph [0057] - paragraph [0060] paragraph [0133] - paragraph [0135]; figure 11	1,7,27, 30,33,35

-/--

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
29 July 2013	07/08/2013

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Poort, Ingrid

2

Form PCT/ISA/210 (second sheet) (April 2005)

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	SIMONE MERLIN (QUALCOMM INC): "Short Beacon ; 11-11-1503-01-00ah-short-beacon", IEEE DRAFT; 11-11-1503-01-00AH-SHORT-BEACON, IEEE-SA MENTOR, PISCATAWAY, NJ USA, vol. 802.11ah, no. 1, 9 November 2011 (2011-11-09), pages 1-11, XP017673186, [retrieved on 2011-11-09]	23-26, 31,32, 34,38,39
A	page 4 - page 6	1-22, 27-30, 33,35-37

Y	US 2008/225768 A1 (WENTINK MAARTEN MENZO [NL]) 18 September 2008 (2008-09-18)	23-26, 31,32, 34,38,39
A	paragraph [0082] - paragraph [0086]	1-22, 27-30, 33,35-37

X,P	JEONGKI KIM, LG ELECTRONICS: "System information update procedure for 11 ah", IEEE 802.11-12/1093R0, vol. IEEE 802.11ah, 17 September 2012 (2012-09-17), pages 1-11, XP002694803, the whole document	1-39

X,P	JEONGKI KIM (LG ELECTRONICS): "TGai Specification Text for enhanced active scanning procedure for FILS ; 11-12-1114-06-00ai-tgai-specification-text-for-enhanced-active-scanning-procedure-for-fils", IEEE SA MENTOR; 11-12-1114-06-00AI-TGAI-SPECIFICATION-TEXT-FOR-ENHANCED-ACTIVE-SCANNING-PROCEDURE-FOR-FILS, IEEE-SA MENTOR, PISCATAWAY, NJ USA, vol. 802.11ai, no. 6, 14 November 2012 (2012-11-14), pages 1-6, XP068039847, [retrieved on 2012-11-14] the whole document	23-26, 31,32, 34,38,39

2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2013/020857

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☒ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-22, 27-30, 33, 35-37

   Transmitting a frame from a station to an access point, and receiving at the station, in response to that frame, an update frame indicating at least one change in the configuration of the access point.

   ---

2. claims: 23-26, 31, 32, 34, 38, 39

   Transmitting a frame from a station to an access point and receiving at the station an acknowledgement frame including an updated beacon sequence number related to an updated configuration of the access point in response to the frame.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2013/020857

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2008133476 A1	06-11-2008	US 2010182963 A1	22-07-2010
		WO 2008133476 A1	06-11-2008
US 2008225768 A1	18-09-2008	NONE	

(19)中华人民共和国国家知识产权局

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2014.07.07
(86)PCT国际申请的申请数据
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(87)PCT国际申请的公布数据
WO2013/106449 EN 2013.07.18
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代理人 李小芳
(51)Int.Cl.
H04W 24/02(2006.01)

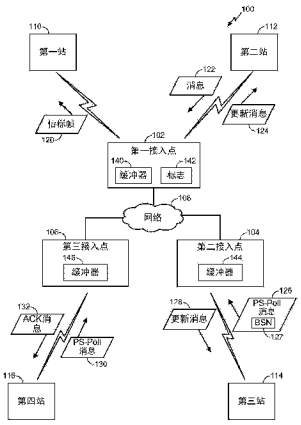
权利要求书4页 说明书13页 附图6页

(54)发明名称

在接入点和站之间传送配置变化消息的系统和方法

(57)摘要

一种特定方法包括从站向接入点传送帧。该帧包括与接入点的配置相关的信标序列号。该方法还包括响应于传送该帧，从接入点接收更新帧。更新帧指示接入点的配置中的至少一个变化。



CN 104170435 A

1. 一种方法，包括：

从站向接入点传送帧，所述帧包括与所述接入点的配置相关的信标序列号；以及

响应于传送所述帧，从所述接入点接收更新帧，所述更新帧指示所述接入点的配置中的至少一个变化。

2. 如权利要求 1 所述的方法，其特征在于，还包括：

响应于传送所述帧，接收包括更新位字段的确收帧，其中所述更新位字段指示所述更新帧在所述接入点处可用；以及

从所述接入点接收所述更新帧。

3. 如权利要求 1 所述的方法，其特征在于，所述帧是响应于所述站转移出低功率模式而传送给所述接入点的，并且其中所述低功率模式包括睡眠模式和断电模式之一。

4. 如权利要求 1 所述的方法，其特征在于，所述接入点的配置中的所述至少一个变化包括信道变化、操作模式变化、或其任何组合。

5. 如权利要求 4 所述的方法，其特征在于，所述信道变化包括信道切换或扩展信道切换。

6. 如权利要求 4 所述的方法，其特征在于，所述操作模式变化包括增强型分布信道接入 (EDCA) 参数的修改、静默信息元素的修改、直接序列扩频 (DSSS) 参数集的修改、无竞争 (CF) 参数集的修改、跳频 (FH) 参数集的修改、高吞吐量 (HT) 操作元素的修改、或其任何组合。

7. 一种方法，包括：

在接入点处从站接收帧，所述帧包括标识在所述站进入低功率模式之前所述站已知的所述接入点的最后已知配置的信标序列号；

确定在所述帧中从所述站接收到的信标序列号是否标识所述接入点的当前配置；以及

响应于确定所述信标序列号没有标识所述当前配置，传送指示所述当前配置与所述信标序列号所标识的配置之间的至少一个差异的更新帧。

8. 如权利要求 7 所述的方法，其特征在于，还包括：

响应于确定所述信标序列号没有标识所述当前配置，调度在所调度传输时间期间所述更新帧到所述站的传输；以及

在所调度传输时间期间向所述站传送所述更新帧，其中所调度传输时间是所述站不处于睡眠模式且不处于断电模式的时间。

9. 如权利要求 7 所述的方法，其特征在于，还包括：

响应于确定所述信标序列号没有标识所述当前配置，传送包括更新位字段的确收帧，其中所述更新位字段指示所述更新帧在所述接入点处可用；以及

将所述更新帧传送给所述站。

10. 如权利要求 7 所述的方法，其特征在于，所述更新帧是指示所述接入点的信道变化的扩展信道切换宣告帧。

11. 如权利要求 7 所述的方法，其特征在于，所述更新帧是指示所述接入点的操作模式变化的甚高吞吐量 (VHT) 通知帧。

12. 一种方法，包括：

从站向接入点传送请求由所述接入点缓冲的要给所述站的数据的帧；以及

响应于传送所述帧，从所述接入点接收指示所述接入点的配置中的至少一个变化的更新帧。

13. 如权利要求 12 所述的方法，其特征在于，所述帧包括功率节省轮询 (PS-Poll) 帧。

14. 如权利要求 12 所述的方法，其特征在于，所述帧包括使得所述接入点将所述数据发送给所述站的触发帧。

15. 如权利要求 12 所述的方法，其特征在于，所述帧包括从所述站发送给所述接入点的上行链路数据。

16. 如权利要求 12 所述的方法，其特征在于，所述配置中的所述至少一个变化是在所述站按低功率模式操作时发生的，并且其中所述低功率模式包括睡眠模式和断电模式之一。

17. 如权利要求 16 所述的方法，其特征在于，所述接入点的配置中的所述至少一个变化包括信道变化、操作模式变化、或其任何组合。

18. 一种方法，包括 ：

在接入点处从站接收帧，其中所述接入点包括存储与按异步模式操作的站相关联的信息的标志寄存器 ；

确定所述站是否按所述异步模式操作 ；

响应于确定所述站按所述异步模式操作，确定存储在所述标志寄存器处的与所述站相关联的信息是否指示更新帧要被传送给所述站 ；以及

响应于确定所述信息指示更新帧要被传送给所述站，将所述更新帧传送给所述站，其中所述更新帧指示所述接入点的配置中的至少一个变化。

19. 如权利要求 18 所述的方法，其特征在于，所述更新帧包括与所述接入点的配置相关的信标序列号。

20. 如权利要求 19 所述的方法，其特征在于，还包括 ：

响应于确定所述信息指示更新帧要被传送给所述站，将确收帧传送给所述站。

21. 如权利要求 18 所述的方法，其特征在于，还包括在将所述更新帧传送给所述站之后清除与所述信息相对应的标志。

22. 如权利要求 18 所述的方法，其特征在于，还包括制止向所述站传送所述更新帧，直至所述站退出睡眠模式或功率节省模式。

23. 一种方法，包括 ：

从站向接入点传送帧 ；

响应于传送所述帧，接收包括与所述接入点的经更新配置相关的经更新信标序列号的确收帧 ；

确定所述经更新信标序列号是否标识所述接入点的最后已知配置 ；以及

响应于确定所述经更新信标号没有标识所述接入点的最后已知配置，向所述接入点传送更新请求帧。

24. 如权利要求 23 所述的方法，其特征在于，还包括从所述接入点接收指示所述接入点的最后已知配置中的至少一个变化的更新帧。

25. 一种方法，包括 ：

在接入点处从站接收帧 ；以及

响应于接收所述帧，传送包括与所述接入点的经更新配置相关的经更新信标序列号的确收帧。

26. 如权利要求 25 所述的方法，其特征在于，还包括：

响应于传送所述确收帧，从所述站接收更新请求帧；以及

向所述站传送指示所述站已知的所述接入点的最后已知配置中的至少一个变化的更新帧。

27. 一种装置，包括：

处理器；以及

存储指令的存储器，所述指令能由所述处理器执行以：

发起从站向接入点传送帧，所述帧包括与所述接入点的配置相关的信标序列号；以及

响应于所述帧的传送，检测接收到来自所述接入点的指示所述接入点的配置中的至少一个变化的更新帧。

28. 如权利要求 27 所述的装置，其特征在于，所述指令能进一步由所述处理器执行以：

响应于所述帧的传送，检测接收到包括更新位字段的确收帧，其中所述更新位字段指示所述更新帧在所述接入点处可用；

发起向所述接入点传送更新请求帧；以及

响应于所述更新请求帧的传送，检测接收到来自所述接入点的更新帧。

29. 如权利要求 27 所述的装置，其特征在于，所述接入点的配置中的所述至少一个变化包括信道变化、操作模式变化、或其任何组合。

30. 如权利要求 27 所述的装置，其特征在于，所述处理器被集成到移动设备、相机、多媒体播放器、娱乐单元、导航设备、个人数字助理 (PDA)、便携式计算机、或其任何组合中。

31. 一种装置，包括：

处理器；以及

存储指令的存储器，所述指令能由所述处理器执行以：

检测在接入点处接收到来自站的帧；以及

响应于接收到所述帧，发起包括与所述接入点的经更新配置相关的经更新信标序列号的确收帧的传送。

32. 如权利要求 31 所述的装置，其特征在于，所述指令能进一步由所述处理器执行以：

响应于所述确收帧的传送，检测接收到来自所述站的更新请求帧；以及

发起向所述站传送指示所述站已知的所述接入点的最后已知配置中的至少一个变化的更新帧。

33. 一种设备，包括：

用于在接入点处从站接收帧的装置，所述帧包括标识在所述站进入低功率模式之前所述站已知的所述接入点的最后已知配置的信标序列号；

用于确定在所述帧中从所述站接收到的信标序列号是否标识所述接入点的当前配置的装置；以及

用于响应于确定所述信标序列号没有标识所述当前配置，传送指示所述当前配置与所述信标序列号所标识的配置之间的至少一个差异的更新帧的装置。

34. 一种设备，包括：

用于从站向接入点传送帧的装置；

用于接收响应于所述帧的包括与所述接入点的经更新配置相关的经更新信标序列号的确收帧的装置；以及

用于确定所述经更新信标序列号是否标识所述接入点的最后已知配置的装置，

其中所述用于传送的装置还被配置成响应于确定所述经更新信标号没有标识所述接入点的最后已知配置而向所述接入点传送更新请求帧。

35. 一种包括程序代码的非瞬态计算机可读介质，所述程序代码在由处理器执行时使得所述处理器：

发起从站向接入点传送帧，所述帧包括与所述接入点的配置相关的信标序列号；以及

响应于所述帧的传送，检测接收到来自所述接入点的指示所述接入点的配置中的至少一个变化的更新帧。

36. 如权利要求 35 所述的非瞬态计算机可读介质，其特征在于，还包括程序代码，所述程序代码在由所述处理器执行时使得所述处理器：

响应于所述帧的传送，检测接收到包括更新位字段的确收帧，其中所述更新位字段指示所述更新帧在所述接入点处可用；

发起向所述接入点传送更新请求帧；以及

响应于所述更新请求帧的传送，检测接收到来自所述接入点的更新帧。

37. 如权利要求 35 所述的非瞬态计算机可读介质，其特征在于，所述接入点的配置中的所述至少一个变化包括信道变化、操作模式变化、或其任何组合。

38. 一种包括程序代码的非瞬态计算机可读介质，所述程序代码在由处理器执行时使得所述处理器：

检测在接入点处接收到来自站的帧；以及

响应于接收到所述帧，发起包括与所述接入点的经更新配置相关的经更新信标序列号的确收帧的传送。

39. 如权利要求 38 所述的非瞬态计算机可读介质，其特征在于，还包括程序代码，所述程序代码在由所述处理器执行时使得所述处理器：

响应于所述确收帧的传送，检测接收到来自所述站的更新请求帧；以及

发起向所述站传送指示所述站已知的所述接入点的最后已知配置中的至少一个变化的更新帧。

在接入点和站之间传送配置变化消息的系统和方法

[0001] 相关申请的交叉引用

[0002] 本申请要求共同拥有的于2012年1月9日提交的美国临时专利申请No.61/584,667的优先权，该临时申请的内容通过援引全部明确纳入于此。

[0003] 领域

[0004] 本公开一般涉及接入点和站之间的配置变化消息传输。

[0005] 相关技术描述

[0006] 在无线网络中，站（例如，蜂窝电话、个人数字助理(PDA)、个人计算设备、膝上型计算机、以及其他计算设备）使用无线通信链路来连接到接入点（例如，路由器）。接入点可连接到一个或多个网络且连接到该接入点的站可经由到该接入点的无线通信链路来接入网络。接入点可向与该接入点相关联的覆盖区域内的站周期性地广播信标帧。信标帧是由接入点根据信标间隔来广播的。信标帧可以指示旨在发往各站之一的数据被存储在接入点处。信标帧还可指示接入点的配置变化。

[0007] 连接到接入点的每一个站可以按同步模式或异步模式来操作。按同步模式操作的站被配置成从接入点接收信标帧并确定该信标帧是否指示接入点正存储着旨在发往该站的数据。该站还可确定该信标帧是否指示接入点处发生了配置变化。如果信标帧指示接入点没有存储旨在发往该站的数据并且没有发生配置变化，则该站可转移到低功率模式（例如，睡眠模式）。在广播下一信标帧之前的后续时间，该站转移出低功率模式并且准备接收下一信标帧。如果信标帧指示已经作出了配置变化和/或接入点正存储着旨在发往该站的数据，则该站可发起与接入点的通信以确定该配置变化和/或接收存储在接入点处的数据。如果已发生了配置变化，则该站可基于与从接入点接收到的配置变化相关联的信息来修改该站的配置。因而，按同步模式操作的站能够通过在每一信标帧的传输之间在该站不需要从接入点接收数据和/或配置变化数据时转移到低功率模式来节省电池功率。因为按同步模式操作的站接收每一信标帧，每一个站接收在接入点处发生的每一配置变化的通知并且能够使该站的配置与接入点的配置同步。

[0008] 与按同步模式操作的站不同，按异步模式操作的站可转移到可比信标间隔更长的异步低功率模式。因此，按异步模式操作的站可以不接收每一信标帧。如果在一个站处于异步低功率模式时接入点传送了标识接入点配置变化的信标帧，则在该站转移出异步低功率模式时该站可能没有接收到该配置变化的通知。因而，按异步模式操作的站可能仍然是根据过时的接入点配置信息来配置的。

[0009] 概述

[0010] 公开了在接入点和站之间传送配置变化消息的系统和方法。在一特定实施例中，所描述的技术可应用于可具有低占空比的兼容电气和电子工程师协会(IEEE)802.11ah的设备中。为了解说，在兼容IEEE8021.11ah的网络上通信的无线传感器可苏醒相对短的时间段以执行少许测量、经由接入点将测量的结果传达给目的地（或将结果传达给接入点）、并随后睡眠相对长的时间段。因为无线传感器经常处于睡眠模式以节省功率，所以无线传感器可能不知道在该无线传感器处于睡眠模式时可能已变化的网络或系统配置。在苏醒之

后，无线传感器可能需要来自接入点的与配置变化相关的信息。所公开的技术可以使经更新配置信息在接入点与低占空比无线传感器之间传达。

[0011] 在一特定实施例中，一种方法包括从站向接入点传送帧。该帧包括与接入点的配置相关的信标序列号。该方法还包括响应于传送该帧，从接入点接收更新帧。更新帧可指示接入点的配置中的至少一个变化。

[0012] 在另一特定实施例中，一种方法包括在接入点处接收来自站的帧。该帧包括标识在该站进入低功率模式之前该站已知的该接入点的最后已知配置的信标序列号。该方法还包括确定在该帧中从该站接收到的信标序列号是否标识接入点的当前配置。该方法还包括响应于确定信标序列号没有标识当前配置，传送指示当前配置与信标序列号所标识的配置之间的至少一个差异的更新帧。

[0013] 在又一特定实施例中，一种方法包括从站向接入点传送帧，该帧请求由接入点缓冲的要给该站的数据。该方法还包括响应于传送该帧，从接入点接收指示接入点的配置中的至少一个变化的更新帧。

[0014] 在又一特定实施例中，一种方法包括在接入点处接收来自站的帧。接入点包括存储与按异步模式操作的站相关联的信息的标志寄存器。该方法还包括确定该站是否按异步模式操作。该方法还包括响应于确定该站按异步模式操作，确定存储在标志寄存器处的与该站相关联的信息指示更新帧要被传送给该站。该方法还包括响应于确定该信息指示更新帧要被传送给该站，将该更新帧传送给该站。该更新帧指示接入点的配置中的至少一个变化。

[0015] 在另一特定实施例中，一种方法包括从站向接入点传送帧。该方法还包括响应于传送该帧，接收包括与接入点的经更新配置相关的经更新信标序列号的确收帧。该方法还包括确定经更新信标序列号是否标识接入点的最后已知配置。该方法还包括响应于确定经更新信标号没有标识接入点的最后已知配置，向接入点传送更新请求帧。

[0016] 在另一特定实施例中，一种方法包括在接入点处接收来自站的帧。该方法还包括响应于接收该帧，传送包括与接入点的经更新配置相关的经更新信标序列号的确收帧。

[0017] 在一特定实施例中，一种装置包括处理器和存储可由处理器执行的指令的存储器。这些指令可被执行以发起从站向接入点传送帧。该帧包括与接入点的配置相关的信标序列号。这些指令还可被执行以响应于该帧的传送，检测接收到来自接入点的指示接入点的配置中的至少一个变化的更新帧。

[0018] 在另一特定实施例中，一种装置包括处理器和存储可由该处理器执行的指令的存储器。这些指令可被执行以检测在接入点处接收到来自站的帧。这些指令还可被执行以响应于接收该帧，发起包括与接入点的经更新配置相关的经更新信标序列号的确收帧的传送。

[0019] 在一特定实施例中，一种设备包括用于在接入点处接收来自站的帧的装置。该帧包括标识在该站进入低功率模式之前该站已知的该接入点的最后已知配置的信标序列号。该设备还包括用于确定在该帧中从该站接收到的信标序列号是否标识接入点的当前配置的装置。该设备还包括用于响应于确定信标序列号没有标识当前配置而传送指示当前配置与信标序列号所标识的配置之间的至少一个差异的更新帧的装置。

[0020] 在另一特定实施例中，一种设备包括用于从站向接入点传送帧的装置。该设备还

包括用于接收响应于该帧的包括与接入点的经更新配置相关的经更新信标序列号的确收帧的装置。该设备还包括用于确定经更新信标序列号是否标识接入点的最后已知配置的装置。用于传送的装置还被配置成响应于确定经更新信标号没有标识接入点的最后已知配置而向接入点传送更新请求帧。

[0021] 在一特定实施例中，一种非瞬态计算机可读介质包括程序代码，该程序代码在由处理器执行时使得该处理器发起从站向接入点传送帧。该帧包括与接入点的配置相关的信标序列号。该程序代码可被执行以使得该处理器响应于该帧的传送，检测接收到来自接入点的指示接入点的配置中的至少一个变化的更新帧。

[0022] 在一特定实施例中，一种非瞬态计算机可读介质包括程序代码，该程序代码在由处理器执行时使得该处理器检测在接入点处接收到来自站的帧。这些指令还可被执行以使得该处理器响应于接收该帧，发起包括与接入点的经更新配置相关的经更新信标序列号的确收帧的传送。

[0023] 所描述的实施例中的至少一个实施例所提供的一个优点包括向低功率站高效且准确地提供当前网络 / 系统配置（即，接入点配置）的能力。

[0024] 本公开的其他方面、优点和特征将在阅读了整个申请后变得明了，整个申请包括下述章节：附图简述、详细描述以及权利要求。

[0025] 附图简述

[0026] 图 1 是可操作用于在接入点和站之间传送配置变化消息的系统的特定实施例的示图；

[0027] 图 2 是在图 1 的系统中的接入点和站之间传送配置变化消息的方法的特定实施例的示图；

[0028] 图 3 是在图 1 的系统中的接入点和站之间传送配置变化消息的方法的另一实施例的示图；

[0029] 图 4 是在图 1 的系统中的接入点和站之间传送配置变化消息的方法的又一实施例的示图；

[0030] 图 5 是根据图 1-4 的可操作用于向接入点传送配置变化消息的站的特定实施例的框图；以及

[0031] 图 6 是根据图 1-4 的可操作用于向站传送配置变化消息的接入点的特定实施例的框图。

[0032] 详细描述

[0033] 参考图 1，可操作用于在接入点和站之间传送配置变化消息的系统的特定实施例的示图被示出并且被一般指定为 100。系统 100 包括接入点 102、104 和 106。接入点 102、104、106 中的每一个可连接到一个或多个站以及一个或多个网络 108。接入点 102、104、106 可经由有线或无线连接来连接到一个或多个网络 108。

[0034] 如图 1 所示，第一接入点 102 经由第一无线通信链路连接到第一站 110 并经由第二无线通信链路连接到第二站 112。第二接入点 104 经由第三无线通信链路连接到第三站 114，并且第三接入点 106 经由第四无线通信链路连接到第四站 116。这些无线通信链路中的每一个可根据一个或多个无线通信协议（例如，兼容电气和电子工程师协会 (IEEE)802.11ah 的协议）来建立。

[0035] 在一特定实施例中，站可向接入点传送帧。该帧可请求由接入点缓冲的要给该站的数据（例如，在该站处于低功率模式时由接入点接收到和/或缓冲的要给该站的数据）。例如，该帧可以是功率节省轮询(PS-Poll)帧，它在长度上可短于探测请求帧。作为替换或补充，该帧可以是使得接入点将该数据发送给该站的触发帧。在一特定实施例中，该帧可包括从该站发送给接入点的上行链路数据。一旦接收到该帧，接入点就可以确定该接入点的寄存器（例如，标志寄存器）中存储的与该站相关联的标志是否指示要向该站传送更新帧。响应于确定该标志指示要向该站传送更新帧，接入设备可以将更新帧传送给该站。在一特定实施例中，该更新帧可指示接入点的配置中的至少一个变化。该站可接收该更新帧并且因此知晓接入点的当前配置并且可基于该当前配置来与接入点通信。

[0036] 为了解说，第一站 110 可按同步模式操作并且第二站 112 可按异步模式操作。如图 1 所示，第一接入点 102 包括缓冲器 140 和标志寄存器 142。在第一时间，第一接入点 102 可从一个或多个网络 108 之一接收第一数据。第一接入点 102 可以确定第一数据的预期接收者是第一站 110 并且可以将第一数据存储在缓冲器 140 中。在第一时间，第一站 110 可处于低功率模式。在后续时间，在第一站 110 转移出低功率模式后，第一接入点 102 可广播信标帧 120 并且第一站 110 可接收该信标帧 120。第一站 110 可以确定信标帧 120 指示旨在发往第一站 110 的第一数据被存储在第一接入点 102 的缓冲器 140 中。第一站 110 还可确定信标帧 120 指示在信标帧 120 的广播之前且在先前信标帧的广播之后（即，在第一站 110 处于睡眠模式时）在第一接入点 102 处已发生了配置变化。第一站 110 可以基于信标帧 120 中包括的信息来修改第一站 110 的配置。

[0037] 第一接入点 102 的标志寄存器 142 可以存储与连接到第一接入点 102 并且按异步模式操作的站相关联的信息。例如，标志寄存器 142 中的条目可以与第二站 112 相关联。第一接入点 102 可以响应于确定自从第一接入点 102 的配置发生变化以来第二站 112 尚未与第一接入点 102 通信，从而将标志寄存器 142 中与第二站 112 相关联的条目设置成第一值。在一特定实施例中，第一接入点 102 可被配置成响应于对第一接入点 102 的配置作出的显著变化而将标志寄存器 142 中的条目设置成第一值，而非显著的配置变化将不会使得第一接入点 102 将标志寄存器 142 中的条目设置成第一值。在一特定实施例中，配置变化是否“显著”可在标准（例如，IEEE802.11ah）中定义并且第一接入点 102 可被配置成标识该标准中定义的显著配置变化。

[0038] 在第一接入点 102 广播信标帧 120 时，第二站 112 可能正按异步低功率模式操作并且可能没有接收到信标帧 120 中指示的配置变化通知。因为第二站 112 没有接收到信标帧 120，所以第二站 112 的配置可能与第一接入点 102 的配置失去同步。响应于转移出异步低功率模式，第二站 112 可以向第一接入点 102 传送消息 122。在一特定实施例中，消息 122 是功率节省轮询(PS-Poll)帧。替换地，该帧可以是使得第一接入点 102 向第二站 112 发送数据（例如，在第二站 112 处于低功率模式时由第一接入点 102 接收到和/或缓冲的要给第二站 112 的数据）的触发帧。在一特定实施例中，该帧可包括从第二站 112 发送给第一接入点 102 的上行链路数据。

[0039] 响应于接收到消息 122（例如，PS-Poll 帧），第一接入点 102 可以确定第二站 112 是否按异步模式操作。响应于确定第二站 112 按异步模式操作，第一接入点 102 可以确定标志寄存器 142 中用于第二站 112 的条目是否被设置成第一值，从而指示自从第一接入点

102 的配置发生变化以来第二站 112 尚未与第一接入点 102 通信。在标志寄存器 142 中的条目被设置成第一值时，第一接入点 102 将更新消息 124 传送给第二站 112。

[0040] 在一特定实施例中，更新消息 124 可包括标识第一接入点 102 的当前配置中的一个或多个参数值的信息，该一个或多个参数值在值方面与第一接入点 102 的先前配置中的一个或多个参数值不同。在另一实施例中，更新消息 124 可包括标识与第一接入点 102 的配置相关联的所有参数值或预定参数值集合的信息。在又一实施例中，更新消息 124 可包括指示第一接入点 102 的配置已变化的信息。第二站 112 可以响应于接收到更新消息 124 而基于更新消息 124 中包括的信息来修改其配置。

[0041] 在另一实施例中，更新消息 124 可以是包括更新位的确收 (ACK) 帧。更新位的第一值可以指示第一接入点 102 不具有要发送给第二站 112 的数据。更新位的第二值可以指示第一接入点 102 具有要发送给第二站 112 的数据。该数据可包括与第一接入点 102 处的配置变化相关联的信息。作为替换或补充，该数据可包括从网络（例如，网络 108 之一）接收到的旨在发往第二站 112 并且被存储在缓冲器 140 中的信息。响应于确定确收消息（例如，更新消息 124) 中包括的更新位被设置成第一值，第二站 112 可转移到异步低功率模式。响应于确定确收消息（例如，更新消息 124) 中包括的更新位被设置成第二值，第二站 112 可制止转移到异步低功率模式，直至第二站 112 从第一接入点 102 接收到数据。

[0042] 在一特定实施例中，更新消息 124 可以是兼容 IEEE802.11ah 无线网络的帧，诸如 IEEE802.11ah 标准中定义的一个或多个帧、一个或多个经修改的更新帧、探测响应帧、信道变化帧、扩展信道切换宣告 (ECSA) 帧、操作模式变化帧、甚高吞吐量 (VHT) 操作模式通知帧、另一帧、或其组合。

[0043] 在一特定实施例中，第二接入点 104 包括缓冲器 144。第二接入点 104 的缓冲器 144 可如参考第一接入点 102 的缓冲器 140 所描述的那样操作。例如，第二接入点 104 可以经由网络 108 接收定址到第三站 114 的第二数据。第三站 114 可以按异步模式操作。第二接入点 104 可以将第二数据存储在缓冲器 144 中，直至第三站 114 向第二接入点 104 传送了指示第三站 114 准备好接收该数据的消息。

[0044] 通过响应于改变第二接入点 104 的配置而将标志寄存器中与第三站 114 相关联的条目的值设置成第一值，第二接入点 104 能够确定在指示第二接入点 104 处的配置变化的信标帧被广播时第三站 114 是否处于异步低功率模式。因而，响应于从第三站 114 接收到 PS-Poll 消息，第二接入点 104 能够自动地确定第三站 114 是否已接收到配置变化的通知，并且如果没有，则向第三站 114 自动地传送包括标识该配置变化的信息的更新消息 124。

[0045] 在另一特定实施例中，与接入点通信的站可以向该接入点传送帧。该帧可请求由接入点缓冲的要给该站的数据（例如，在该站处于低功率模式时由接入点接收到和 / 或缓冲的要给该站的数据）。例如，该帧可以是功率节省轮询 (PS-Poll) 帧。作为替换或补充，该帧可以是使得接入点将该数据发送给该站的触发帧。在一特定实施例中，该帧可包括从该站发送给接入点的上行链路数据。该帧可包括与接入点的配置相关的信标序列号（即，在该站进入低功率模式之前该站已知的接入点的最后已知配置）。接入点可以接收该帧并且可以确定该帧中包括的信标序列号与接入点的‘旧’配置相对应（即，并非接入点的当前配置）。接入点随后可传送指示当前配置与由接收到的信标序列号所标识的旧配置之间的至少一个差异的更新消息。在一替换实施例中，接入点可以调度更新帧到该站的传输（例

如，在该站不处于睡眠模式或功率节省模式时的时段期间）并且可以在所调度的时间期间传送该更新帧。因而，接入点可以制止向该站传送更新帧，直至该站退出睡眠模式或功率节省模式。在又一替换实施例中，接入点可以传送包括向该站通知有更新帧可用（即，当前配置可用）的信息（诸如更新位字段）的确收（ACK）帧。在该站接收到该确收帧时，该站可以向接入点传送更新请求帧并且接入点随后可向该站传送该更新帧。

[0046] 为了解说，第二接入点 104 可被配置成经由无线通信链路与第三站 114 通信。在第三站 114 处于异步低功率模式时在第二接入点 104 处可发生配置变化，如参考图 2-3 所描述的。在一特定实施例中，配置变化与信道配置相关联。例如，第二接入点 104 可以确定由第二接入点 104 用来与第三站 114 和其他站（未示出）通信的信道可能需要暂时静默（即，没有话务）。第二接入点 104 可以修改其配置信息以指示该信道要静默。在一特定实施例中，第二接入点 104 可以改变当前传输或工作信道，可以改变操作模式，或其任何组合。例如，信道变化可以是信道切换或扩展信道切换。作为另一示例，操作模式变化可包括增强型分布信道接入（EDCA）参数的修改、静默信息元素的修改、直接序列扩频（DSSS）参数集的修改、无竞争（CF）参数集的修改、跳频（FH）参数集的修改、高吞吐量（HT）操作元素的修改、或其任何组合。

[0047] 响应于修改配置，第二接入点 104 可以修改（例如，递增或递减）标识第二接入点 104 的当前配置的信标序列号。例如，在修改第二接入点 104 的配置以指示信道要静默之前，信标序列号可具有值 X。响应于修改配置，第二接入点 104 可将信标序列号修改成值 X+1（例如，递增）。

[0048] 在第二接入点 104 处的配置变化之前，第三站 114 可能已经转移到异步低功率模式。第三站 114 可存储指示与第二接入点 104 相关联的信标序列号具有值 X 的信息。在第三站 114 处存储的值 X 表示或对应于在转移到异步低功率模式之前第三站 114 知道的第二接入点 104 的最后配置。在第三站 114 处于异步低功率模式时，第三站 114 不能检测到第二接入点 104 的配置已经变化。在第三站 114 转移出异步低功率模式时，存储在第三站 114 处的信标序列号指示第二接入点 104 的配置是与信标序列号值 X 相关联的配置。在第三站 114 转移出异步低功率模式时，存储在第二接入点 104 处的当前信标序列号具有值 X+1。

[0049] 在第三站 114 转移出异步低功率模式时，第三站 114 向第二接入点 104 传送消息。该消息可包括请求由第二接入点 104 缓冲的要给第三站 114 的数据的 PS-Poll 消息 126。作为替换或补充，该消息可以包括使得接入点将该数据发送给该站的触发帧。在一特定实施例中，该消息可包括从第三站 114 发送给第二接入点 104 的上行链路数据。在一特定实施例中，PS-Poll 消息 126 可包括存储在第三站 114 处的信标序列号 127（例如，具有值 X 的信标序列号）。PS-Poll 消息 126 可以由第二接入点 104 接收。

[0050] 响应于从第三站 114 接收到 PS-Poll 消息 126，第二接入点 104 可以确定 PS-Poll 消息 126 中包括的信标序列号 127（例如，具有值 X 的信标序列号）是否标识了存储在第二接入点 104 处的当前信标序列号（例如，具有值 X+1 的信标序列号）。响应于确定 PS-Poll 消息 126 中包括的信标序列号 127 没有标识存储在第二接入点 104 处的当前信标序列号，第二接入点 104 可以向第三站 114 传送更新消息 128。更新消息 128 可以类似于更新消息 124 并且可包括与更新消息 124 中包括的信息相类似的信息。

[0051] 例如，更新消息 128 可包括标识第二接入点 104 的当前配置中的一个或多个参数

值的信息，该一个或多个参数值在值方面与第二接入点 104 的先前配置中的一个或多个参数值不同。在另一实施例中，更新消息 128 可包括标识与第二接入点 104 的配置相关联的所有参数值或预定参数值集合的信息。在又一实施例中，更新消息 128 可包括指示第二接入点 104 的配置已变化的信息。响应于接收到更新消息 128，第三站 114 可以基于更新消息 128 中包括的信息来修改其配置。

[0052] 在另一特定实施例中，作为传送更新消息 128 的替换或补充，第二接入点 104 可以向第三站 114 传送确收帧（未示出）。该确收帧可包括更新位（例如，标志）。在一特定实施例中，更新位可以指示存储在第三站 114 处的信标序列号 127 是否标识了存储在第二接入点 104 处的当前信标序列号。例如，更新位的第一值可以指示存储在第三站 114 处的信标序列号 127 与存储在第二接入点 104 处的当前信标序列号相匹配。更新位的第二值可以指示存储在第三站 114 处的信标序列号 127 与存储在第二接入点 104 处的当前信标序列号不匹配。

[0053] 在另一特定实施例中，更新位可以指示第二接入点 104 具有要发送给第三站 114 的数据。例如，更新位的第一值可指示第二接入点 104 不具有要发送给第三站 114 的数据。更新位的第二值可以指示第二接入点 104 具有要发送给第三站 114 的数据。在一特定实施例中，该数据可以与第二接入点 104 处的配置变化相关。在另一实施例中，该数据可以与第二接入点 104 处的配置变化相关或可包括从网络（例如，网络 108 之一）接收到的旨在发往第三站 114 的数据。

[0054] 第三站 114 可以接收确收帧并确定更新位被设置成第一值还是第二值。在更新位被设置成第一值时，第三站 114 可以确定第二接入点 104 不具有要发送给第三站 114 的数据并且第三站 114 可以转移回异步低功率模式。在一特定实施例中，在更新位被设置成第二值时，第三站 114 可以延迟转移回异步低功率模式，直至第三站 114 从接入点 104 接收到该数据。在另一实施例中，第三站 114 可以向第二接入点 104 传送指示第三站 114 准备好接收来自第二接入点 104 的数据的更新请求消息（未示出）。第二接入点 104 可以响应于接收到来自第三站 114 的更新请求而传送更新消息（例如，更新消息 128）。在一特定实施例中，更新消息可包括配置变化数据，如参考更新消息 124 和 128 所描述的。作为替换或补充，更新消息可包括从网络（例如，网络 108 之一）接收到的旨在发往第三站 114 的数据。

[0055] 通过在 PS-Poll 消息 126 中接收存储在第三站 114 处的信标序列号 127，第二接入点 104 能够确定在指示第二接入点 104 处的配置变化的信标帧被第二接入点 104 广播时第三站 114 是否处于异步低功率模式。因此，第二接入点 104 能够响应于接收到 PS-Poll 消息 126 而向第三站 114 自动地传送包括标识该配置变化的信息的更新消息 128。

[0056] 在一特定实施例中，站可以向接入点传送帧（例如，PS-Poll 帧、触发帧、请求所缓冲数据的帧、和 / 或包括上行链路数据的帧）并且可以接收响应于该帧的包括与接入点的经更新配置相关的经更新信标序列号的确收帧。该站可确定经更新序列号是否标识接入点的最后已知配置。如果接收到的经更新信标序列号没有标识接入点的最后已知配置，则该站可以向接入点传送更新请求帧。接入点可以向该站传送更新帧，该更新帧指示该站所知的接入点的最后已知配置中的至少一个变化。

[0057] 如所解说的，第四站 116 可以按异步模式操作并且转移到异步低功率模式。在第四站 116 处于异步低功率模式时，第三接入点 106 的配置可被修改。在第三接入点 106 的

配置修改之后，第四站 116 可转移出异步低功率模式并且向第三接入点 106 传送 PS-Poll 消息 130。第三接入点 106 可以接收 PS-Poll 消息 130 并向第四站 116 传送确收消息 132。确收消息 132 可包括标识第三接入点 106 的当前配置的当前信标序列号。

[0058] 响应于接收到确收消息 132，第四站 116 可以确定存储在第四站 116 处的信标序列号是否与确收消息 132 中包括的当前信标序列号所标识的配置相对应。在存储在第四站 116 处的信标序列号与确收消息 132 中包括的当前信标序列号相匹配时，第四站 116 可以确定第四站 116 知晓第三接入点 106 的当前配置。在存储在第四站 116 处的信标序列号与确收消息 132 中包括的当前信标序列号不匹配时，第四站 116 可以确定第四站 116 不知晓第三接入点 106 的当前配置并且第四站 116 需要修改其配置。响应于确定存储在第四站 116 处的信标序列号与确收消息 132 中包括的当前信标序列号不匹配，第四站 116 可以向第三接入点 106 传送更新请求消息（未示出）。

[0059] 响应于在第三接入点 106 处接收到更新请求消息，第三接入点 106 可以传送更新消息（未示出）。第三接入点 106 所传送的更新消息可以与上述更新消息 128 相类似。

[0060] 在一特定实施例中，第三接入点 106 包括缓冲器 146。第三接入点 106 的缓冲器 146 可如参考第一接入点 102 的缓冲器 140 所描述的那样操作。例如，第三接入点 106 可以经由网络 108 接收定址到第四站 116 的第三数据。第四站 116 可以按异步模式操作。第三接入点 106 可以将第三数据存储在缓冲器 146 中，直至第四站 116 向第三接入点 106 传送指示第四站 116 准备好接收该数据的消息。

[0061] 通过在确收消息 132 中接收存储在第三接入点 106 处的当前信标序列号，第四站 116 能够确定在第三接入点 106 处的配置变化发生时第四站 116 是否处于异步低功率模式。因此，第四站 116 能够向第三接入点 106 自动地传送更新请求消息并且第三接入点 106 能够传送包括标识接入点 106 的配置变化的信息的更新消息（未示出）。

[0062] 参考图 2，在接入点和站之间传送配置变化消息的方法的特定实施例的示图被示出并且被一般指定为 200。在图 2 中，示出了站 202 和接入点 204。在一特定实施例中，接入点 204 可以是图 1 的第二接入点 104。如图 2 所示，接入点 204 可以存储当前信标序列号（例如，接入点信标序列号 (AP-BSN)）208。当前信标序列号 208 可以标识接入点 204 的当前配置。在一特定实施例中，站 202 可以存储信标序列号（例如，站信标序列号 (S-BSN)）206。站信标序列号 206 可以标识站 202 已知的接入点 204 的最后已知配置。

[0063] 在第一时间，站信标序列号 206 可被设置成值 X 并且当前信标序列号 208 可被设置成值 X。在 210，站 202 可进入异步低功率模式。在站 202 处于异步低功率模式时，在 212，接入点 204 可以修改接入点 204 的配置，并且当前信标序列号 208 可递增到 X+1。因为站 202 处于异步低功率模式，所以站 202 可能没有接收到接入点 204 的配置已变化的通知（例如，信标帧、更新消息等）。

[0064] 在 214，站 202 可转移出异步低功率模式。随后，在 216，站 202 向接入点 204 传送 PS-Poll 消息 218。PS-Poll 消息 218 可包括存储在站 202 处的站信标序列号 206。在 222，接入点 204 可以从站 202 接收 PS-Poll 消息 218 并确定站信标序列号 206 是否与存储在接入点 204 处的当前信标序列号 208 相对应。

[0065] 响应于确定站信标序列号 206 不与当前信标序列号 208 相对应，在 224，接入点 204 可传送更新帧 234（例如，更新消息 128）。更新帧 234 可包括更新数据 236。在一特定

实施例中，更新数据 236 可包括标识接入点 204 的当前配置中的一个或多个参数值的信息，该一个或多个参数值在值方面与接入点 204 的先前配置（例如，由存储在站 202 处的站信标序列号 206 所标识的配置）中的一个或多个参数值不同。在另一实施例中，更新数据 236 可包括标识与接入点 204 的配置相关联的所有参数值或预定参数值集合的信息。在又一实施例中，更新数据 236 可包括指示接入点 204 的配置已改变的其他信息。响应于接收到更新帧 234，站 202 可以基于更新帧 234 中包括的更新数据 236 来修改其配置（未示出）。

[0066] 在一替换实施例中，在 226，接入点 204 可以响应于确定站信标序列号 206 不与当前信标序列号 208 相对应而向站 202 传送确收帧 228。确收帧 228 可包括指示存储在站 202 处的站信标序列号 206 是否与存储在接入点 204 处的当前信标序列号 208 相对应的更新位 230（例如，标志）。例如，更新位 230 的第一值可以指示存储在站 202 处的站信标序列号 206 与存储在接入点 204 处的当前信标序列号 208 相匹配。更新位 230 的第二值可以指示存储在第三站 114 处的站信标序列号 206 与存储在第二接入点 104 处的当前信标序列号 208 不匹配。

[0067] 在 232，站 202 可以接收确收帧 228 并确定更新位 230 被设置成第一值还是第二值。在更新位 230 被设置成第一值时，站 202 可以确定接入点 204 的当前配置是由存储在站 202 处的站信标序列号 206 所标识的配置。在更新位 230 被设置成第二值时，站 202 可以确定接入点 204 的当前配置不是与存储在站 202 处的站信标序列号 206 相对应的配置。响应于确定更新位 230 被设置成第二值，在 238，站 202 可以向接入点 204 传送更新请求消息 240。更新请求消息 240 可以请求接入点 204 传送更新消息（例如，更新消息 124、128 之一）。在 224，第三接入点 106 可以响应于在接入点 204 处接收到更新请求帧 234 而传送更新帧 234。更新帧 234 可类似于参考图 1 描述的更新消息 124、128。

[0068] 替换地，响应于具有第二值的更新位 230，站 202 可以保持活跃状态（即，与异步低功率状态或关闭状态不同的状态）以等待来自接入点 204 的更新帧 234 的传输，并且接入点 204 可在传送确收帧 228 之后自动地传送更新帧 234。

[0069] 参考图 3，在接入点和站之间传送配置变化消息的方法的另一实施例的示图被示出并且被一般指定为 300。在图 3 中，示出了站 302 和接入点 304。接入点 304 包括标志寄存器 306。标志寄存器 306 可以是图 1 的标志寄存器 142。

[0070] 在 308，站 302 可以进入异步低功率模式。在站 302 处于异步低功率模式时，在 310，接入点 304 可以修改接入点 304 的配置。因为站 302 处于异步低功率模式，所以站 302 可能没有接收到接入点 304 的配置已变化的通知（例如，信标帧、更新消息等）。在 312，接入点 304 可以将标志寄存器 306 中的一个或多个条目初始化成指示与该一个或多个条目相关联的站（例如，包括站 302）可能没有接收到配置变化的通知的值，如参考图 1 所解释的。

[0071] 在 314，站 302 可转移出异步低功率模式。随后，在 316，站 302 向接入点 304 传送 PS-Poll 消息 318。在 320，接入点 304 可以从站 302 接收 PS-Poll 消息 318 并确定标志寄存器 306 中与站 302 相关联的条目的值是否指示站 302 没有接收到接入点 304 的配置变化的通知。响应于确定站 302 没有接收到该通知，在 322，接入点 304 可以向站 302 传送更新帧 324。更新帧 324 可包括更新数据 326，如以上参考图 1 和 2 所描述的。

[0072] 参考图 4，在接入点和站之间传送配置变化消息的方法的另一实施例的示图被示出并且被一般指定为 400。在图 4 中，示出了站 402 和接入点 404。如图 4 所示，接入点 404

可以包括当前信标序列号 408（例如，接入点信标序列号 (AP-BSN)）。当前信标序列号 408 可以标识接入点 404 的当前配置。在一特定实施例中，站 402 可以包括信标序列号 406（例如，站信标序列号 (S-BSN)）。站信标序列号 406 可以标识站 402 已知的接入点 404 的最后已知配置。

[0073] 在第一时间，站信标序列号 406 可被设置成值 X 并且当前信标序列号 408 可被设置成值 X。在 410，站 402 可进入异步低功率模式。在站 402 处于异步低功率模式时，在 412，接入点 404 可以修改接入点 404 的配置，并且当前信标序列号 408 可递增到 X+1。因为站 402 处于异步低功率模式，所以站 402 可能没有接收到接入点 404 的配置已变化的通知（例如，信标帧、更新消息等）。

[0074] 在 414，站 402 可转移出异步低功率模式。随后，在 416，站 402 向接入点 404 传送 PS-Poll 消息 418。然而，与图 2 的 PS-Poll 消息 218 形成对比，PS-Poll 消息 418 可不包括存储在站 402 处的站信标序列号 406。响应于接收到 PS-Poll 消息 418，在 420，接入点 404 可以向站 402 传送确收帧 422。确收帧 422 可包括存储在接入点 404 处的当前信标序列号 408（在图 4 中示为确收帧 422 中的 AP-BSN424)AP-BSN424 可以标识或对应于接入点 404 的当前配置。

[0075] 在 426，站 402 可以接收确收帧 422 并确定站信标序列号 406 是否与当前信标序列号 408 所标识的接入点配置相对应。在当前信标序列号 408 和站信标序列号 406 具有相同的值时，站 402 可以确定接入点 404 的当前配置是由存储在站 402 处的站信标序列号 406 所标识的配置。在当前信标序列号 408 和站信标序列号 406 不具有相同的值时，站 402 可以确定接入点 404 的当前配置不是由存储在站 402 处的站信标序列号 406 所标识的配置。

[0076] 响应于确定接入点 404 的当前配置不是站信标序列号 406 所标识的配置，在 428，站 402 可以向接入点 404 传送更新请求帧 430。响应于更新请求帧 430，接入点可以向站 402 发送更新数据，诸如参考图 1 所描述的更新消息 124、128 中的一个或多个。

[0077] 参考图 5，根据图 1-4 的可操作用于向接入点传送配置变化消息的站的特定实施例的框图被公开并被一般指定为 500。站 500 包括处理器，诸如耦合到存储器 532 的处理器 510。

[0078] 存储器 532 可以是存储数据（例如，代表性配置数据 562)、指令或这两者的非瞬态计算机可读存储介质。在一特定实施例中，存储器 532 可包括可由处理器 510 执行以使得处理器 510 执行站 500 的一个或多个功能的指令 552。例如，指令 552 可包括用户应用、操作系统、其他可执行指令、或其组合。指令可由处理器 510 执行以使得处理器执行参考图 1-4 描述的功能性的至少一部分。

[0079] 站 500 可包括用于发送和接收信号和 / 或数据分组的收发机 550。例如，站 500 可以在站 500 向接入点传送帧（例如，PS-Poll 帧、触发帧、请求所缓冲数据的帧、包括上行链路数据的帧，等等）、更新请求帧、或任何其他数据时充当发射机。作为另一示例，站 500 可在站 500 从接入点接收确收帧、更新帧、或任何其他数据时充当接收机。

[0080] 在一特定实施例中，收发机 550 可以提供用于从站向接入点传送帧（例如，PS-Poll 帧）的装置。收发机 550 还可提供用于从接入点接收响应于该帧的指示接入点的配置中的至少一个变化的更新帧的装置。收发机 550 还可提供用于接收响应于该帧的包括与接入点的经更新配置相关的经更新信标序列号的确收帧的装置。在一特定实施例中，处

理器 510 可提供用于确定经更新信标序列号是否标识接入点的最后已知配置的装置。

[0081] 图 5 还示出可被耦合至处理器 510 以及显示器 528 的显示控制器 526。编码器 / 解码器 (CODEC)534(例如音频和 / 或语音 CODEC) 可被耦合至处理器 510。扬声器 536 和话筒 538 可被耦合至 CODEC534。图 5 还指示了无线控制器 540 可被耦合至处理器 510 以及收发机 550(经由调制解调器 541),该收发机 550 被耦合至无线天线 542。在一特定实施例中,可将处理器 510、显示控制器 526、存储器 532、调制解调器 541、CODEC534、无线控制器 540 和收发机 550 包括在系统级封装或片上系统设备 522 中。

[0082] 在一特定实施例中,输入设备 530 和电源 544 被耦合至片上系统设备 522。此外,在特定实施例中,如图 5 中所解说的,显示器 528、输入设备 530、扬声器 536、话筒 538、无线天线 542 和电源 544 在片上系统设备 522 的外部。然而,显示器 528、输入设备 530、扬声器 536、话筒 538、无线天线 542 和电源 544 中的每一者可被耦合至片上系统设备 522 的组件,诸如接口或控制器。

[0083] 应该注意,虽然图 5 描绘了无线通信设备,但处理器 510 和存储器 532 可被集成到其他设备中,诸如移动设备、相机、多媒体播放器、娱乐单元、导航设备、个人数字助理 (PDA)、固定位置数据单元、计算机 (例如平板计算机、膝上型计算机、台式计算机、便携式计算机等)、媒体设备、路由器或网关设备、或被配置成无线地传达数据的另一设备。

[0084] 参考图 6,根据图 1-4 的可操作用于向站传送配置变化消息的接入点的特定实施例的框图被公开并被一般指定为 600。接入点 600 包括处理器,诸如耦合到存储器 632 的处理器 610。

[0085] 存储器 632 可以是存储数据 (例如,代表性配置数据 672)、指令或这两者的非瞬态计算机可读存储介质。在一特定实施例中,存储器 632 还可包括包含与同接入点 600 通信的对应站相关联的标志 662 的一个或多个寄存器。在一特定实施例中,标志 662 可指示接入点 600 的经更新配置要被传送给站。

[0086] 在一特定实施例中,存储器 632 可包括可由处理器 610 执行以使得处理器 610 执行接入点 600 的一个或多个功能的指令 652。例如,指令 652 可包括用户应用、操作系统、或其他可执行指令、或其组合。指令 652 可由处理器 610 执行以使得处理器 610 执行关于图 1-4 中任一者描述的功能性的至少一部分。

[0087] 接入点 600 可包括用于发送和接收信号和 / 或数据分组的收发机 650。例如,接入点 600 在接入点 600 传送信号和 / 或分组时可充当发射机,并且在接入点 600 接收信号和 / 或分组时可充当接收机。为了解说,接入点 600 可在接入点 600 向站传送确收帧、更新帧或其任何组合时充当发射机。接入点 600 还可在接入点 600 从站接收帧 (例如,PS-Poll 帧、触发帧、请求在接入点 600 处缓冲的数据的帧、包括上行链路数据的帧,等等)、更新请求、或其任何组合时充当接收机。

[0088] 图 6 还指示了调制解调器 641 和无线控制器 640 可被耦合至处理器 610 和收发机 650,该收发机 650 被耦合至无线天线 642。在一特定实施例中,可将处理器 610、存储器 632、调制解调器 641、无线控制器 640 和收发机 650 包括在系统级封装或片上系统设备 622 中。在一特定实施例中,电源 644 被耦合至片上系统设备 622。此外,在一特定实施例中,无线天线 642 和电源 644 处于片上系统设备 622 外部。

[0089] 应该注意,虽然图 6 描绘了无线通信设备,但处理器 610 和存储器 632 可被集成

到其他设备中，诸如移动设备、相机、多媒体播放器、娱乐单元、导航设备、个人数字助理(PDA)、固定位置数据单元、计算机（例如平板计算机、膝上型计算机、台式计算机、便携式计算机等）、媒体设备、路由器或网关设备、或被配置成无线地传递数据的另一设备。

[0090] 结合所描述的实施例，公开了一种设备，其包括用于在接入点处从站接收帧的装置，该帧包括标识该站在进入低功率模式之前已知的该接入点的最后已知配置的信标序列号。例如，该用于接收的装置可包括图 1 的接入点 102、104 和 106 的组件，图 2 的接入点 204 的组件，图 3 的接入点 304 的组件，图 4 的接入点 404 的组件，或图 6 的接入点 600 的组件，图 6 的收发机 650，配置成接收帧的一个或多个其他设备，或其任何组合。

[0091] 该设备还包括用于确定在该帧中从该站接收到的信标序列号是否标识接入点的当前配置的装置。例如，该用于确定的装置可包括图 6 的处理器 610，图 1 的接入点 102、104 和 106 的组件，图 2 的接入点 204 的组件，图 3 的接入点 304 的组件，图 4 的接入点 404 的组件，或图 6 的接入点 600 的组件，图 6 的收发机 650，配置成确定信标序列号是否标识接入点的当前配置的一个或多个其他设备，或其任何组合。

[0092] 该设备包括用于响应于确定信标序列号没有标识当前配置而传送指示当前配置与信标序列号所标识的配置之间的至少一个差异的更新帧的装置。例如，该用于传送更新帧的装置可包括图 1 的接入点 102、104 和 106 的组件，图 2 的接入点 204 的组件，图 3 的接入点 304 的组件，图 4 的接入点 404 的组件，或图 6 的接入点 600 的组件，图 6 的收发机 650，配置成传送更新帧的一个或多个其他设备，或其任何组合。

[0093] 结合所描述的实施例，公开了一种设备，其包括用于从站向接入点传送帧的装置。例如，该用于传送的装置可包括图 1 的站 110、112、114 和 116 的组件，图 2 的站 202 的组件，图 3 的站 302 的组件，图 4 的站 402 的组件，或图 5 的站 500 的组件，图 5 的收发机 550，配置成传送帧的一个或多个其他设备，或其任何组合。

[0094] 该设备包括用于接收响应于该帧的包括与接入点的经更新配置相关的经更新信标序列号的确收帧的装置。例如，该用于接收确收帧的装置可包括图 1 的站 110、112、114 和 116 的组件，图 2 的站 202 的组件，图 3 的站 302 的组件，图 4 的站 402 的组件，或图 5 的站 500 的组件，图 5 的收发机 550，配置成接收确收帧的一个或多个其他设备，或其任何组合。

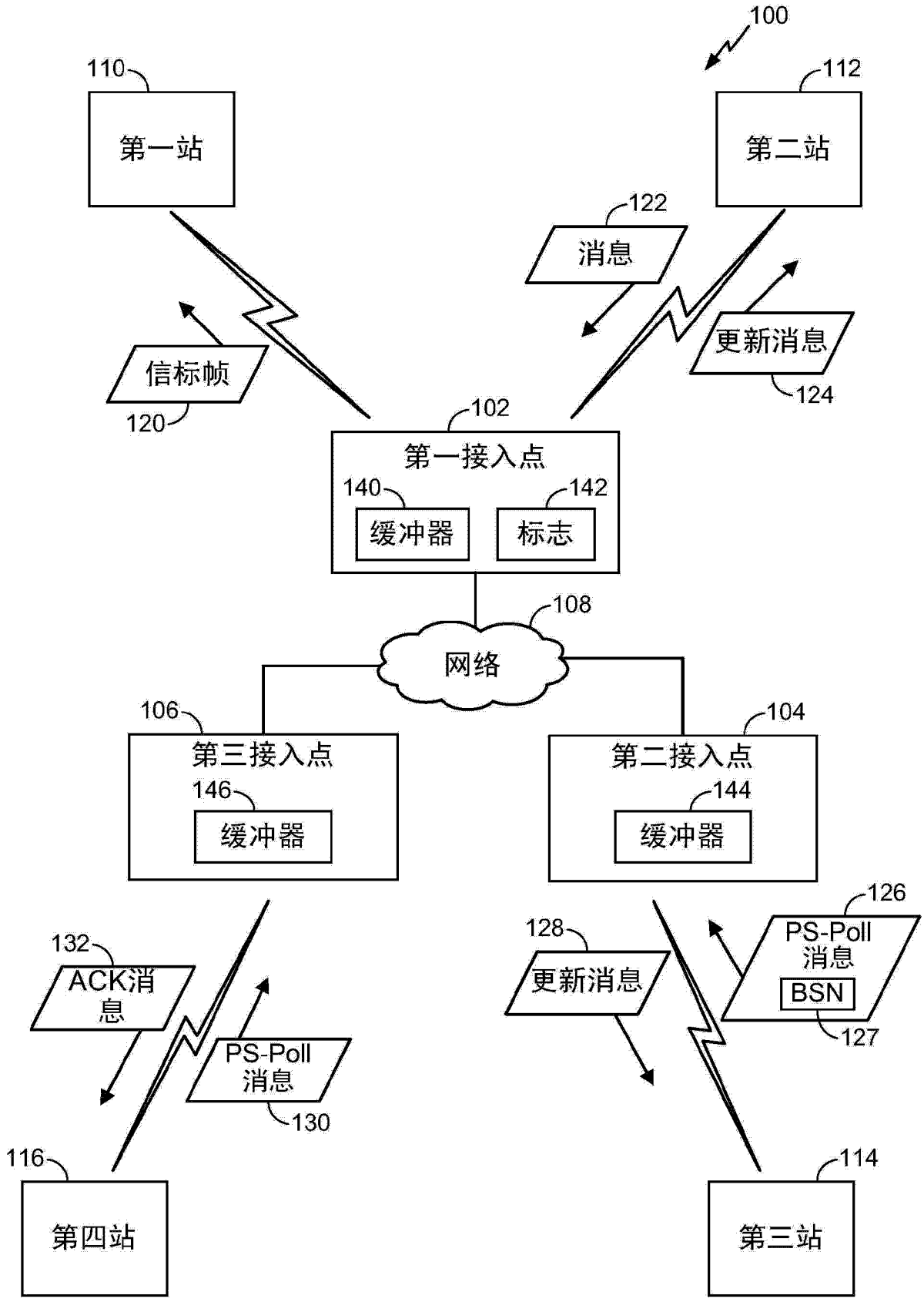
[0095] 该设备还包括用于确定经更新信标序列号是否标识接入点的最后已知配置的装置。例如，该用于确定的装置可包括图 5 的处理器 510，图 1 的站 110、112、114 和 116 的组件，图 2 的站 202 的组件，图 3 的站 302 的组件，图 4 的站 402 的组件，或图 5 的站 500 的组件，图 5 的收发机 550，配置成确定经更新信标序列号是否标识接入点的最后已知配置的一个或多个其他设备，或其任何组合。该用于传送的装置还被配置成响应于确定经更新信标号没有标识接入点的最后已知配置而向接入点传送更新帧。

[0096] 本领域技术人员将进一步领会，结合本文所公开的实施例来描述的各种解说性逻辑框、配置、模块、电路、和算法步骤可实现为电子硬件、计算机软件或这两者的组合。各种解说性组件、框、配置、模块、电路、和步骤已经在上文以其功能性的形式作了一般化描述。此类功能性是被实现为硬件还是软件取决于具体应用和施加于整体系统的设计约束。技术人员可针对每一具体应用以不同方式来实现所描述的功能，但此类实现决策不应被解读为致使脱离本公开的范围。

[0097] 结合本文所公开的实施例描述的方法或算法的各个步骤可直接用硬件、由处理器

执行的软件模块或两者的组合来实现。软件模块可驻留在随机存取存储器 (RAM)、闪存、只读存储器 (ROM)、可编程只读存储器 (PROM)、可擦式可编程只读存储器 (EPROM)、电可擦式可编程只读存储器 (EEPROM)、寄存器、硬盘、可移动盘、压缩盘只读存储器 (CD-ROM)、或任何其他形式的非瞬态存储介质。示例性存储介质被耦合到处理器，以使得处理器能从 / 向该存储介质读取 / 写入信息。替换地，存储介质可以被整合到处理器。处理器和存储介质可驻留在专用集成电路 (ASIC) 中。ASIC 可驻留在计算设备或用户终端 (例如移动电话或 PDA) 中。在替换方案中，处理器和存储介质可作为分立组件驻留在计算设备或用户终端中。

[0098] 提供前面对所公开的实施例的描述是为了使本领域技术人员皆能制作或使用所公开的实施例。对这些实施例的各种修改对于本领域技术人员而言将是显而易见的，并且本文中定义的原理可被应用于其他实施例而不会脱离本公开的范围。因此，本公开并非旨在被限定于本文中公开的实施例，而是应被授予与如由所附权利要求定义的原理和新颖性特征一致的最广的可能范围。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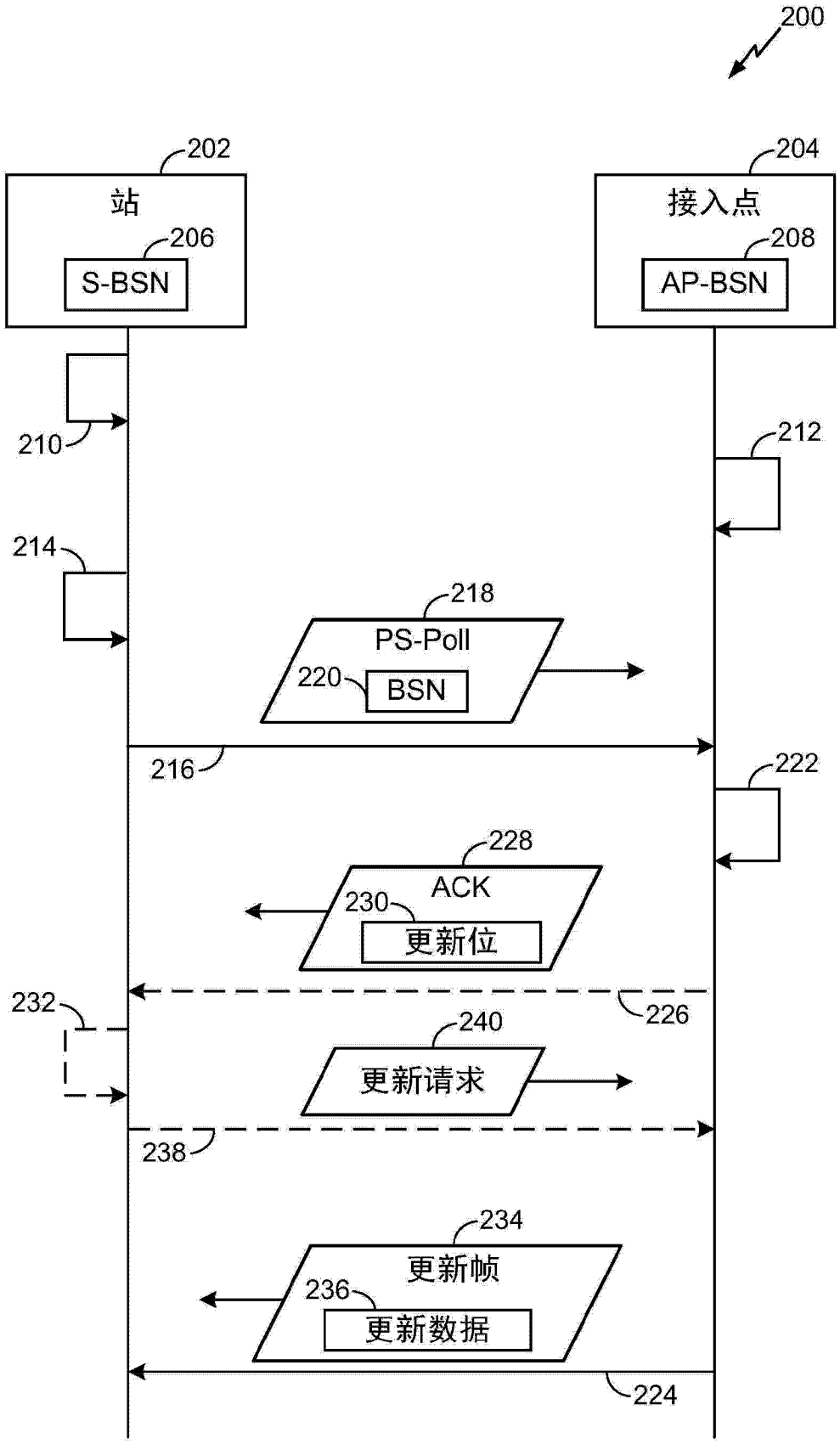
110
第一站
112
第二站
122
消息
更新消息
124
信标帧
120
102
第一接入点
140
缓冲器
142
标志
108
网络
106
第三接入点
146
缓冲器
104
第二接入点
144
缓冲器
126
PS-Poll
消息
BSN
127
128
更新消息
132
ACK消息
PS-Poll
消息
130
116
第四站
114
第三站

图 1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AP-BSN
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214
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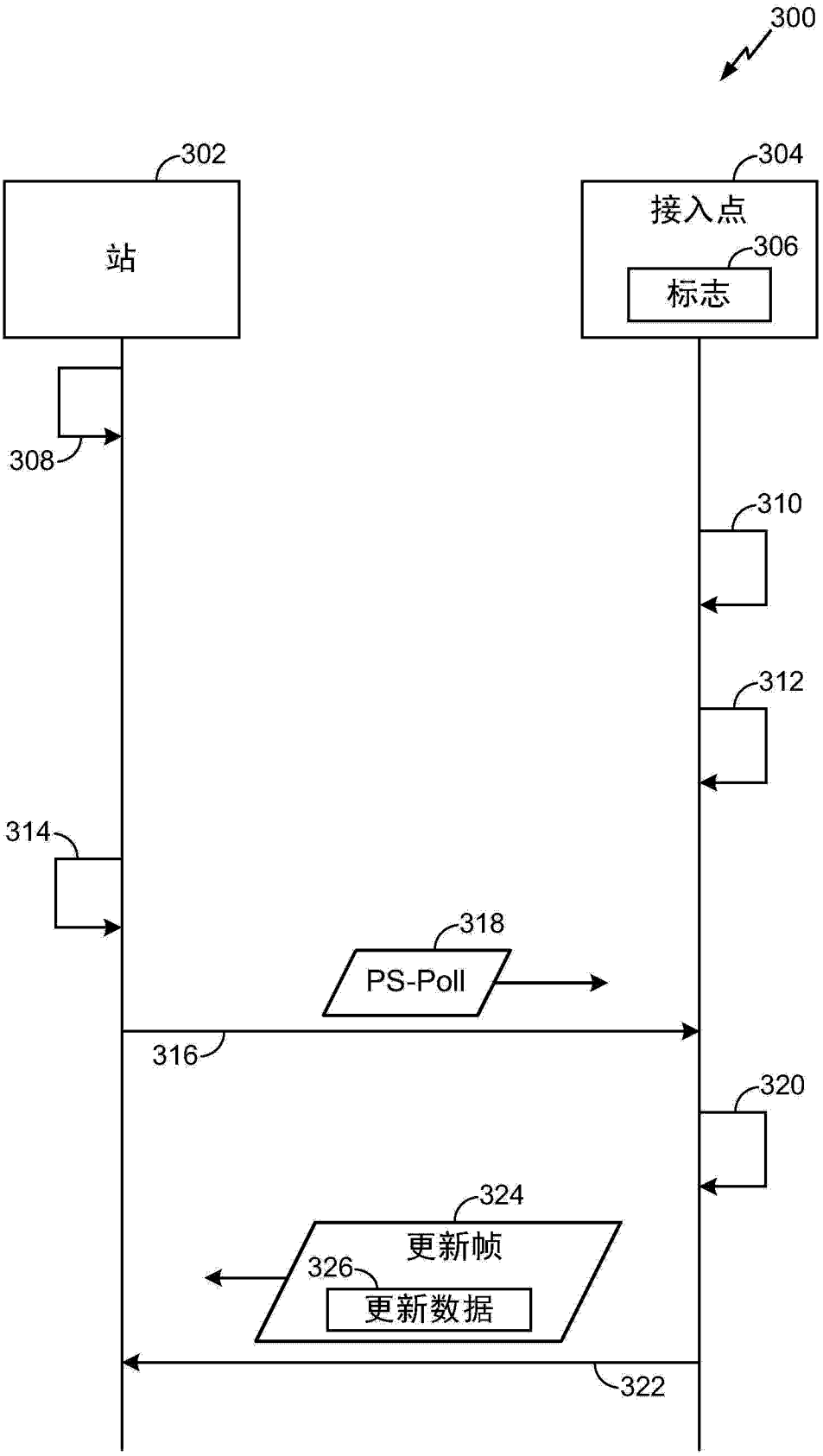
PS-Poll
220
BSN
216
222
228
ACK
230
更新位
232
226
240
更新请求
238
234
更新帧
236
更新数据
224

图 2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站
304
接入点
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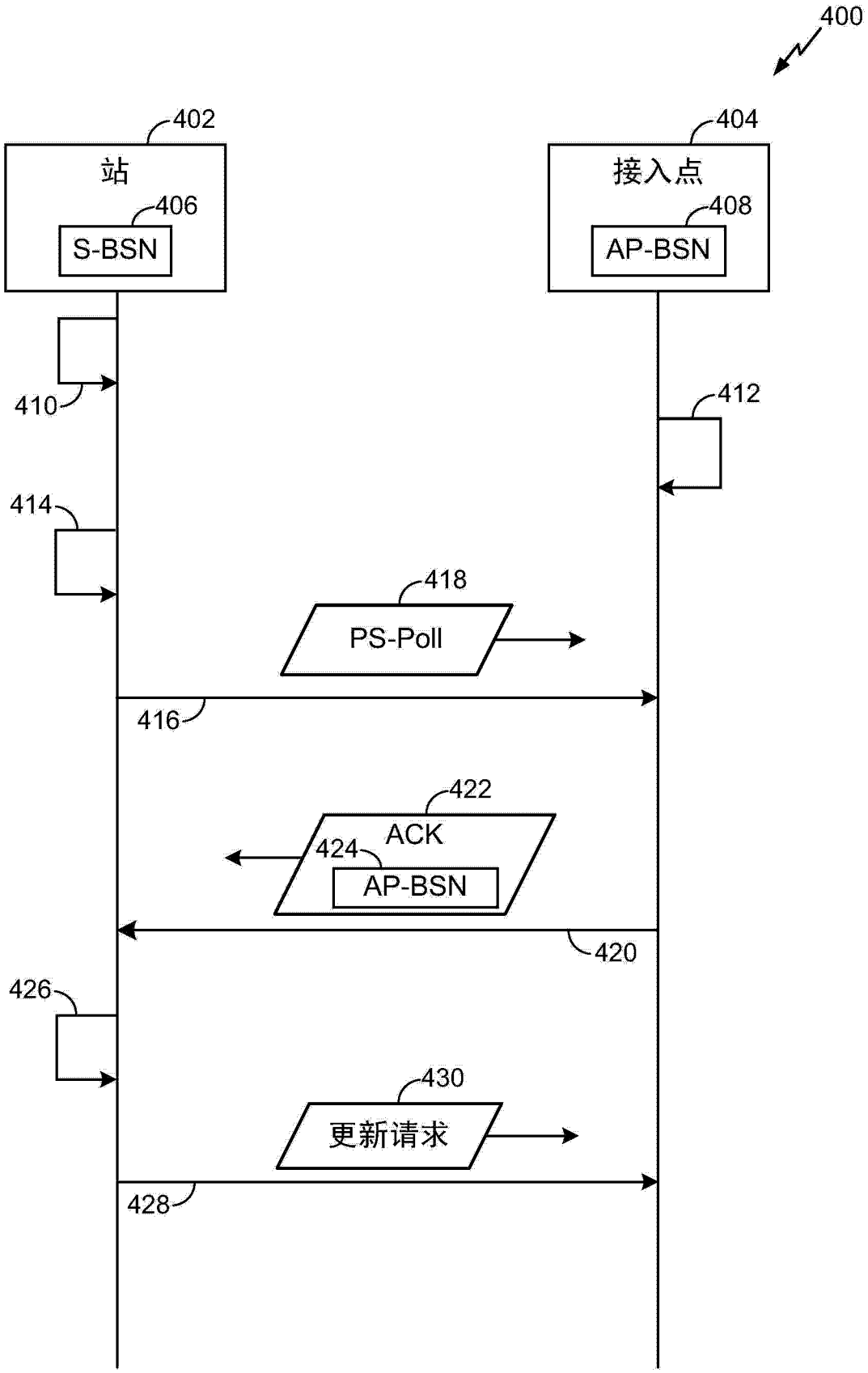
PS-Poll
316
320
324
更新帧
326
更新数据
322

图 3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站
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S-BSN
404
接入点
408
AP-BSN
410
412
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PS-Poll
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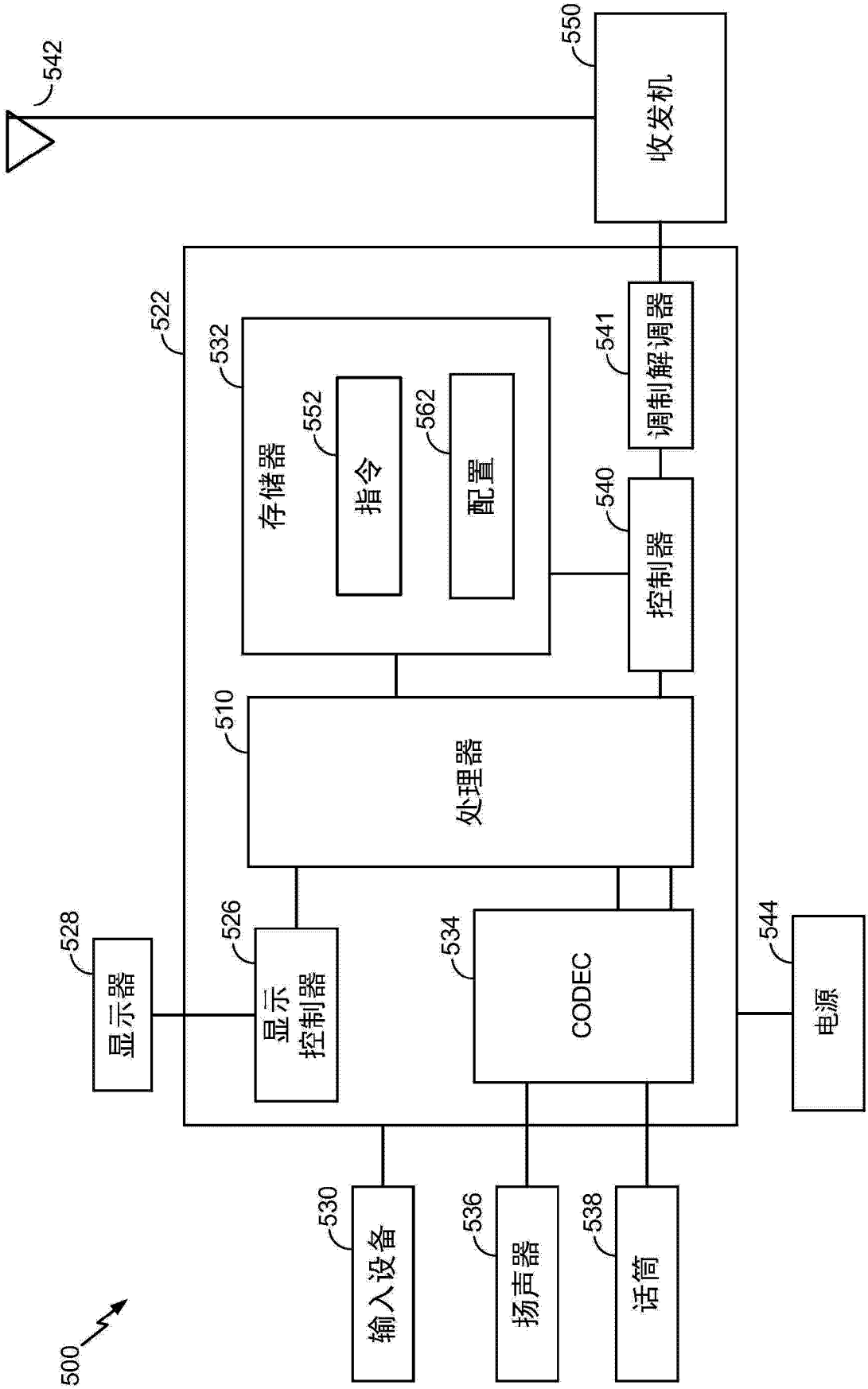
422
ACK
424
AP-BSN
420
426
430
更新请求
428

图 4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存储器
552
指令
562
配置
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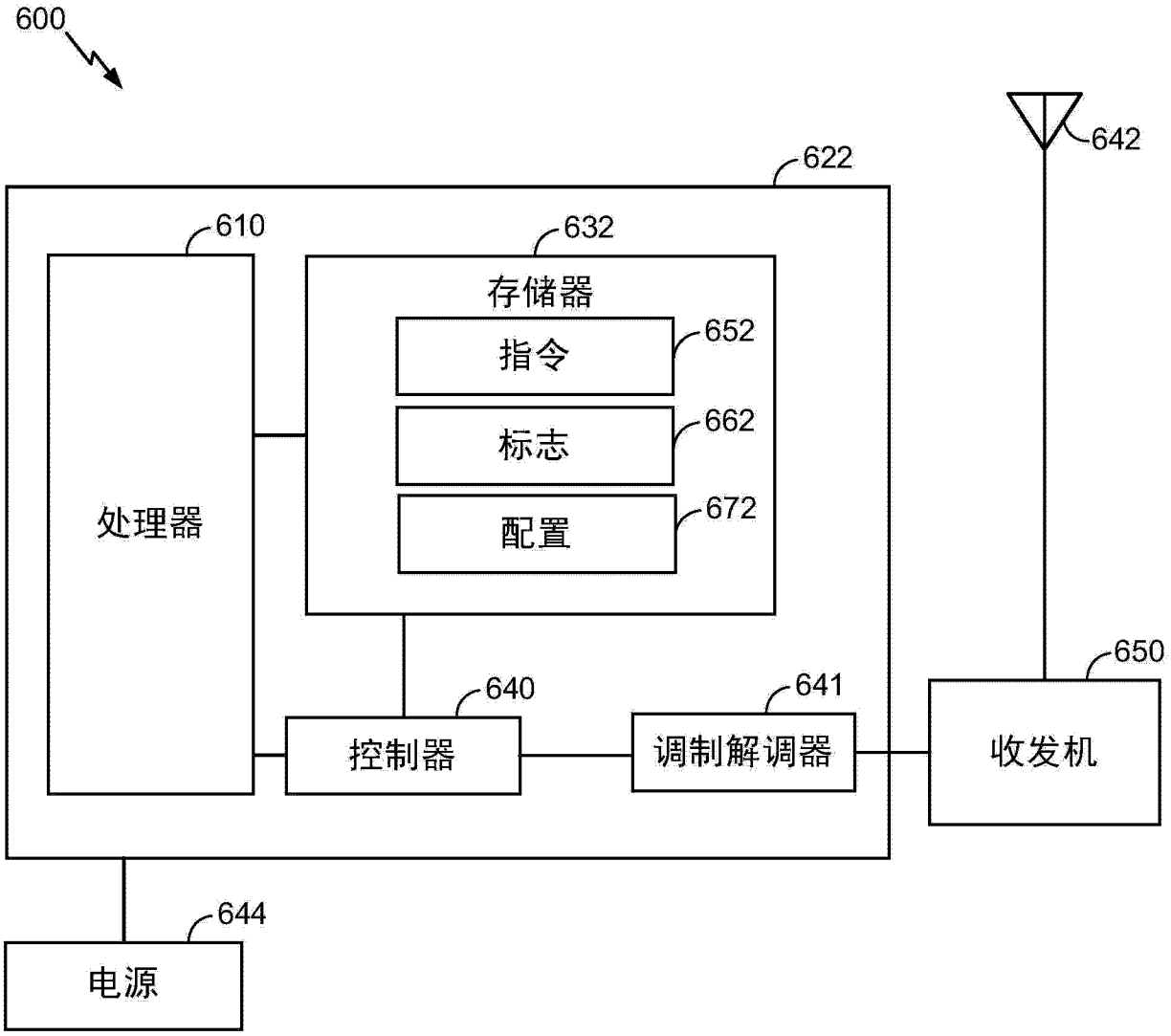
调制解调器
540
控制器
510
处理器
528
显示器
526
显示控制器
534
CODEC
544
电源
530
输入设备
536
扬声器
538
话筒
500

图 5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622
610
632
存储器
指令
652
标志
662
配置
672
处理器
640
控制器
641
调制解调器
650
收发机
644
电源

图 6