



(51) International Patent Classification:

H04W 48/16 (2009.01)

(21) International Application Number:

PCT/US2015/032557

(22) International Filing Date:

27 May 2015 (27.05.2015)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

14/290,298 29 May 2014 (29.05.2014) US

(71) Applicant: **QUALCOMM INCORPORATED** [US/US];
Attn: International IP Administration, 5775 Morehouse Drive, San Diego, California 92121-1714 (US).(72) Inventor: **KUMAR, Rajeev**; 5775 Morehouse Drive, San Diego, California 92121 (US).(74) Agent: **KOENIG, Nathan P.**; Bay Area Technology Law Group PC, 2171 E. Francisco Blvd., Suite L, San Rafael, California 94901 (US).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY,

BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, 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, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

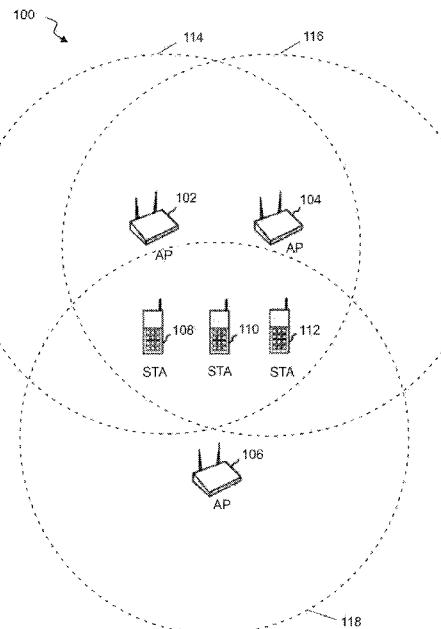
Declarations under Rule 4.17:

- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))
- as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))

[Continued on next page]

(54) Title: SYSTEMS AND METHODS FOR SHARING SCANNING INFORMATION

(57) Abstract: Systems and methods are disclosed for facilitating a scanning process to obtain information about available WLANs operating within range. Scanning information already obtained by one or more wireless communications devices may be shared with another wireless communications device, thereby reducing the time spent by performing scans by other wireless communications device. As desired, shared scanning information may be used preferentially depending on one or more metrics characterizing the information, such as the age of the scanning information or the relative distance to the sharing wireless communications device.

**FIG. 1**



Published:

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

SYSTEMS AND METHODS FOR SHARING SCANNING INFORMATION

RELATED APPLICATIONS

[001] This application claims the benefit of and priority to U.S. Patent Application No. 14/290,298, filed May 29, 2014, entitled “SYSTEMS AND METHODS FOR SHARING SCANNING INFORMATION,” which is assigned to the Applicant hereof and which is incorporated herein by reference in its entirety.

FIELD OF THE PRESENT DISCLOSURE

[002] This disclosure generally relates to wireless communication systems and more specifically to systems and methods for facilitating gathering information about available wireless networks.

BACKGROUND

[003] Wireless local area networks (WLANs) conforming to specifications in the Institute of Electrical and Electronics Engineers (“IEEE”) 802.11 family typically involve a basic service set (BSS) managed by a device acting in the role of an access point (AP). Each BSS may be identified by a service set identifier (SSID), such that a wireless communications device using a WLAN protocol may receive broadcast messages or beacons from access points within range advertising the SSID of their associated networks. The wireless communications device may then manually or automatically select the one or more of the detected networks and perform an association process to create one or more communications links. In order to identify suitable access points and thereby utilize available WLANs, a wireless communications device may perform scans on the wireless channels of one or more frequency bands. Existence of available networks may be determined passively by spending a period of time on a WLAN channel to receive any beacons that are periodically broadcast by APs operating on that channel or actively by sending a probe request that triggers a probe response sent by an AP receiving the transmission. The scanning process may be used to find usable networks prior to association or may be performed as a background process after associating with one network to determine the availability of alternative networks that may have more desirable characteristics. Scanning may also be

performed to assess channel conditions and profile network characteristics.

[004] Accordingly, a wireless communications device may spend a considerable amount of time to complete a comprehensive scan of the available wireless channels. During this time, the transceiver of the wireless communications device may be devoted to the scanning process and unable to perform other operations. As such, it would be desirable to decrease the amount of time devoted to the scanning process to free the transceiver for other tasks. Further, since the wireless communications device must be in active mode rather than a power saving mode when performing the scanning process, a significant amount of energy consumption may also be involved. Particularly for battery powered mobile devices, it would be desirable to minimize the amount of energy used by a wireless communications device to obtain information about nearby access points.

[005] In light of these goals, this disclosure provides systems and methods to facilitate the scanning process, such as by identifying available networks more quickly. These and other aspects are described below in the materials that follow.

SUMMARY

[006] This specification discloses a method for sharing scanning information that may include transmitting a probe request with a first wireless communications device and receiving shared scanning information from a second wireless communications device that is transmitted in response to the probe request. As desired, the shared scanning information may include a metric determined by the second wireless communications device characterizing the scanning information. Further, the first wireless communications device may selectively employ the shared scanning information received from the second wireless communications device based, at least in part, on the metric determined by the second wireless communications device.

[007] In one aspect, the first wireless communications device may receive shared scanning information from at least one additional wireless communications device that is transmitted in response to a probe request. The shared scanning information received from the at least one additional wireless communications device may include a metric determined by the at least one additional wireless communications device and the first wireless communications device may selectively employ the shared scanning

information received from the second wireless communications device and the shared scanning information received from the at least one additional wireless communications device based, at least in part, on the metric determined by the second wireless communications device and the metric determined by the at least one additional wireless communications device.

[008] In one aspect, the first wireless communications device may determine a metric characterizing the shared scanning information received from the second wireless communications device and may selectively employ the shared scanning information based, at least in part, on the metric determined by the first wireless communications device.

[009] In one aspect, the first wireless communications device may transmit the probe request as part of a scanning process that includes receiving scanning information as a probe response transmitted by an access point or a beacon transmitted by an access point. The first wireless communications device may terminate the scanning process based, at least in part, on at least one of a metric determined by the second wireless communications device characterizing the scanning information and a metric determined by the first wireless communications device characterizing the scanning information. As desired, the metric determined by the second wireless communications device may be a time metric; the metric determined by the first wireless communications device may be a distance metric; and the scanning process may be terminated when the time metric meets a first threshold and the distance metric meets a second threshold.

[0010] This disclosure also includes a wireless communications device for sharing scanning information having a WLAN module and a scanning manager, wherein the scanning manager may transmit a probe request with the WLAN module and process shared scanning information received from another wireless communications device that is transmitted in response to the probe request. The shared scanning information may include a metric determined by the other wireless communications device characterizing the scanning information.

[0011] In one aspect, the scanning manager may selectively employ the shared scanning information received from the other wireless communications device based,

at least in part, on the metric determined by the other wireless communications device.

[0012] In one aspect, the scanning manager may process shared scanning information received from a plurality of additional wireless communications devices, each of which is transmitted in response to a probe request. The shared scanning information received from the plurality of wireless communications devices may include a metric determined by each of the plurality of additional wireless communications devices such that the scanning manager may selectively employ the shared scanning information received from the plurality of additional wireless communications devices based, at least in part, on the metrics determined by each of the plurality of additional wireless communications devices.

[0013] In one aspect, the scanning manager may determine a metric characterizing the shared scanning information received from the other wireless communications device and may selectively employ the shared scanning information based, at least in part, on the metric.

[0014] In one aspect, the scanning manager may transmit the probe request as part of a scanning process that includes receiving scanning information comprising at least one of a probe response transmitted by an access point and a beacon transmitted by an access point. The scanning manager may also terminate the scanning process based, at least in part, on at least one of a metric determined by the other wireless communications device characterizing the scanning information and a metric determined by the scanning manager. As desired, the metric determined by the other wireless communications device may be a time metric; the metric determined by the scanning manager may be a distance metric; and the scanning manager may terminate the scanning process when the time metric meets a first threshold and the distance metric meets a second threshold.

[0015] This disclosure also includes a wireless communications device for sharing scanning information having a WLAN module and a scanning manager, wherein the scanning manager may obtain scanning information and may transmit the scanning information using the WLAN module to another wireless communications device when the WLAN module receives a probe request from the other wireless communications device. The scanning manager may also determine a metric characterizing the

scanning information and may include the metric in the scanning information transmitted to the other wireless communications device.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] Further features and advantages will become apparent from the following and more particular description of the embodiments of the disclosure, as illustrated in the accompanying drawings, and in which like referenced characters generally refer to the same parts or elements throughout the views, and in which:

[0017] FIG. 1 schematically depicts a wireless environment including WLANs operated by respective APs, according to one embodiment;

[0018] FIG. 2 schematically depicts functional blocks of a wireless communications device configured for sharing scanning information, according to one embodiment;

[0019] FIG. 3 schematically depicts the format of an action management frame, according to one embodiment;

[0020] FIG. 4 is a flowchart showing an exemplary routine for sharing scanning information, according to one embodiment;

[0021] FIG. 5 is a flowchart showing an exemplary routine for obtaining and utilizing shared scanning information, according to one embodiment; and

[0022] FIG. 6 is a sequence diagram showing coordination between wireless communications devices to share scanning information, according to one embodiment.

DETAILED DESCRIPTION OF THE INVENTION

[0023] At the outset, it is to be understood that this disclosure is not limited to particularly exemplified materials, architectures, routines, methods or structures as such may vary. Thus, a number of such options, similar or equivalent to those described herein, can be used in the practice or embodiments of this disclosure.

[0024] It is also to be understood that the terminology used herein is for the purpose of describing particular embodiments of this disclosure only and is not intended to be limiting.

[0025] The detailed description set forth below in connection with the appended drawings is intended as a description of exemplary embodiments of the present disclosure and is not intended to represent the only exemplary embodiments that may be practiced. The term “exemplary” used throughout this description means “serving as an example, instance, or illustration,” and should not necessarily be construed as preferred or advantageous over other exemplary embodiments. The detailed description includes specific details for the purpose of providing a thorough understanding of the exemplary embodiments of the specification. It will be apparent to those skilled in the art that the exemplary embodiments of the specification may be practiced without these specific details. In some instances, well known structures and devices are shown in block diagram form in order to avoid obscuring the novelty of the exemplary embodiments presented herein.

[0026] For purposes of convenience and clarity only, directional terms, such as top, bottom, left, right, up, down, over, above, below, beneath, rear, back, and front, may be used with respect to the accompanying drawings or chip embodiments. These and similar directional terms should not be construed to limit the scope of the disclosure in any manner.

[0027] In this specification and in the claims, it will be understood that when an element is referred to as being “connected to” or “coupled to” another element, it can be directly connected or coupled to the other element or intervening elements may be present. In contrast, when an element is referred to as being “directly connected to” or “directly coupled to” another element, there are no intervening elements present.

[0028] Some portions of the detailed descriptions which follow are presented in terms of procedures, logic blocks, processing and other symbolic representations of operations on data bits within a computer memory. These descriptions and representations are the means used by those skilled in the data processing arts to most effectively convey the substance of their work to others skilled in the art. In the present application, a procedure, logic block, process, or the like, is conceived to be a self-consistent sequence of steps or instructions leading to a desired result. The steps are those requiring physical manipulations of physical quantities. Usually, although not necessarily, these quantities take the form of electrical or magnetic signals capable of being stored, transferred, combined, compared, and otherwise manipulated in a

computer system.

[0029] It should be borne in mind, however, that all of these and similar terms are to be associated with the appropriate physical quantities and are merely convenient labels applied to these quantities. Unless specifically stated otherwise as apparent from the following discussions, it is appreciated that throughout the present application, discussions utilizing the terms such as “accessing,” “receiving,” “sending,” “using,” “selecting,” “determining,” “normalizing,” “multiplying,” “averaging,” “monitoring,” “comparing,” “applying,” “updating,” “measuring,” “deriving” or the like, refer to the actions and processes of a computer system, or similar electronic computing device, that manipulates and transforms data represented as physical (electronic) quantities within the computer system’s registers and memories into other data similarly represented as physical quantities within the computer system memories or registers or other such information storage, transmission or display devices.

[0030] Embodiments described herein may be discussed in the general context of processor-executable instructions residing on some form of processor-readable medium, such as program modules, executed by one or more computers or other devices.

Generally, program modules include routines, programs, objects, components, data structures, etc., that perform particular tasks or implement particular abstract data types. The functionality of the program modules may be combined or distributed as desired in various embodiments.

[0031] In the figures, a single block may be described as performing a function or functions; however, in actual practice, the function or functions performed by that block may be performed in a single component or across multiple components, and/or may be performed using hardware, using software, or using a combination of hardware and software. To clearly illustrate this interchangeability of hardware and software, various illustrative components, blocks, 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. Also, the exemplary wireless communications devices may include

components other than those shown, including well-known components such as a processor, memory and the like.

[0032] The techniques described herein may be implemented in hardware, software, firmware, or any combination thereof, unless specifically described as being implemented in a specific manner. Any features described as modules or components may also be implemented together in an integrated logic device or separately as discrete but interoperable logic devices. If implemented in software, the techniques may be realized at least in part by a non-transitory processor-readable storage medium comprising instructions that, when executed, performs one or more of the methods described above. The non-transitory processor-readable data storage medium may form part of a computer program product, which may include packaging materials.

[0033] The non-transitory processor-readable storage medium may comprise random access memory (RAM) such as synchronous dynamic random access memory (SDRAM), read only memory (ROM), non-volatile random access memory (NVRAM), electrically erasable programmable read-only memory (EEPROM), FLASH memory, other known storage media, and the like. The techniques additionally, or alternatively, may be realized at least in part by a processor-readable communication medium that carries or communicates code in the form of instructions or data structures and that can be accessed, read, and/or executed by a computer or other processor.

[0034] The various illustrative logical blocks, modules, circuits and instructions described in connection with the embodiments disclosed herein may be executed by one or more processors, such as one or more digital signal processors (DSPs), general purpose microprocessors, application specific integrated circuits (ASICs), application specific instruction set processors (ASIPs), field programmable gate arrays (FPGAs), or other equivalent integrated or discrete logic circuitry. The term “processor,” as used herein may refer to any of the foregoing structure or any other structure suitable for implementation of the techniques described herein. In addition, in some aspects, the functionality described herein may be provided within dedicated software modules or hardware modules configured as described herein. Also, the techniques could be fully implemented in one or more circuits or logic elements. A general purpose processor may be a microprocessor, but in the alternative, the processor may be any conventional processor, controller, microcontroller, or state machine. A processor may also be

implemented as a combination of computing devices, e.g., a combination of a DSP and a microprocessor, a plurality of microprocessors, one or more microprocessors in conjunction with a DSP core, or any other such configuration.

[0035] Embodiments are described herein with regard to a wireless communications device, which may include any suitable type of user equipment, such as a system, subscriber unit, subscriber station, mobile station, mobile wireless terminal, mobile device, node, device, remote station, remote terminal, terminal, wireless communication device, wireless communication apparatus, user agent, or other client devices. Further examples of a wireless communications device include mobile devices such as a cellular telephone, cordless telephone, Session Initiation Protocol (SIP) phone, smart phone, wireless local loop (WLL) station, personal digital assistant (PDA), laptop, handheld communication device, handheld computing device, satellite radio, wireless modem card and/or another processing device for communicating over a wireless system.

[0036] Moreover, embodiments may also be described herein with regard to an access point (AP). An AP may be utilized for communicating with one or more wireless nodes and may be termed also be called and exhibit functionality associated with a base station, node, Node B, evolved NodeB (eNB) or other suitable network entity. An AP communicates over the air-interface with wireless terminals. The communication may take place through one or more sectors. The AP may act as a router between the wireless terminal and the rest of the access network, which may include an Internet Protocol (IP) network, by converting received air-interface frames to IP packets. The AP may also coordinate management of attributes for the air interface, and may also be the gateway between a wired network and the wireless network.

[0037] Further, embodiments are discussed in specific reference to wireless networks. As such, this disclosure is applicable to any suitable wireless communication systems having the necessary characteristics. Although discussed in specific reference to an infrastructure WLAN, the techniques of this disclosure may be applied to other network configurations, to other wireless communication systems or to other wireless protocols involving scanning for available networks. For example, one of skill in the art will recognize that these techniques may be applied when the access point functionality is embedded in other devices of an information handling system such as, for example, routers, switches, servers, computers, or the like, and the

designation as an AP is not limited to dedicated access point devices.

[0038] Unless defined otherwise, all technical and scientific terms used herein have the same meaning as commonly understood by one having ordinary skill in the art to which the disclosure pertains.

[0039] Finally, as used in this specification and the appended claims, the singular forms “a,” “an” and “the” include plural referents unless the content clearly dictates otherwise.

[0040] As noted above, this disclosure provides systems and methods for facilitating a scanning process and enable a wireless communications device to obtain information about available WLANs operating within range. In one aspect, this may be accomplished by sharing scanning information already obtained by one or more wireless communications devices, thereby reducing the time spent by performing scans by another wireless communications device operating in the same vicinity. Correspondingly, the other wireless communications device may either spend a greater period of time in a power save mode to reduce power consumption or utilize the transceiver to conduct other network operations. As will be appreciated, a wireless communications device operating in a given area may be within range of other devices that have already performed a scanning process or otherwise have obtained scanning information. By utilizing already obtained scanning information, the wireless communications device may be able to lessen or avoid time spent performing the scanning process itself.

[0041] Thus, in the context of this disclosure, the term “scanning information” includes any information that may be obtained in a conventional active or passive scan. For example, in addition to the SSIDs of any active WLANs, scanning information may also include information requested in a probe request or included in a beacon regarding operation of each WLAN, such as supported rates, parameter sets and/or capability requirements. Scanning information may also include one or more metrics associated with the obtained information. For example, a timing metric may be used to indicate when a particular piece of scanning information was obtained. Further, an AP distance metric may be used to indicate a location of the AP relative to the obtaining STA. Relative distance between wireless communications devices may be determined in any

suitable manner as known in the art, including signal strength, such as in the form of received signal strength indication (RSSI), external positioning information from global positioning satellites (GPS) systems, ranging techniques, WiFi or cellular positioning and others. Still further, a quality metric may be used to indicate any qualitative or quantitative measure of actual or anticipated performance regarding the AP. As one example, the obtaining STA may be aware of channel conditions such as congestion that may affect throughput or response times. In another aspect, the obtaining STA may be associated with the AP for which scanning information is being shared and may have a direct measure of network performance. As desired, any other suitable metric may be associated with the scanning information.

[0042] In addition, the term “shared scanning information” refers to any scanning information obtained from another wireless communications device regarding a WLAN not managed by the other wireless communications device. As indicated, shared scanning information may often be received from a wireless communications device acting in the role of a STA. However, when an AP has scanning information regarding WLANs other than the one it manages, the AP may share such information with other wireless communications devices according to the techniques of this disclosure. Further, a wireless communications device may act in multiple roles, such as in the case of device configured to act as a software-enabled AP (softAP), that may also function as a STA.

[0043] The systems and methods of this disclosure may be described in reference to an exemplary wireless network environment 100 as shown in FIG. 1, which may include one or more wireless communications devices acting in the role of an AP, each managing a WLAN, and one or more wireless communications devices acting in the role of a STA, that may be associated with or seeking to associate with one of the APs. In this example, three APs, AP 102, AP 104 and AP 106, and three wireless communications devices, STA 108, STA 110 and STA 112, are depicted, but the techniques of this disclosure may accommodate any number of APs and STAs. AP 102, AP 104 and AP 106 may be operating on the same wireless channel or on different channels and/or frequency bands and each independently manages WLAN 114, WLAN 116 and WLAN 118, respectively. STA 108 may perform a conventional scanning process, including active or passive scanning, to obtain scanning information such as the

respective SSIDs and other association parameters from AP 102, AP 104 and AP 106. STA 108 may also correlate any desired metric that may be used to characterize the scanning information as described above.

[0044] According to the techniques of this disclosure, STA 110 may then initiate its own scanning process to identify available WLANs. In one aspect, STA 110 may broadcast a probe request on a first wireless channel and may then monitor that channel for any probe responses or any beacon transmissions that may indicate the availability of a WLAN on the channel. STA 110 may repeat the process as desired on additional wireless channels and/or frequency bands. When STA 110 broadcasts a probe request on the wireless channel on which STA 108 is operating, STA 108 may respond to the probe request with a unicast transmission containing any or all scanning information that it has obtained. For example, STA 108 may select which scanning information to share based, at least in part, on one or more of the metrics used to characterize the scanning information. In the context of this example, STA 108 may have obtained scanning information for AP 102, AP 104 and AP 106, or a subset of these, and therefore may transmit this information to STA 110. Upon receipt of the shared scanning information from STA 108, STA 110 may select one of the APs to associate with or may continue to perform the conventional scanning as desired.

[0045] In another aspect, STA 110 may also receive shared scanning information in response to its probe request from STA 112, which may also have completed a conventional scanning process or may have received scanning information from another source, such as by receiving shared scanning information from another wireless communications device in range (not shown in this example). As will be appreciated, STA 110 may continue to perform operations associated with a conventional scanning process including switching wireless channels and sending additional probe requests. Thus, STA 112 may share scanning information after receiving the probe request sent by STA 110 that was received by STA 108, or may receive another probe request sent by STA 110 transmitted on the same or a different wireless channel. Upon receipt of shared scanning information from multiple obtaining STAs, STA 108 may select which shared scanning information to employ based, at least in part, on the metrics or any other suitable criteria.

[0046] To help illustrate aspects associated with this disclosure, FIG. 2 depicts high

level functional blocks of one embodiment of a wireless communications device 200 that may be configured to function in the role of a station sharing scanning information, such as STA 108 or STA 112, or a station receiving shared scanning information, such as STA 110. As shown, wireless communications device 200 may employ an architecture in which the lower levels of the wireless protocol stack are implemented through firmware and/or hardware in respective subsystems. Wireless communications device 200 may therefore include wireless protocol circuitry as indicated by WLAN module 202, having media access controller (MAC) 204 to perform functions related to the handling and processing of frames of data including verification, acknowledgment, routing, formatting and the like. Incoming and outgoing frames are exchanged between MAC 204 and physical layer (PHY) 206, which may include the functions of modulating the frames according to the relevant 802.11 protocol as well as providing the analog processing and RF conversion necessary to provide transmission and reception of wireless signals through antenna 208. Although one antenna is depicted for the purpose of illustration, wireless communications device 200 may employ multiple antennas if desired, such as to enable the use of multiple streams.

[0047] Wireless communications device 200 may also include host CPU 210 configured to perform the various computations and operations involved with the functioning of wireless communications device 200, in its role as either STA 108 or STA 110. Host CPU 210 may be coupled to WLAN module 202 through bus 212, which may be implemented as a peripheral component interconnect express (PCIe) bus, a universal serial bus (USB), a universal asynchronous receiver/transmitter (UART) serial bus, a suitable advanced microcontroller bus architecture (AMBA) interface, a serial digital input output (SDIO) bus, or other equivalent interface. Upper layers of the protocol stacks of the wireless protocols may be implemented in software stored in memory 214 that may be accessed by host CPU 210 over bus 212.

[0048] In the embodiment shown, wireless communications device 200 includes scanning manager 216 configured to share or receive shared scanning information using WLAN module 202. For example, when acting in the role of STA 108 (or STA 112) having already obtained scanning information, scanning manager 216 may be configured to share the scanning information by transmitting some or all of the information using WLAN module 202 to STA 110 in response to receiving a probe

request. In one aspect, STA 108 may share the scanning information by transmitting a unicast action management frame having the general format shown in FIG. 3. As depicted, management frame 300 may include a MAC header 302, containing the frame control 304, duration/ID 306, address fields 308, 310 and 312 and sequence control field 314. To route the unicast frame from STA 108 to STA 110, for example, address field 308 may identify the MAC address of STA 110 and address fields 310 and 312 may identify the MAC address of STA 108. Frame 300 further includes a variable length frame body 316 and cyclic redundancy check (CRC) field 318. Frame control 304 segment of MAC header 302 includes fields providing various types of control information, including an identification of the 802.11 protocol of the frame, the type and subtype of the frame, distribution system information, information regarding additional information to be transmitted, security and order information. CRC field 318 may be employed to provide a frame check sequence (FCS) function. Frame body 316 may be used to convey the shared scanning information in any suitable format. Category field 320 may be used to identify the type of action frame and action field 322 may identify the action to be taken. Variable length action field 322 may include a sufficient number of suitably configured information elements (IEs) to convey the shared scanning information, including any metrics determined by STA 108.

[0049] Further, when wireless communications device 200 is acting in the role of STA 110 and is seeking scanning information, scanning manager 216 may cause the broadcast of a probe request and may process any shared scanning information received in response. In the depicted embodiment, scanning manager 216 may be implemented as processor-readable instructions stored in memory 214 that may be executed by host CPU 210. However, it will be appreciated that scanning manager 216 may be implemented in any location using any combination of software, firmware and hardware as desired. As will be appreciated, scanning manager 216 may cooperate with MAC 204 to transmit probe requests, to receive beacons and/or probe responses as well as to receive shared scanning information. Depending upon the implementation and capabilities of wireless communications device 200, this may include operating on one or more wireless channels located in one or more frequency bands.

[0050] When operating in the context of STA 110, scanning manager 216 may gather all received shared scanning information as well as any conventionally obtained

scanning information and subsequently initiate an association procedure with a selected AP, such as AP 102, AP 104 or AP 106. Scanning manager 216 may employ any criterion or combination of criteria when selecting an AP for association. In one aspect, scanning manager 216 may select an AP using any of the metrics included with the shared scanning information. For example, scanning manager 216 may employ any timing metric included with the shared scanning information to preferentially weight information that was obtained more recently. Similarly, the AP distance and/or quality metric in any combination may also be used when selecting an AP for association. Alternatively or in addition to any metrics determined by the obtaining STA, scanning manager 216 may determine one or more metrics to characterize the received shared scanning information. As described above, suitable metrics may include a timing metric to indicate when wireless communications device 200 received the shared scanning information, a STA distance metric to how far the wireless communications device that obtained the shared scanning information is from wireless communications device 200, a quality metric and/or the like. Thus, as an additional example, scanning manager 216 may employ a STA distance metric to preferentially weight shared scanning information received from a more proximate wireless communications device under the assumption that such information is more likely represent WLANs that will be available to wireless communications device 200.

[0051] To help illustrate aspects of the disclosure, the flowchart depicted in FIG. 4 represents one embodiment in the context of STA 108. As shown, a suitable routine may begin in 400 with STA 108 performing a conventional scanning process. The scan may be active, passive or any combination thereof. STA 108 may also receive shared scanning information from another suitably configured wireless communications device. As desired, in 402 STA 108 may determine one or more metrics that characterize the scanning information. In 404, STA 108 may receive a probe request from a wireless communications device seeking to obtain scanning information. In response to the probe request, STA 108 may transmit scanning information it has obtained in 406. As noted, STA 108 may share all currently stored scanning information or a subset of the information depending on any suitable criteria. In one aspect, STA 108 may select scanning information to share based, at least in part, on one or more metrics that characterize the scanning information. For example, STA 108 may share only scanning information that was obtained within a configurable period of time

from when the probe request was received.

[0052] Similarly, the flowchart depicted in FIG. 5 represents another embodiment in the context of STA 110. As shown, a suitable routine may begin in 500 with STA 110 initiating an active scanning process by transmitting a probe request specifying a broadcast SSID. In 502, STA 110 may receive conventionally obtained scanning information, such as in the form of probe responses or beacons from any APs within range. In 504, STA 110 may also obtain shared scanning information from any suitably configured wireless communications device that received the broadcast probe response. In one aspect, STA 110 may determine one or more metrics that characterize the shared scanning information. Accordingly, STA 110 may select an AP to associate with in 508 based, at least in part, on the shared scanning information and on any suitable criteria, such as any of the metrics described above as determined by either or both of STA 108 and STA 110.

[0053] In one aspect, STA 110 may be configured to reduce power expenditure associated with performing a scanning operation. To help clarify these features, FIG. 6 illustrates a sequence diagram showing the coordination of STA 110 with another wireless communications device sharing scanning information, such as STA 108. As shown, STA 110 may transmit a probe request to initiate a scanning process according to the techniques of this disclosure. STA 108 then monitors the wireless channel to receive any probe responses or beacons. Upon receiving the probe request, STA 108 may respond by sharing scanning information as indicated. Next, STA 110 may evaluate the received shared scanning information. If the received shared scanning information meets specified criteria, STA 110 may end the scanning process. For example, if the timing metric determined by STA 108 meets a suitable age threshold and if the STA distance metric determined by STA 110 indicates STA 108 is sufficiently close that its scanning information may be considered applicable, STA 110 may cease the scanning process and use the shared scanning information to associate with an identified AP. As will be appreciated, any one or combination of metrics determined by STA 110 or STA 108 may be used by scanning manager 216 in the evaluation of the shared scanning information. Accordingly, when shared scanning information is received that is considered sufficient, STA 110 may end the scanning process without the conventional requirement of actively or passively scanning on each

desired wireless channel. Thus, by reducing the amount of time spent scanning, STA 110 may free WLAN module 202 to perform other tasks or may operate WLAN module 202 in a power save mode to conserve resources.

[0054] Described herein are presently preferred embodiments. However, one skilled in the art that pertains to the present invention will understand that the principles of this disclosure can be extended easily with appropriate modifications to other applications.

CLAIMS

What is claimed is:

1. A method for sharing scanning information comprising:
transmitting a probe request with a first wireless communications device; and
receiving shared scanning information from a second wireless communications device that is transmitted in response to the probe request.
2. The method of claim 1, wherein the shared scanning information includes a metric determined by the second wireless communications device characterizing the shared scanning information.
3. The method of claim 2, further comprising the first wireless communications device selectively employing the shared scanning information received from the second wireless communications device based, at least in part, on the metric determined by the second wireless communications device.
4. The method of claim 2, further comprising receiving shared scanning information from at least one additional wireless communications device that is transmitted in response to a probe request.
5. The method of claim 4, wherein the shared scanning information received from the at least one additional wireless communications device includes a metric determined by the at least one additional wireless communications device, further comprising the first wireless communications device selectively employing the shared scanning information received from the second wireless communications device and the shared scanning information received from the at least one additional wireless communications device based, at least in part, on the metric determined by the second wireless communications device and the metric determined by the at least one additional wireless communications device.
6. The method of claim 2, further comprising the first wireless communications device determining a metric characterizing the shared scanning

information received from the second wireless communications device and selectively employing the shared scanning information based, at least in part, on the metric determined by the first wireless communications device.

7. The method of claim 1, wherein transmitting the probe request is a part of a scanning process that includes receiving scanning information comprising at least one of a probe response transmitted by an access point and a beacon transmitted by an access point.

8. The method of claim 7, further comprising terminating the scanning process based, at least in part, on at least one of a metric determined by the second wireless communications device characterizing the shared scanning information and a metric determined by the first wireless communications device characterizing the shared scanning information.

9. The method of claim 8, wherein the metric determined by the second wireless communications device comprises a time metric, wherein the metric determined by the first wireless communications device comprises a distance metric and wherein the scanning process is terminated when the time metric meets a first threshold and the distance metric meets a second threshold.

10. A wireless communications device for sharing scanning information comprising a wireless local area network (WLAN) module and a scanning manager, wherein the scanning manager is configured to transmit a probe request with the WLAN module and to process shared scanning information received from another wireless communications device that is transmitted in response to the probe request.

11. The wireless communications device of claim 10, wherein the shared scanning information includes a metric determined by the other wireless communications device characterizing the shared scanning information.

12. The wireless communications device of claim 11, wherein the scanning manager is further configured to selectively employ the shared scanning information received from the other wireless communications device based, at least in part, on the

metric determined by the other wireless communications device.

13. The wireless communications device of claim 11, wherein the scanning manager is further configured to process shared scanning information received from a plurality of additional wireless communications devices, each of which is transmitted in response to a probe request.

14. The wireless communications device of claim 13, wherein the shared scanning information received from the plurality of wireless communications devices includes a metric determined by each of the plurality of additional wireless communications devices and wherein the scanning manager is further configured to selectively employ the shared scanning information received from the plurality of additional wireless communications devices based, at least in part, on the metrics determined by each of the plurality of additional wireless communications devices.

15. The wireless communications device of claim 11, wherein the scanning manager is further configured to determine a metric characterizing the shared scanning information received from the other wireless communications device and to selectively employ the shared scanning information based, at least in part, on the metric.

16. The wireless communications device of claim 10, wherein the scanning manager transmits the probe request as part of a scanning process that includes receiving scanning information comprising at least one of a probe response transmitted by an access point and a beacon transmitted by an access point.

17. The wireless communications device of claim 16, wherein the scanning manager is further configured to terminate the scanning process based, at least in part, on at least one of a metric determined by the other wireless communications device characterizing the shared scanning information and a metric determined by the scanning manager.

18. The wireless communications device of claim 17, wherein the metric determined by the other wireless communications device comprises a time metric, wherein the metric determined by the scanning manager is a distance metric and

wherein the scanning manager terminates the scanning process when the time metric meets a first threshold and the distance metric meets a second threshold.

19. A wireless communications device for sharing scanning information comprising a wireless local area network (WLAN) module and a scanning manager, wherein the scanning manager is configured to obtain scanning information and to transmit the scanning information using the WLAN module to another wireless communications device when the WLAN module receives a probe request from the other wireless communications device.

20. The wireless communications device of claim 10, wherein the scanning manager is further configured to determine a metric characterizing the scanning information and to include the metric in the scanning information transmitted to the other wireless communications device.

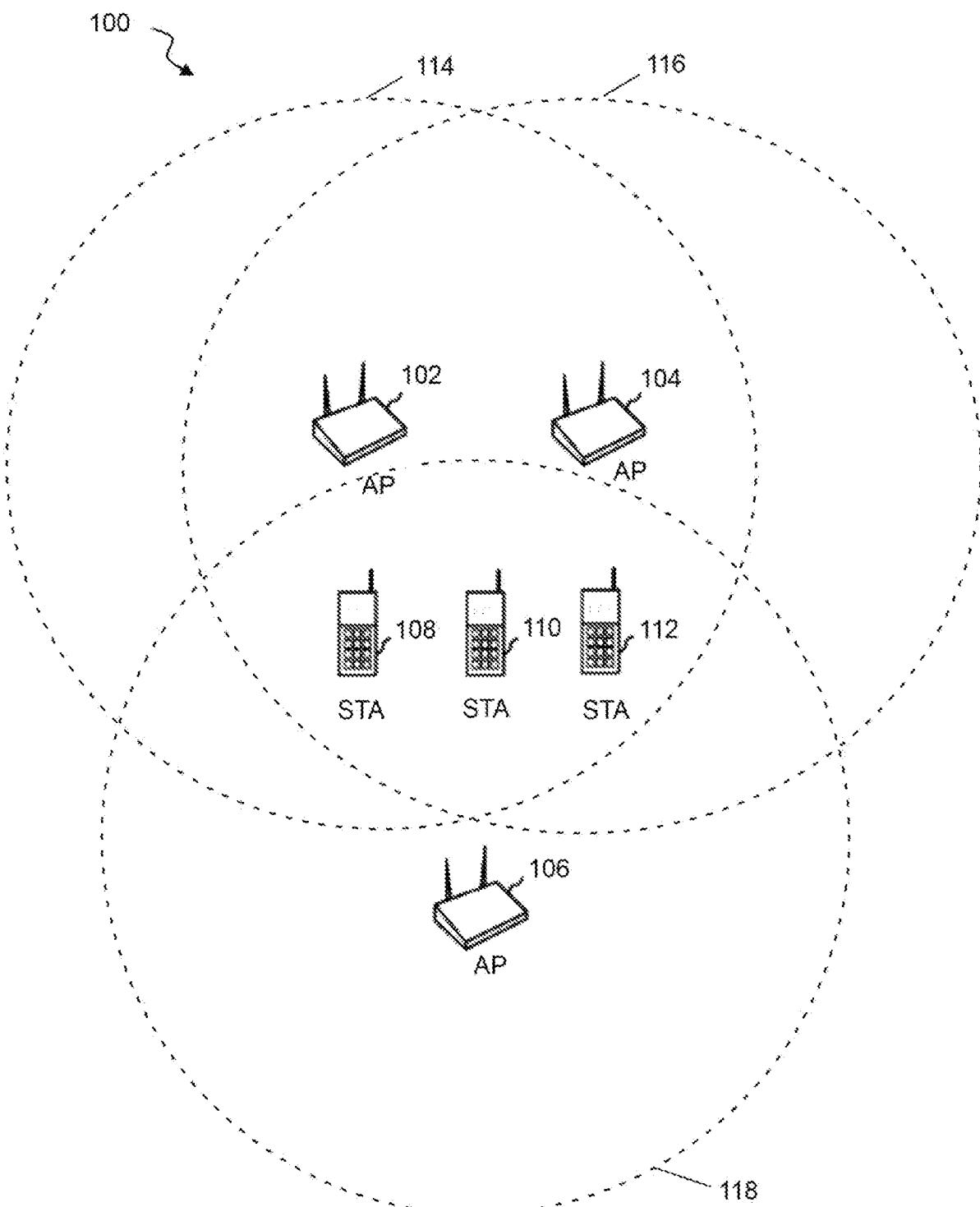


FIG. 1

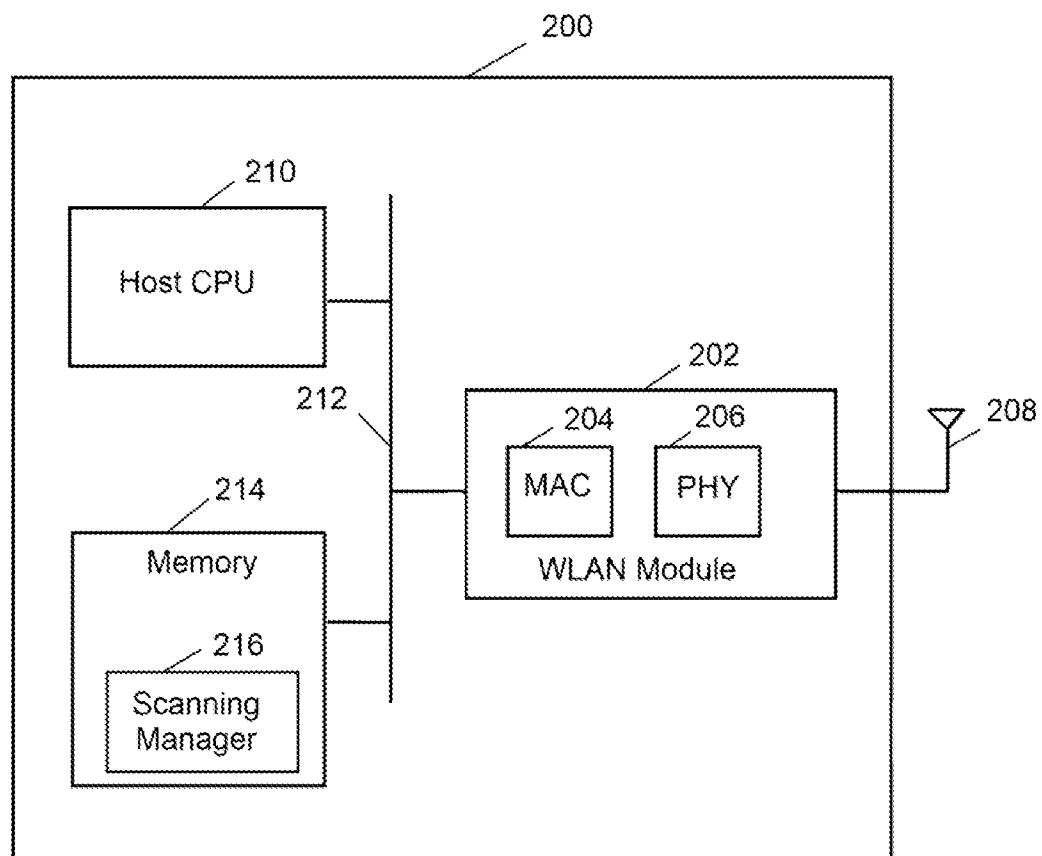


FIG. 2

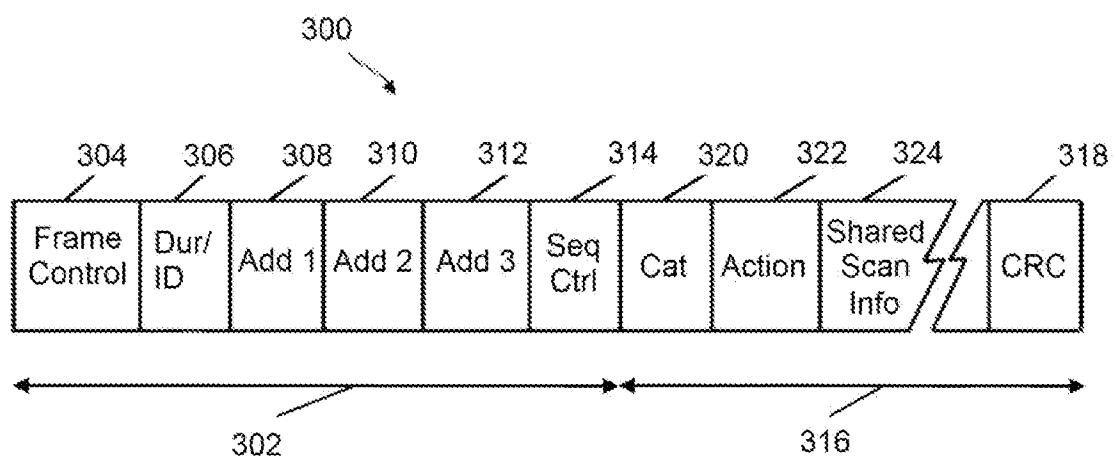


FIG. 3

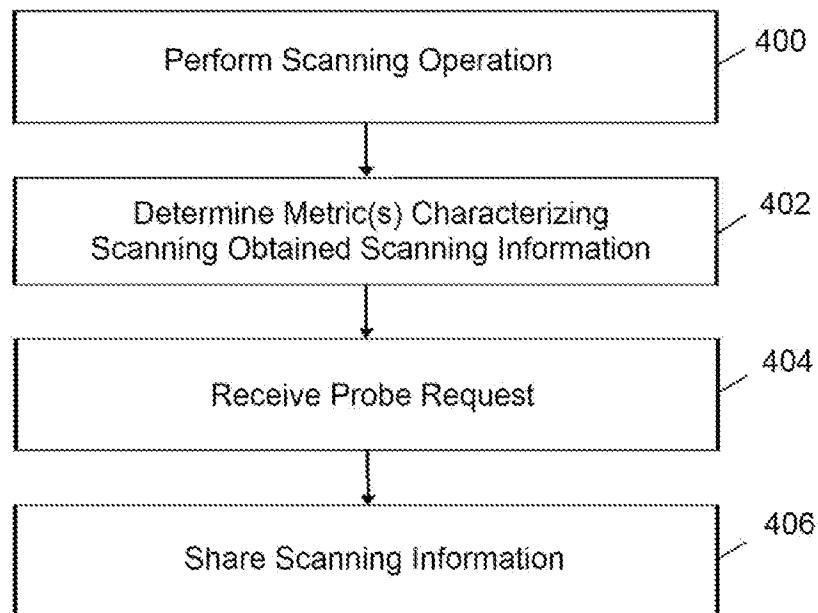


FIG. 4

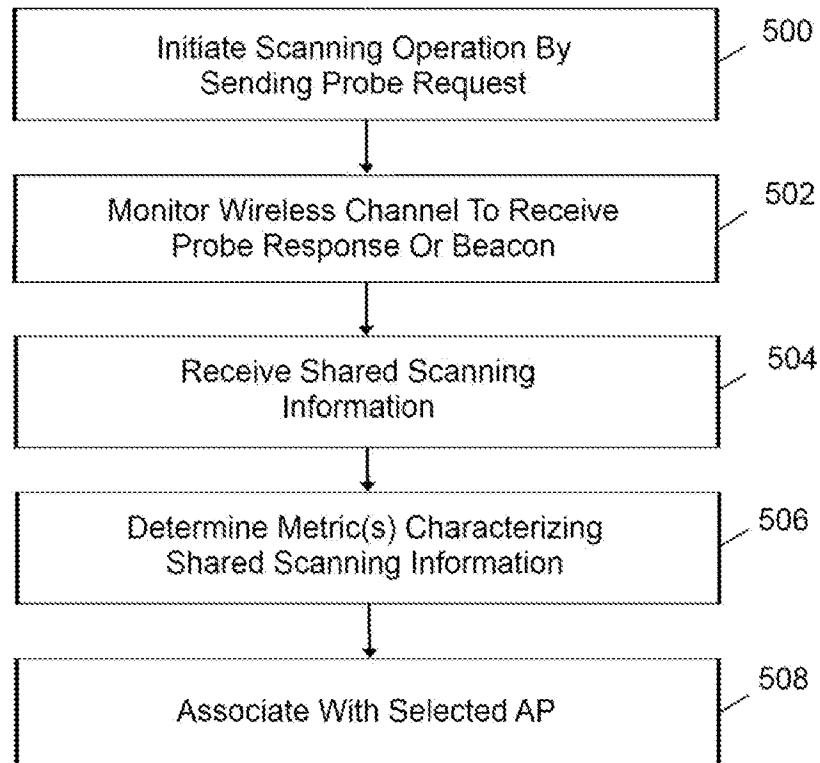


FIG. 5

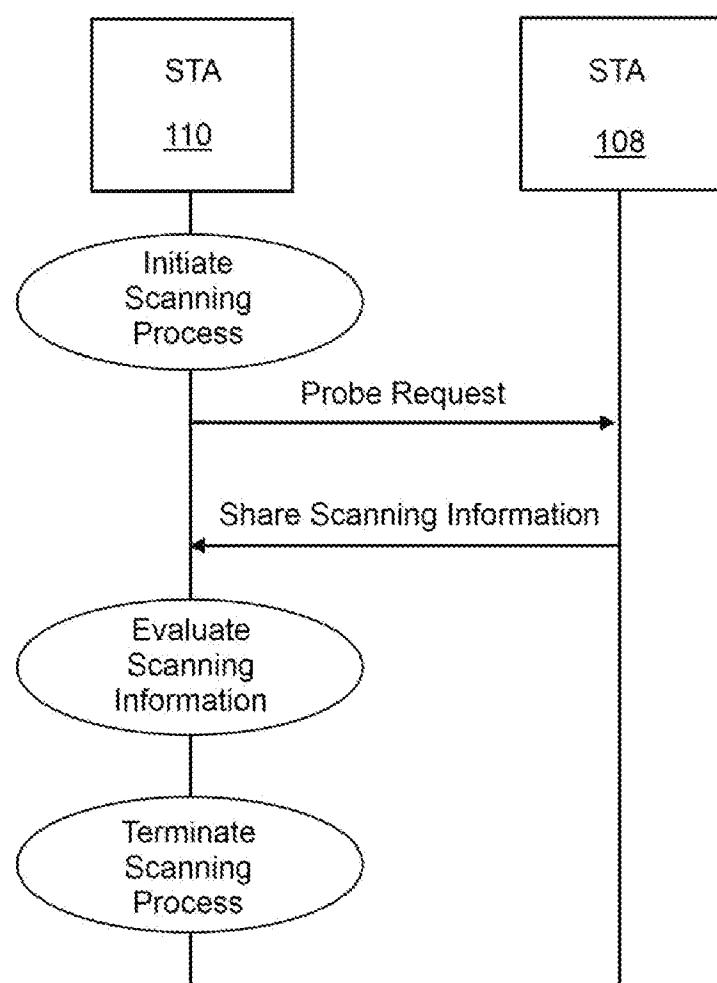


FIG. 6

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2015/032557

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04W48/16
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

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, COMPENDEX, INSPEC, 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	GB 2 410 153 A (TOSHIBA RES EUROP LTD [GB]) 20 July 2005 (2005-07-20) page 3, line 23 - page 14 -----	1-20
X	EP 2 621 220 A1 (RESEARCH IN MOTION LTD [CA]) 31 July 2013 (2013-07-31) paragraph [0005] - paragraph [0008] paragraph [0018] - paragraph [0083] -----	1-20
X	US 2009/061862 A1 (ALBERTH JR WILLIAM P [US] ET AL) 5 March 2009 (2009-03-05) paragraph [0011] - paragraph [0021] -----	1-20
X	WO 2008/020285 A2 (NOKIA CORP [FI]; NOKIA INC [US]; KAAJA HARALD [FI]; SALOKANNEL JUHA [F] 21 February 2008 (2008-02-21) paragraph [0014] - paragraph [0020] paragraph [0040] - paragraph [0100] -----	1-20



Further documents are listed in the continuation of Box C.



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
20 August 2015	26/08/2015
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer Frantzeskakis, D

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2015/032557

Patent document cited in search report	Publication date	Patent family member(s)			Publication date
GB 2410153	A 20-07-2005	NONE			
EP 2621220	A1 31-07-2013	CA 2802280 A1 EP 2621220 A1			27-07-2013 31-07-2013
US 2009061862	A1 05-03-2009	US 2009061862 A1 WO 2009032713 A1			05-03-2009 12-03-2009
WO 2008020285	A2 21-02-2008	EP 2052496 A2 US 2008045210 A1 WO 2008020285 A2			29-04-2009 21-02-2008 21-02-2008