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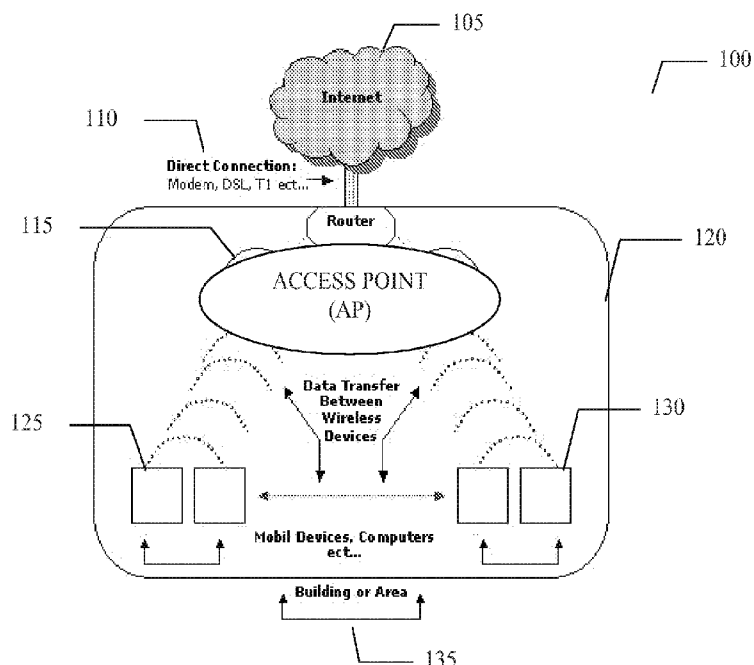


FIG. 1

(57) Abstract: An embodiment of the present invention provides a method to resolve a location of nodes operating in a wireless network, comprising using a wireless network infrastructure of the wireless network to determine the location of the nodes by each location aware node distributing location information within the wireless network such that each node may learn its location directly from the infrastructure of the network.



SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, —
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TECHNIQUES FOR AUTONOMOUS WIRELES NETWORK INFRASTRUCTURE ASSISTED LOCATION RESOLUTION

BACKGROUND

Retrieving location information by nodes operating in wireless networks, such as but not
5 limited to, those operating in conformance with the Institute for Electronic and Electrical
Engineering (IEEE) 802.11 standard (which may also be referred to herein as a Wi-Fi network),
have become common practice. However, current methods use a centralized data base on the
network to retrieve the location, some other methods may cache segments of the central data
base on the mobile device itself. The centralized data base approach has many disadvantages,
10 such as: It is complicated and costly to build such a data base; using it is associated with
registration and payment; the centralized data base approach does not resolve mobile access
points (APs) location; and the data collection is usually built by sending vehicles with WiFi
sniffers and such methods cannot detect APs in higher floors or inner building locations.

Thus, a critical need is prevalent for improvements in node location determination in
15 wireless networks, such as 802.11 wireless networks.

BRIEF DESCRIPTION OF THE DRAWINGS

The subject matter regarded as the invention is particularly pointed out and distinctly
claimed in the concluding portion of the specification. The invention, however, both as to
20 organization and method of operation, together with objects, features, and advantages thereof,
may best be understood by reference to the following detailed description when read with the
accompanying drawings in which:

FIG. 1 illustrates a block diagram of an illustrative wireless network according to
25 embodiments of the present invention; and

FIG. 2 provides a flow chart depicting methods enabling techniques for autonomous
wireless network infrastructure assisted location resolution according to embodiments of the
present invention.

30 It will be appreciated that for simplicity and clarity of illustration, elements illustrated in
the figures have not necessarily been drawn to scale. For example, the dimensions of some of
the elements are exaggerated relative to other elements for clarity. Further, where considered
appropriate, reference numerals have been repeated among the figures to indicate corresponding

or analogous elements.

DETAILED DESCRIPTION

In the following detailed description, numerous specific details are set forth in order to provide a thorough understanding of the invention. However, it will be understood by those skilled in the art that the preset invention may be practiced without these specific details. In other instances, well-known methods, procedures, components and circuits have not been described in detail so as not to obscure the present invention.

Although embodiments of the invention are not limited in this regard, discussions utilizing terms such as, for example, “processing,” “computing,” “calculating,” “determining,” “establishing,” “analyzing,” “checking,” or the like, may refer to operation(s) and/or process(es) of a computer, a computing platform, a computing system, or other electronic computing device, that manipulate and/or transform data represented as physical (e.g., electronic) quantities within the computer’s registers and/or memories into other data similarly represented as physical quantities within the computer’s registers and/or memories or other information storage medium that may store instructions to perform operations and/or processes.

Although embodiments of the invention are not limited in this regard, the terms “plurality” and “a plurality” as used herein may include, for example, “multiple” or “two or more”. The terms “plurality” or “a plurality” may be used throughout the specification to describe two or more components, devices, elements, units, parameters, or the like. For example, “a plurality of stations” may include two or more stations.

Embodiments of the present invention provide techniques to resolve location determination using wireless networks (such as but not limited to those that conform to the IEEE 802.11 standard, also referred to herein as a WiFi) without using a centralized data base. Specifically, updated location information may propagate seamlessly within the wireless network, without any user intervention. Conceptually, this is a new service as the WiFi network and devices autonomously learn and exchange location information, and may further transfer this information to higher level applications, peripherals, other communication devices etc.

Increasingly devices are running location aware applications and more and more devices are equipped with both WiFi and global positioning systems (GPS) - specifically cellphones, but also tablets and netbooks, just to name a few. Further, the concept of internetwork information-sharing and knowledge collaboration has become increasingly popular. In indoor environments it is difficult to get GPS lock and indoor locations can be

provided using other technologies like wifi, or using Assisted GPS techniques.

Thus, embodiments of the present invention provide methods and algorithms enabling retrieval and updating of location information using the WiFi infrastructure without a need for centralized data base. Each location aware node (such as, but not limited to a mobile device (STA) or access point (AP)) may distribute location information within a WiFi network, and each node may learn its location directly from the network. The network location information is constantly updated and may be propagated constantly, hence enabling mobile network support.

Turning now to the figures, FIG. 1 at 100 depicts an embodiment of the present invention which provides an apparatus and system, comprising a transceiver associated with a mobile device (125 or 130), which may be referred to as a wireless station (STA) operable to communicate in a wireless network 140 that may be located in a specific area or building 135. The mobile devices may be in communication with access point 115 with an associated transceiver, which may be connected to the Internet 105 via, for example, a T-1 line or fiber optic line 110. The AP and STAs may be operating as part of the same basic service set (BSS) 120. The transceivers associated with the AP and STA may operate according to the techniques outlined above and according to the method described below.

Looking now at FIG. 2, generally as 205, is a flowchart depicting methods according to embodiments of the present invention and depict wireless mobile station (STA) 210 and AP 215. As an optional embodiment of the present invention, when a STA which knows its location (for example, but not limited to, a smartphone with GPS) and associates 220 to an access point (AP) 215, it might report 230 its location to the AP 215. Alternatively, the STA 210 may report itself as "location aware" 235, and then the AP can query 240 the location from the device. After the query at 240, STA may report its location at 245. This handshake can be done using proprietary Information elements in the WiFi association packets, or as separate messages.

The AP may process location information from different stations and calculate its location as shown at 250. Other stations which don't have locations set, can query at 255 the AP for location information. It is noted that the AP might be also a Soft AP and the AP might also retrieve its location from other sources. (for example, but not limited to, an IP network or set manually, etc.). Further, a WiFi Station that queries for location can use it for different location application, or as assisted data for a GPS capable device.

In order to resolve its location STA at 265 may ask for location information. At 270 the AP may respond with location information. Another optional method to resolve

location is at 260 wherein the AP may broadcast its location periodically.

Thus, embodiments of the present invention may provide an apparatus, comprising a node operable in a wireless network and adapted to resolve its location using a wireless network infrastructure of said wireless network to determine said location of said node by each location
5 aware node distributing location information within said wireless network such that each node may learn its location directly from said infrastructure of said network.

Embodiments of the present invention may further provide a computer readable medium encoded with computer executable instructions, which when accessed, cause a machine to perform operations comprising resolving a location of nodes operating in a
10 wireless network using a wireless network infrastructure of said wireless network to determine said location of said nodes by each location aware node distributing location information within said wireless network such that each node may learn its location directly from said infrastructure of said network.

While certain features of the invention have been illustrated and described herein, many
15 modifications, substitutions, changes, and equivalents may occur to those skilled in the art. It is, therefore, to be understood that the appended claims are intended to cover all such modifications and changes as fall within the true spirit of the invention.

We Claim:

1. A method to resolve a location of nodes operating in a wireless network, comprising:

5 using a wireless network infrastructure of said wireless network to determine said location of said nodes by each location aware node distributing location information within said wireless network such that each node may learn its location directly from said infrastructure of said network.

10 2. The method of claim 1, wherein said network location information is updated by nodes operating in said wireless network and propagated constantly by said network infrastructure.

15 3. The method of claim 1, wherein a node is an access point (AP) operating in said wireless network and wherein said AP determines its location by receiving location information from a location determination capable wireless station (STA) in communication with said access point and operating within said wireless network.

20 4. The method of claim 3, wherein when said STA determines its location, it reports its location to said AP.

5. The method of claim 3, wherein said STA reports itself as location aware and then said AP may query location information said STA via a handshake.

25 6. The method of claim 5, wherein said handshake is accomplished using a proprietary information element (IE) in the association packets or as separate messages.

7. The method of claim 1, wherein said wireless network operates conforming to the Institute for Electronic and Electrical Engineering (IEEE) 802.11 standard.

30 8. The method of claim 5, wherein said AP can process location information from a plurality of location aware STAs to determine said AP's location.

9. The method of claim 5, wherein if a STA operating within said wireless network is incapable of determining its location, it may derive location information from an AP with

which it is in communication with.

10. A computer readable medium encoded with computer executable instructions, which when accessed, cause a machine to perform operations comprising:

5 resolving a location of nodes operating in a wireless network using a wireless network infrastructure of said wireless network to determine said location of said nodes by each location aware node distributing location information within said wireless network such that each node may learn its location directly from said infrastructure of said network.

10 11. The computer readable medium encoded with computer executable instructions of claim 10, wherein said network location information is updated by nodes operating in said wireless network and propagated constantly by said network infrastructure.

15 12. The computer readable medium encoded with computer executable instructions of claim 10, wherein a node is an access point (AP) operating in said wireless network and wherein said AP determines its location by receiving location information from a location determination capable wireless station (STA) in communication with said access point and operating within said wireless network.

20 13. The computer readable medium encoded with computer executable instructions of claim 12, wherein when said STA determines its location, it reports its location to said AP.

25 14. The computer readable medium encoded with computer executable instructions of claim 12, wherein said STA reports itself as location aware and then said AP may query location information said STA via a handshake.

30 15. The computer readable medium encoded with computer executable instructions of claim 14, wherein said handshake is accomplished using a proprietary information element (IE) in an association packet or as a separate message.

16. The computer readable medium encoded with computer executable instructions of claim 10, wherein said wireless network operates conforming to the Institute for Electronic and Electrical Engineering (IEEE) 802.11 standard.

17. The computer readable medium encoded with computer executable instructions of claim 14, wherein said AP can process location information from a plurality of location aware STAs to determine said AP's location.

5 18. The computer readable medium encoded with computer executable instructions of claim 14, wherein if a STA operating within said wireless network is incapable of determining its location, it may derive location information from an AP with which it is in communication with.

10 19. An apparatus, comprising:
a node operable in a wireless network and adapted to resolve its location using a wireless network infrastructure of said wireless network to determine said location of said node by each location aware node distributing location information within said wireless network such that each node may learn its location directly from said infrastructure of said network.

15 20. The apparatus of claim 19, wherein said network location information is updated by nodes operating in said wireless network and propagated constantly by said network infrastructure.

20 21. The method of claim 19, wherein a node is an access point (AP) operating in said wireless network and wherein said AP determines its location by receiving location information from a location determination capable wireless station (STA) in communication with said access point and operating within said wireless network.

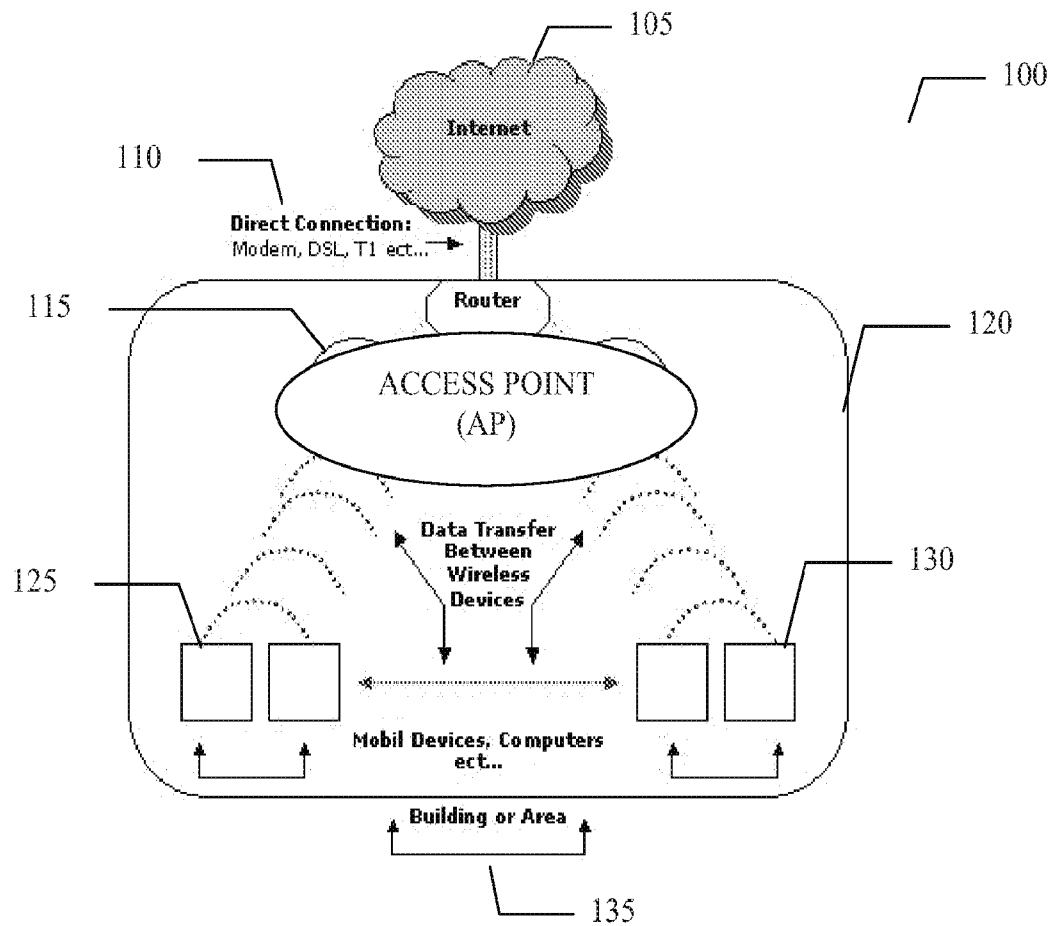


FIG. 1

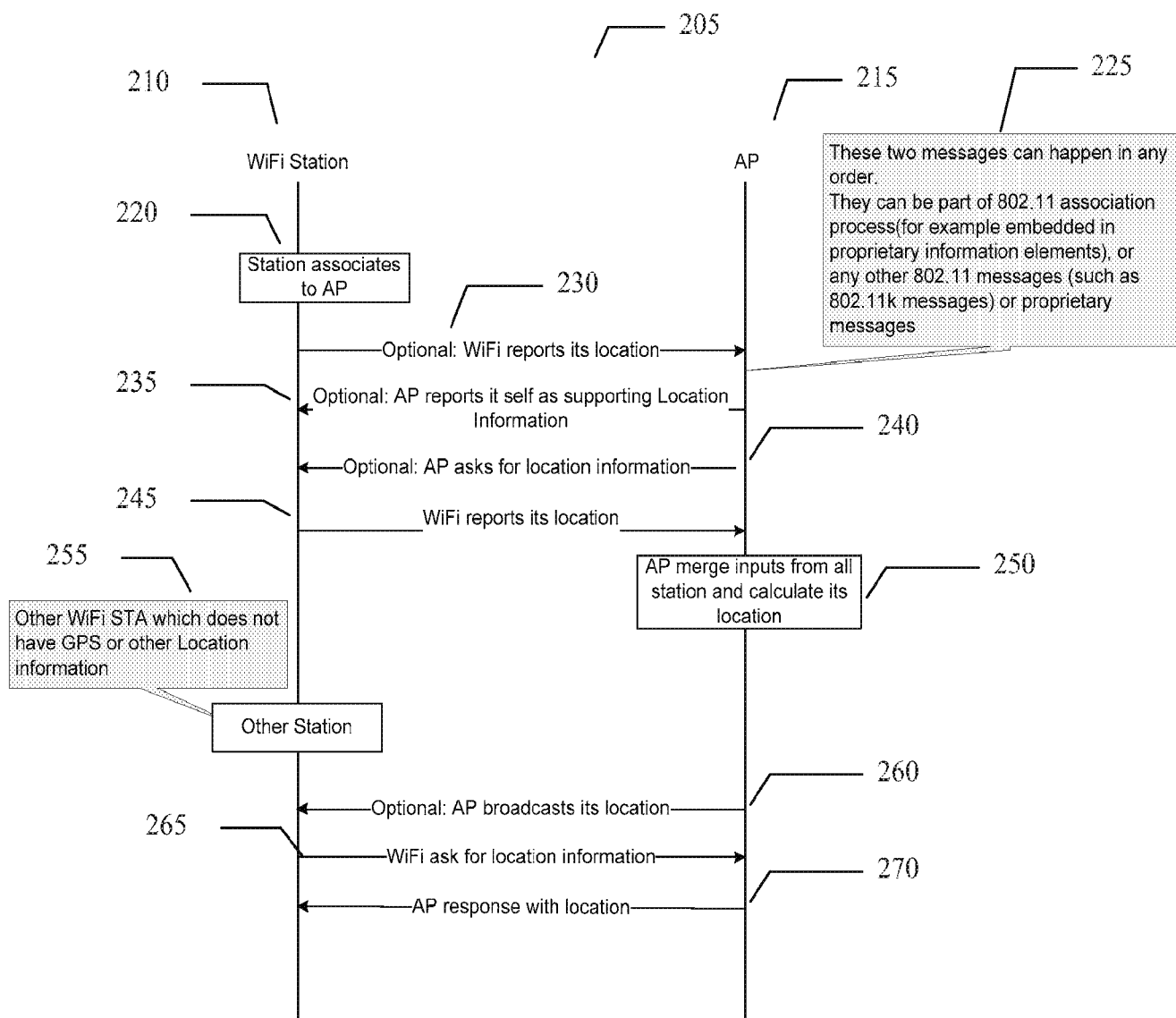


FIG. 2

A. CLASSIFICATION OF SUBJECT MATTER***H04W 64/00(2009.01)i, H04W 24/04(2009.01)i***

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 64/00

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

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal) & Keywords: access point, location, 802.11

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2009-0088183 A1 (KURT W. PIERSON et al.) 02 April 2009 See description paragraphs [0010],[0048],[0049],[0105].	1,3-4,7,10,12-13 ,16,19,21
A		2,5-6,8-9,11,14-15 ,17-18,20
A	US 2009-0257376 A1 (KARTHIKEYAN BALAJI DHANAPAL et al.) 15 October 2009 See description paragraph [0009].	1-21
A	US 2006-0045056 A1 (ROBERT B. O'HARA JR.) 02 March 2006 See description paragraphs [0032],[0034],[0035].	1-21
A	US 2004-0246934 A1 (SANG-HEE KIM) 09 December 2004 See description paragraph [0053].	1-21



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

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"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 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

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INTERNATIONAL SEARCH REPORT

Information on patent family members

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