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(54) LOCATION AWARENESS IN WIRELESS NETWORKS

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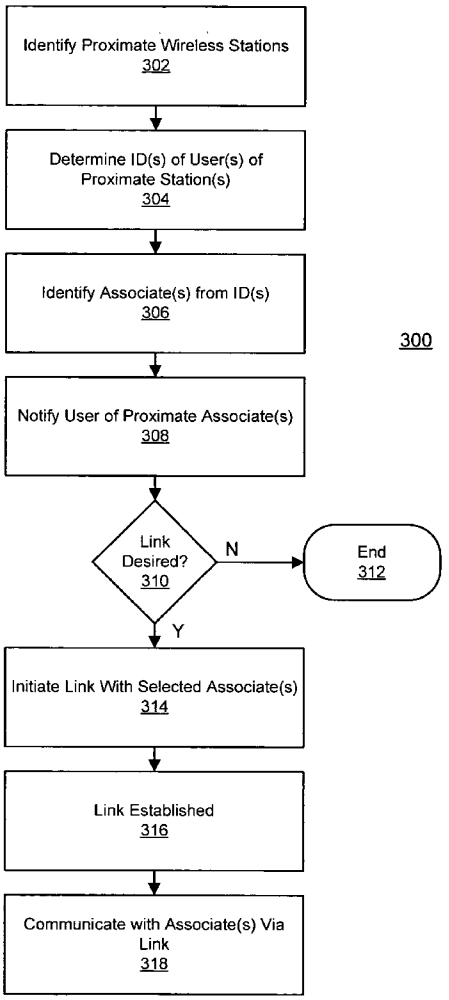
(57) **ABSTRACT**

Disclosed herein are exemplary techniques for establishing a direct link independent of an access point and for identifying proximate wireless stations users. The method and method are provided in a wireless network with an access point logically connected to at least a first wireless device and a second wireless device to notify the first wireless device that the second wireless device is in proximity to said first device. The system and method also establish a direct wireless link between a first wireless device and at least one proximate wireless device by identifying a second wireless device within a predetermined proximity of the first wireless device, determining an identity associated with a user of the second wireless device, comparing the identify with a set identities, and notifying the user of a proximity of the user of the second wireless device based on the comparison.



APPLE 1028

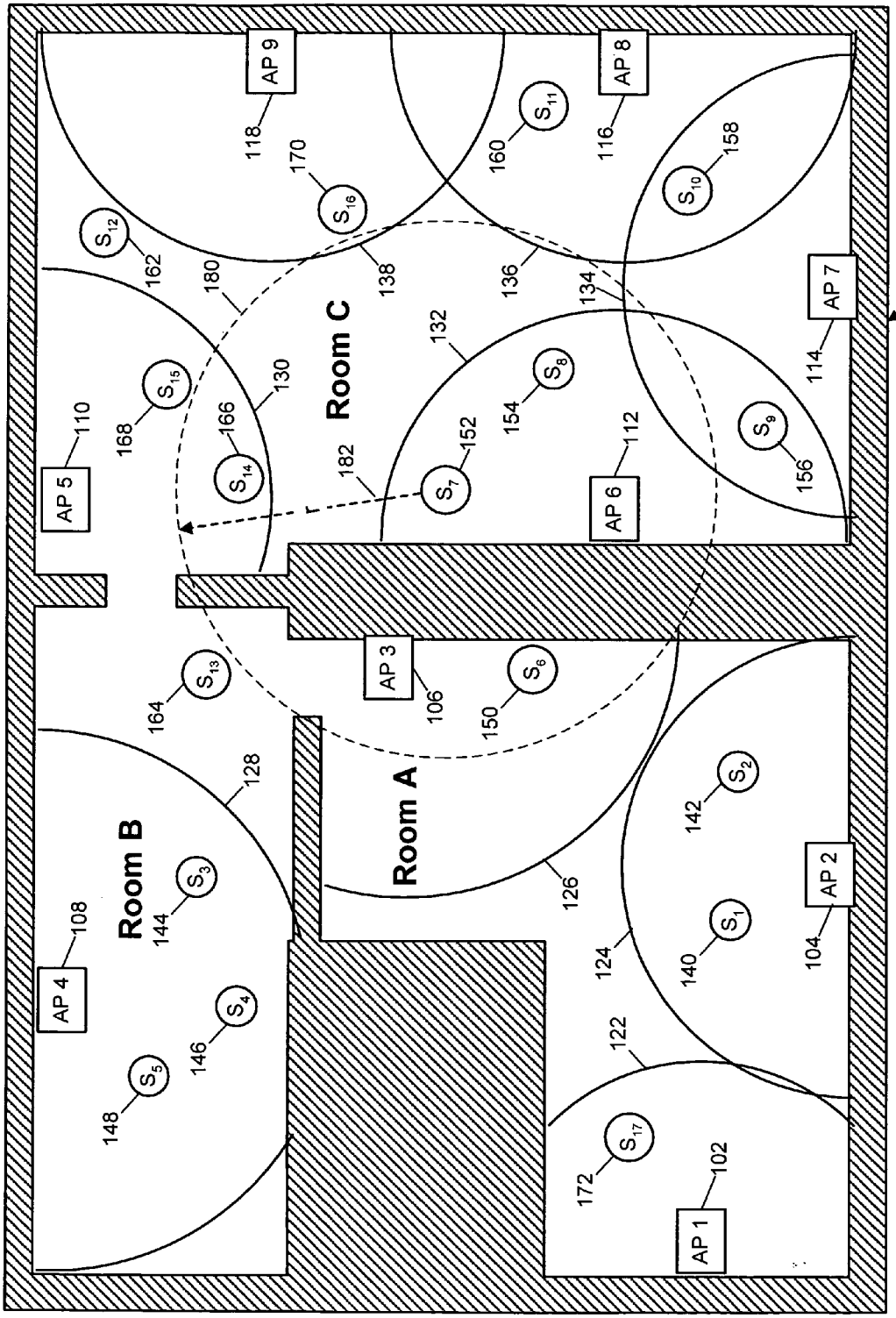

AP 1
AP 2
AP 3
AP 4
AP 5
AP 6
AP 7
AP 8
AP 9
Room A
Room B
Room C
100
102
104
106
108
110
112
114
116
118
122
124
126
128
130
132
134
136
138
140
142
144
146
148
150
152
154
156
158
160
162
164
166
168
170
172
180
182
S_1
S_2
S_3
S_4
S_5
S_6
S_7
S_8
S_9
S_{10}
S_{11}
S_{12}
S_{13}
S_{14}
S_{15}
S_{16}
S_{17}

Fig. 1

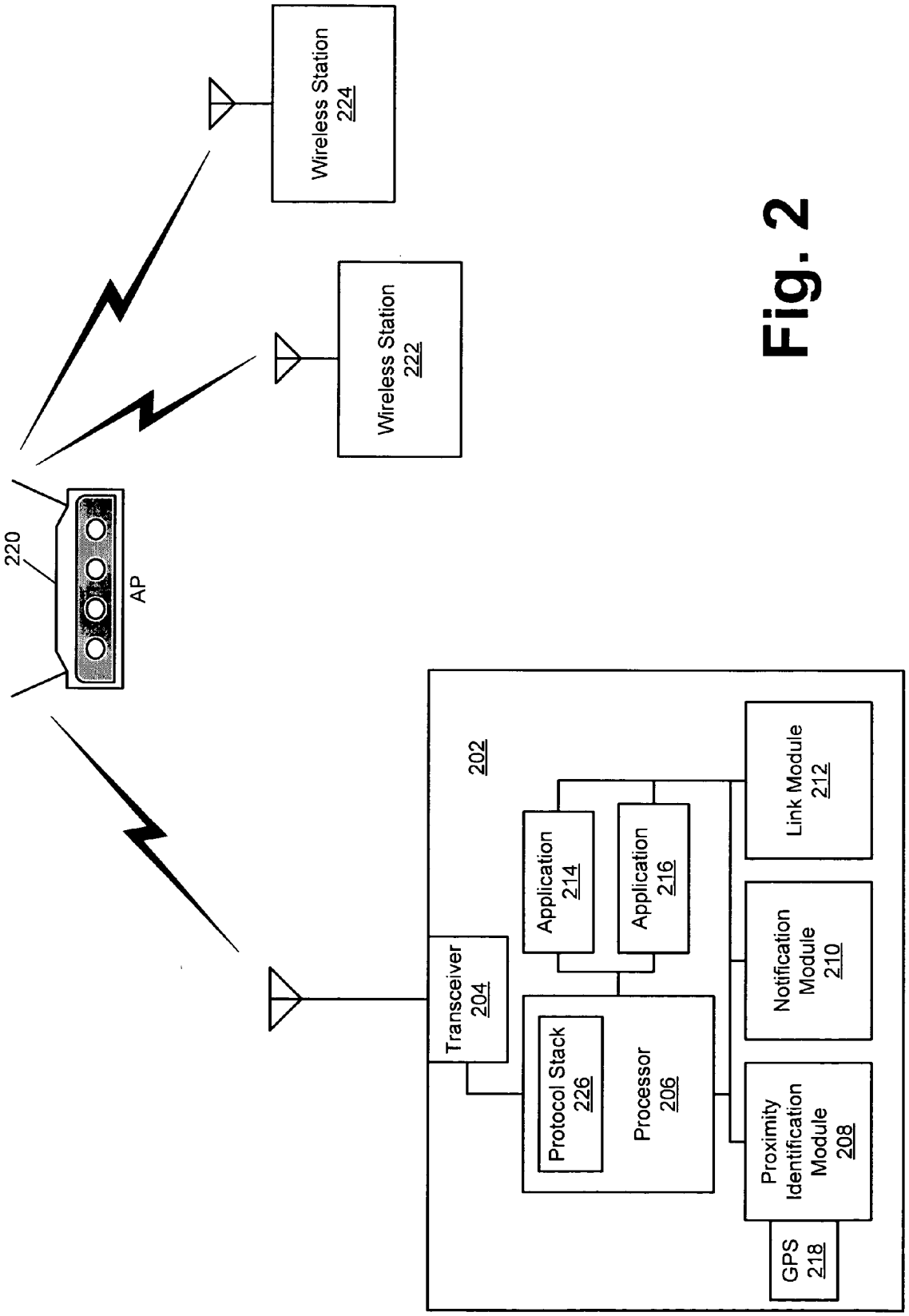

Wireless Station
224
Wireless Station
222
220
AP
202
Transceiver
204
Application
214
Application
216
Protocol Stack
226
Processor
206
Link Module
212
Notification
Module
210
Proximity
Identification
Module
208
GPS
218

Fig. 2

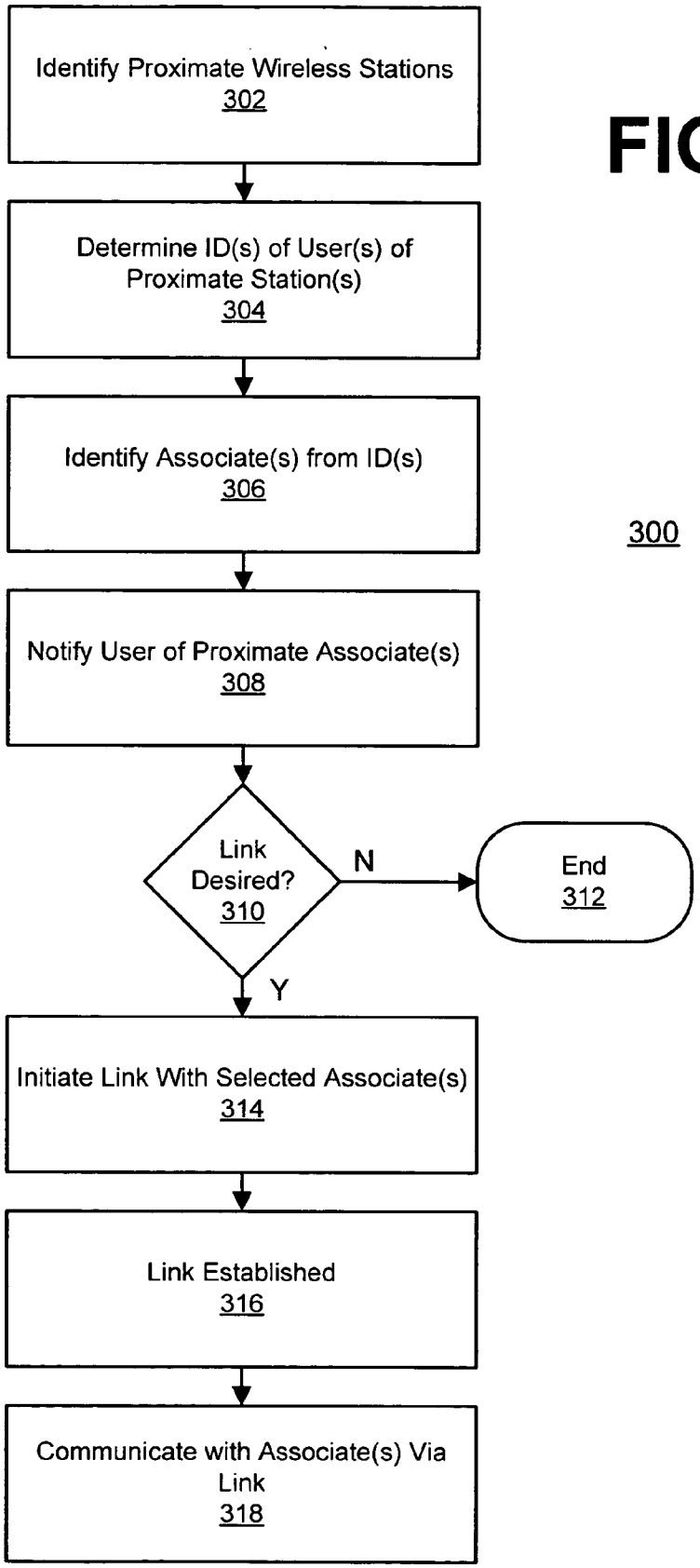

Identify Proximate Wireless Stations
302
Determine ID(s) of User(s) of Proximate Station(s)
304
Identify Associate(s) from ID(s)
306
Notify User of Proximate Associate(s)
308
Link Desired?
310
N
End
312
Y
Initiate Link With Selected Associate(s)
314
Link Established
316
Communicate with Associate(s) Via Link
318

FIG. 3

300

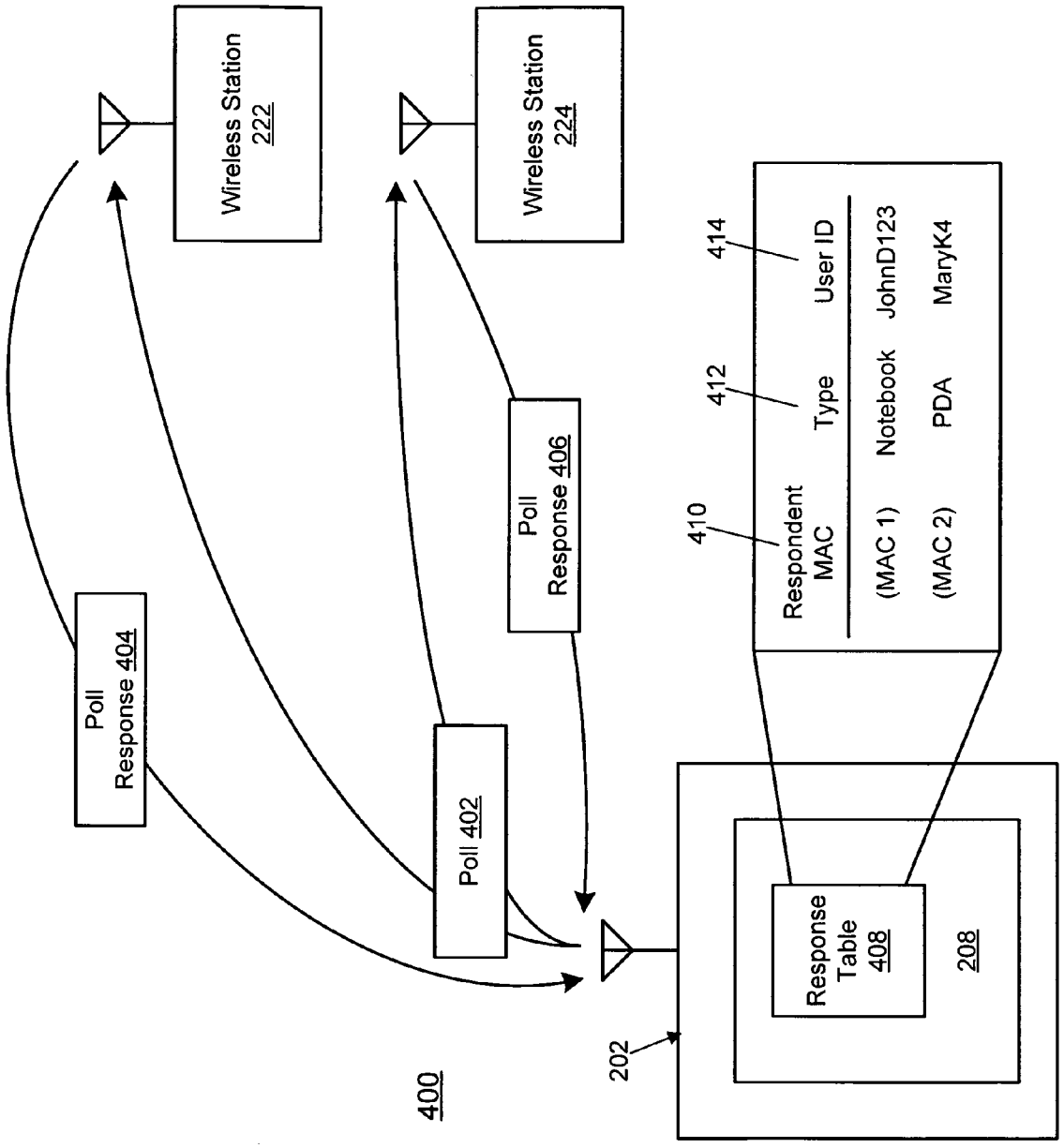

Wireless Station 222
Wireless Station 224
Poll Response 404
Poll Response 406
Poll 402
400
202
Response Table 408
208
410
412
414
Respondent MAC
Type
User ID
(MAC 1)
Notebook
JohnD123
(MAC 2)
PDA
MaryK4

Fig. 4

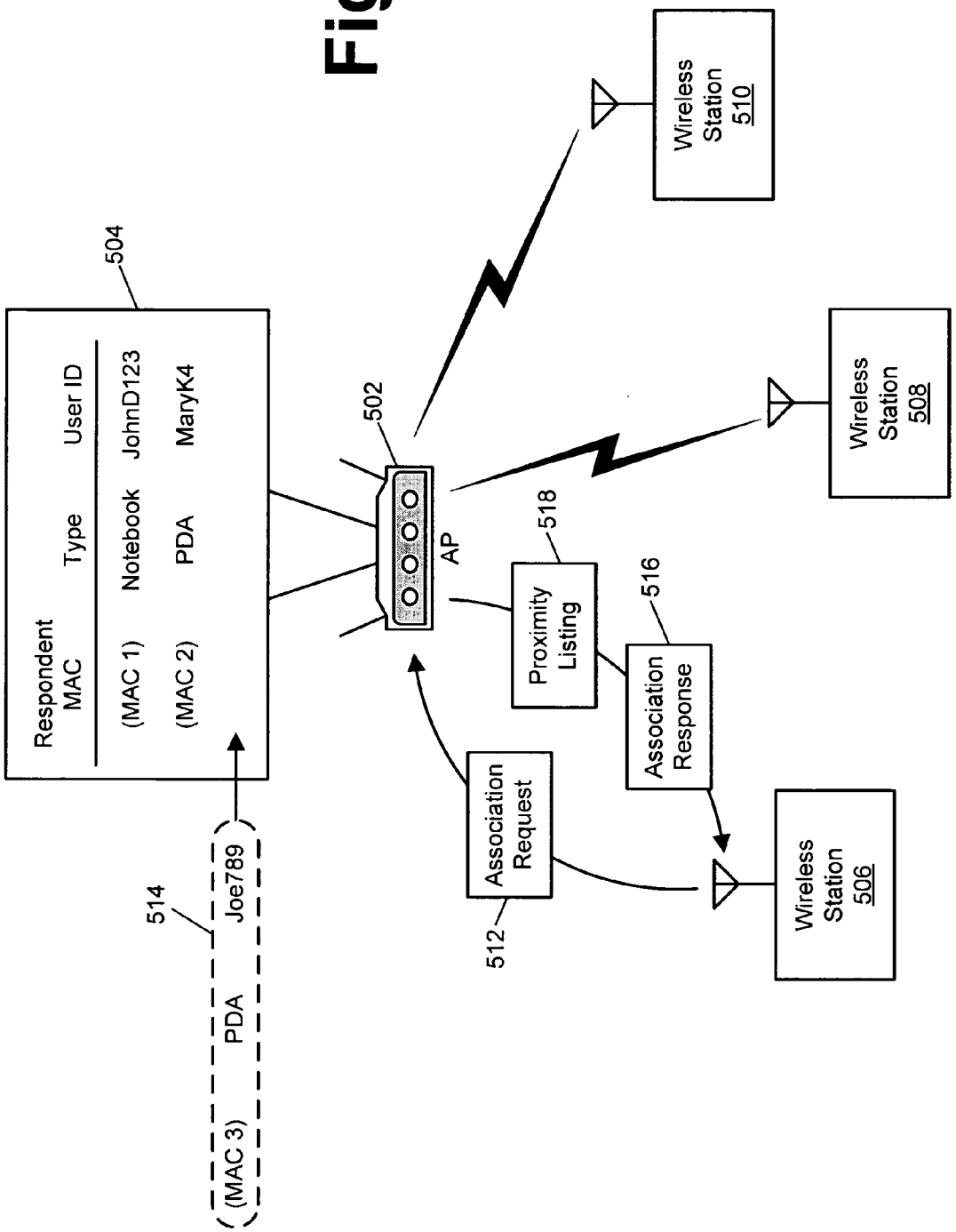

Respondent MAC
Type
User ID
(MAC 1)
Notebook
JohnD123
(MAC 2)
PDA
MaryK4
504
(MAC 3)
PDA
Joe789
514
502
AP
Proximity Listing
518
Association Response
516
Association Request
512
Wireless Station 510
Wireless Station 508
Wireless Station 506

Fig. 5

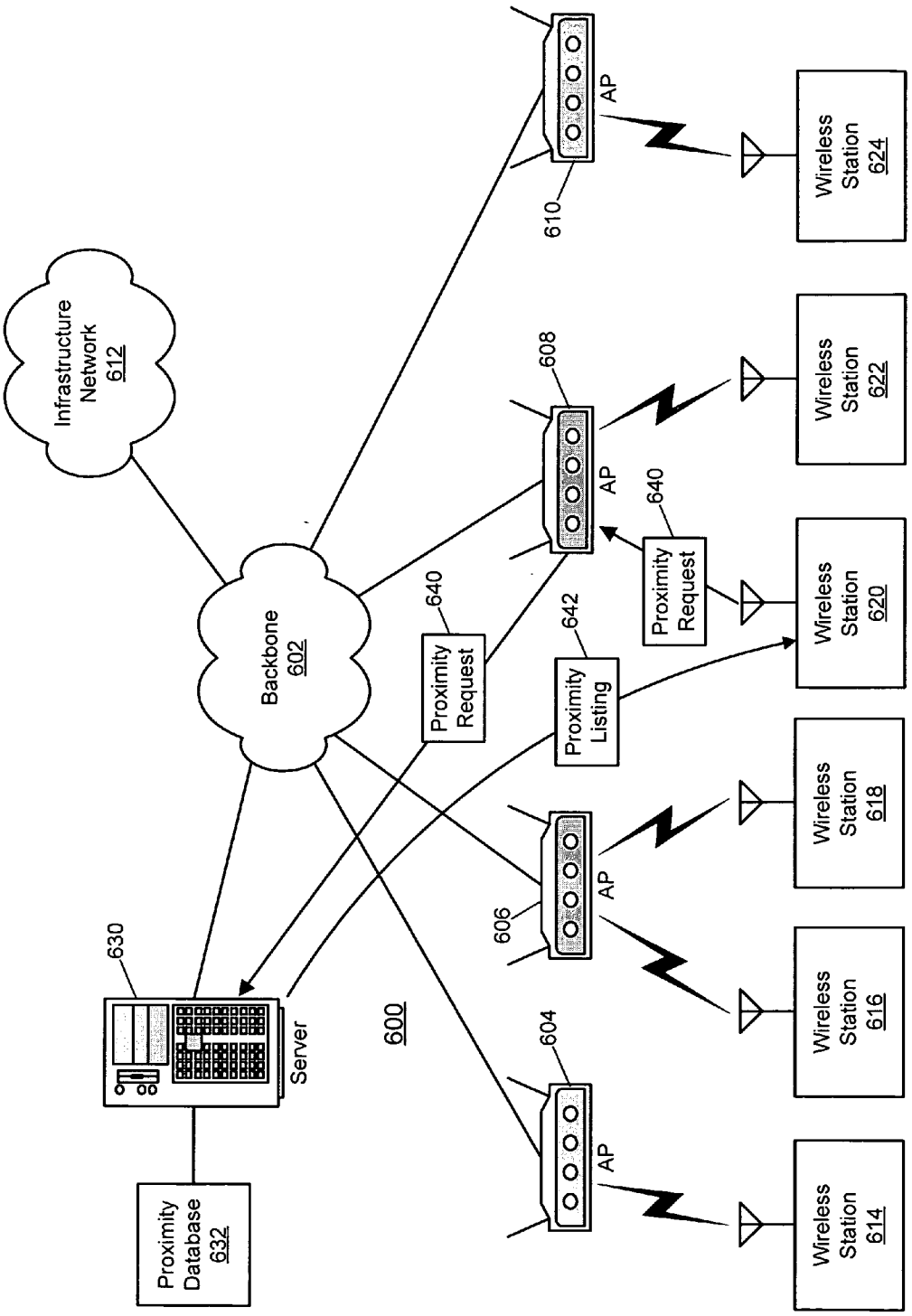

Infrastructure Network 612
Backbone 602
Server
630
Proximity Database 632
600
Proximity Request
640
Proximity Listing
642
Proximity Request
640
604
606
608
610
AP
AP
AP
AP
Wireless Station 614
Wireless Station 616
Wireless Station 618
Wireless Station 620
Wireless Station 622
Wireless Station 624

Fig. 6

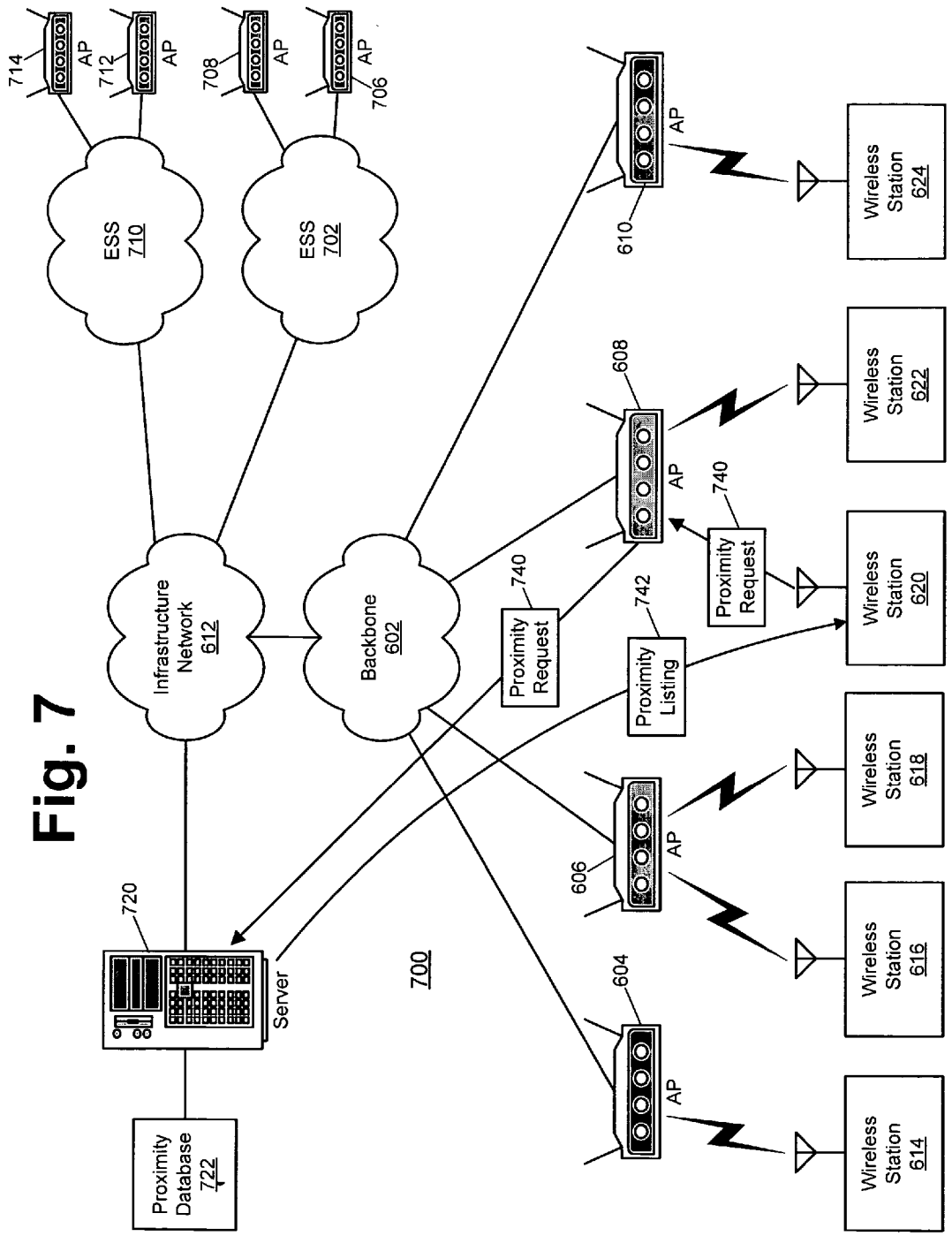

714
AP
712
AP
708
AP
706
AP
ESS
710
ESS
702
Infrastructure
Network
612
Backbone
602
720
Server
700
Proximity
Database
722
604
AP
606
AP
608
AP
610
AP
740
Proximity
Request
742
Proximity
Listing
740
Proximity
Request
Wireless
Station
614
Wireless
Station
616
Wireless
Station
618
Wireless
Station
620
Wireless
Station
622
Wireless
Station
624

Fig. 7

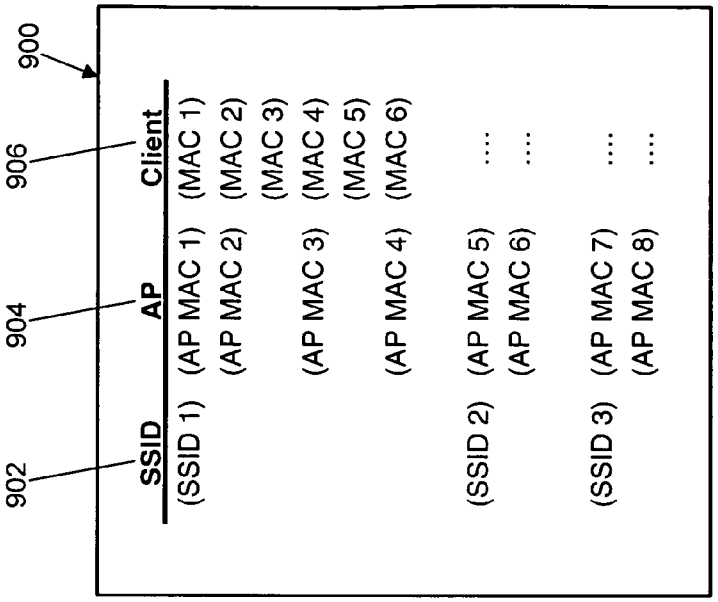

900
902
904
906
SSID
AP
Client
(SSID 1)
(AP MAC 1)
(MAC 1)
(AP MAC 2)
(MAC 2)
(MAC 3)
(AP MAC 3)
(MAC 4)
(MAC 5)
(AP MAC 4)
(MAC 6)
(SSID 2)
(AP MAC 5)
....
(AP MAC 6)
....
(SSID 3)
(AP MAC 7)
....
(AP MAC 8)
....

Fig. 9

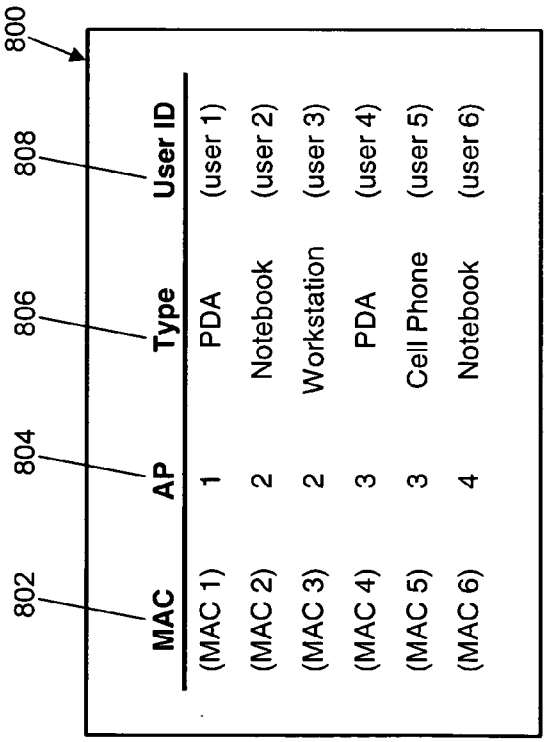

800
802
804
806
808
MAC
AP
Type
User ID
(MAC 1)
1
PDA
(user 1)
(MAC 2)
2
Notebook
(user 2)
(MAC 3)
2
Workstation
(user 3)
(MAC 4)
3
PDA
(user 4)
(MAC 5)
3
Cell Phone
(user 5)
(MAC 6)
4
Notebook
(user 6)

Fig. 8

1010

1016

1014

1012

Room 1	Room 2	Proximity
A	B	1
B	C	1
A	C	2

Fig. 10B

1020

1024

1022

MAC	Location
(MAC 1)	X1, Y1
(MAC 2)	X2, Y2
(MAC 3)	X3, Y3
(MAC 4)	X4, Y4
(MAC 5)	X5, Y5
(MAC 6)	X6, Y6
(MAC 7)	X7, Y7
(MAC 8)	X8, Y8
(MAC 9)	X9, Y9
(MAC 10)	X10, Y10
(MAC 11)	X11, Y11
(MAC 12)	X12, Y12
(MAC 13)	X13, Y13
(MAC 14)	X14, Y14
(MAC 15)	X15, Y15

Fig. 10C

1000

1004

1006

1002

AP	MAC	Room
1	(MAC 1)	A
2	(MAC 2)	A
3	(MAC 3)	A
4	(MAC 4)	B
5	(MAC 5)	C
6	(MAC 6)	C
7	(MAC 7)	C
8	(MAC 8)	C
9	(MAC 9)	C

Fig. 10A

1030

1034

1032

Room	Boundary Description
A	xxxxxxx
B	xxxxxxx
C	xxxxxxx

Fig. 10D

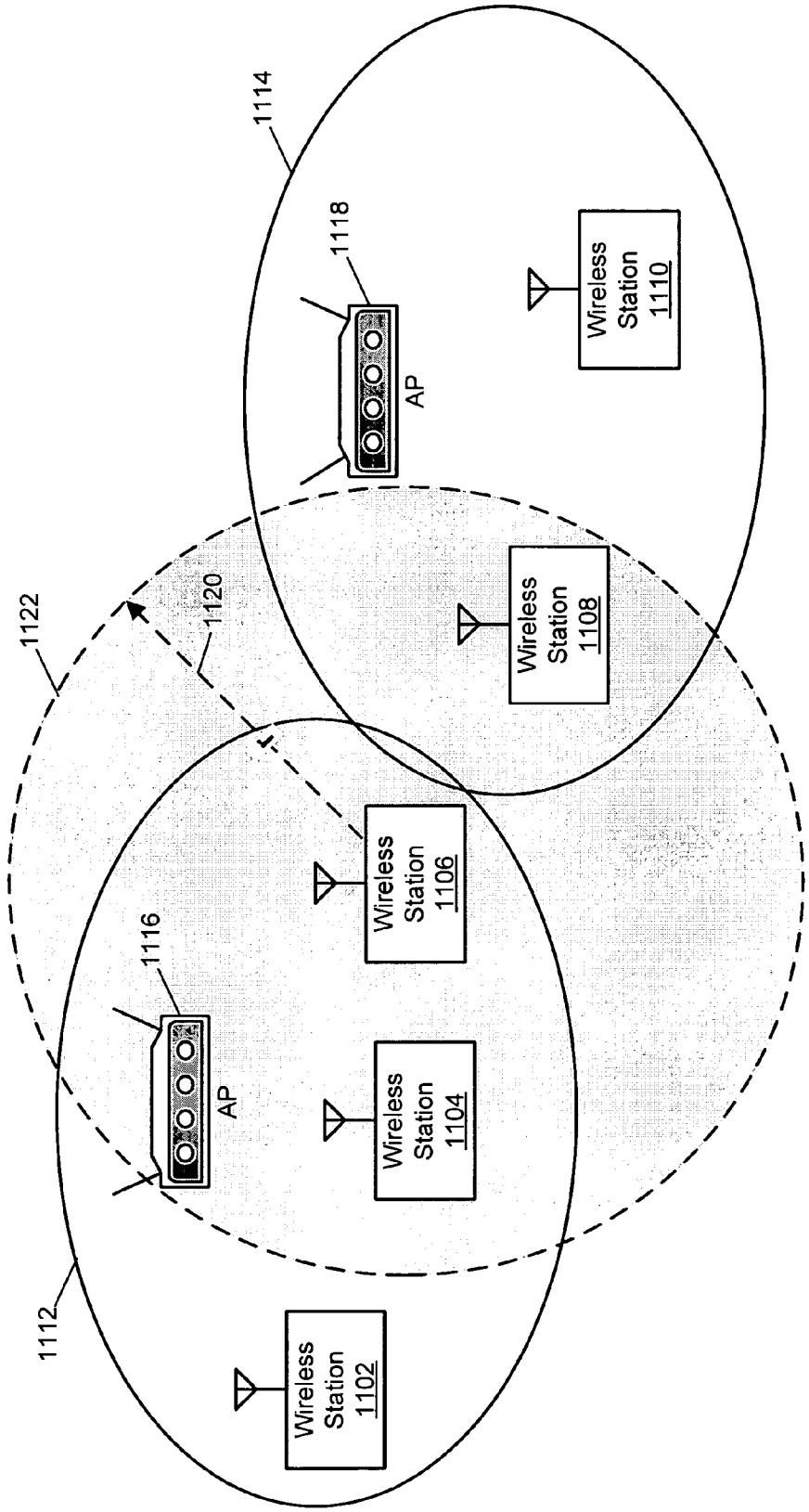
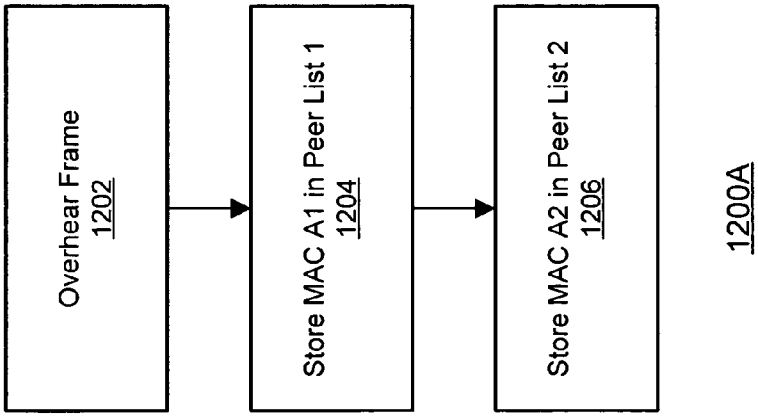

1114
1118
AP
Wireless Station 1110
Wireless Station 1108
1122
1120
Wireless Station 1106
1116
AP
Wireless Station 1104
1112
Wireless Station 1102

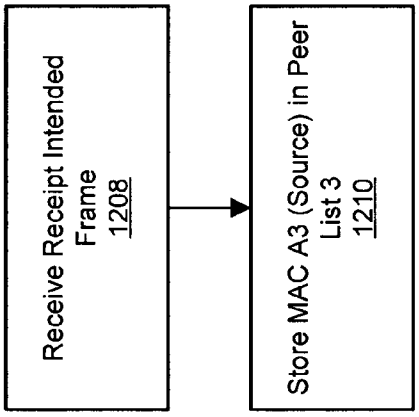
Fig. 11

Fig. 12A



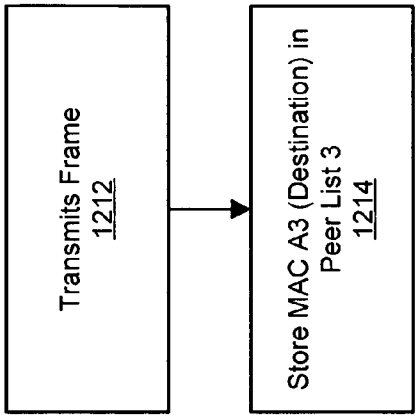
1200A

Fig. 12B



1200B

Fig. 12C



1200C

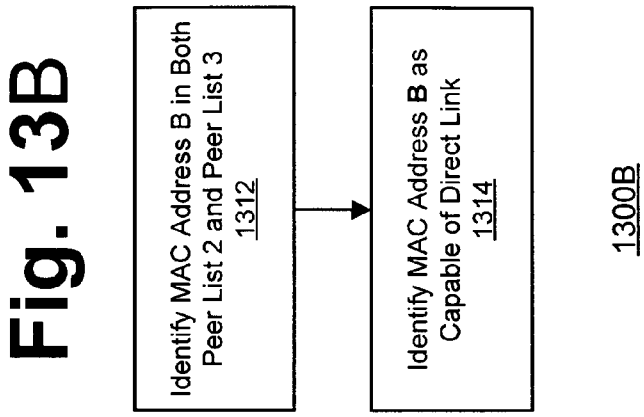


Fig. 13B

1300B

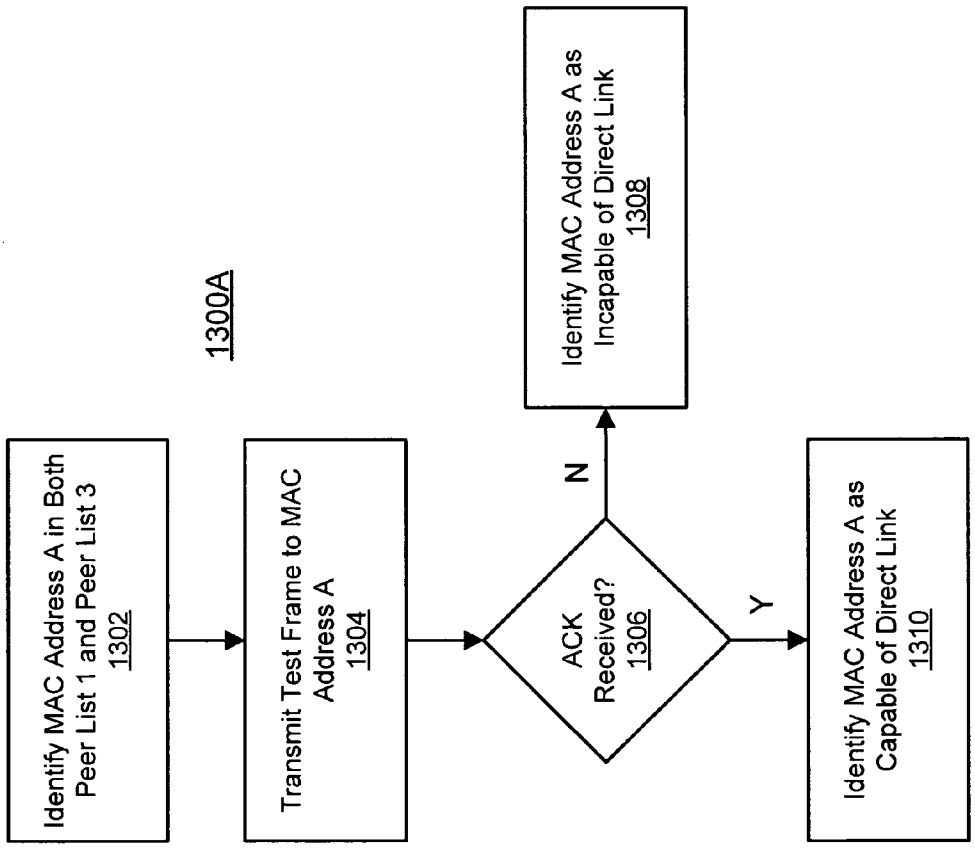


Fig. 13A

1300A

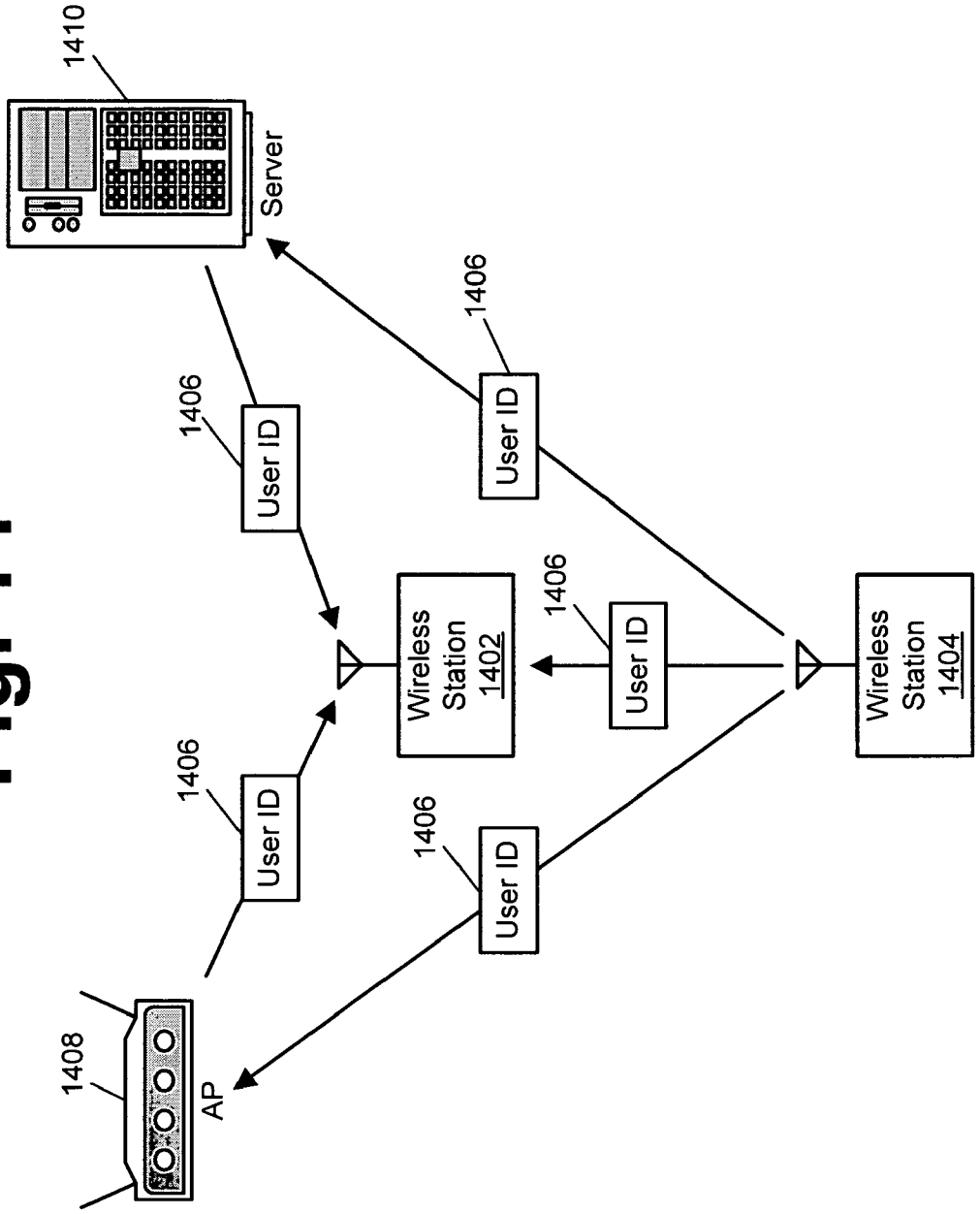

1410
Server
1406
User ID
1406
User ID
1406
User ID
Wireless Station 1402
1406
User ID
1406
User ID
Wireless Station 1404
1408
AP

Fig. 14

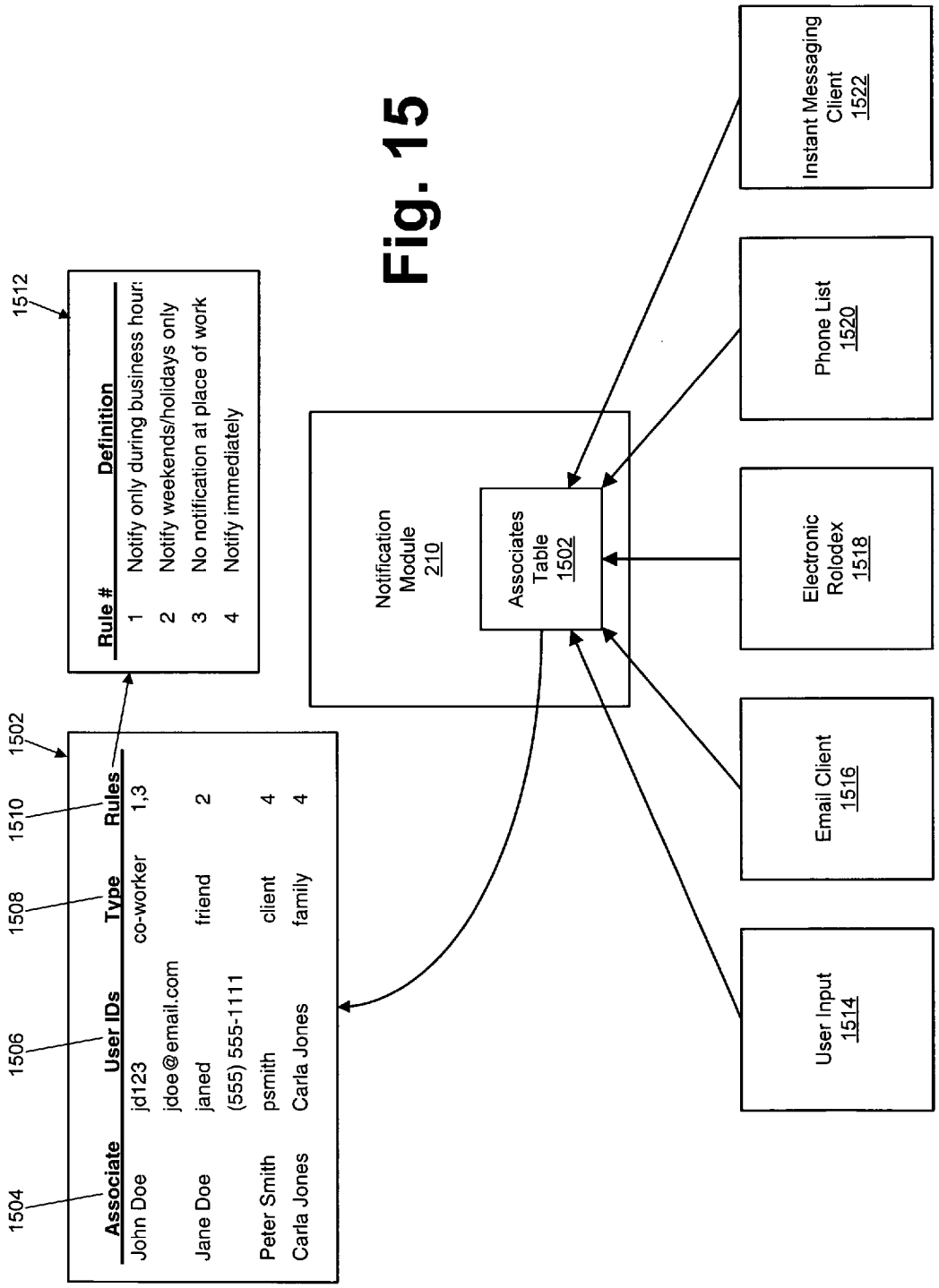

1504
1506
1508
1510
1502
1512
Associate
User IDs
Type
Rules
John Doe
jd123
jdoe@email.com
co-worker
1,3
Jane Doe
janed
(555) 555-1111
friend
2
Peter Smith
psmith
client
4
Carla Jones
Carla Jones
family
4
Rule #
Definition
1
Notify only during business hour
2
Notify weekends/holidays only
3
No notification at place of work
4
Notify immediately
Notification Module 210
Associates Table 1502
User Input 1514
Email Client 1516
Electronic Rolodex 1518
Phone List 1520
Instant Messaging Client 1522

Fig. 15

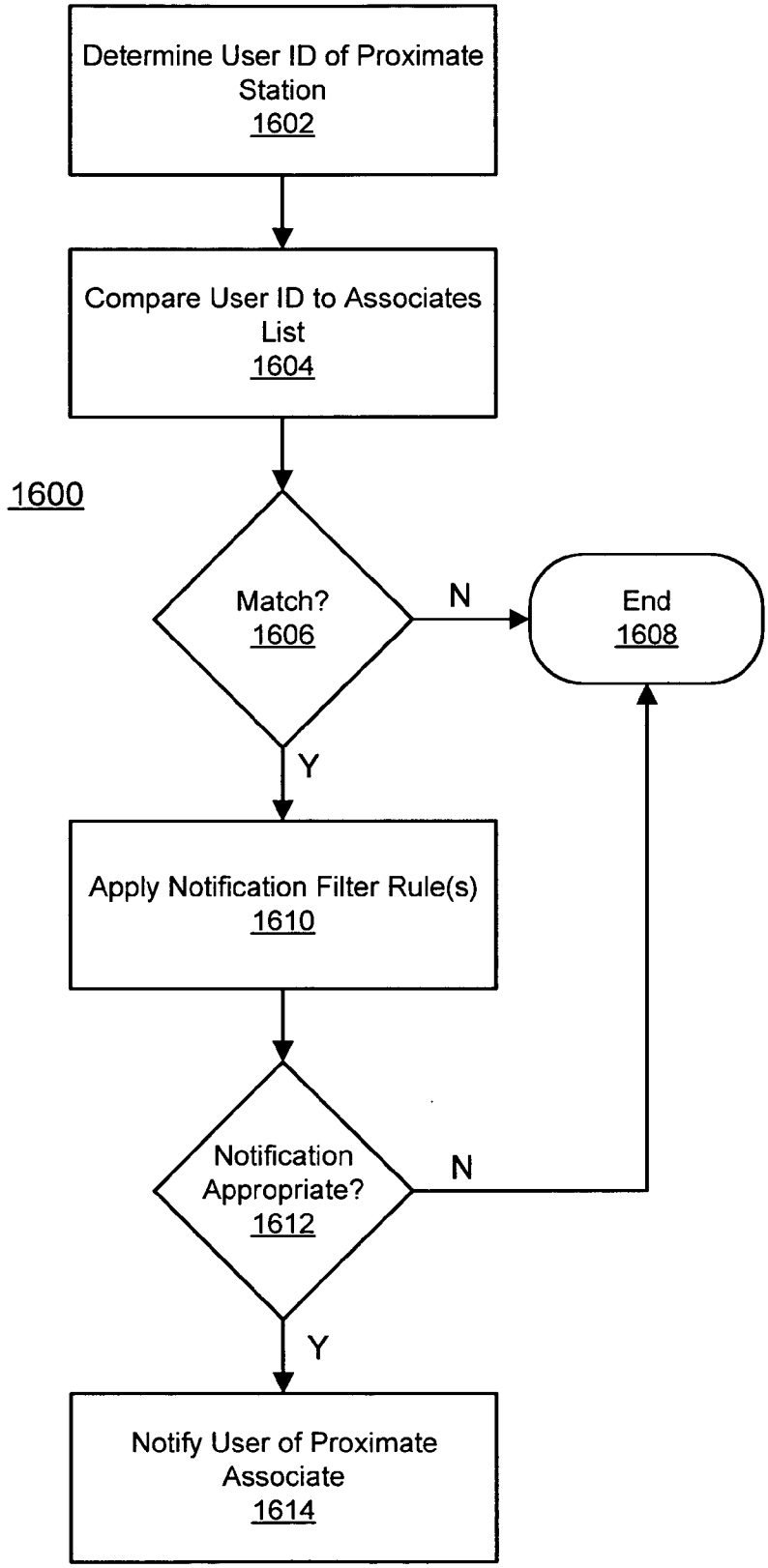

Determine User ID of Proximate Station
1602
Compare User ID to Associates List
1604
1600
Match?
1606
N
End
1608
Y
Apply Notification Filter Rule(s)
1610
Notification Appropriate?
1612
N
Y
Notify User of Proximate Associate
1614

Fig. 16

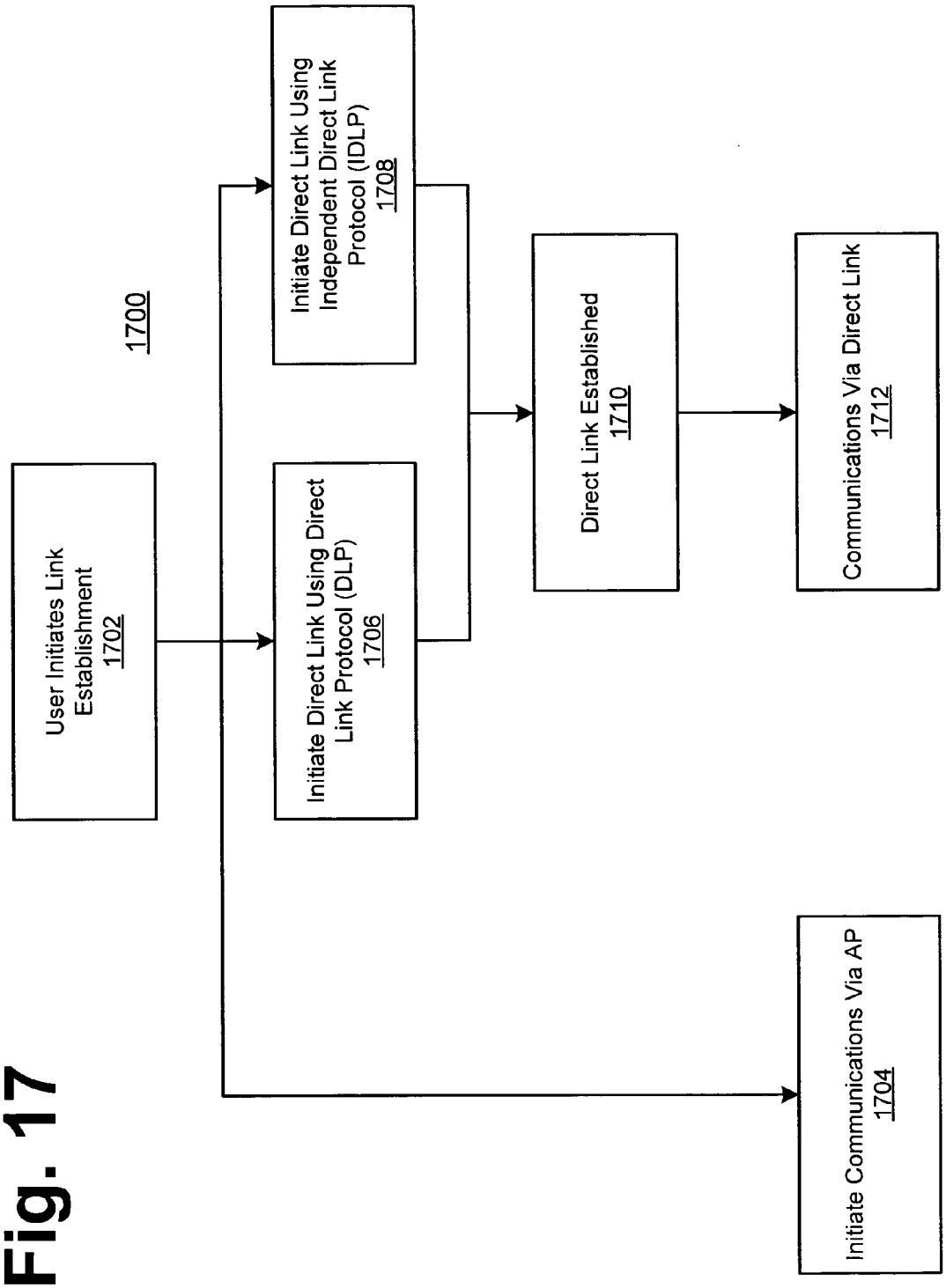

1700
User Initiates Link Establishment 1702
Initiate Direct Link Using Direct Link Protocol (DLP) 1706
Initiate Direct Link Using Independent Direct Link Protocol (IDLP) 1708
Direct Link Established 1710
Communications Via Direct Link 1712
Initiate Communications Via AP 1704

Fig. 17

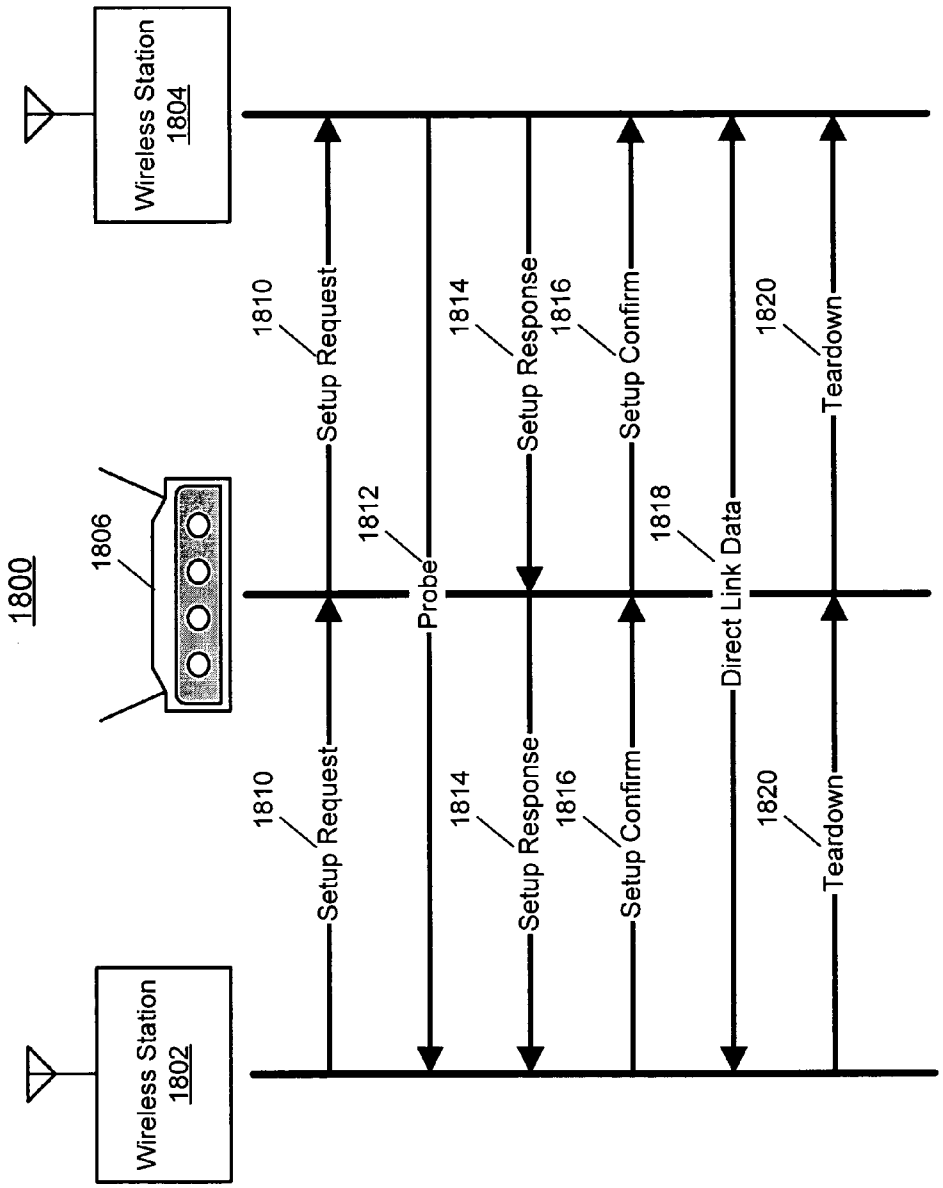

1800
1806
Wireless Station
1802
Wireless Station
1804
1810
Setup Request
1812
Probe
1814
Setup Response
1816
Setup Confirm
1818
Direct Link Data
1820
Teardown
1810
Setup Request
1814
Setup Response
1816
Setup Confirm
1820
Teardown

Fig. 18

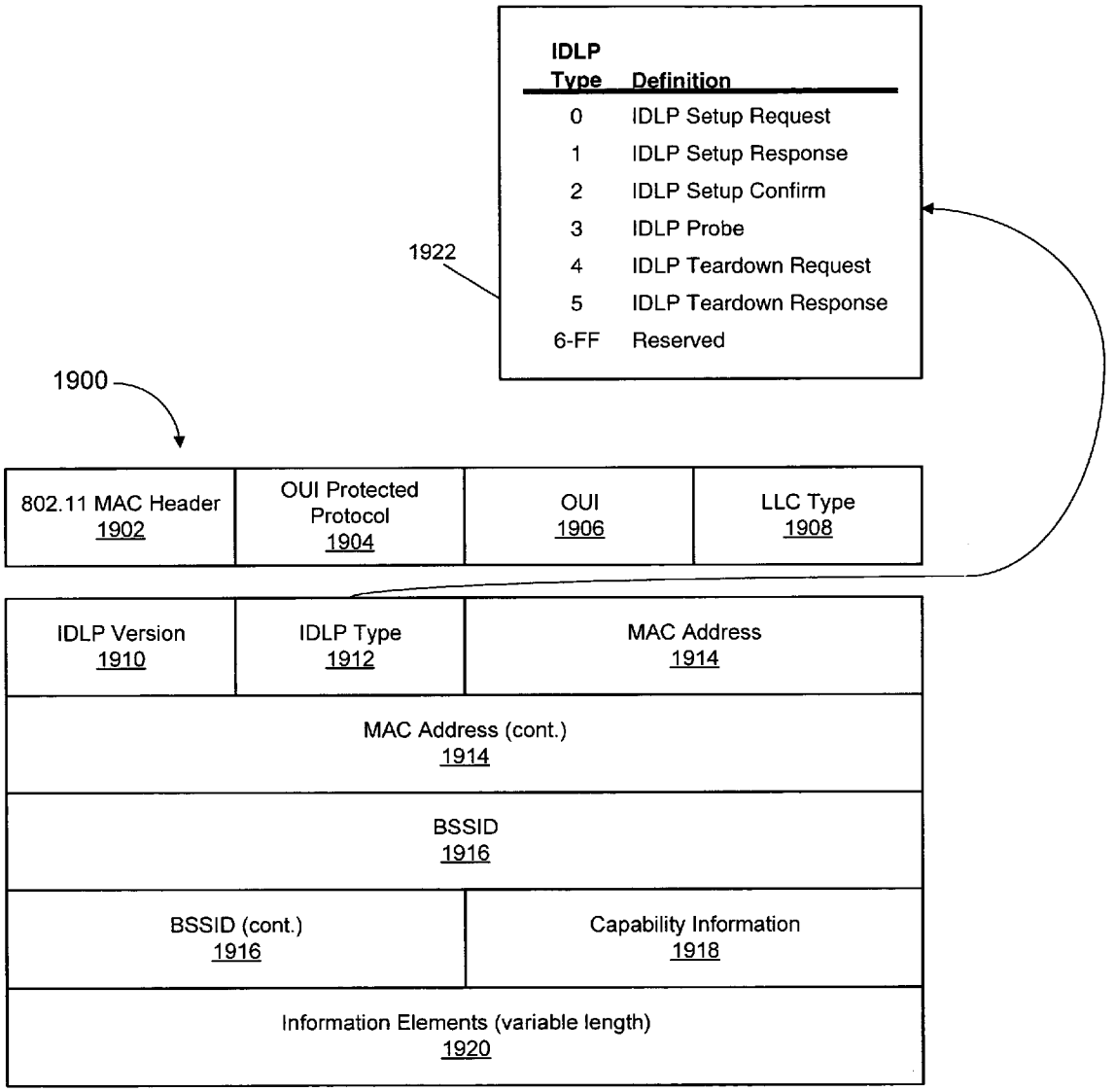

IDLP Type
Definition
0 IDLP Setup Request
1 IDLP Setup Response
2 IDLP Setup Confirm
3 IDLP Probe
4 IDLP Teardown Request
5 IDLP Teardown Response
6-FF Reserved
1922
1900
802.11 MAC Header 1902
OUI Protected Protocol 1904
OUI 1906
LLC Type 1908
IDLP Version 1910
IDLP Type 1912
MAC Address 1914
MAC Address (cont.) 1914
BSSID 1916
BSSID (cont.) 1916
Capability Information 1918
Information Elements (variable length) 1920

Fig. 19

LOCATION AWARENESS IN WIRELESS NETWORKS

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The present invention claims benefit of U.S. Provisional Patent Application No. 60/515,701 (Client Reference: GV 297; Attorney Docket No.: 56162.000497) filed Oct. 31, 2003 and entitled "Location Awareness in Wireless Networks," the disclosures of each of which are herein incorporated by reference in their entireties.

[0002] U.S. patent application Ser. No. _____ (Client Reference: GV 298; Attorney Docket No.: 56162.000498) filed concurrently herewith and entitled "Independent Direct Link Protocol," U.S. patent application Ser. No. _____ (Client Reference: GV 299; Attorney Docket No.: 56162.000499) filed concurrently herewith and entitled "Automatic Peer Discovery" all claiming benefit of U.S. Provisional Application No. 60/515,701 (Client Reference: GV 297; Attorney Docket No.: 56162.000497) filed Oct. 31, 2003, the entireties of which are incorporated by reference herein.

FIELD OF THE INVENTION

[0003] The present invention relates generally to location awareness in wireless networks and more particularly to identifying and communicating with proximate wireless stations. The present invention also relates generally to communications between stations in wireless networks and more particularly to establishing wireless direct links between proximate stations.

BACKGROUND OF THE INVENTION

[0004] Various wireless standards, such as Institute of Electrical and Electronics Engineers (IEEE) standards 802.11a/b/c/e/g/i (referred to collectively as IEEE 802.11), provide for wireless connectivity between a wireless station and an infrastructure network (e.g., the Internet) via an access point. Processes covered by these standards include the association of a wireless station with an access point, the transmission of data from wireless station to infrastructure network, and vice versa, via the access point, communication between wireless stations via an access point, and the like.

[0005] Some wireless standards, such as the direct link protocol (DLP) proposed for inclusion in IEEE 802.11e, provide a technique for initiating direct communications between wireless stations without the access point acting as an intermediary for the forwarding the data frames. The direct communications are commonly referred to as a wireless "direct link." These conventional direct link processes, however, require active cooperation from the access point in initiating and establishing the direct link. It will be appreciated that the access point may be configured to prevent the establishment of a direct link or may be incapable of supporting direct link capabilities (e.g., modulation type) preferred by the wireless stations. Wireless stations using conventional direct link techniques therefore may be unable to establish a direct link or may restricted to establishing and using a direct link with capabilities limited to the supported capabilities of the access point.

[0006] While providing for the establishment of a direct link in limited instances, conventional wireless techniques fail to provide an adequate technique for identifying nearby wireless stations with which a direct link may be established. Further, conventional wireless standards fail to provide processes that allow a wireless user to identify nearby users of wireless stations with whom the wireless user may want to meet or converse.

[0007] Accordingly, techniques for establishing a direct link independent of an access point and for identifying proximate wireless stations users would be advantageous.

SUMMARY OF THE INVENTION

[0008] The present invention mitigates or solves the above-identified limitations in known solutions, as well as other unspecified deficiencies in known solutions. A number of advantages associated with the present invention are readily evident to those skilled in the art, including economy of design and resources, transparent operation, cost savings, etc.

[0009] In accordance with an aspect of this invention a method is provided for determining a proximity of one or more wireless devices to a first wireless device. The method includes providing network information associated with the first wireless device to a server, the network information including at least a media access control (MAC) address and service set identifier (SSID) of an access point to which the first wireless device is connected. The method further includes comparing, at the server, the network information associated with the first wireless device wit network information associated with each of a predetermined set of wireless devices to identify one or more wireless devices connected to a same access point as the first device. The method further includes notifying a user of the first wireless device of a proximity of the one or more wireless devices.

[0010] In accordance with an aspect of this invention a method is provided in a wireless network comprising an access point logically connected to at least a first wireless device and a second wireless device, to notify the first wireless device that the second wireless device is in proximity to said first device.

[0011] In accordance with a further aspect of this invention a method is provided for establishing a direct wireless link between a first wireless device and at least one proximate wireless device. The method includes identifying a second wireless device within a predetermined proximity of the first wireless device; determining an identity associated with a user of the second wireless device; comparing the identify associated with the user of the second wireless device with a set of one or more predetermined identities; and notifying a user of the first wireless device that the user of a proximity of the user of the second wireless device based on the comparison of the identity with the set of one or more predetermined identities.

[0012] In accordance with a further aspect of this invention a wireless device is provided comprising: a radio frequency (RF) transceiver for transmitting and receiving data in an RF form; means for identifying a second wireless device within a predetermined proximity of the RF transceiver; means for determining an identity associated with a user of the second wireless device; means for comparing the

identify associated with the user of the second wireless device with a set of one or more predetermined identities; and means for notifying a user of the wireless device of a proximity of the user of the second wireless device based at least in part on the comparison of the identity with the set of one or more predetermined identities.

[0013] Still further features and advantages of the present invention are identified in the ensuing description, with reference to the drawings identified below.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] The purpose and advantages of the present invention will be apparent to those of ordinary skill in the art from the following detailed description in conjunction with the appended drawings in which like reference characters are used to indicate like elements, and in which:

[0015] **FIG. 1** is a top view of an exemplary building having wireless network access provided by a plurality of access points in accordance with at least one embodiment of the present invention.

[0016] **FIG. 2** is a schematic diagram illustrating an exemplary wireless station for identifying proximate wireless stations in accordance with at least one embodiment of the present invention.

[0017] **FIG. 3** is a flowchart illustrating an exemplary operation of the wireless station of **FIG. 2** in accordance with at least one embodiment of the present invention.

[0018] **FIG. 4** is a schematic diagram illustrating an exemplary technique for identifying proximate wireless stations using direct polling in accordance with at least one embodiment of the present invention.

[0019] **FIG. 5** is a schematic diagram illustrating an exemplary technique for identifying proximate wireless stations using proximity information maintained by an access point in accordance with at least one embodiment of the present invention.

[0020] **FIG. 6** is a schematic diagram illustrating an exemplary technique for identifying proximate wireless stations using proximity information maintained by a proximity server associated with an extended service set (ESS) in accordance with at least one embodiment of the present invention.

[0021] **FIG. 7** is a schematic diagram illustrating an exemplary technique for identifying proximate wireless stations using proximity information maintained by a proximity server associated with an infrastructure network in accordance with at least one embodiment of the present invention.

[0022] **FIGS. 8, 9** and **10A-10D** are block diagrams illustrating various tables of proximity information that may be maintained by a proximity server in accordance with at least one embodiment of the present invention.

[0023] FIGS. **11, 12A-12C** and are schematic and flow diagrams illustrating an exemplary technique for identifying wireless stations within a transmission/reception range of another wireless station in accordance with at least one embodiment of the present invention.

[0024] **FIG. 14** is a schematic diagram illustrating a technique for obtaining one or more user identifications (IDs) associated with a proximate wireless station in accordance with at least one embodiment of the present invention.

[0025] **FIG. 15** is a schematic diagram illustrating an exemplary table of information related to associates of a user of a wireless station in accordance with at least one embodiment of the present invention.

[0026] **FIG. 16** is a flow diagram illustrating an exemplary technique for notifying a wireless station user of one or more proximate wireless station users using the table of **FIG. 15** in accordance with at least one embodiment of the present invention.

[0027] **FIG. 17** is a flow diagram illustrating exemplary techniques for communicating with a proximate wireless station in accordance with at least one embodiment of the present invention.

[0028] **FIG. 18** is a schematic diagram illustrating an independent link protocol (IDLP) technique for establishing a wireless direct link between proximate wireless stations in accordance with at least one embodiment of the present invention.

[0029] **FIG. 19** is a schematic diagram illustrating an exemplary IDLP frame used by the technique of **FIG. 18** in accordance with at least one embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0030] The following description is intended to convey a thorough understanding of the present invention by providing a number of specific embodiments and details involving the identification of, and communication with, proximate wireless stations. It is understood, however, that the present invention is not limited to these specific embodiments and details, which are exemplary only. It is further understood that one possessing ordinary skill in the art, in light of known systems and methods, would appreciate the use of the invention for its intended purposes and benefits in any number of alternative embodiments, depending upon specific design and other needs.

[0031] For ease of illustration, the various techniques of the present invention are discussed below in the context of IEEE 802.11-based wireless networking. However, those skilled in the art, using the teachings provided herein, may advantageously implement the disclosed techniques in other wireless networks. Accordingly, reference to techniques and components specific to IEEE 802.11, such as a media access control (MAC) addresses, applies also to the equivalent technique or component in other wireless network standards unless otherwise noted.

[0032] Referring now to **FIG. 1**, an exemplary implementation of one or more techniques is illustrated in accordance with at least one embodiment of the present invention. **FIG. 1** depicts a top view **100** of a building, where the building may include any of a variety of structures, such as, for example, an airport, a shopping mall, a factory, a business office, a school campus, a residence, and the like. Situated at various points within the buildings interior are a plurality of access points **102-118** (illustrated as AP **1**-AP **9**, respectively) having coverage areas **122-138**, respectively. The access points **102-118** typically are connected via a back-

bone network (not illustrated) to form one or more extended service sets (ESSs). The backbone network in turn typically is connected to an infrastructure network, such as, for example, a wide area network (WAN), metropolitan area network (MAN), the Internet, etc. Thus, wireless network access to the infrastructure network may be provided to one or more wireless stations **140-172** (illustrated as S_1-S_{17}, respectively) that are positioned within one or more of the coverage areas **122-138**.

[**0033**] The wireless stations **140-172** include devices enabled to communicate wirelessly using one or more protocols supported by one or more the access points **102-118**. Such protocols may include, for example, the IEEE 802.11 protocols (802.11a/b/e/g/i, etc. Examples of wireless-enabled devices may include notebook (or "laptop") computers, handheld computers, desktop computers, workstations, servers, portable digital assistants (PDAs), cellular phones, etc.

[**0034**] In conventional wireless applications, a wireless station typically is unaware of the position or proximity of wireless stations and is further unaware of the one or more user IDs associated with the users of nearby wireless stations. In many instances, however, a user of a wireless station may desire to receive notification of other users of proximate wireless stations. Particularly, a certain user may want to be notified of other users with whom the certain user has some sort of association (i.e., "associates" of the certain user). Accordingly, in one embodiment of the present invention, one or more of the wireless stations **140-172** may be adapted to identify proximate wireless devices and determine one or more user IDs associated with the user or users of the proximate wireless devices. A user's ID may include, for example, a login ID supplied by the user to enable the user's use of the wireless station, an email address associated with the user and used by an email client operating on the wireless station, a user ID associated with one or more software programs operating on the wireless station, such as an instant messenger client, and the like.

[**0035**] After determining the user ID(s) associated with a nearby station, the wireless station may automatically notify the user of the wireless station. Alternatively, in one embodiment, a filtering process may be performed to determine whether the user should be notified of a proximate station user. The filtering process may include, for example, comparing the user ID with a list of associate user IDs or applying one or more notification filter rules that govern the notification process. Examples of notification filter rules may include rules that prevent or allow notification of proximate users during certain time periods, at certain locations, or in other situations. Exemplary filtering processes are discussed in greater detail herein.

[**0036**] The user of the wireless station may be notified of proximate users in a variety of manners. For example, a pop-up window could be displayed on a display screen of the station that informs the user of the proximity of the identified proximate user and also may provide additional related information, such as, for example, a value representing the degree of proximity (e.g., a physical distance value). The pop-up window could be displayed in conjunction with a communications program operating on the wireless station, such as an email client or an instant messaging program. Notification also may be provided by, for example, automated speech output by a speaker of the station, transmitting an email to an email client operating on the wireless station, etc.

[**0037**] After receiving notification of proximate users or associates, a user may take any of a variety of actions, such as initiating communications with a proximate user via their respective wireless stations, attempting to locate the proximate user for a face-to-face meeting, etc. Communications between nearby wireless stations may be accomplished via conventional wireless techniques where data communications between two wireless stations are communicated via one or more access points and/or the backbone network. Alternatively, in one embodiment, if the nearby wireless stations are within each other's transmission range, a wireless direct link may be established between the nearby wireless stations whereby data is communicated directly between the wireless stations without assistance or interference from an access point.

[**0038**] After establishing a direct link with the proximate station, various types of information may be transmitted over the direct link. For example, the proximate users could establish an instant messaging session using the direct link, transmit email directly without routing the emails through the infrastructure network, conduct a videoconference over the direct link, and the like. As another example, if one station belongs to a business and the other station to a potential customer, the direct link formed between the stations could be used to send advertisements, promotionals, coupons, and the like, from the business to the potential customer. Thus, advertising could be targeted by the business to potential customers that are within a certain proximity of the business.

[**0039**] As described above, a user of a wireless station may be interested in learning of other users of wireless stations within a certain proximity. The proximity may be defined by the user, an access point, or a third party based at least in part on equipment capabilities and the desires of the user and/or administrator of the wireless network. Various exemplary definitions of proximity are described in the following using **FIG. 1** for illustrative purposes. For ease of reference, the one or more conditions that define a proximity in a particular instance are collectively referred to herein as a proximity definition.

[**0040**] In at least one embodiment, wireless stations associated with a same access point (i.e., in a same basic service set or BSS) may be classified as proximate to each other. For example, the user of wireless station **144** may want be notified only of those wireless stations that are in the same coverage area **128** of access point **108** to which wireless station **144** is associated. In this case, wireless stations **146** and **148** may be considered as proximate to wireless station **144**. In another embodiment, a user of certain wireless station may consider only those wireless stations that are associated with the same access point or another access point having a coverage area that overlaps or is immediately adjacent to the coverage area of the access point associated with the certain wireless station. For example, under this classification of proximity, wireless stations **156**, **158** and **170** may be considered proximate to wireless station **160** because the access points **114**, **118** associated with one or more of the wireless stations **156**, **158** and **170** have coverage areas **134** and **138**, respectively, which overlap or are

immediately adjacent to coverage area **136** of access point **116**. Further, in one embodiment, wireless stations may be considered proximate when they are associated with the same ESS. To illustrate, assume that access points **102-108** form an ESS that spans rooms A and B. In this case, wireless stations **140-150** and **172** may be considered proximate to each other as each is associated with an access point that is a member of the same ESS.

[**0041**] As described above, a proximity definition may be based at least in part on the physical proximity or logical proximity of the access points to which the wireless stations are associated. In other circumstances, however, a proximity definition may be substantially based on the physical proximity, or physical distance, between wireless stations. In one embodiment, proximity may be defined as a physical distance from a certain wireless station. For example, the user of the wireless station **152** may consider only those wireless stations within an area **180** described by a radius **182** as proximate wireless stations. Under this exemplary proximity definition, wireless stations **150**, **154** and **166** would be proximate wireless stations while wireless station **156** would not even though it is associated with the same access point **112** as the wireless station **152**. The dimensions of the proximate area may be defined in part by features of the area where the wireless station is located (e.g., the walls or ceiling), by the transmission/reception range of the wireless station (e.g., radius **182** may represent the maximum transmission range), or by the coverage areas of nearby access points.

[**0042**] Rather than, or in addition to, basing proximity on a distance from the wireless station, features of the room or building where the wireless station is located may be used to aid in defining proximity. For example, the contours of room A may set the boundary for an area considered proximate by a user of a wireless station located in room A. In another example, the wireless stations located in either room A or room B may be considered proximate to each other because rooms A and B are adjacent and wireless stations in either room B or room C may be considered proximate to each other because Rooms B and C are adjacent. Wireless stations in room A, however, may not be considered proximate to wireless stations in room C, and vice versa, in this example because the areas of room A and C are not adjacent.

[**0043**] In other embodiments, proximity may be defined based on both physical proximity of the wireless stations and the proximity of access points. For example, wireless stations may be considered to be proximate when they are located in the same room and are associated with the same ESS or are associated with access points having overlapping or adjacent coverage areas. Although various exemplary proximity definitions have been disclosed, other definitions of proximity may be utilized based on the teachings provided herein without departing from the spirit or the scope of the present invention.

[**0044**] Referring now to **FIGS. 2 and 3**, an exemplary wireless station **202** for implementing the various techniques described herein and an exemplary method **300** for its use are illustrated in accordance with at least one embodiment of the present invention. The wireless station **202** includes a radio frequency (RF) transceiver **204**, one or more processors **206**, a proximity identification module **208**, a notification module **210** and a link module **212**. The wireless station **202** further may include one or more software applications **214**, **216**. The software applications **214**, **216** may include, for example, communications based applications such as an email client, an instant messaging client, videoconferencing software, and the like. The wireless station **202** further may include a global positioning system (GPS) receiver **218** for determining the position of the wireless station **202**.

[**0045**] In at least one embodiment, data and other signaling is communicated between the wireless device **202** and one or more access points **220** or other wireless stations **222**, **224** as frames represented by RF energy transmitted by and received via the RF transceiver **204**. Incoming data from the RF transceiver **204** may be processed by the processor **206** using one or more protocol stacks **226**, such as, for example, an Internet Protocol (IP) stack. The resulting extracted data may be used by the proximity identification module **208**, the notification module **210**, the link module **212** and/or one or more of the software applications **214**, **216** as described herein. Similarly, data generated by one or more of the modules **208-212** and/or software applications **214**, **216** may be encapsulated or otherwise processed by the processor **206** using the one or more protocol stacks **226** and transmitted to the access point **220** or wireless stations **222**, **224** via the transceiver **204**.

[**0046**] In at least one embodiment, the modules **208-210** are at least partially implemented as software executed by one or more processors **206** to perform the associated function. In other embodiments, some or all of the modules **208-210** may be implemented as hardware, firmware, or a combination thereof. For example, the modules **208-212** may be implemented as a software application installed on and executed by the wireless station **202** to perform the proximity detection, notification, and link establishment techniques described herein. Alternatively, the modules **208-212** may be implemented as software "plug-ins" for implementation in conjunction with another software application, such as an email client application.

[**0047**] Referring to **FIG. 3**, an exemplary method **300** illustrating an operation of the wireless station **202** is illustrated. The method **300** initiates at step **302** wherein the proximity identification module **208** identifies wireless stations proximate the wireless station **202** under one or more proximity definitions. In one embodiment, the proximity identification module **208** identifies proximate wireless stations using a direct polling approach as described with reference to **FIG. 4**. In another embodiment, the proximity identification module **208** identifies proximate wireless stations based at least in part on proximity information provided by the access point **220** or a proximity server implemented by, or connected to, the access point **220** as described with reference to **FIGS. 6-10D**. Alternatively, the proximity identification module **208** may identify proximate wireless stations using an automatic peer discovery technique as described with reference to **FIGS. 12-14B**. Other techniques for identifying proximate wireless stations may be implemented without departing from the spirit or the scope of the present invention.

[**0048**] At step **304**, the proximity identification module **208** determines one or more user IDs associated with the identified proximate wireless stations. A user ID may include, for example, a login ID used to access the wireless station, an email address associated with a user of the

wireless station, a user ID provided by the user in response to a request for identification, a user ID provided specifically for proximate identification purposes, etc. In one embodiment, the user ID of the user of a proximate wireless station may be received by the proximity identification module **208** as data transmitted by the proximate wireless station in response to a identification request transmitted by the proximity identification module **208**. Alternatively, the user ID of a user of a proximate wireless station may be provided by the proximity server or the access point **220**.

[**0049**] As noted above, in some instances the user of the wireless station **202** may want to be notified of a proximate station user only under certain conditions. For example, one condition may be that the proximate station user be associated in some way with the user of the wireless station **202**, i.e., the proximate station user is an associate of the user of the wireless station **202**. An associate may include, for example, a family member, a friend, a co-worker, a business associate, a fellow club member, etc. Accordingly, at step **306**, the user IDs of proximate wireless stations may be compared to a list of user IDs related to identified associates of the user of the wireless station **202**. In the event that the user ID of a proximate wireless station substantially matches a user ID on the list of associate IDs, the proximity identification module **208** may identify the user of the proximate wireless station as an associate. In other embodiments, however, the user of the wireless device **202** may opt to receive notification of proximate users regardless of an association, or lack thereof, with the user of the wireless device **202**. In this case, step **306** may be omitted.

[**0050**] At step **308**, the notification module **210** notifies the user of the wireless station **202** of the proximity of nearby station users. The notification module **210** may notify the user by, for example, displaying a display window having proximate user information on a display screen of the wireless station **202** for observation by the user, by playing an automated voice output identifying proximate users, by sending an email to an email client operating on the wireless station **202**, etc.

[**0051**] In certain instances, however the notification module **210** performs a filtering process before notifying the user of proximate users. The filtering process may include subjecting the user IDs associated with the proximate wireless stations to one or more notification filter rules set by the user of wireless station **202**. The one or more notification filter rules may include, for example, conditions relating to the time of notification, the place of notification, the means of notification, and the like. For example, the wireless station **202** may include a notebook computer and the user of the wireless station may work at an office with other workers having similarly configured notebook computers. The user therefore may not desire to receive notification of the proximity of associates at the office due to user's preexisting awareness that the other workers are proximate due to their co-employment at the same office. Accordingly, the user may set a notification filter rule whereby no notification is given for proximate users identified as coworkers when the wireless station **202** is within the confines of the user's office.

[**0052**] After notifying the user of proximate users, the user may be provided with the choice of whether to initiate a direct link with one or more proximate wireless stations. If the user does not want to establish a direct link, the user may so indicate at step **310** and the method **300** terminates at end step **312**. Otherwise, the user may select one or more proximate users with whom the link module **212** may attempt to establish a direct link.

[**0053**] At step **314**, the link module **212** may initiate the one or more direct link techniques to establish a direct link with the wireless station(s) of the selected proximate user(s). Any of a variety of techniques may be used to establish a direct link, two of which are discussed with reference to **FIGS. 17-19**. After a direct link is established at step **316**, the user may communicate with the proximate user, and vice versa, via the direct link at step **318**. Such communications may include instant messaging, direct email, video conferencing, etc.

[**0054**] Referring now to **FIG. 4**, an exemplary direct polling technique **400** for identifying proximate wireless stations is illustrated in accordance with at least one embodiment of the present invention. In the illustrated example, the proximity identification module **208** of station **202** generates and provides for transmission a poll frame **402** having a broadcast or multicast MAC address in its destination address field. The poll frame **402** further may include, for example, data identifying the frame as a request for wireless devices to identify themselves upon receipt of the poll frame **402**. In this case, the proximate wireless stations **222**, **224** may prepare and transmit poll response frames **404** and **406**, respectively, for receipt by the wireless station **202**. The poll response frames **404** and **406** may include, for example, data representing the MAC address of the proximate wireless station sending the poll response frame, an indicator of the type of wireless station (e.g., PDA, notebook computer, cell phone, etc.), one or more user IDs associated with the wireless station, and the like.

[**0055**] It will be appreciated that the receipt of a poll response frame from a wireless station indicates a strong possibility that the wireless station is nearby. Based on this possibility, upon receipt of a broadcast response frame, the proximity identification module **208** may insert relevant data from the poll response frame into a response table **408** maintained at the wireless station **202**. In other embodiments, rather than transmitting a poll response frame in response to a poll frame **402**, the wireless stations **202**, **222**, and **224** may be adapted to periodically transmit a beacon frame, similar to the poll response frames **404** and **406**, identifying the MAC address, type, user ID, etc., of the wireless station transmitting the beacon frame. Upon receipt of a beacon frame from another wireless station, the receiving wireless station may add information from the beacon frame to the response table **208**.

[**0056**] In the illustrated example, the response table **408** includes an entry for each broadcast response frame received, the entry including the MAC address (column **410**), type (column **412**) and user ID (column **414**) associated with the wireless station transmitting the response frame. Information from the response table **408** therefore may be used by the proximity identification module **408** and notification module **410** to identify proximate station users and to provide notification of their proximity.

[**0057**] Referring now to **FIG. 5**, an exemplary technique for identifying proximate wireless stations based on proximity information provided an access point is illustrated in

accordance with at least one embodiment of the present invention. IEEE 802.11 and other wireless standards describe an association process whereby a wireless station that enters the coverage area of an access point may identify itself to the access point and request that the access point handle incoming and outgoing frames on behalf of the wireless station. In at least one embodiment, the access point and wireless device may be adapted to provide proximity information during or in response to the association process.

[**0058**] To illustrate, the access point **502** may be adapted to maintain an association table **504** that stores information relating to wireless stations associated with the access point **502**. This information may include, for example, the MAC address of the wireless station, the type of wireless station, user ID(s) associated with the wireless station, etc.

[**0059**] When wireless device **506** enters the coverage area of the access point **502** (already associated with wireless stations **508** and **510**), the wireless station **506** may transmit an association request frame **512** to the access point **502** requesting association with the access point **502**. Information related to the wireless device **506** may be transmitted as part of the association request **512** or in subsequent frame(s). Upon receipt of the frame(s) containing information related to wireless station **506**, the access point **502** may use this information to create an entry **514** in the associates table **504** for the wireless station **506**.

[**0060**] As described in IEEE 802.11, the access point **502** conventionally responds to an association request frame **512** with an association response frame **516** indicating whether the association request of the wireless station **202** is successful, and if so, the association response frame **516** also generally includes an association ID for use by the wireless station **506**. In one embodiment, the access point **502** may further respond to a successful association request by transmitting a proximity listing **518** to the wireless station **506** as part of the association response frame **516** or as one or more separate frames. The proximity listing **518** preferably includes information related to other wireless stations **506** and **508** associated with the access point **502**, such as, for example, the proximate stations' MAC addresses, user IDs, type, GPS position, etc. The information presented in the proximity listing **518** may be culled from the associates table **504** maintained by the access point **502**. The proximity identification module **208** may store part or all of the information of the proximity listing **518** in the response table **408** or similar table for use in identifying and providing notification of proximate users.

[**0061**] Referring now to **FIG. 6**, an exemplary system **600** and technique for providing proximity information in an ESS is illustrated in accordance with at least one embodiment of the present invention. System **600** includes a backbone network **602** connecting a plurality of access points **604-610** to form an ESS. The backbone network **602** is further connected to an infrastructure network **612** (e.g., the Internet) to provide network connectivity between wireless stations **614-624** and the infrastructure network **612**.

[**0062**] The system **600** further includes a proximity server **630** operably connected to the access points **604-610** via the backbone network **602**. In at least one embodiment, the notification server **630** may be adapted to monitor the physical and/or logical locations of wireless stations associated with the ESS. To facilitate this monitoring process, the proximity server **630** may be adapted to maintain, or have access to, a proximity database **632** storing various information related to the locations, positions, identities, types, connection capabilities, etc. of the wireless stations **614-624**. Various examples of information that may be stored in the proximity database **632** are discussed below with reference to **FIGS. 8, 9**, and **10**A-D.

[**0063**] Information stored in the proximity database **632** may be provided directly by the wireless stations **614-634**, provided by the access points **604-610**, or the proximity database **632** may obtain information from other sources. To illustrate, when a wireless station associates with one of the access points **604-610**, the access point may obtain information related to the workstation as described with reference to **FIG. 5** and provide this information to the proximity server **630**. Alternatively, the address of the proximity server **630** may be provided to the wireless station during, for example, the association process and the wireless station may provide the proximity server with the information directly.

[**0064**] To receive information from the proximity server **630** identifying proximate wireless stations, a wireless station (e.g., wireless station **620**) may be adapted to transmit a proximity request **640** to the proximity server **630**. In instances where the address of the proximity server **630** is known to the wireless station **620**, the wireless station **620** may transmit the proximity request **640** directly to the proximity server **630** via the access point **608**. In instances where the wireless station **620** is unaware of the proximity server **630**, the wireless station **620** may transmit the proximity request **640** for receipt by the access point **608**. The access point **608**, knowing the address of the proximity server **630**, then may forward the proximity request **640** to the proximity server **630**.

[**0065**] The proximity request **640** may include various information useful to the proximity server **630** in identifying proximate stations and providing their relevant information. The information in the proximity request **640** may include, for example, information associated with the wireless station **620** such as its MAC address, one or more user IDs, a BSSID, position coordinates provided by the GPS receiver **218** (**FIG. 2**), etc. The information in the proximity request **640**, in one embodiment, may also include a desired proximity definition, such as a maximum proximity radius, a limitation to a same room, BSS, set of BSSs, etc.

[**0066**] Using the information of the proximity request **640** and the proximity database **632**, the proximity server **630** may identify proximate stations using a default proximity definition or a proximity definition provided by the wireless device **620**. After identifying proximate stations, the proximity server **630** may identify information in the proximity database **632** corresponding to the identified proximate stations and provide some or all of this information to the wireless station **620** as a proximity listing **642**. The proximity identification module **208** (**FIG. 2**) of the wireless station **620** may process the information of the proximity listing **642** as appropriate and provide relevant portions to the notification module **210** (**FIG. 2**) for use in notifying the user of the wireless station **620** of nearby wireless station users.

[**0067**] Referring now to **FIG. 7**, an exemplary system **700** and technique for providing proximity information for mul-

tiple ESSs are illustrated in accordance with at least one embodiment of the present invention. System **700** includes the backbone network **602** connecting a plurality of access points **604-610** to form an ESS. The backbone network **602** is further connected to the infrastructure network **612** (e.g., the Internet) to provide network connectivity between wireless stations **614-624** and the infrastructure network **612**. The infrastructure network **612** is further connected to one or more other ESSs, such as ESS **702** having access points **706**, **708** and ESS **710** having access points **712**, **714**.

[**0068**] System **600** of **FIG. 6** depicts a system whereby proximity information may be provided to a wireless station in an ESS by a proximity server **630** that is associated with the ESS. In certain instances, it may be advantageous to maintain a proximity server **720** capable of providing proximity information for a plurality of ESSs. For example, as noted above, multiple ESSs may be present in a building. In this case, a useful proximity definition may span multiple ESSs. Accordingly, the proximity station **720** may be adapted to maintain a proximity database **722** (analogous to proximity database **632**, **FIG. 6**) for the wireless stations associated with multiple ESSs. The station-related information populating the proximity database **722** may be provided by, for example, the access points **604-610**, **706**, **708**, **712** and **714** when a wireless station associates with one of the access points. Examples of information maintained in the proximity database **722** are discussed with reference to **FIGS. 8, 9** and **10**A-**10**D.

[**0069**] To obtain proximity information, the wireless station **620** can transmit a proximity request **740** (analogous to proximity request **640**, **FIG. 6**) to the proximity server **720**. The proximity request **740** may include a proximity definition that provides, for example, a definition of proximity that spans multiple ESSs. In response to the proximity request **740**, the proximity server **722** may identify proximate wireless stations using proximity database **722** and provide information relevant to identified proximate wireless stations as proximity listing **742** (analogous to proximity listing **642**, **FIG. 6**) for use by the wireless device **620**.

[**0070**] Referring now to **FIGS. 8, 9** and **10**A-**10**D, examples of information maintained in proximity databases **632** (**FIG. 6**) or proximity database **722** (**FIG. 7**) are illustrated in accordance with at least one embodiment of the present invention.

[**0071**] **FIG. 8** illustrates an exemplary table **800** whereby information related to wireless stations (e.g., stations **614-624**, **FIG. 6**) of an ESS may is stored by, for example, MAC address of the wireless stations (column **802**), MAC address of the access point associated with the corresponding wireless station (column **804**), the device type (column **806**), and one or more user IDs associated with the corresponding work station (column **808**).

[**0072**] As noted above, proximity may be limited to a BSS or a group of adjacent BSSs. Under this proximity definition, the proximity server **630**/**720** may identify a wireless stations proximate to a certain wireless station by identifying entries in the table **800** having an AP MAC address (or BSSID) common to the certain wireless station. To illustrate, to identify stations proximate to the wireless station having MAC address MAC **4**, the proximity server **630**/**720** can analyze the table **800** to identify other wireless stations associated with the same access point identified by MAC address AP MAC **3**. In the illustrated example, the proximate wireless station would include the station having MAC address MAC **5**. The proximity server **630**/**72** then may select information associated with the identified proximate stations, such as the device type (column **806**) and the user ID(s) (column **808**).

[**0073**] In certain instances, proximity may be defined as wireless stations within the same ESS as a certain wireless device. Accordingly, **FIG. 9** illustrates an exemplary table **900** organized by ESS (column **902**) and then classified by access point (column) **904** and subclassified by wireless station (column **906**). Using table **900**, the proximity server **630**/**720** may identify wireless stations in a same BSS or, alternatively, in the same ESS for proximity identification purposes.

[**0074**] **FIGS. 10A and 10B** illustrate exemplary tables **1000** and **1010**, respectively, that may be used by the proximity server **630**/**720** to identify proximate workstations when proximity is based at least in part on the relation of wireless stations to the topography of an area or the room boundaries of a building. Table **1000** of **FIG. 10A** illustrates a table whereby access points (columns **1002**) are organized based on the room (column **1006**) in which the access points are located. Table **1000** may include additional information related to the access points, such as their MAC addresses (column **1006**), their position coordinates (not shown), etc. In instances where proximity is limited to the same room, enclosure or area as a certain wireless station, the proximity server **630**/**720** may use table **1000** to identify access points located in the same room and consequently identify wireless stations in the same room based on their association with an access point in that room.

[**0075**] In other instances, proximity may be limited to adjacent rooms. **FIG. 10B** illustrates an exemplary table **1010** that may be used by the proximity server **630**/**720** to identify adjacent rooms. The table **1010** may include, for example, columns **1012** and **1014** listing possible pairings of rooms and column **1016** listing a proximity value (column **1016**) used to identify the degree of proximity between the pair of rooms. For example, referring to **FIG. 1**, room A is adjacent to room B and room B is adjacent to room C, so the pairings (room A, room B) and (room B, room C) may be assigned a proximity value of 1 to identify them as immediately adjacent. However, room A and room C are only connected via room B, so the pairing (room A, room C) may be assigned a proximity value of 2 to identify that they are indirectly connected by a third room (room B).

[**0076**] Rather than identifying wireless stations as being located in a certain room based on their association with a particular access point, position coordinates of the wireless stations may be used to identify their location within a building and, therefore, their proximity to a certain wireless device. To illustrate, exemplary table **1020** of **FIG. 10C** lists wireless stations by an identifier, such as a MAC address (column **1022**), and the corresponding position coordinates (e.g., latitude X_k, longitude Y_j) of the wireless stations (column **1024**). The position coordinates for a wireless station may be supplied by the GPS receiver **218** (**FIG. 2**) of the wireless station. To illustrate, the proximity identification module **208** (**FIG. 2**) may be adapted to transmit the position coordinates supplied by the GPS receiver to the access point or proximity server on a periodic basis or in

response to a poll transmitted by the access point. In other embodiments, the position of the wireless station may be determined one or a plurality of access points using well known wireless triangulation methods.

[0077] Using table **1020**, the proximity server **630/720** may identify wireless stations occurring within a certain proximity of another wireless station, where the proximity may be defined as, for example, an area occurring within a certain radius of the wireless station. If proximity is defined as, for example, the confines of a particular room or building, the proximity server **630/720** may use exemplary table **1030** of **FIG. 10D** to identify proximate wireless stations based on their position. In the illustrated example, table **1030** includes one or more entries having an identifier (column **1032**) identifying a certain room, area or building and a boundary description (column **1034**) describing the boundaries of the room, area or building using for example, the position coordinates of certain features of the boundaries (e.g., corners of a room). Accordingly, the proximity server **630/720** may identify wireless stations within a certain room, area or building by identifying those wireless stations having position coordinates that fall within the described boundary for the room/area/building.

[0078] In addition to receiving location-related information from the wireless stations and/or access points, the proximity server **630/720** could be adapted to obtain location-related information by performing an Internet Protocol (IP) traceroute. The resulting traceroute information typically provides information about the networks between the wireless station and the proximity server (or other Internet host). The traceroute path provides value in two ways. First, it can provide an indication of relative degree of "closeness." If two users are connected to the same service provider, but not on the same local subnet, they might share a common router on the path back to the central server. An example might be two users in different terminals at an airport equipped with a wireless LAN infrastructure. A common network router in a traceroute path does not guarantee physical proximity, but there frequently is a correlation due to the way networks are deployed and the way blocks of IP addresses are often assigned. The proximity server **630/720** may report the possible proximity back to both users. The second value of the traceroute function is to prevent "false positive" proximity indications due to the common use of network address translation (NAT) in wireless access areas. Where low-cost wireless routers are use, there is a very high probability that a wireless user will be issued an IP address of the form 192.168.0.X. This private address space provides no location information. However, the traceroute can identify the next router in the path and identify a public IP address that the router is connecting to the Internet with and, therefore, additional location information can be derived. Furthermore, third party services are available that provide location information for most IP addresses on the Internet.

[0079] Referring now to FIGS. **11**, **12A-12C** and **13A-13B**, an exemplary automatic discovery technique for identifying proximate wireless stations is illustrated in accordance with at least one embodiment of the present invention. Rather than relying on proximity information from a proximity server or an access point, the proximity identification module **208** (**FIG. 2**) of a wireless station may be adapted to identify proximate wireless stations directly by monitoring frames transmitted by wireless stations within a transmission/reception area of the wireless station. In this instance, the proximity may be defined, for example, as those wireless stations within transmission/reception range.

[0080] To illustrate with reference to **FIG. 11**, a plurality of wireless devices **1102-1110** may be located within one of coverage areas **1112** and **114** of access points **1116** and **1118**, respectively. By monitoring frames transmitted by or to wireless stations within a transmission/reception range **1120** (defining transmission/reception area **1122**), the wireless station **1106** may identify proximate stations within its transmission/reception range, i.e., wireless stations **1104**, **1108**, using the automatic discovery technique described below.

[0081] As provided by IEEE 802.11 and related standards, frames typically contain several address fields inside the MAC header, depending on their type (control, data, or management). The first address field, denoted herein as address field **A1**, indicates the MAC address of the immediate receiver of the frame. The second address field, denoted herein as address field **A2**, contains the MAC address of the transmitter of the frame. The third address field, denoted herein as address field **A3**, contains either the MAC address of the ultimate source of the frame (for downlink frames), the MAC address of the ultimate destination (for uplink frames), or the BSSID (for direct link and ad hoc frames). Acknowledgement (ACK) frames typically only have address field **A1**. Therefore, it will be appreciated that three types of frames may exist within the transmission/reception range of a wireless station: 1) a frame intended for receipt by the wireless station (e.g., a frame having the MAC address of the wireless station as its destination address), referred to herein as a "receipt intended frame"; 2) a frame overheard by the wireless station but intended for receipt by another wireless station (e.g., a frame having a MAC address of another wireless station as its destination address), referred to herein as an "overheard frame"; and 3) a frame transmitted by the wireless station for receipt by another station (e.g., a frame having the MAC address of the certain wireless station as the source address), referred to herein as an "originating frame."

[0082] **FIGS. 12A-12C** illustrate various exemplary methods **1200**A, **1200**B and **1200**C for monitoring frames transmitted within the transmission/reception range of a wireless station (e.g., wireless station **1106**) to identify potential proximate stations using the address fields **A1**, **A2** and **A3** of the frames. Exemplary method **1200**A describes a method for monitoring overheard frames, exemplary method **1200**B describes a method for monitoring receipt intended frames and exemplary method **1200**C describes a method for monitoring originating frames.

[0083] Method **1200**A initiates at step **1202** wherein the wireless station **1106** overhears a frame transmitted by another station. The proximity identification module **208** (**FIG. 2**) may identify the frame as an overheard frame by, for example, noting that the MAC address in address field **A1** does not match the MAC address of the wireless station **1106**. At step **1204**, the MAC address stored in address field **A1** of the frame is stored in peer list **1** (PL**1**) maintained by the proximity identification module **208**. At step **1206**, the MAC address stored in address field **A2** is stored in a peer list **2** (PL**2**) maintained by proximity identification module **208**. Method **1200**B initiates at step **1208** when a the

wireless station **1106** receives a receipt intended frame, i.e., a frame having the wireless station **1106** as the ultimate destination. The proximity identification module **208** may identify the frame as such by noting that the MAC address in address field A**3** matches the MAC address of the wireless station **1106**. At step **1210**, the MAC address in address field A**3** is stored in a peer list **3** (PL**3**) maintained by proximity identification module **208**. Method **1200**C initiates at step **1212** when the wireless station **1106** transmits a frame. At step **1214**, the proximity notification module **208** stores the MAC address of address field A**3** of the transmitted frame in PL**3**.

[**0084**] In methods **1200**A-**1200**C, filtering of frames that contain a BSSID, multicast address or broadcast address preferably is performed to prevent the storage of such in PL**1**, PL**2** or PL**3**. Furthermore, PL**1**, PL**2** and PL**3** preferably are aged or periodically refreshed to maintain the accuracy of the lists. PL**1** and PL**2** may be pre-populated when stations periodically transmit a null frame at a low PHY rate; a station's own MAC address stored in address fields A**1** and A**2** (i.e. Null-to-self). The peer lists may also be pre-populated when other stations join and authentication or association request/response frames are received. Address information from probe request/response frames preferably is not added to the peer lists because such frames do not indicate the presence of a station on that channel.

[**0085**] As a result of methods **1200**A-**1200**C, PL**1**, PL**2** and PL**3** are populated with the MAC addresses of wireless stations overheard by wireless station **1106** or in communication with the wireless station. To identify wireless stations that potentially are within transmission/reception range of the wireless station **1106**, the proximity identification module **208** may implement exemplary method **1300**A of **FIG. 13A** and method **1300**B of **FIG. 13B**.

[**0086**] Method **1300**A initiates at step **1302** wherein PL**1** and PL**3** are compared to identify MAC addresses that occur in both PL**1** and PL**3**. A MAC address stored in PL**3** implies that wireless station **1106** is either receiving data from that MAC address or it is sending data to that MAC address, so the wireless station having the MAC address might be a potential peer. The occurrence of the same MAC address in PL**1** and PL**3** indicates that wireless station **1106** overheard a frame being transmitted to another station that is not in communication with the wireless station **1106**, which in turn implies that that other station is nearby and potentially inside the same BSS. This is, however, no guarantee that the two stations are within transmission/reception range because no frame was received from that address. Accordingly, at step **1304**, the proximity identification module **208** may transmit a test frame directly (i.e., bypassing the access point) to the wireless station having the MAC address occurring in both PL**1** and PL**3**. The test frame may include, for example, a null frame or randomly generated frame. At step **1306**, the proximity identification module **208** waits for an ACK frame from the other wireless station in response to the test frame. If no ACK frame is received, the other wireless station is marked as out of transmission/reception range of the wireless station **1106** at step **1308**. If an ACK frame is received, the proximity identification module **208** at step **1310** may mark the other wireless station as within the transmission/reception range of the wireless station **1106** and therefore proximate to the station **1106** if proximity is defined as such.

[**0087**] If no ACK frame received, a direct link may still be set up even though direct communications may not be possible. The direct link communications may be relayed by the access point but it may still be possible to use a subset of the extra capabilities in this context. To illustrate, two stations may be in the same BSS but outside of direct link range. In this case, they typically need the access point to relay their traffic because direct transmission is not possible. However, it may be useful to setup an "indirect" direct link in this case by allowing the stations to use a subset of the performance enhancements provided by a direct link. These performance enhancements may include those features which are transparently forwarded by the access point, such as compression, concatenation, encryption, etc.

[**0088**] In this situation, stations which are not within transmission/reception range of each other but which are associated with the same access point may trigger a direct link setup procedure with access point. Similarly, if two stations are engaged in a direct link and they move out of range, the direct link may be logically maintained by routing traffic via the AP and reducing the capability set to match the capabilities of the AP. An indirect direct link (e.g., a long-distance direct link or extended direct link) may require that an additional capability be added to the IDLP signaling. If the long range capability is present in both peer stations, this may imply that the direct link is not ended when a direct transmission fails, but only when the idle timeout passes or when a teardown occurs.

[**0089**] Instead of using a test frame, the first data frame transmitted over the direct link formed between the wireless station **1106** and the other station (as described below) may also function as the test frame. When an ACK frame in response to the first data frame exceeds the retry limit, the direct link may be discarded and the other wireless station marked as out of transmission/reception range. This alternate test process, however, may introduce duplicates at the receiving station so the use of a separate test frame is preferable. Note that the Direct Link typically must be established on a logical level before the test frame is used to test the link.

[**0090**] Method **1300**B initiates at step **1312** wherein PL**2** and PL**3** are compared to identify MAC addresses that occur in both PL**2** and PL**3**. The same MAC address showing up in both PL**2** and PL**3** implies that wireless station **1106** overheard a frame from another station with which it is currently exchanging traffic. The occurrence of the MAC address of the other wireless station in PL**2** indicates that a direct radio connection exists and, therefore, the other wireless station is proximate to wireless station **1106** under a proximity defined by the reception radius **1120** (**FIG. 11**). Accordingly, due to the high probability that the other wireless station is within transmission/reception range of the wireless station **1106**, the proximity identification module **208** may identify the other wireless station as within transmission/reception range and proximate at step **1314** without transmitting a test frame.

[**0091**] In certain instances, the technique described with reference to **FIGS. 1200A-1300B** may be simplified by collapsing PL**1** and PL**2** into a Nearby Node List (NNL) where NNL=PL**1**∪PL**2**. PL**3** then becomes a Peer List (PL) that contains the addresses of peer stations. When the same MAC address occurs in both PL and NNL, the station having

the MAC address may be marked as a potential proximate station, but this procedure should include a directed test frame to assess the quality of the radio link between the wireless station **1106** and the other station. The technique may be simplified further by identifying any station having a MAC address in the NNL as a potentially proximate station. The actual proximity of the potentially proximate station then may be verified by, for example, transmitting a test frame to the potentially proximate station.

[**0092**] Referring now to **FIG. 14**, exemplary techniques for determining one or more user IDs associated with an identified proximate wireless station are illustrated in accordance with at least one embodiment of the present invention. For the following, assume a wireless station **1402** has identified a wireless station **1404** as proximate under a default proximity definition or a proximity definition defined by a user of the wireless station **1404**. Prior to notifying the user of the wireless station **1402** of the proximate wireless station **1404**, the proximity identification module **208** or notification module **210** (**FIG. 2**) may attempt to obtain one or more user IDs **1406** associated with the user of the wireless station **1404**.

[**0093**] In one embodiment, the wireless station **1404** may directly supply the desired user ID information **1406** to the wireless device **1402** using, for example, a frame transmitted over a wireless direct link formed between the stations **1402** and **1404** (the formation of direct links are discussed in detail below) by transmitting the user ID information **1406** to the wireless device **1402** as a broadcast or multicast frame. Alternatively, user ID information **1406** may be supplied to an access point **1408** associated with the wireless station **1404** or a proximity server **1410** (analogous to proximity server **630**/**720**) responsible for providing proximity information to wireless station **1402**. The wireless device **1402**, in turn, may request the information from the access point **1408** or the proximity server **1410** using one or more techniques described above.

[**0094**] Referring now to **FIGS. 15 and 16**, an exemplary technique for filtering proximate station users for notification purposes is illustrated in accordance with at least one embodiment of the present invention. As noted above, the notification module **210** of a wireless station may perform a filtering process to determine whether the user of the wireless station should be notified of a proximate user. In at least one embodiment, this filtering process includes maintaining an associates table **1502** of user IDs of associates of the user of the wireless station. The associates table **1502** may include a variety of information, such as, for example, a name of the associate (column **1504**), user ID(s) of the associate (column **1506**), an associate type (column **1508**), notification filter rules to be applied to the associated (column **510**, rules table **1512**), etc.

[**0095**] Information populating the associates table **1502** may be derived from any of a variety of sources. For example, the notification module **210** may be adapted to facilitate the input of associate information directly by the user (user input **1514**). Associate information also may be obtained from other information sources, such as the email list of an email client **1516**, (e.g., the contacts list information from a Microsoft® Outlook® software program), information from an electronic rolodex **1518**, an electronic phone list **1520** maintained in, for example, a cell phone or PDA, or user information from a instant messaging client **1522**.

[**0096**] **FIG. 16** illustrates an exemplary method **1600** for filtered notification of proximate users using the associates table **1502** of **FIG. 15**. The method initiates at step **1602** wherein the user IDs associated with proximate stations are determined as described above. At step **1604**, the user ID obtained from a proximate station is compared with the user IDs (column **1506**) of the associates table **1502**. In the event that a user ID from a proximate station does not substantially match a user ID in the associates table **1502** (step **1606**), the consideration of the user ID for notification purposes may terminate at step **1608** and the next user ID, if any, may be considered for notification purposes.

[**0097**] In the event that the user ID from a proximate station substantially matches a user ID in the associates table **1502**, the user ID from the proximate station may be identified as belonging to an associate. Accordingly, at step **1610** the notification module **210** may apply one or more notification filter rules in determining the manner in which the user is notified. The notification rules applicable to a particular associate may be determined from the associates table **1502** or other filter rule source or a default set of notification filter rules may be applied.

[**0098**] The notification filter rules preferably provide guidelines for proximity notification under various conditions. For example, the user may desire to be notified of proximate business associates only during normal business hours (e.g., 9 AM-5 PM, Monday-Friday). Accordingly, the user may set a rule whereby the notification module **210** is prevented from notifying the user of a proximate business associate during non-business hours. In another example, it may be appropriate to prevent notification of proximate associates in circumstances where their proximity to the user may already be assumed. For example, the user may set a rule whereby notification of proximate co-workers is deactivated within the user's place of work. Other filter rules may be utilized by those skilled in the art using the teachings provided herein without departing from the spirit or the scope of the present invention.

[**0099**] In at least one embodiment, a user may desire notification of proximate wireless users regardless of any association between the user and the proximate users. In this case, after determining the user IDs of a proximate station at step **1602**, the notification module **210** may be adapted to automatically notify the user without comparing the user ID to the associates table **1502** or applying notification filter rules.

[**0100**] If notification of a proximate associate is appropriate (step **1612**) after applying the relevant notification filter rules, the notification module **210** may notify the user of the wireless station that the associate is nearby at step **1614**. Various methods may be used to notify the user. For example, the notification module **210** may prompt the display of a window on a display screen of the user's wireless station that contains text or other graphical representations that notify the user of the proximate associate and provide information about the proximate user. Notification also may be performed by providing speech output via a speaker of the wireless station, the speech output informing the user of the proximate user and providing information about the proximate user. Information about the proximate user may include, for example, the name of the proximate user, the user ID, a telephone number or email address associated

with the proximate user, a position (e.g., position coordinates, location within a particular room/area, etc.) of the proximate wireless station, and the like.

[0101] In at least one embodiment, the notification also presents the user with the option of initiating a wireless direct link with the proximate station if the proximate station is within transmission/reception distance of the user's station. Alternatively, the user's wireless station could be configured to automatically initiate a wireless direct link with a proximate station. The initiation and establishment of a wireless direct link is discussed in detail below.

[0102] Referring now to **FIG. 17**, an exemplary process **1700** for selecting a communication method between proximate wireless stations is illustrated in accordance with at least one embodiment of the present invention. After receiving an indication from a user of a wireless station that communications with a proximate station are desired (step **1702**), the link module **212** (**FIG. 2**) of the wireless station may attempt to establish communications with the proximate station either via conventional means or via a direct link. In the event that the proximate station is out of transmission/reception range or the proximate station is incapable of or prevented from forming a direct link, at step **1704** the link module **212** may establish communications with the proximate station in a conventional manner whereby frames are transmitted to the proximate station, and vice versa, via the access points, backbone network, and/or infrastructure network to which the wireless station and proximate station are connected.

[0103] Otherwise, if a wireless direct link is feasible between the proximate stations, a direct link may be initiated by the wireless station using any of a variety of direct link establishment techniques. For example, in instances wherein the access point is enabled to facilitate the establishment of a wireless direct link between stations, the wireless station may initiate a direct link at step **1706** using the Direct Link Protocol (DLP) technique described in U.S. Patent Application No. 60/388,569 filed Jun. 12, 2002, the entirety of which is hereby incorporated by reference.

[0104] Where the access point is prevented from facilitating a direct link between the proximate stations or where the proximate stations may be capable of a PHY rate that is not supported by the access point, the wireless station may initiate a direct link at step **1708** using an Independent Direct Link Protocol (IDLP) technique as described below with reference to **FIGS. 18 and 19**.

[0105] Direct links offer a number of advantages over conventional communications between stations using an access point as an intermediary. For one, direct links typically are more efficient as the access point is eliminated as an intermediary hop. Furthermore, the bandwidth allocated to a particular wireless station may be limited due to the volume of traffic handled by the access point or the access point may not support a PHY rate of which the proximate stations are capable. To illustrate, the access point may support only IEEE 802.11b with a maximum rate of 11 megabits per second (Mbps), whereas the proximate stations may support IEEE 802.11g with a maximum rate of 54 Mbps. With a direct link, however, active involvement by the access point is removed from the process and a higher data rate therefore may be established between the two proximate stations.

[0106] After a direct link has been established between the proximate stations at step **1710**, the users of the proximate stations may initiate communications via the direct link at step **1712**. The communications carried over the direct link may serve a variety of purposes. When the users of the proximate stations are associates, the communications may include, for example, instant messages or direct emails transmitted between the users for the purpose of setting up a time and or place for the users to meet face-to-face. The users may establish a videoconference over the direct link to allow for interactive audio and video communications. Alternatively, the direct link may be established for establishing a relationship between the proximate users. For example, a wireless station may include a workstation operated by a business, where the workstation is adapted to transmit one or more advertisements, coupon offers or other business communications to the users of proximate stations over direct links established with the proximate stations. The users may consider the business communications in view of the proximity of the business and may choose to visit the business.

[0107] Referring now to **FIGS. 18 and 19**, the IDLP technique for establishing a wireless direct link between proximate wireless stations is illustrated in accordance with at least one embodiment of the present invention. As noted above, U.S. Patent Application No. 60/388,569 discloses a DLP technique for use with IEEE 802.11 e that uses MAC management frames to establish a direct link between stations. The DLP technique provides for the transmission of a protocol message from a station to an access point. The access point, in turn, sends the protocol message to the proximate station. The proximate station responds with a message to the access point, which then sends a message to the initiating station to establish a direct link. Because the messages are in the form of MAC management frames, the access point interprets these messages and forms new messages for the receiving station as a result.

[0108] In certain instances, however, the access point may not be enabled to process MAC management frames in accordance with the DLP technique or the access point may be configured to prevent the establishment of a direct link between proximate stations by analyzing incoming frames to eliminate those MAC management frames that may be used to initiate a direct link. Accordingly, in at least one embodiment, the IDLP technique described herein overcomes the limitations of the access point by initiating and establishing a direct link without active cooperation by the access point. The access point's active cooperation may be bypassed by encapsulating the IDLP signaling messages at the logical link control (LLC) level instead of the MAC level. The LLC encapsulated signaling messages may be transmitted as MAC data frames which typically are transparently forwarded by the access point regardless of the LLC type. As a result, both the setup and capabilities (e.g., PHY rate) become independent of the limitations of the access point. To illustrate, two IDLP-enabled wireless stations may negotiate and setup a direct link implementing, for example, IEEE 802.11 g orthogonal frequency division multiplexing (OFDM) modulations even though the access point is only capable of supporting Barker and complementary code keying (CCK) modulations as set forth in IEEE 802.11b.

[0109] To illustrate an exemplary operation of a IDLP direct link setup, **FIG. 18** depicts proximate wireless sta-

tions **1802** and **1804** associated with access point **1806**. After determining that a direct link is possible between the wireless devices **1802**, **1804** (e.g., they are within transmission/reception range of each other), the wireless station **1802** may transmit a setup request frame **1810** to the access point **1806**. To avoid a situation where an IDLP setup procedure is started by both stations **1802** and **1804**, the stations **1802** and **1804** may adhere to a convention that only the station with the lowest MAC address shall start an IDLP setup procedure. The setup request frame **1810** preferably includes a MAC data frame having the MAC address of the wireless station **1804** as the destination address. The setup request frame **1810**, in at least one embodiment, further includes direct link information encapsulated at the LLC layer as discussed below with reference to IDLP frame **1900** of **FIG. 19**. The direct link information may include, for example, proposed link capabilities, such as proposed IEEE 802.11 characteristics (e.g., supported rates) and vendor-specific features (e.g., compression). In one embodiment, the direct link information further may include encryption key information, as discussed below.

[**0110**] The access point **1806** receives the setup request frame **1810** and because it appears to be a typical MAC data frame to the access point **1806**, the access point **1806** sends the setup request frame **1810** to the wireless station **1804** as a unicast frame. The wireless station **1802** preferably is prevented from entering a power save mode after transmitting the setup request frame **1810**.

[**0111**] Upon receiving the setup request frame **1810**, in at least one embodiment, the wireless station **1804** transmits a IDLP probe frame **1812** directly to the wireless station **1802**. The IDLP probe frame **1812** may include, for example, a random 1500-byte data frame having the MAC address of the wireless station **1802** in both address fields A1 and A2 (discussed above). Upon receipt of the IDLP probe frame **1812**, the wireless station **1802** preferably is adapted to immediately send an ACK frame to the wireless station **1804** rather than processing the IDLP probe frame **1812** by the protocol stack **226** (**FIG. 2**) before sending an ACK frame.

[**0112**] If the wireless station **1804** does not receive an ACK frame from the wireless station **1802** in response to the IDLP probe frame **1812**, the wireless station **1804** may transmit a IDLP teardown response to abort the direct link establishment process. Otherwise, if the ACK frame is received, the wireless station **1804** may consider the proposed capabilities presented in the setup request frame **1810**. If the proposed capabilities are acceptable to the wireless station **1804**, the wireless station **1804** may transmit a setup response frame **1814** to the wireless station **1802** via the access point **1806**. If the setup request frame **1810** advertises multiple capabilities of the same sort (for instance a selection of supported compression algorithms), the wireless station **1804** may choose and select one of these and indicate its selection in the setup response. As with the setup request frame **1810**, the setup response frame **1814** may include an IDLP frame encapsulated at the LLC layer to appear as a typical MAC data frame to the access point **1806** so that the access point **1806** forwards the setup request frame **1814** to the wireless station **1802** with minimal modification.

[**0113**] Upon receipt of the setup response frame **1814**, the wireless station **1802** enables itself to receive frames directly from wireless station **1804** and transmits a setup confirm frame **1816** to the wireless station **1804** via access point **1806**. The setup confirm frame **1816** confirms the successful negotiation of the capabilities of the direct link between the stations **1802** and **1804** and notifies the station **1804** to enter direct link mode. As with frames **1810** and **1814**, the setup confirm frame **1816** may include an LLC encapsulated frame that appears as a MAC data frame to the access point **1806** so that it is forwarded with minimal processing by the access point **1806**.

[**0114**] After setup confirm frame **1816** has been received by the wireless station **1804**, a direct link is established between the wireless stations **1802**, **1804** and each station therefore may transmit data frames **1818** directly to the other station without the access point **1806** acting as an intermediary.

[**0115**] When the direct link is to be terminated, one of the wireless stations **1802** and **1804** may transmit an IDLP teardown request frame **1820** to the other either directly via the direct link or via the access point **1806**. The receipt of the IDLP teardown request frame **1820** directs the receiving wireless station to cease direct transmission of frames to the other workstation. The receiving wireless station may then transmit a teardown response frame (not shown) to the other station to acknowledge receipt of the teardown request.

[**0116**] **FIG. 19** illustrates and exemplary LLC-encapsulated IDLP frame **1900** that may be used as the setup request frame **1810**, setup response frame **1814**, setup confirm frame **1816** or teardown request frame **1820**. In the illustrated example, the IDLP frame **1900** is similar to a MAC data frame in that it includes a MAC header field **1902** in accordance with one or more wireless standards, an Organizationally Unique Identifier (OUI) protected protocol field **1904**, an OUI field **1906**, and an LLC type field **1908**. The IDLP frame **1900** further includes an IDLP version field **1910**, and IDLP type field **1912**, a MAC address field **1914**, a BSSID field **1916**, a capability information field **1918** and an information elements field **1920**.

[**0117**] The LLC type field **1908**, in one embodiment, includes a value (e.g., 0x0003) identifying the frame **1900** as an IDLP frame. Accordingly, upon receipt of the frame **1900**, an IDLP-enabled wireless station may note the IDLP identifier in the LLC type field **1908** and process the frame **1900** in accordance with the IDLP techniques described above. The IDLP version field **1910** contains a value indicating the IDLP version applicable to the frame **1900**. The IDLP type field **1912** contains a value indicating the type of IDLP frame as shown by table **1922**. The MAC address field **1914** stores the MAC address of the station transmitting the frame **1900** and the BSSID field **1916** stores the BSSID with which the transmitting station is associated.

[**0118**] As noted above, the setup request frame **1810**, the setup response frame **1814** and setup confirm frame **1816** are used to negotiate the capabilities of the proposed direct link. Accordingly, the capability information field **1918** may include data related to the capabilities, such as PHY rate, compression types, encryption capabilities, etc. The probe frame **1812** and teardown request/response frames typically do not convey link characteristic information. These frames therefore may omit the capability information field **1918** and information elements field **1920**.

[**0119**] Security via encryption is frequently provided in Wireless Fidelity Protected Access (WPA) or similar envi-

ronments, such as IEEE 802.11i. Pairwise encryption keys established by WPA or the like may be used to secure the IDLP setup messages. The encryption key for protecting subsequent station-to-station IDLP data therefore can simply be transferred over the WPA protected link, as the entire IDLP Setup Request/Response exchange is protected by the pairwise key between the stations and the access point. In one embodiment, the information elements field **1920** may be used to transport the key material to be used on the direct link. This information preferably is provided only in the setup request frame **1810**. A key material type field preceding the key material in the information elements field **1920** may be used to indicate the type and context of the key material present in the information elements field **1920**. There is one simple key material type indicating that the direct link uses the same cipher suites as used on the pairwise links between a station and the access point and only key material is provided. Other types may indicate specific cipher suites to be used on the direct link. To illustrate, if TKIP is being used on pairwise links between stations and the access point in the network and both stations intend to use TKIP for the direct link as well, providing key material only suffices and the cipher suite will default to the cipher suite used between the station and the access point. However, if for example the stations wish to use the stronger AES (advanced encryption standard) algorithm for their direct link (this may not even be available on the access point), cipher suites need to be negotiated explicitly along with provision of key material.

[0120] Referring now to the documents attached as Appendices A-C, additional features associated with location awareness and the establishment of a direct link are disclosed.

[0121] Other embodiments, uses, and advantages of the invention will be apparent to those skilled in the art from consideration of the specification and practice of the invention disclosed herein. The specification and drawings should be considered exemplary only, and the scope of the invention is accordingly intended to be limited only by the following claims and equivalents thereof.

What is claimed is:

1. A method for determining a proximity of one or more wireless devices to a first wireless device, the method comprising:

providing network information associated with the first wireless device to a server, the network information including at least a media access control (MAC) address and service set identifier (SSID) of an access point to which the first wireless device is connected;

comparing, at the server, the network information associated with the first wireless device wit network information associated with each of a predetermined set of wireless devices to

identify one or more wireless devices connected to a same access point as the first device; and

notifying a user of the first wireless device of a proximity of the one or more wireless devices.

2. A method for determining a proximity of one or more wireless devices to a first wireless device, the method comprising:

providing network information associated with the first wireless device to a server, the network information including at least a media access control (MAC) address and service set identifier (SSID) of an access point and network, respectively, to which the first wireless device is connected;

comparing, at the server, the network information associated with the first wireless device with network information associated with each of a predetermined set of wireless devices to identify one or more wireless devices connected to a same network or access point as the first device; and

notifying a user of the first wireless device of a selected one or more of the one or more wireless devices which are within a proximity of the first wireless device.

3. In a wireless network comprising an access point logically connected to at least a first wireless device and a second wireless device, a method comprising:

notifying said first wireless device that the second wireless device is in proximity to said first device.

4. The method of claim 4, further comprising the steps of:

providing a location of the first wireless device to a server; and

determining at the server the proximity of the first wireless device to the second device by comparing the location of the first device to a location of the one or more wireless devices.

5. The method of claim 4, wherein the step of notifying further comprises notifying the user via a screen on the first wireless device.

6. The method of claim 4, wherein the step of notifying further comprises notifying the user via an audio output on the first wireless device.

7. The method of claim 4, wherein the step of notifying further comprises notifying the user of the degree of proximity of the one or more wireless devices.

8. The method of claim 5, wherein proximity is further determined by the coverage area of the access point.

9. The method of claim 5, wherein proximity is further determined by the coverage area of the access point and an additional access point which is adjacent to the access point.

10. The method of claim 5, wherein proximity is further determined by the physical distance between the first wireless device and the one or more wireless devices.

11. The method of claim 5, wherein the first wireless device is in a first room and the one or more wireless devices are one or more rooms and the first room and the one or more rooms are in a building and wherein proximity is further determined based on the room in which first wireless device is located and the one or more rooms in which the one or more wireless devices are located.

12. The method of claim 4, wherein the step of notifying further comprises sending data from said one or more wireless devices to the first wireless device via a direct wireless link.

13. In a wireless network having an access point, a first wireless device comprising:

a transceiver; and

a direct link module operably connected to the transceiver and adapted to:

to notify the first wireless device that one or more wireless devices are in proximity to the first wireless device.

14. The device of claim 13, wherein the transceiver is adapted to provide a location of the first wireless device to a server; and

wherein the server is adapted to determine the proximity of the first wireless device to the second device by comparing the location of the first device to a location of the one or more wireless devices

15. The device of claim 13, wherein notifying the first wireless device further comprises providing information to the user via a screen on the first wireless device.

16. The device of claim 13, wherein notifying the first wireless device further comprises providing information to the user via an audio output on the first wireless device.

17. The device of claim 13, wherein notifying the first wireless device further comprises providing information to the user of the degree of proximity of the one or more wireless devices.

18. The device of claim 14, wherein proximity is further determined by the coverage area of the access point.

19. The device of claim 14, wherein proximity is further determined by the coverage area of the access point and an additional access point which is adjacent to the access point.

20. The device of claim 14, wherein proximity is further determined by the physical distance between the first wireless device and the one or more wireless devices.

21. The device of claim 14, wherein the first wireless device is in a first room and the one or more wireless devices are one or more rooms and the first room and the one or more rooms are in a building and wherein proximity is further determined based on the room in which first wireless device is located and the one or more rooms in which the one or more wireless devices are located.

22. The device of claim 13, wherein notifying the first wireless device further comprises providing information via a direct wireless link.

23. A wireless system comprising:

an access point; and

at least a first wireless device and one or more wireless devices;

wherein the first wireless device adapted to:

notify the first wireless device that the one or more wireless devices are in proximity to the first wireless device.

24. The system of claim 23, wherein the first wireless device is adapted to provide a location of the first wireless device to a server; and

wherein the server is adapted to determine the proximity of the first wireless device to the second device by comparing the location of the first wireless device to a location of the one or more wireless devices

25. The system of claim 23, wherein notifying the first wireless device further comprises providing information to the user via a screen on the first wireless device.

26. The system of claim 23, wherein notifying the first wireless device further comprises providing information to the user via an audio output on the first wireless device.

27. The system of claim 23, wherein notifying the first wireless device further comprises providing information to the user of the degree of proximity of the one or more wireless devices.

28. The system of claim 24, wherein proximity is further determined by the coverage area of the access point.

29. The system of claim 24, wherein proximity is further determined by the coverage area of the access point and an additional access point which is adjacent to the access point.

30. The system of claim 24, wherein proximity is further determined by the physical distance between the first wireless device and the one or more wireless devices.

31. The system of claim 24, wherein the first wireless device is in a first room and the one or more wireless devices are one or more rooms and the first room and the one or more rooms are in a building and wherein proximity is further determined based on the room in which first wireless device is located and the one or more rooms in which the one or more wireless devices are located.

32. The system of claim 23, wherein notifying the first wireless device further comprises providing information via a direct wireless link.

33. A method for determining a proximity of one or more wireless devices to a first wireless device, the method comprising:

providing network information associated with the first wireless device to a server, the network information including at least a media access control (MAC) address and service set identifier (SSID) of a network of access points to which the first wireless device is connected;

comparing, at the server, the network information associated with the first wireless device with network information associated with each of a predetermined set of wireless devices to identify one or more wireless devices connected to a same network of access points as the first device; and

notifying a user of the first wireless device of a proximity of the one or more wireless devices.

34. A method for determining a proximity of one or more wireless devices to a first wireless device, the method comprising:

providing network information associated with the first wireless device to a server, the network information including at least a media access control (MAC) address and service set identifier (SSID) of a collection of networks of access points to which the first wireless device is connected;

comparing, at the server, the network information associated with the first wireless device with network information associated with each of a predetermined set of wireless devices to identify one or more wireless devices connected to a same collection of networks of access points as the first device; and

notifying a user of the first wireless device of a proximity of the one or more wireless devices.

35. A method for establishing a direct wireless link between a first wireless device and at least one proximate wireless device, the method comprising the steps of:

identifying a second wireless device within a predetermined proximity of the first wireless device;

determining an identity associated with a user of the second wireless device;

comparing the identify associated with the user of the second wireless device with a set of one or more predetermined identities; and

notifying a user of the first wireless device that the user of a proximity of the user of the second wireless device based on the comparison of the identity with the set of one or more predetermined identities.

36. The method as in claim 35, further comprising the step of establishing a direct wireless link between the first wireless device and the second wireless device, wherein the direct link is established based on input from the user of the first wireless device.

37. The method as in claim 35, further comprising the step of automatically establishing a direct wireless link between the first wireless device and the second wireless device.

38. The method as in claim 35, wherein the predetermined proximity includes one of a group consisting of: a predetermined distance from the first wireless device.

39. The method as in claim 35, wherein the predetermined proximity includes a predetermined segment of at least one network to which the first wireless device is connected

40. The method as in claim 35, wherein the predetermined proximity includes a transmission range of the first wireless device.

41. The method as in claim 35, wherein the predetermined identities are stored in a table.

42. The method as in claim 35, wherein the notifying step is further based on one or more predetermined conditions.

43. The method as in claim 42, where in the one or more predetermined conditions include a time condition whereby notification occurs only during a certain time.

44. The method as in claim 42, where in the one or more predetermined conditions include a location condition whereby notification occurs only at a certain location.

45. A wireless device comprising:

a radio frequency (RF) transceiver for transmitting and receiving data in an RF form;

means for identifying a second wireless device within a predetermined proximity of the RF transceiver;

means for determining an identity associated with a user of the second wireless device;

means for comparing the identify associated with the user of the second wireless device with a set of one or more predetermined identities; and

means for notifying a user of the wireless device of a proximity of the user of the second wireless device based at least in part on the comparison of the identity with the set of one or more predetermined identities.

46. A wireless device as in claim 45, further comprising means for establishing a direct wireless link with the second wireless device via the RF transceiver.

47. A wireless device as in claim 45, further comprising the means for automatically establishing a direct wireless link with the second wireless device via the RF transceiver.

48. A wireless device as in claim 45, wherein the predetermined proximity includes one of a group consisting of: a predetermined distance from the first wireless device.

49. A wireless device as in claim 45, wherein the predetermined proximity includes a predetermined segment of at least one network to which the first wireless device is connected

50. A wireless device as in claim 45, wherein the predetermined proximity includes a transmission range of the first wireless device.

51. A wireless device as in claim 45, wherein the predetermined identities are stored in a table.

52 A wireless device as in claim 45, wherein the notifying step is further based on one or more determined conditions.

53. A wireless device as in claim 52, where in the one or more predetermined conditions include a time condition whereby notification occurs only during a certain time.

54. A wireless device as in claim 52, where in the one or more predetermined conditions include a location condition whereby notification occurs only at a certain location.

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