(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) **International Patent Classification:**
H04Q 7/38 (2006.01)

(21) **International Application Number:**
PCT/EP2007/011427

(22) **International Filing Date:**
27 December 2007 (27.12.2007)

(25) **Filing Language:** English

(26) **Publication Language:** English

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

(84) **Designated States** *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*

(54) **Title:** MAINTAINING THE INTEGRITY OF CONFIGURATION INFORMATION OF A NETWORK OF ACCESS POINTS FOR USE IN POSITIONING AN APPARATUS
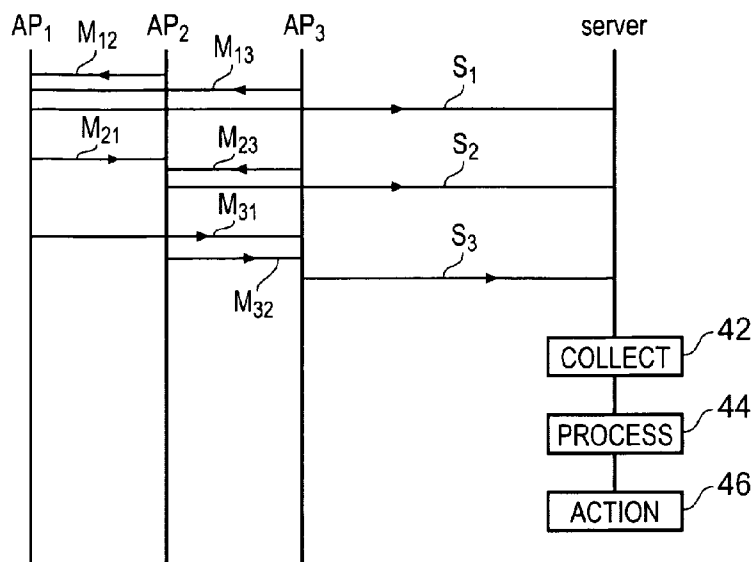

FIG. 4

(57) **Abstract:** A method comprising: collecting from each of multiple access points in a network of access points a set of measurements made at a respective access point for signals transmitted by other access points, wherein the network of access points is for use in positioning a device that communicates with the network of access points; processing the collected sets of measurements to classify changes in the network of access points; and performing an action that is conditional upon how a change is classified.

TITLE

**MAINTAINING THE INTEGRITY OF CONFIGURATION INFORMATION OF A
NETWORK OF ACCESS POINTS FOR USE IN POSITIONING AN APPARATUS**

FIELD OF THE INVENTION

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Embodiments of the present invention relate to positioning. In particular, they relate to maintaining the integrity of data used during a positioning procedure.

BACKGROUND TO THE INVENTION

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There are many types of positioning procedures. Typically to position an apparatus using wireless communication there is wireless communication between the apparatus and a network of transceivers of known location. By measuring parameters of the communication such as angle of arrival, time of

15   flight or received power it is possible to position the apparatus using known algorithms.

The accuracy of the positioning process is dependent upon the transceivers being at a known location and, perhaps, having known transmission

20   properties such as power and directional gain.

BRIEF DESCRIPTION OF VARIOUS EMBODIMENTS OF THE INVENTION

According to various embodiments of the invention there is provided a method

25   comprising: collecting from each of multiple access points in a network of access points a set of measurements made at a respective access point for signals transmitted by other access points, wherein the network of access points is for use in positioning a device that communicates with the network of access points; processing the collected sets of measurements to classify

30   changes in the network of access points; and performing an action that is conditional upon how a change is classified.

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According to various embodiments of the invention there is provided an apparatus comprising: means for collecting from each of multiple access points in a network of access points a set of measurements made at a respective access point for signals transmitted by other access points, wherein the network of access points is for use in positioning a device that communicates with the network of access points; means for processing the collected sets of measurements to classify changes in the network of access points; and means for performing an action that is conditional upon how a change is classified.

According to various embodiments of the invention there is provided a system comprising: a network of access points for use in positioning a device that communicates with the network of access points; means for collating for each of multiple access points in the network of access points a set of measurements made at a respective access point for signals transmitted by other access points; means for processing the collated sets of measurements to classify changes in the network of access points; and means for performing an action that is conditional upon how a change is classified.

According to various embodiments of the invention there is provided a computer readable medium having a tangibly encoded computer program which when loaded into a computer provides: means for collecting from each of multiple access points in a network of access points a set of measurements made at a respective access point for signals transmitted by other access points, wherein the network of access points is for use in positioning a device that communicates with the network of access points; means for processing the collected sets of measurements to classify changes in the network of access points; and means for performing an action that is conditional upon how a change is classified.

According to various embodiments of the invention there is provided a method of maintaining the integrity of a database that records configuration

information of a network of access points for use in positioning an apparatus that communicates with the network of access points comprising: collecting from respective access points a set of measurements made at the respective access point for signals transmitted by other access points; processing the

5   collected sets of measurements to identify a change in the network of access points associated with a particular access point; and automatically adapting the configuration information in the database associated with the particular access point.

10   According to various embodiments of the invention there is provided an apparatus comprising: a database that records configuration information of a network of access points for use in positioning an apparatus that communicates with the network of access points; means for collecting from respective access points a set of measurements made at the respective

15   access point for signals transmitted by other access points; means for processing the collected sets of measurements to identify a change in the network of access points associated with a particular access point; and means for automatically adapting the configuration information in the database associated with the particular access point.

20

According to various embodiments of the invention there is provided a computer readable medium having a tangibly encoded computer program which when loaded into a computer provides: means for collating from respective access points a set of measurements made at the respective

25   access point for signals transmitted by other access points; means for processing the collected sets of measurements to identify a change associated with a particular access point in a network of access points; and means for automatically adapting network configuration information associated with the particular access point in a database.

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BRIEF DESCRIPTION OF THE DRAWINGS

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For a better understanding of various embodiments of the present invention reference will now be made by way of example only to the accompanying drawings in which:

Fig 1 schematically illustrates an access point network;

5   Fig 2A schematically illustrates one example of a server;

Fig 2B schematically illustrates one example of an apparatus which is to be positioned;

Fig 3A schematically illustrates a positioning procedure than uses estimates of the angle at which transmissions are received by an apparatus to

10   determine a position of the apparatus;

Fig 3B schematically illustrates a positioning procedure than uses estimates of the distance between an apparatus and access points to determine a position of the apparatus;

Fig 4 illustrates a process for detecting a change in the physical configuration

15   of the access point network, classifying the change and performing appropriate actions; and

Fig 5 illustrates an example of how different classifications of network change may be mapped to different respective actions.

20

DETAILED DESCRIPTION OF VARIOUS EMBODIMENTS OF THE INVENTION

Figure 1 schematically illustrates a wireless network or infrastructure 10 that

25   comprises a number of wireless transceivers 2_1, 2_2, 2_3, 2_4... 2_n . The wireless transceivers 2_n operate as access points (AP) for the network 10.

The network 10 may be a wireless local area network (WLAN) and the access points 2_n may be WLAN access points.

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The access point network 10 may be used in positioning an apparatus 12, which may be a mobile apparatus. Although the apparatus 12 communicates

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with the network of access points 10 it is not part of the network of access points 10.

The Figure also illustrates a server 4 and a database 6. The server 4 facilitates access to the information stored in the database 6. The database 6 stores configuration information 8 of the access point network 10. The configuration information 8 is information that is required to position an apparatus 12 as a result of communication between the apparatus 12 and APs 2_n.

One example of a server 4 is schematically illustrated in Fig 2A. This server 4 comprises a processor 11, a memory 13 and an input/output interface 14. The memory 13 stores the database 6 and also a computer program 15 which controls the operation of the processor 11. The processor 11 is arranged to write to and read from the memory 13 and to provide data to and receive data from the input/output interface 14. The input/output interface 14 is used to communicate with each of the access points 2_n. It may be a hard-wired interface such as an Ethernet adapter or it may be a wireless interface such as a WLAN adapter.

One example of an apparatus 12 is schematically illustrated in Fig 2B. This apparatus 12 comprises a processor 16, a memory 17 and a wireless transceiver 19. The memory 17 stores a computer program 18 which controls the operation of the processor 16. The processor 16 is arranged to write to and read from the memory 17 and to provide data to and receive data from the wireless transceiver 19. The wireless transceiver 19 is used to communicate with each of the access points 2_n. If the access points are WLAN APs then the wireless transceiver 19 is a WLAN transceiver.

The computer program instructions may provide the logic and routines that enable a computer to perform the methods illustrated in Figs 4 and 5.

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The computer program instructions may arrive at an apparatus 12, 4 via an electromagnetic carrier signal or be copied from a physical entity such as a computer program product, a memory device or a record medium such as a CD-ROM or DVD.

The database 6 and server 4 may be distributed over one or more APs 2_n and/or one or more apparatus 12 or they may be provided by one or more separate distinct components as illustrated in Figure 1. The calculation of the position of the apparatus 12 may occur at an AP 2_n, at the apparatus 12 or at the server 4.

The configuration information 8 includes the current location of the separate access points 2_n and may also include the network addresses of the access points. The configuration information 8 may also include additional information that is dependent upon the algorithm used for positioning the apparatus 12. For example, if positioning is performed on the basis of signal strength measurements, the configuration information 8 may additionally include the transmission power of the AP and perhaps its antenna orientation.

The apparatus 12 communicates with the APs and a communication parameter is measured either at the apparatus 12 or at the access points 2_n. Knowledge of the positions of the access points 2_n and knowledge of the measured parameters are collected at the apparatus 2_n, 4, 12 where the position of apparatus 12 is determined and used to determine the position of the apparatus 12.

There follows some examples of positioning. In these examples, the positioning is performed by the apparatus 12, however, in other implementations the same positioning methods may be performed by the access point. The positioning methods described measure one of the following parameter types: signal strength measurement, time of arrival measurement and angle of arrival measurement. However other parameter

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types may also be used for positioning such as bit error rate (BER) or the impulse response (IR) of the radio channel.

For example, referring to Fig 3A, the apparatus 12 detects the angle θ_n at
5   which transmissions from the nth access point 2_n are received. The apparatus 12 receives the positions of the APs 2_n from the database 6. It uses this knowledge and the detected angles θ_n at which transmissions from the access points 2_n are received to determine its position using known algorithms.

10   For example, referring to Fig 3B, the apparatus 12 may detect the time of flight for transmissions received from the access points 2_n. The apparatus 12 receives the positions of the APs 2_n from the database 6. It uses this knowledge, the flight times of transmissions from the APs and knowledge of how the flight times vary with distance to determine its position using known
15   algorithms.

For example, referring to Fig 3B, the apparatus 12 may measure received signal strength for transmissions received from the access points 2_n. The apparatus 12 receives the positions of the APs 2_n from the database 6. It uses
20   this knowledge, the received signal strengths and knowledge of how the received signal strength attenuates with distance to determine its position using known algorithms.

According to another algorithm, the signal strength measurement p_n made at
25   apparatus 12 of transmissions from the nth AP 2_n is modeled using an attenuation model $p_n = T_n - PL(d_n)$, where T_n is the power of transmissions by the nth AP 2_n and PL is a path loss model that is dependent on the path length d_n. The path loss may be modeled as being inversely proportional to the distance d_n between the apparatus 12 and the nth AP 2_n. In this example,
30   the network configuration information 8 received by the apparatus 12 from the database 6 includes not only the positions of the APs but also their transmission powers T_n, and if directional gain antennas are used also the

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direction of gain (i.e. orientation). Trilateration may be used using to position the apparatus 12.

According to another algorithm, a set of signal strength measurements $\{s_n\}$ of
5   transmissions from the APs 2_n is made at each of a number of known locations L_n. The known locations and their respective sets $\{s_n\}$ are associated together in a fingerprint database, which may be a part of the database 6. A set of signal strength measurements $\{p_n\}$ of transmissions from the n APs 2_n is made at apparatus 12. The set $\{p_n\}$ is matched to one of the sets $\{s_m\}$ and
10   the position of the apparatus 12 is determined as L_m. The matching may occur by determining the Euclidian distance Σs_n^2 that is closest to Σp_n^2.

It is apparent that the integrity of the configuration information 8 in the database 6 is critical for positioning the apparatus 12.
15

Changes may occur within the access point network 10 that result in the actual configuration of the AP network 10 and the configuration defined by the configuration information 8 being different. The effect of differences may be significant or insignificant. Some differences may be significant for one
20   positioning procedure but not for another different positioning procedure.

The differences may be dealt with by flagging incorrect configuration information 8 in the database 6 so that it is not used or is used with caution or may be dealt with by resolving the difference between the real configuration
25   and the virtual configuration.

Resolution of the differences may occur either by changing the physical configuration of the AP network so that it matches the 'virtual' configuration defined by the configuration information 8 or by changing the configuration
30   information 8 so that the 'virtual' configuration matches the physical configuration of the AP network.

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Changing the configuration information 8 so that the 'virtual' configuration matches the physical configuration of the AP network may in some instances require a labor intensive process such as repopulating a fingerprint database or in some instances the database may be automatically selectively adapted.

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Figs 4 and 5 illustrate processes for detecting a change in the physical configuration of the AP network and performing appropriate action to flag or resolve the change. In other embodiments, the action may include changing the physical configuration of the network 10.

10

A first access point AP_1 transmits with a transmit power T_1, a second access Point AP_2 transmits with a transmit power T_2, and a third access Point AP_3 transmits with a transmit power T_3.

15   An access point AP_n makes measurements m_{nm} for transmissions from access points AP_m, where m=1, 2...N but m ≠ n. The measurements m_{n1}, m_{n2}, m_{n3} ..., are combined into a set s_n of measurements and sent to the server 4.

20   Thus, in the illustrated example, the first access Point AP_1 makes a measurement m_{12} in respect of transmit power T_2 of the second access point AP_2 and makes a measurement m_{13} in respect of transmit power T_3 of the third access point AP_3. The measurements m_{12} and m_{13} are combined into a set s_1 of measurements and sent to the server 4.

25

The second access Point AP_2 makes a measurement m_{21} in respect of transmit power T_1 of the first access point AP_1 and makes a measurement m_{23} in respect of transmit power T_3 of the third access point AP_3. The measurements m_{21} and m_{23} are combined into a set s_2 of measurements and

30   sent to the server 4.

10

The third access Point AP_3 makes a measurement m_{32} in respect of transmit power T_2 of the second access point AP_2 and makes a measurement m_{31} in respect of transmit power T_1 of the first access point AP_1. The measurements m_{32} and m_{31} are combined into a set s_3 of measurements and sent to the

5   server 4.

The measurements m_{ij} in one embodiment are received signal strength (RSS) measurements. Each RSS measurement m_{ij} may include a mean value p_{ij} and a standard deviation from the mean σ_{ij}. The measurements m_{ij} may be

10   made according to a schedule e.g. once a day. The measurements m_{ij} made may always be sent to the server 4 or may only be sent if they differ significantly from the previous measurement or the average of the last few measurements.

15   The server 4, at block 42, collects a set of measurements s_n for each of access point AP_n.

The server 4, at block 44, processes the sets of measurements to identify and classify changes between measurements $m_{ij}(t)$ and previous

20   measurements $m_{ij}(t-T)$.

The server 4, at block 46, performs an action that is dependent upon the classification of the change.

25   A change indicates an inconsistency between the real configuration of the AP network 10 and the virtual configuration of the AP network defined by the configuration information 8. The classification of an action enables different remedial actions to be performed for different types of changes.

30   An action may, for example, cause a change in the real configuration of the access point network so that the real configuration of the AP network is made consistent with the virtual configuration of the AP network

An action may, for example, flag the inconsistency. For example, if the change is associated with a particular AP, then the action may flag in the database 6 some or all of the configuration data 8 associated with that access point as unreliable.

An action may, for example, cause a change in the virtual configuration of the access point network so that the virtual configuration of the AP network is consistent with the real configuration of the AP network. For example, if the change is a quantifiable change associated with a particular AP, then the action may adapt in the database 6 the configuration information 8 associated with that particular access point to reflect the quantifiable change. For example, if the change is not a quantifiable change, then the action may result in repopulation of the database 6 so that it is consistent with the current configuration of the AP network.

Figure 5 illustrates an example of how different classifications 51, 52, 53, 54 may be mapped to different respective actions 61, 62, 63, 64. The different respective actions may be performed with different urgency. That is there may be a significant delay before some actions are performed whereas other actions may be performed immediately.

If it is determined at block 51 that a transmit parameter such as transmit power has changed for an access point, then the database 6 is automatically and selectively adapted at block 61. The selective adaptation may involve flagging the transmit data for the access point as inaccurate or changing the transmit power value for the access point to the new value.

It can, for example, be determined that the transmit power T_i of access point AP_i has changed when

$p_{ni}(t) \neq p_{ni}(t-T)$ for all/most n.

$p_{in}(t) \sim p_{in}(t-T)$ for all/most n

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The quantitative value of $T_i(t)$ may be calculated from

$$p_{mi}(t) - p_{im}(t) = T_i(t) - T_m(t)$$

if $T_m(t)$ is known.

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As $p_{mi} = T_i + G_i - PL_{mi} + G_m$ where G_i is antenna gain at AP_i and PL_{mi} is the path loss at AP_m from AP_i which is the same as the path loss PL_{im} at AP_i from AP_m then $p_{mi}(t) - p_{im}(t) = T_i + G_i - PL_{mi} + G_m - (T_m + G_m - PL_{im} + G_i) = T_i - T_m$.

10 Alternatively, the quantitative value of the change Δ in $T_i(t)$ may be calculated as follows:

let $a = p_{mi}(t) - p_{im}(t) = T_i(t) - T_m(t)$

let $b = p_{mi}(t-T) - p_{im}(t-T) = T_i(t-T) - T_m(t-T)$

as $T_m(t) = T_m(t-T)$ but $T_i(t) \neq T_i(t-T)$, then

15 then $\Delta = T_i(t) - T_i(t-T) = b - a$

If it is determined at block 52 that an access point has been removed from the network of access points, then the database 6 is automatically and selectively adapted at block 62. The selective adaptation may involve flagging the data

20 associated with the access point as inaccurate or removing the data associated with the access point.

It can, for example, be determined that the access point AP_i has been removed when

25 $p_{ni}(t-T) \neq 0$, $p_{ni}(t) \sim 0$ for all/most n.

$p_{in}(t-T) \neq 0$, $p_{in}(t) \sim 0$ for all/most n

If it is determined at block 53 that an access point has been moved or reoriented or its environment has changed, then the database 6 may be

30 repopulated at block 63 so that the virtual configuration accurately reflects the real configuration.

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It can, for example, be determined that the access point AP_i has been moved, reoriented or its environment has changed when:

$p_{ni}(t) \neq p_{ni}(t-T)$ for all/most n.

$p_{in}(t) \neq p_{in}(t-T)$ for all/most n

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It may also be possible to discriminate between a change in position, a change in orientation and a change in environment.

For example, if we define the set of access points X for which $p_{ni}(t) > p_{ni}(t-T)$

10    $+ \varepsilon$ and define the set of access points Y for which $p_{mi}(t) < p_{mi}(t-T) - \varepsilon$, then:

If there is only a change in position, the positions of set X and the positions of set Y should cluster on either side of the previous position of AP_i.

15   In the event that the change is classified as a position change of an access point AP_i, it may be possible to calculate the new position of AP_i using the set of measurements $p_{im}(t)$ and an attenuation model with trilateration. The new position could also be calculated using angle of arrival measurements or time-of-flight measurements.

20

If there is only a change in orientation of directional gain, the positions of set X and the positions of set Y should cluster adjacent one another.

If there is only a change in environment, it is likely that only the positions of

25   set X or set Y will cluster and it may be unlikely that both will cluster.

If it is determined at block 54 that an access point has been added, then the database 6 may be repopulated at block 64 so that the virtual configuration accurately reflects the real configuration.

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The discrimination between changes in position, orientation or environment may also be achieved using angle of arrival measurements. If there is a

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change in power angular profile (measured powers as a function of angle of arrival) that the peaks of the profile remain at the same angles, but the power levels change that could be an indication of re-orientation or environment change. If the angles of the peak powers change then there has been re-

5   location.

When the database 6 is adapted, for example, selectively or by repopulation, then the new entries may be time stamped. When positioning occurs only the more recent entries of the database may be downloaded to an apparatus 12

10   or used by the apparatus that is running the positioning algorithm. Alternatively, differential weighting may be used so that the more recent entries have a greater influence on the result of a positioning algorithm.

The blocks illustrated in the Figs 4 and 5 may represent steps in a method

15   and/or sections of code in the computer program. The illustration of a particular order to the blocks does not necessarily imply that there is a required or preferred order for the blocks and the order and arrangement of the block may be varied.

20   Although embodiments of the present invention have been described in the preceding paragraphs with reference to various examples, it should be appreciated that modifications to the examples given can be made without departing from the scope of the invention as claimed.

25   Features described in the preceding description may be used in combinations other than the combinations explicitly described.

Whilst endeavoring in the foregoing specification to draw attention to those features of the invention believed to be of particular importance it should be

30   understood that the Applicant claims protection in respect of any patentable feature or combination of features hereinbefore referred to and/or shown in the drawings whether or not particular emphasis has been placed thereon.

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CLAIMS

1. A method comprising:

collecting from each of multiple access points in a network of access points a

5 set of measurements made at a respective access point for signals transmitted by other access points, wherein the network of access points is for use in positioning a device that communicates with the network of access points;

processing the collected sets of measurements to classify changes in the

10 network of access points; and

performing an action that is conditional upon how a change is classified.

2. A method as claimed in claim 1, wherein the measurements measure any one of the following parameter types: signal strength measurement, time of

15 arrival measurement and angle of arrival measurement.

3. A method as claimed in claim 1 or 2, wherein classification depends upon a parameter type measured by the measurements.

20 4. A method as claimed in claim 1, 2 or 3, wherein classification depends upon patterns of change in the measurements.

5. A method as claimed in any preceding claim, wherein classification comprises processing the collected sets of measurements to identify a

25 change in the network of access points associated with a particular access point.

6. A method as claimed in any preceding claim, wherein classification comprises detecting when all or most measurements made at access points

30 resulting from transmissions by a first access point change but all or most measurements made by the first access point do not change.

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7. A method as claimed in any preceding claim, wherein classification comprises identifying a change as consequent on one of: access point position change, access point orientation change, access point environment change, access point transmission power change, access point addition and
5   access point removal.

8. A method as claimed in any preceding claim, wherein action includes maintaining the integrity of a database that records configuration information of the access point network, wherein the database is for use in positioning an
10 apparatus that communicates with the access point network.

9. A method as claimed in any preceding claim, wherein the action includes automatically adapting the configuration information associated with a particular access point in the database.
15

10. A method as claimed in any preceding claim, wherein the action includes automatically adapting the configuration information in the database to record a calculated change in a transmission power of an access point.

20 11. A method as claimed in any preceding claim, wherein the action includes automatically adapting the configuration information in the database to remove data associated with a particular access point.

12. A method as claimed in any preceding claim, wherein the action includes
25 indicating that a manual action is required.

13. An apparatus comprising:
    means for collecting from each of multiple access points in a network of access points a set of measurements made at a respective access point for
30 signals transmitted by other access points, wherein the network of access points is for use in positioning a device that communicates with the network of access points;

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means for processing the collected sets of measurements to classify changes in the network of access points; and

means for performing an action that is conditional upon how a change is classified.

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14. An apparatus as claimed in claim 13, wherein means for processing is configured to process the collected sets of measurements to identify a change in the network of access points associated with a particular access point.

10   15. An apparatus as claimed in claim 13 or 14, wherein means for processing is configured to process the collected sets of measurements to detect when all or most measurements made at access points resulting from transmissions by a first access point change but all or most measurements made by the first access point do not change.

15

16. An apparatus as claimed in claim 13, 14 or 15, wherein means for processing is configured to process the collected sets of measurements to detect when all or most measurements made at access points resulting from transmissions by a first access point change and all or most measurements

20   made by the first access point do not change.

17. An apparatus as claimed in any one of claims 13 to 16, wherein means for performing an action is configured to maintain integrity of a database that records configuration information of the access point network, wherein the

25   database is for use in positioning an apparatus that communicates with the access point network.

18. An apparatus as claimed in claim 17, wherein means for performing an action is configured to automatically adapt the configuration information in the

30   database associated with a particular access point.

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19. An apparatus as claimed in claim 17 or 18, wherein means for performing an action is configured to automatically adapt the configuration information in the database to record a calculated change in the transmission power of an access point.

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20. A system comprising:

a network of access points for use in positioning a device that communicates with the network of access points;

means for collating for each of multiple access points in the network of access

10   points a set of measurements made at a respective access point for signals transmitted by other access points;

means for processing the collated sets of measurements to classify changes in the network of access points; and

means for performing an action that is conditional upon how a change is

15   classified.

21. A computer readable medium having a tangibly encoded computer program which when loaded into a computer provides:

means for collecting from each of multiple access points in a network of

20   access points a set of measurements made at a respective access point for signals transmitted by other access points, wherein the network of access points is for use in positioning a device that communicates with the network of access points;

means for processing the collected sets of measurements to classify changes

25   in the network of access points; and

means for performing an action that is conditional upon how a change is classified.

22. A method of maintaining the integrity of a database that records

30   configuration information of a network of access points for use in positioning an apparatus that communicates with the network of access points comprising:

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collecting from respective access points a set of measurements made at the respective access point for signals transmitted by other access points;

processing the collected sets of measurements to identify a change in the network of access points associated with a particular access point; and

5   automatically adapting the configuration information in the database associated with the particular access point.

23. A method as claimed in claim 22, wherein the measurements are received signal strength measurements.

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24. A method as claimed in claim 22 or 23, further comprising detecting when all or most measurements made at access points resulting from transmissions by a first access point change but all or most measurements made by the first access point do not change.

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25. A method as claimed in claim 24, wherein adapting the configuration information comprises flagging that transmission power of the first access point has changed.

20   26. A method as claimed in claim 24, wherein adapting the configuration information comprises adapting the configuration information to reflect a calculated change in transmission power of the first access point.

27. A method as claimed in claim 22 or 23, further comprising detecting when

25   an access point is no longer present in the network of access points.

28. A method as claimed in claim 27, wherein adapting the configuration information comprises removing data associated with the no-longer-present access point.

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29. A method as claimed in claim 27, wherein adapting the configuration comprises flagging data associated with the no-longer-present access point.

21

30. An apparatus comprising:

a database that records configuration information of a network of access points for use in positioning an apparatus that communicates with the network

5   of access points;

means for collecting from respective access points a set of measurements made at the respective access point for signals transmitted by other access points;

means for processing the collected sets of measurements to identify a change

10   in the network of access points associated with a particular access point; and means for automatically adapting the configuration information in the database associated with the particular access point.

31. An apparatus as claimed in claim 30, wherein the means for processing is

15   configured to detect when all or most measurements made at access points resulting from transmissions by a first access point change but all or most measurements made by the first access point do not change.

32. An apparatus as claimed in claim 31, wherein the means for adapting the

20   configuration information is configured to flag that transmission power of the first access point has changed.

33. An apparatus as claimed in claim 31, wherein the means for adapting the configuration information is configured to adapt the configuration information

25   to reflect a calculated change in transmission power of the first access point.

34. An apparatus as claimed in claim 30, wherein the means for processing is configured to detect when an access point is no longer present in the network of access points.

30

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35. An apparatus as claimed in claim 34, wherein the means for processing is configured to remove configuration information associated with the no-longer-present access point.

5   36. A computer readable medium having a tangibly encoded computer program which when loaded into a computer provides:

means for collating from respective access points a set of measurements made at the respective access point for signals transmitted by other access points;

10   means for processing the collected sets of measurements to identify a change associated with a particular access point in a network of access points; and

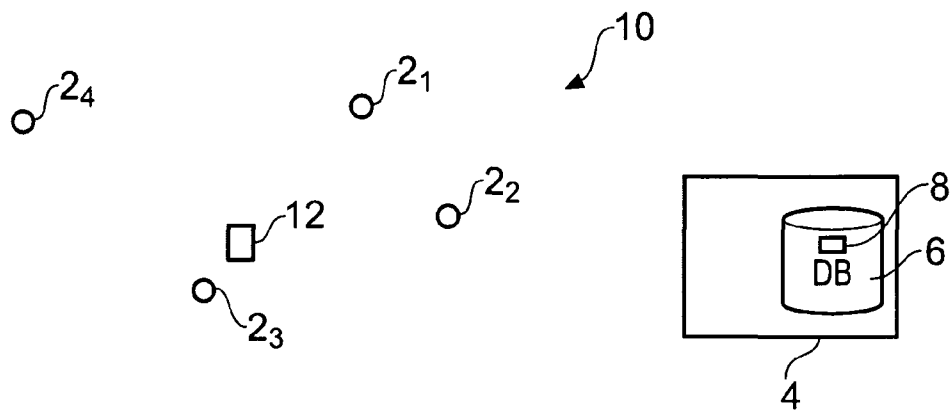means for automatically adapting network configuration information associated with the particular access point in a database.
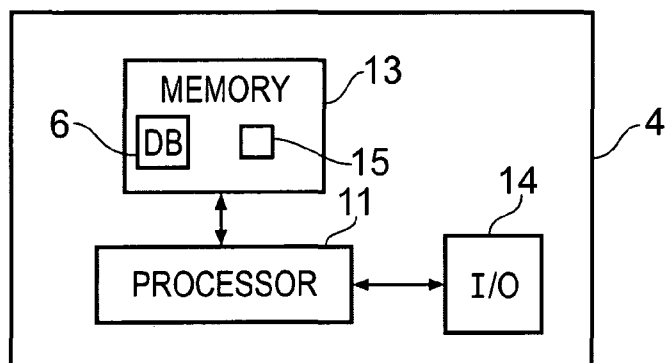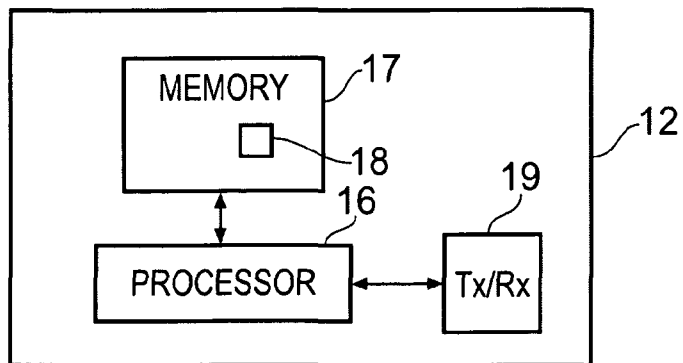

15

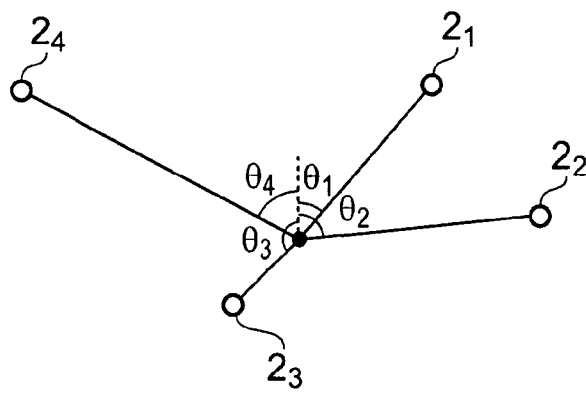1/3

FIG. 1

FIG. 2A

FIG. 2B

2/3

FIG. 3A
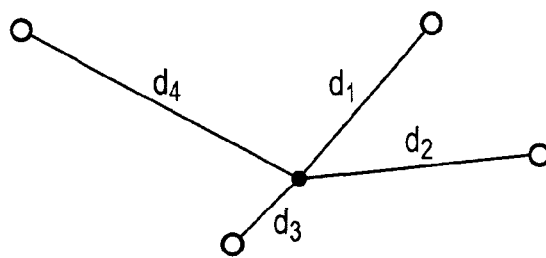
FIG. 3B

3/3
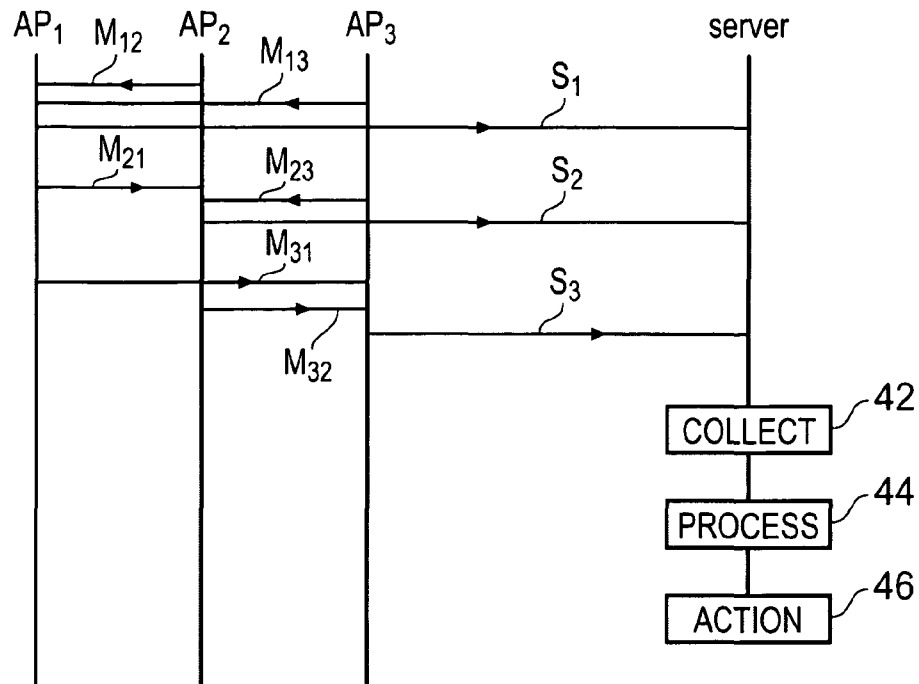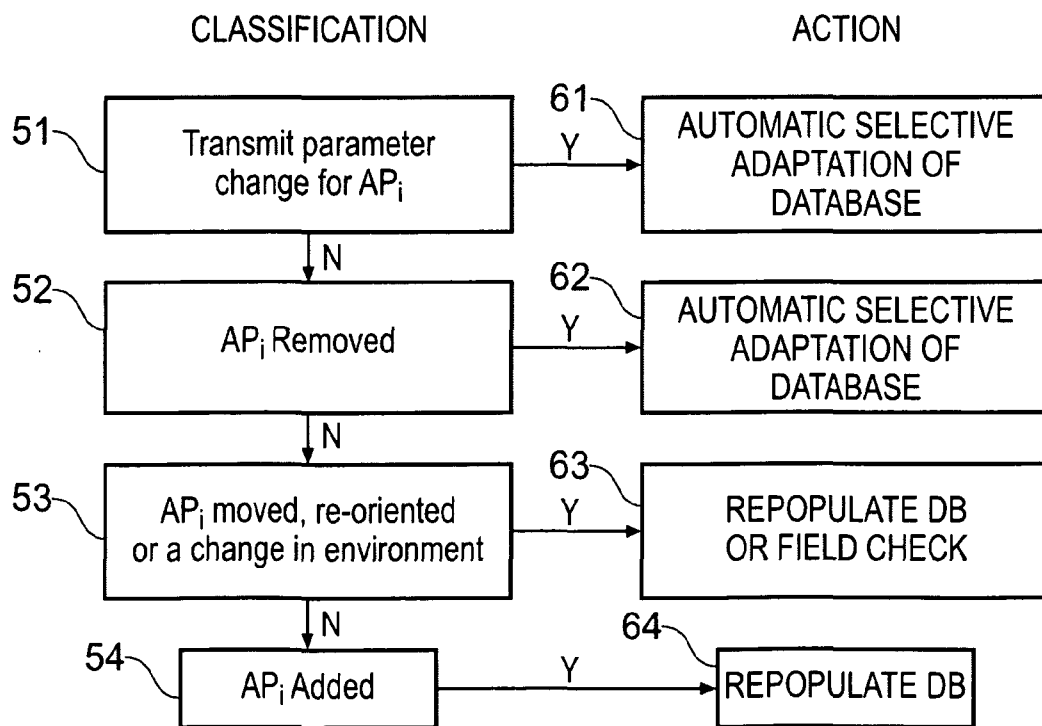
AP₁ M₁₂   AP₂   M₁₃   AP₃   server

S₁

S₂

M₂₁   M₂₃

M₃₁   S₃

M₃₂

COLLECT   42

PROCESS   44

ACTION   46

FIG. 4

CLASSIFICATION   ACTION

51   Transmit parameter   61 Y   AUTOMATIC SELECTIVE
      change for APᵢ   ADAPTATION OF
                                                 DATABASE

                    N

52   APᵢ Removed   62 Y   AUTOMATIC SELECTIVE
                                                 ADAPTATION OF
                                                 DATABASE

                    N

53   APᵢ moved, re-oriented   63 Y   REPOPULATE DB
      or a change in environment   OR FIELD CHECK

                    N

54   APᵢ Added   64 Y   REPOPULATE DB

FIG. 5

INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04Q7/38

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H04Q

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

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

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2005/143092 A1 (TAMAKI TSUYOSHI [JP] ET AL) 30 June 2005 (2005-06-30) abstract paragraph [0040] – paragraph [0042] paragraph [0056] – paragraph [0062] paragraph [0083] figures 1,4-7	1-36
X	US 2007/258409 A1 (ALIZADEH-SHABDIZ FARSHID [US] ET AL) 8 November 2007 (2007-11-08) abstract paragraph [0015] paragraph [0028] paragraph [0030] – paragraph [0031] paragraph [0049] – paragraph [0050] figure 1	1-36

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X	Further documents are listed in the continuation of Box C.		X	See patent family annex.

* Special categories of cited documents :

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

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
10 September 2008	02/10/2008

Name and mailing address of the ISA/	Authorized officer
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INTERNATIONAL SEARCH REPORT

C(Continuation).   DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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