



(51) International Patent Classification:

H04W 48/16 (2009.01) *H04W 48/18* (2009.01)

(21) International Application Number:

PCT/EP2009/058673

(22) International Filing Date:

8 July 2009 (08.07.2009)

(25) Filing Language:

English

(26) Publication Language:

English

(71) Applicant (for all designated States except US): **NOKIA SIEMENS NETWORKS OY** [FI/FI]; Karaportti 3, FI-02610 Espoo (FI).

(72) Inventor; and

(75) Inventor/Applicant (for US only): **MUSTAJARVI, Jari Pekka** [FI/FI]; Seitsemäs Järvikuja 6, FI-02730 Espoo (FI).

(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,

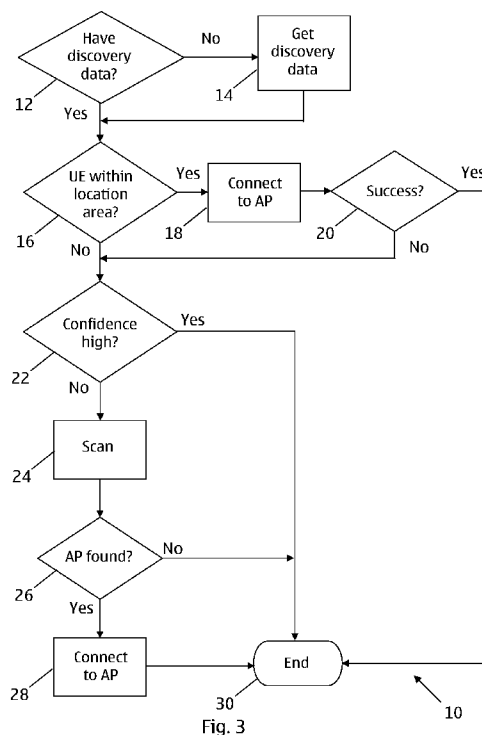
CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, 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, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

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

(54) Title: NETWORK ACCESS CONTROL



(57) Abstract: A method of network selection is provided. A mobile communication device is provided with policy and discovery information. The policy information provides prioritised policies for connecting to a number of networks. The discovery information provides information for identifying available networks. The discovery information includes coverage information and/or confidence information relating to the discovery information. The extent to which a mobile communication device searches for a higher priority access network when a lower priority access network is available depends on the coverage information and/or the confidence information.

Description

Network Access Control

5

The invention relates to network access control; for example the control of access to a mobile communication network.

10 Many mobile communication devices are able to make use of more than one communication access technology. For example, some mobile communication devices are able to make use of both the 3GPP standard and WLAN (wireless local area network).

15 Providing a mobile communication device with alternative communication technologies has a number of potential advantages. For example, the mobile communication device may be able to function in areas where only one of a number of access technologies is available. Also, if a user requires a low cost
20 connection, then the cheapest of a number of available connection options can be chosen. Alternatively, if a user wants to send a large amount of data over a connection, then a connection with a high available bandwidth can be chosen.

25 It is known to provide mobile communication devices with information regarding access technologies that are available. For example, Access Network Discovery and Selection Function (ANDSF) mechanisms allow a mobile operator to provide subscriber devices with inter-system mobility policies for auto-
30 matic, intelligent network selection in a heterogeneous network environment, where a plurality of different non-3GPP access technologies are available together with 3GPP or fulfilling gaps where 3GPP is not available.

35 Figure 1 is a block diagram of a system, indicated generally by the reference numeral 1, comprising a mobile communication device 2, an ANDSF server 4, a first mobile network 6 and a second mobile network 8.

In the use of the system 1, the ANDSF server 4 provides information to the mobile communication device 2 regarding the priority in which the access networks available to the mobile device (such as the networks 6 and 8) should be accessed.
The mobile communication device requests this priority information from the ANDSF server 4, and the ANDSF server returns the requested data to the mobile communication device. The mobile communication device 2 may choose the network to be used with ANDSF communication according to existing network selection information or by any other means available to the mobile device.

Figure 2 is a flow chart showing an algorithm, indicated generally by the reference number 100, showing an exemplary use of the system 1.

The algorithm 100 starts at step 102, where ANDSF information is obtained. The ANDSF information may, for example, be provided (by the ANDSF server 4) on request from the mobile communication device 2 (in a "pull" mode) or may be provided in a manner determined and initiated by the ANDSF server (in a "push" mode).

The ANDSF server 4 provides a number of policies for connecting the mobile communication device 2 to networks (such as the first mobile network 6 or the second mobile network 8). Priorities are assigned to the various policies and, at step 104 of the algorithm 100, the highest priority valid policy is applied. A policy is considered to be "valid" if it meets a number of validity conditions. Such conditions may, for example, relate to location or the time of day.

The policy selected at step 104 will have a number of access network options associated with it. The access network options will be prioritized within the policy. At step 105 of the algorithm 100, the highest priority access network option of the selected policy is selected.

The algorithm 100 moves to step 106 where it is determined whether or not the highest priority access network option of the selected policy has resulted in a successful connection to an available network. If a network connection has been made, then the algorithm 100 terminates at step 112. If a connection has not been made then the algorithm 100 moves to step 108, where it is determined whether or not the selected policy has any more (lower priority) access network options available.

It should be noted that ANDSF information does not define when a network connection is considered to be good enough. Even if a mobile communication device is able to connect to a network, the network quality may still be low. It is left to the mobile communication device to decide whether a given network fulfills its own requirements for the connection. If the network quality is too low, then the mobile communication device can choose the next preferred network in the policy.

If no further access network options exist, the algorithm 100 terminates at step 112. If further access network options do exist, then the next highest priority access network is selected at step 110. The algorithm 100 then returns to step 106, where it is determined whether or not the newly selected access network results in a successful connection to an available network. If a connection is made, then the algorithm 100 terminates at step 112. If a connection is not made, then the algorithm 100 moves to step 108, as discussed above.

The algorithm 100 continues until either a successful connection is made or all access network options of the selected policy have been tried. In some implementations of ANDSF systems, if the highest priority valid policy does not result in a connection being made, then no further efforts are made to make a connection. In other implementations, if the highest priority valid policy does not result in a connection be-

ing made, then the next highest priority policy is used and steps 105 to 112 of the algorithm 100 are repeated using that policy.

5 In addition to providing network selection policies, ANDSF allows mobile operators to provide access network discovery information (ANDI) to assist user equipment (UE) in detecting access networks specified in the ANDSF policy rules. Policies are used to list preferred access networks in any given loca-
10 tion or time.

Discovery information consists of radio technology specific information like frequencies and channels. This is particularly important, for example, for WiMAX where blind scanning
15 of the whole frequency domain can take a considerable period of time (perhaps as much as 15 minutes or more) and can use considerable battery resources.

Both policies and discovery information can have validity
20 area, expressed for example using 3GPP Cell Identifier or tracking area data. Typically, an ANDSF server runs in an operator network and delivers the policies and discovery information to a user device either on request from the user device (pull mode) or at the operator's preference (push
25 mode).

Although ANDSF can be used to provide a mobile communication device with information regarding connection options, it is not currently always clear how that information should be
30 used by mobile communication devices.

Consider the following example, in which an active ANDSF policy has two preferred networks. The higher priority network is a WLAN network, which has SSID=OpenZone. The lower priority network is a 3GPP network.
35

In this example, assume that the access network discovery information (ANDI) data does not contain any information about

the preferred WLAN network. Thus, the mobile communication device is aware that the WLAN network is the preferred network, so that, applying the algorithm 100, it is clear that the WLAN network should be selected at step 105. However, the mobile communication device does not have the information required (such as the frequency to use) in order to find the relevant channel. Accordingly, the application of the WLAN network at step 105 is not trivial. Moreover, there is no direct mapping between a policy and relevant access network discovery information. Both can be defined for example for specific locations, but there is no requirement to do so. Even though a mobile communication has some policy, the mobile communication device cannot know whether it has all relevant discovery information for the policy.

In this scenario, there are at least two options for what the mobile communication device should do:

1. Conduct a full WLAN scan to find if there are any Open-Zone access points available. This will determine whether there is a WLAN network available (the preferred option according to the ANDSF policy). However, if there is no WLAN network available, this is very wasteful, considering that there may a better option available.
2. Decide not to use the WLAN connection (even though it is preferred) on the basis that no information regarding the available connections is provided. The lower priority 3GPP connection can be used instead. However, if a suitable WLAN network is available, it would be preferable to make use of that network, in accordance with the active ANDSF policy.

As it may be unrealistic to assume that an ANDSF server knows details of all available networks, this may suggest that in the exemplary scenario set out above, the mobile communication device should perform a full WLAN scan. However, this might result in unnecessary scanning, even all the time and

causing rapid battery drain. Thus, an alternative solution might only search for networks that are fully defined (e.g. where a frequency or channel is specified).

- 5 The present invention seeks to address at least some of the problems outlined above.

The present invention provides a method (such as a method of network selection) comprising: retrieving a preferred network
10 connection policy for connecting a mobile communication device to a network, wherein the policy includes one or more prioritised network connection options; retrieving network connection data (such as discovery data, for example access network discovery information), wherein the network connection
15 data provides information for connecting the mobile communication device to network connection options; retrieving a confidence value that is indicative of the completeness or accuracy of the network connection data within a given area; and determining whether or not to attempt to connect to a
20 particular network connection option on the basis of the network connection data (this may, for example, include considering the confidence value).

The present invention also provides an apparatus (such as a user device) comprising: a first input for receiving network
25 connection data (such as discovery data) for a highest priority network connection option, wherein the network connection data provides information for connecting the mobile communication device to network connection options; a second input for receiving a confidence value that is indicative of the
30 completeness or accuracy of the network connection data within a given area; a controller for determining whether or not to attempt to connect to the highest priority network connection option on the basis of the nature of network connection data and on the confidence value. The first and second
35 inputs may be the same physical input. The confidence data may form part of the network connection data, such that the confidence data is received at the first input as part of the network connection data. The apparatus may further com-

prise a third input for receiving a preferred network connection policy for connecting a mobile communication device to a network, wherein the policy includes one or more prioritised network connection options. The controller may be arranged
5 such that, in the event that an access point to the highest priority network connection option is not available within the given area, then the action taken is dependent on the confidence value.

10 The present invention also provides an apparatus (such as a server, e.g. an ANDSF server) comprising a memory module (or multiple memory modules) adapted to store: a preferred network connection policy for connecting a mobile communication device to a network, wherein the policy includes one or more
15 prioritised network connection options; network connection data (such as discovery data), wherein the network connection data provides information for connecting the mobile communication device to network connection options; and a confidence value that is indicative of the completeness or accuracy of
20 the network connection data within a given area. The preferred network connection policy, the network connection data and confidence value may be stored on different memory modules. In one form of the invention, the network connection policy is stored at a first memory module and the network
25 connection data and confidence data are stored at a second memory module.

The present invention also provides a system comprises a user device as described above and a server as described above.

30 The preferred network connection policy may be one of several available policies. For example, the highest priority valid policy may be selected as the preferred policy. The policies may, for example, be ANDSF policies, and may be obtained from
35 an ANDSF server.

The retrieving steps of the present invention (such as retrieving a preferred network connection policy, retrieving

network connection data and retrieving a confidence value) may encompass retrieving data (for example from a server) on request by a user device (such as a mobile communication device) or retrieving data that has previously been stored locally at the user device. By way of example, data may be received at a mobile communication device from a server (such as an ANDSF server) and stored at the device; the said server may, for example, be providing data in a "push" mode.

10 The given area may be a coverage area defining an area in which all available discovery data is provided. In some forms of the invention, the coverage area is included in the network connection data. The coverage area may be defined for each network connection option separately. The coverage
15 area may consist of a plurality of areas which together make up a coverage area.

The given area may be a location area defining the location of access points for one or more of said one or more prioritised network connection options. In some forms of the invention, the location area data may be included in the network connection data.

In the event that an access point to the highest priority
25 network connection option is available, the mobile communication device may use that access point to connect to the highest priority network connection option.

In the event that an access point to the highest priority
30 network connection option is not available within the given area, then the action taken may be dependent on the confidence value.

In the event that the confidence value is above a first
35 threshold (for example, the confidence value is "high"), then, in one form of the invention, no attempt is made to connect to the highest priority network connection option (for which an access point is either unavailable or unknown).

In such a scenario, the confidence value may indicate that the access point data is sufficient complete that searching for unknown access points is unlikely to be successful. By way of example, in the event that the given area is a coverage area, then the high confidence may indicate that no further access points are within the coverage area and so a further search is not justified.

In the event that no attempt is made to connect to the highest priority network connection option, then the next highest priority network connection (if any) may be considered.

In the event that the confidence value is below a second threshold (for example, the confidence value is "low"), then a scan may be made for access points to the highest priority network connection option. The low confidence value may indicate that further (unknown) access points may be available, such that a search is justified. In the event that the given area is a coverage area, then the low confidence may indicate that it is unknown whether or not further access points are available within the coverage area.

The first and second thresholds may be the same. Thus, the confidence value is either above the first threshold (e.g. "high") or below the second threshold (e.g. "low"). Alternatively, there may be more than two confidence levels available.

In an alternative form of the invention, in the event that the confidence value is above a third threshold (for example, the confidence value is "high"), specified channels (if any) of the highest priority network connection option are checked. Furthermore, in some forms of the invention, in the event that said specified channels do not result in a connection being made, no further connection attempts are made for that network connection option.

In the event that the confidence value is below a fourth

threshold (for example, the confidence level is "low"), a scan of all potentially available channels may be conducted.

5 In the event that the confidence value is between the third and fourth thresholds (for example, the confidence level is "medium"), specified channels (if any) of the highest priority network connection option may be checked. Furthermore, in the event that the specified channels do not result in a connection being made, a scan of all potentially available
10 channels is conducted.

The invention may further comprise: obtaining a set of network selection policies (such as ANDSF policies), the network selection policies defining an ordered list of mobile communication network connection options (such as WLAN and 3GPP);
15 and using said ordered list to determine the highest priority network connection option.

20 In some forms of the invention, the network connection data (such as discovery data) may include frequency ranges and/or channels.

The present invention further provides a computer program product comprising: retrieving a preferred network connection policy for connecting a mobile communication device to a network, wherein the policy includes one or more prioritised network connection options; retrieving network connection data, wherein the network connection data provides information for connecting the mobile communication device to network connection options; retrieving a confidence value that
30 is indicative of the completeness or accuracy of the network connection data within a given area; and determining whether or not to attempt to connect to a particular network connection option on the basis of the network connection data and
35 the confidence value:

The present invention further provides a computer program comprising: code for retrieving a preferred network connec-

tion policy for connecting a mobile communication device to a network, wherein the policy includes one or more prioritised network connection options; code for retrieving network connection data, wherein the network connection data provides
5 information for connecting the mobile communication device to network connection options; code for retrieving a confidence value that is indicative of the completeness or accuracy of the network connection data within a given area; and code for
10 determining whether or not to attempt to connect to a particular network connection option on the basis of the network connection data and the confidence value. The computer program may be a computer program product comprising a computer-readable medium bearing computer program code embodied therein for use with a computer.

15

Exemplary embodiments of the invention are described below, by way of example only, with reference to the following numbered drawings.

20 Figure 1 is a block diagram of a system in which the present invention may be used;

Figure 2 is a flow chart showing a network access selection algorithm;

25 Figure 3 is a flow chart showing an algorithm in accordance with an aspect of the present invention;

Figure 4 is a flow chart showing an algorithm in accordance with an aspect of the present invention; and

Figure 5 is a flow chart showing an algorithm in accordance with an aspect of the present invention.

30

As described above, the ANDSF server 4 provides at least the following information to the mobile communication device 2:

35 1. Policy information, providing one or more policies that can be used for connecting to networks. The policies each have a priority. Each policy includes a number of prioritised access network options.

2. Discovery information, providing information, such as frequency and other channel information, for identifying available networks. The discovery information includes location data defining area(s) where access network access points can be expected to be found.

The present invention seeks to address the problem that even if an ANDSF server knows all the locations and related discovery information, there is no mechanism to inform a user device and the user device has no way to know if it has all the relevant information available. For example, a user device may have discovery information of a specific WLAN access point with validity condition of a 3GPP Cell area. The policy however might be given for a location area. If the user device enters another cell in the same location area, the user device cannot know if it should contact the ANDSF server to refresh the discovery information. If it does contact the ANDSF server, but server knows there is no related WLAN access point under this cell area, how can this be told to the user device? Absence of discovery information can be interpreted as 'network doesn't know if there is a suitable access point in the area' or 'network knows there is no suitable access point in the area'. The latter indicates there is no need to scan the WLAN access point, while the former indicates that the user device should perform a scan. In one embodiment of the invention, this problem is addressed by additionally providing (typically, although not exclusively, as part of the discovery information) one or both of the following:

1. Coverage information, defining an area within which the discovery information is valid. If a user device is within the coverage area, then the user device knows that it has all of the available discovery information for that area (at least from the ANDSF server concerned - of course, further discovery information could be available from other ANDSF service providers).

2. Confidence information, indicating the level of confidence that the mobile communication device can place on the provided discovery information. The confidence information may, for example, be indicative of the completeness of the discovery information.

A sample policy might be as follows:

1. home wifi;
 2. operator wlan,
 3. 3gpp.
- Valid within PLMN.

In this case, sample discovery information might be provided as follows: Home wifi [type=WLAN, location 3GPP-Cell-1, accessRef -> WLAN AP config, coverage PLMN, confidence=high].

In the example policy above, the user device knows it has all information for the WLAN access point (since the confidence level is high), it knows where to search for it and it knows where not to search. Accordingly, in this example, as the confidence level is high, there is no need to request discovery information update while within the PLMN.

Figure 3 is a flow chart showing an algorithm, indicated generally by the reference numeral 10, demonstrating the use of the coverage and confidence information in accordance with an aspect of the present invention. The algorithm 10 takes place between the steps 105 and 106 of the algorithm 100 described above. Accordingly, step 102 (obtaining ANDSF information), step 104 (apply highest priority valid policy) and step 105 (apply highest priority valid access network) have already been carried out when the algorithm 10 starts. The algorithm 10 seeks to connect to the selected access network.

The algorithm 10 starts at step 12, where the user device determines whether it has discovery information (including coverage area data) for the location of the user device. If the user device has the required discovery information, the algo-

rithm 10 moves to step 16. Otherwise, discovery information is obtained from the relevant ANDSF server at step 14, before the algorithm 10 moves to the step 16.

5 At step 16, it is determined whether the user device is at a location that falls within a location area specified in the discovery information. The location areas given in the discovery information define locations of access points for a particular access network (typically the access network selected at step 105). If the user device is within a location area specified in the discovery information, then the algorithm moves to step 18, where the user device attempts to connect to the access point at that location. If the user device is not within a location area, then the algorithm 10 moves to step 22.

From step 18, the algorithm 10 moves to step 20 where it is determined whether or not the attempt to connect to the access point was successful. If the attempt was successful, the algorithm 10 terminates at step 30. Otherwise, the algorithm 10 moves to the step 22.

At step 22, the confidence level associated with the discovery information is checked. The confidence level is either high or low. A high confidence level indicates that the location information given in the discovery data is complete. A low confidence level indicates that the location information may not be complete.

30 Accordingly, at step 22 it has been determined that the user device is within the coverage area of up-to-date discovery data, but not within the area of a known access point. A high confidence level indicates that the ANDSF server is certain that there are no further access points in this area and so no attempt should be made to look for an access point. A low confidence level indicates that the ANDSF server is not certain whether or not a further access point might be available.

Accordingly, if, at step 22, the confidence level is high, then there is no need to search for further access points and the algorithm 10 terminates at step 30. However, if the confidence level is low, then there may be further access points available and so the algorithm 10 moves to step 24, where a scan of the coverage area for further access points is carried out.

From step 24, the algorithm 10 moves to step 26, which determines whether or not an access point has been found. If not, the algorithm 10 terminates at step 30. If an access point is found, then the algorithm 10 attempts to connect to that access point (at step 28) before terminating at step 30.

From step 30 of the algorithm 10, the algorithm 100 moves to step 106, where it is determined whether or not a connection has been successfully made. If so, the algorithm 100 terminates. If not, an attempt is made to connect to the next highest priority access network (if any). The algorithm 10 would then be repeated.

Thus, the confidence level specified in the discovery information specifies whether or not the access network information includes all possible access points within the coverage area. A "high" confidence level indicates that all access points are defined: a "low" confidence level indicates that further access points may be available, so that a scan may be justified.

In the algorithm 10 as described above, it is assumed that if discovery data is requested at step 14, then that discovery data is obtained. If, however, a user device cannot access the server or the server does not provide new discovery data, then a number of options are possible. For example, in the event that existing discovery data is available to the user device, then this data may be used (especially if that data is relatively recent). If discovery data cannot be obtained,

then the user device can set the confidence level to "low" such that, at step 22, the algorithm 10 moves to step 24 where a scan is carried out.

5 The algorithm 10 can be applied to the example described above in which an active ANDSF policy has two preferred networks. The higher priority network is a WLAN network, which has SSID=OpenZone and the lower priority network is a 3GPP network. As discussed above, in this example, the access
10 network discovery information (ANDI) message does not contain any information about the preferred WLAN network.

Following the algorithm 10, the action taken depends first on whether an access point is available. Assuming that an ac-
15 cess point is not available, then the action taken depends on the confidence level associated with the discovery information.

If the confidence level is high, then the algorithm 10 termi-
20 nates at step 30, without any attempt to connect to a preferred WLAN channel. This is because the confidence level is high, indicating that the reason that no WLAN channels are specified in the discovery information is that no such channels are available. In this case, the less preferred 3GPP
25 network would be used. If the confidence level given to the discovery information was low, then a full scan of the WLAN frequency range would be carried out at step 24.

In the exemplary embodiment described above, the confidence
30 information has two levels: high and low. A high level indicates either that the ANDSF server is confident that, within the specified coverage area, there either is, or is not, an available access point. A low level indicates that the ANDSF server is not certain. Although the use of two confidence
35 levels is often sufficient, it is possible for more than two confidence levels to be provided.

Figure 4 is a flow chart showing an algorithm, indicated generally by the reference numeral 40, in accordance with an aspect of the present invention. As described below, the algorithm 40 makes use of three confidence levels: high, medium
5 and low.

As with the algorithm 10 described above, the algorithm 40 takes place between the steps 105 and 106 of the algorithm 100 described above. Accordingly, step 102 (obtaining ANDSF
10 information), step 104 (apply highest priority valid policy) and step 105 (apply highest priority valid access network) have already been carried out when the algorithm 40 starts. The algorithm 40 seeks to connect to the selected access network.

15 The algorithm 40 starts at step 42, where the user device determines whether it has discovery information for the location of the user device. If the user device has the required discovery information, the algorithm 40 moves to step 46.
20 Otherwise, discovery information is obtained from the relevant ANDSF server at step 44, before the algorithm 40 moves to the step 46.

At step 46, the algorithm 40 asks whether the confidence data
25 associated with the policy that is being implemented is low, medium or high. Of course, although three confidence levels are described in this example, more or fewer than three confidence levels could be used in alternative embodiments of the invention.

30 If, at step 46, it is determined that the confidence level is high, indicating that the operator is confident that the discovery information is accurate and complete, then the algorithm 40 moves to step 48. Since the discovery information
35 is complete, in order to find this network, the mobile communication device 2 need only check the defined frequencies and/or channels to determine whether the preferred network is available. If the network is not found, then the network is

presumably not available. Thus, there is no need for full scan of the possible network frequencies to be carried out. Accordingly, once the defined frequencies and/or channels have been checked, the algorithm 40 terminates at step 56,
5 regardless of whether or not the channel has been found.

If, at step 46, it is determined that the confidence level is low, then the algorithm 40 moves to step 50. At step 50, the operator knows that it should not rely on any discovery
10 information that has been provided by the ANDSF server 4. Thus, at step 50, the mobile communication device needs to perform a full scan of the available frequency range in order to find a network. Once the scan has been carried out, the algorithm 40 terminates at step 56.

15 If, at step 46, it is determined that the confidence level is medium, then the algorithm 40 moves to step 52. A medium confidence level indicates that the discovery information provided by the ANDSF server 4 may well be incomplete. At
20 step 52, the mobile communication device 2 first tries the known channels and/or frequencies. Next, at step 54, it is determined whether or not the desired channel has been found. If the desired channel has been found, then the algorithm 40 terminates at step 56. If the desired channel has not been
25 found, then the algorithm 40 moves to step 50, where, as described above, a full scan of the available bandwidth is carried out. The algorithm then terminates at step 56.

The algorithm 40 can readily be applied to the example described above in which an active ANDSF policy has two preferred networks. The higher priority network is WLAN network, which has SSID=OpenZone. The lower priority network is a 3GPP network. As discussed above, in this example, the access network discovery information (ANDI) message does not
30 contain any information about the preferred WLAN network.
35

Following the algorithm 40, the action taken depends on the confidence level given to the discovery information. If the

confidence level is high, then the algorithm 40 moves from step 46 to step 48. No WLAN channels are defined, so no action is taken and the algorithm simply terminates at step 56, without any attempt to connect to a preferred WLAN channel.

5 This is because the confidence level is high, indicating that the reason that no WLAN channels are specified in the discovery information is that no such channels are available. In this case, the less preferred 3GPP network would be used.

10 If the confidence level given to the discovery information was low, then a full scan of the WLAN frequency range would be carried out at step 50. Similarly, if the confidence level was medium, an attempt to check known channels at step 52 would result in step 54 returning a negative answer and a
15 full scan of the WLAN frequency range being carried out at step 50.

Figure 3 shows an algorithm in which both coverage and confidence data are provided. Figure 4 shows an algorithm in
20 which confidence data is provided, but coverage data is not provided (or, at least, is not considered). Figure 5 shows an algorithm, indicated generally by the reference numeral 10', in which coverage data is provided, but confidence data is not provided.

25 The algorithm 10' is similar to the algorithm 10, except that the steps 22 to 28 are omitted. In essence, the algorithm 10' implements the algorithm 10, where the confidence level is always set to high.

30 The algorithm 10' starts at step 12', where the user device determines whether it has discovery information (including coverage area data) for the location of the user device. If the user device has the required discovery information, the
35 algorithm 10' moves to step 16'. Otherwise, discovery information is obtained from the relevant ANDSF server at step 14', before the algorithm 10' moves to the step 16'.

At step 16', it is determined whether the user device is at a location that falls within a location area specified in the discovery information. The location areas given in the discovery information define locations of access points for a particular access network (typically the access network selected at step 105). If the user device is within a location area specified in the discovery information, then the algorithm moves to step 18', where the user device attempts to connect to the access point at that location. From step 18', the algorithm 10' moves to step 30', where the algorithm terminates. Similarly, if, at step 16', the user device is deemed not to be within a location area, then the algorithm 10' terminates at step 30'.

In the algorithm 10', the coverage area and the discovery data validity area are the same. When the mobile communication device 2 is within the coverage area, then the algorithm 30' knows that all relevant discovery information is available, so that the location data (indicating the location of access points) is complete and so no scanning for access points is required.

In the use of the invention, ANDSF information may be conveyed to the device using OMA DM compliant ANDSF management object defined in the 3GPP 24.312 specification. Each access discovery information element in the management tree consists of AccessNetworkType Information Element (IE), AccessNetworkValidityArea IE and a reference to actual technology specific discovery information element. The arrangement of the present invention adds a new ConfidenceLevel IE to this access discovery information element, next to AccessNetworkValidityArea IE. The confidence level may have two, three or more values to identify the confidence levels discussed above (e.g. low/high confidence, low/medium/high confidence etc.). Of course, other confidence settings could be provided, with different actions being taken in response to different confidence settings. Further, the confidence level may be expressed as a function of the completeness of the information

provided (e.g. complete information, partial information and no information).

By using the present invention, an operator can provide meaningful policies and discovery information to mobile communication devices. The devices know how to behave, resulting in faster connection times and/or saved battery lifetime.

In the embodiments described above, the coverage and/or confidence information has generally been described as being part of the discovery information. This is not essential. For example, at least some of the coverage and/or confidence information could be provided as part of the policy information. Alternatively, at least some of the coverage and/or confidence information could be provided separate to both the policy information and the discovery information.

The present invention has been described, by way of example, with reference to the known ANDSF mechanism. This is not essential. The principles of the invention are applicable to other information distribution systems. One potential system to which the invention could be applied is that described in the IEEE 802.21 standards documents.

The embodiments of the invention described above are illustrative rather than restrictive. It will be apparent to those skilled in the art that the above devices and methods may incorporate a number of modifications without departing from the general scope of the invention. It is intended to include all such modifications within the scope of the invention insofar as they fall within the scope of the appended claims.

CLAIMS:

1. A method comprising:
 - retrieving a preferred network connection policy for
 - 5 connecting a mobile communication device to a network,
 - wherein the policy includes one or more prioritised network connection options;
 - retrieving network connection data, wherein the network connection data provides information for connecting the mo-
 - 10 bile communication device to network connection options;
 - retrieving a confidence value that is indicative of the completeness or accuracy of the network connection data within a given area; and
 - determining whether or not to attempt to connect to a
 - 15 particular network connection option on the basis of the network connection data and the confidence value.
2. A method as claimed in claim 1, wherein the given area is a coverage area defining an area in which all available
- 20 network connection data is provided.
3. A method as claimed in claim 2, wherein an indication of the coverage area is included in the network connection data.
- 25 4. A method as claimed in claim 1, wherein the given area is a location area defining the location of access points for one or more of said one or more prioritised network connection options.
- 30 5. A method as claimed in any preceding claim, wherein, in the event that an access point to a highest priority network connection option is not available within the given area, then the action taken is dependent on the confidence value.
- 35 6. A method as claimed in claim 5, wherein, in the event that the confidence value is above a first threshold, then no attempt is made to connect to the highest priority network connection option.

7. A method as claimed in claim 5 or claim 6, wherein, in the event that the confidence value is below a second threshold, then a scan is made for access points to the highest
5 priority network connection option.

8. A method as claimed in claim 5, wherein in the event that the confidence value is above a third threshold, specified channels of the highest priority network connection option are checked.
10

9. A method as claimed in claim 8, wherein in the event that said specified channels do not result in a connection being made, no further connection attempts are made for that
15 network connection option.

10. A method as claimed in any one of claims 5, 8 or 9, wherein, in the event that the confidence value is below a fourth threshold, a scan of all potentially available channels is conducted.
20

11. A method as claimed in any one of claims 5, 8, 9 or 10, wherein, in the event that the confidence value is between the third and fourth thresholds, specified channels of the
25 highest priority network connection option are checked.

12. A method as claimed in claim 11, wherein, in the event that said specified channels do not result in a connection being made, a scan of all potentially available channels is
30 conducted.

13. An apparatus comprising:
a first input for receiving network connection data for a highest priority network connection option, wherein the
35 network connection data provides information for connecting a mobile communication device to network connection options;

a second input for receiving a confidence value that is indicative of the completeness or accuracy of the network connection data within a given area;

5 a controller for determining whether or not to attempt to connect to the highest priority network connection option on the basis of the nature of network connection data and on the confidence value.

10 14. An apparatus as claimed in claim 13, further comprising a third input for receiving a preferred network connection policy for connecting the mobile communication device to a network, wherein the policy includes one or more prioritised network connection options.

15 15. An apparatus as claimed in claim 13 or claim 14, wherein the controller is arranged such that, in the event that an access point to the highest priority network connection option is not available within the given area, then the action taken is dependent on the confidence value.

20 16. An apparatus comprising a memory module adapted to store:

a preferred network connection policy for connecting a mobile communication device to a network, wherein the policy
25 includes one or more prioritised network connection options;

network connection data, wherein the network connection data provides information for connecting the mobile communication device to network connection options; and
a confidence value that is indicative of the completeness or
30 accuracy of the network connection data within a given area.

17. A computer program product comprising:
means for retrieving a preferred network connection policy for connecting a mobile communication device to a network, wherein the policy includes one or more prioritised
35 network connection options;

means for retrieving network connection data, wherein the network connection data provides information for connect-

ing the mobile communication device to network connection options;

means for retrieving a confidence value that is indicative of the completeness or accuracy of the network connection data

5 within a given area; and

means for determining whether or not to attempt to connect to a particular network connection option on the basis of the network connection data and the confidence value.

1/5

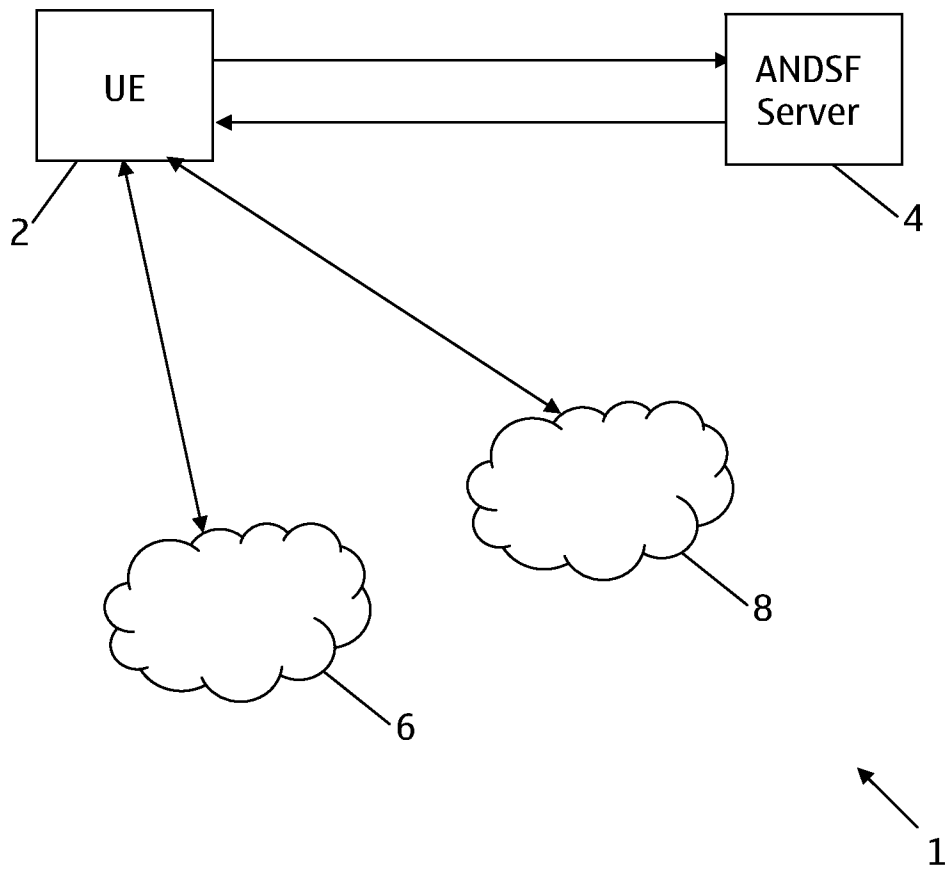


Fig. 1

2/5

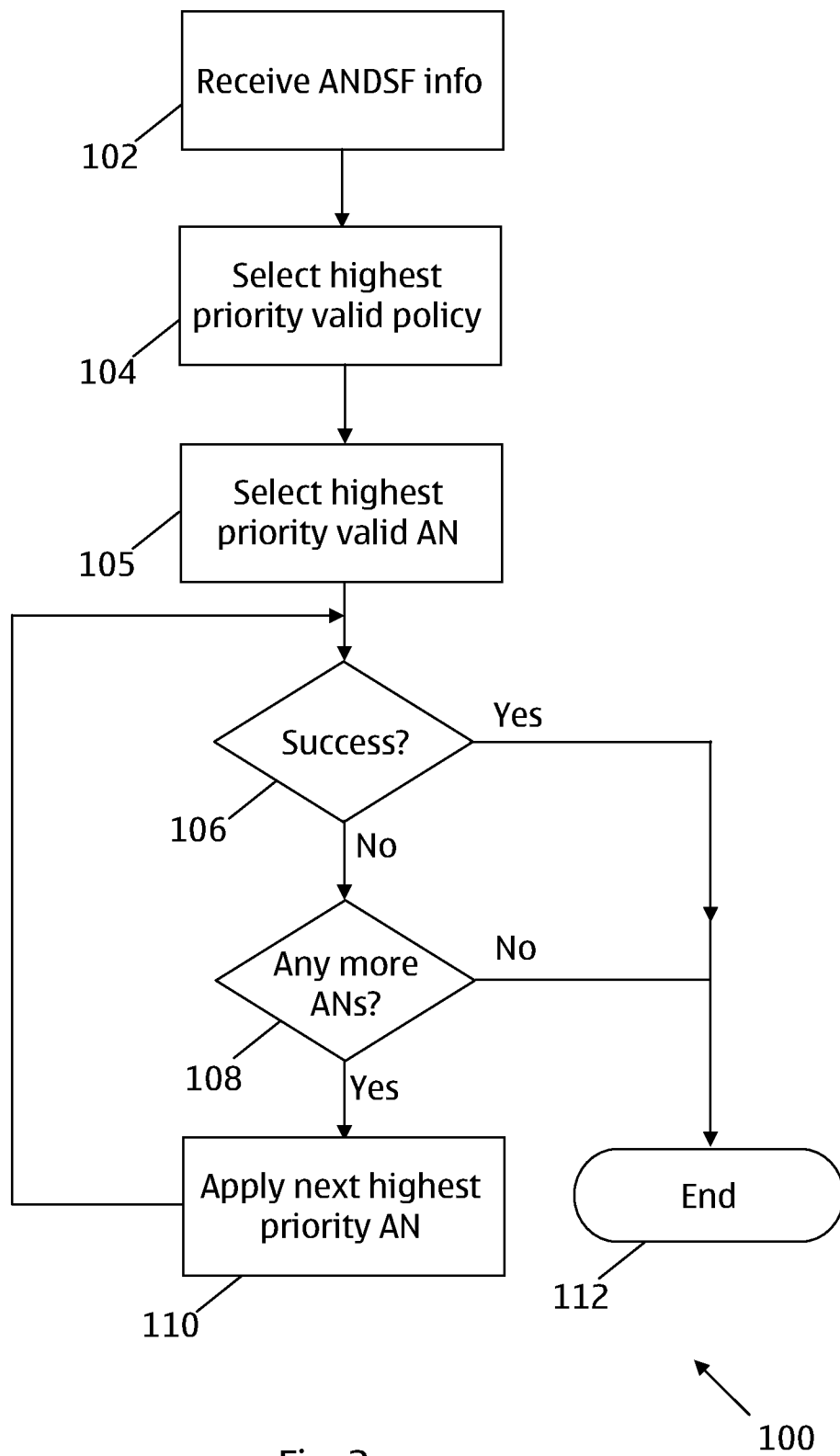


Fig. 2

3/5

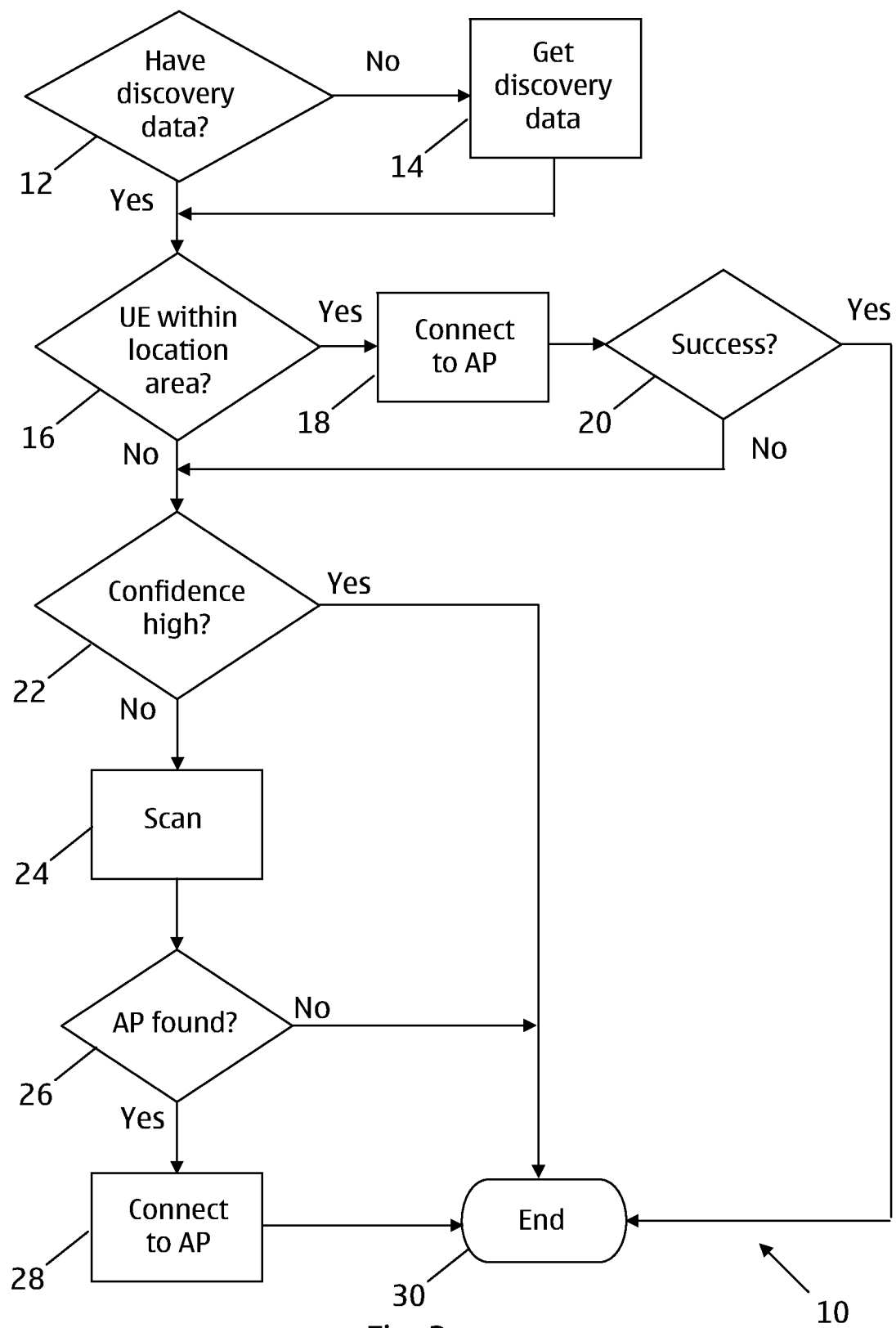


Fig. 3

4/5

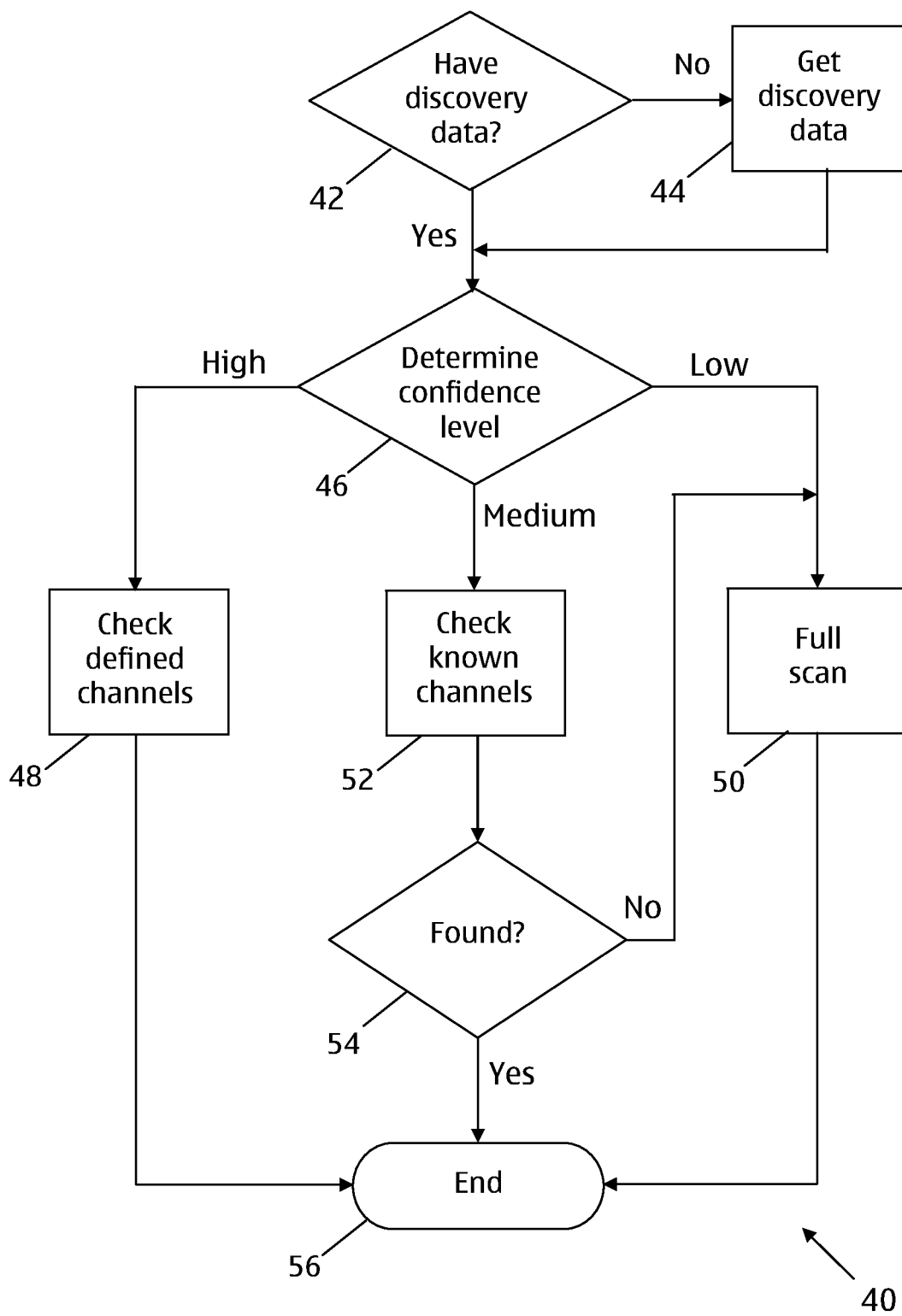


Fig. 4

5/5

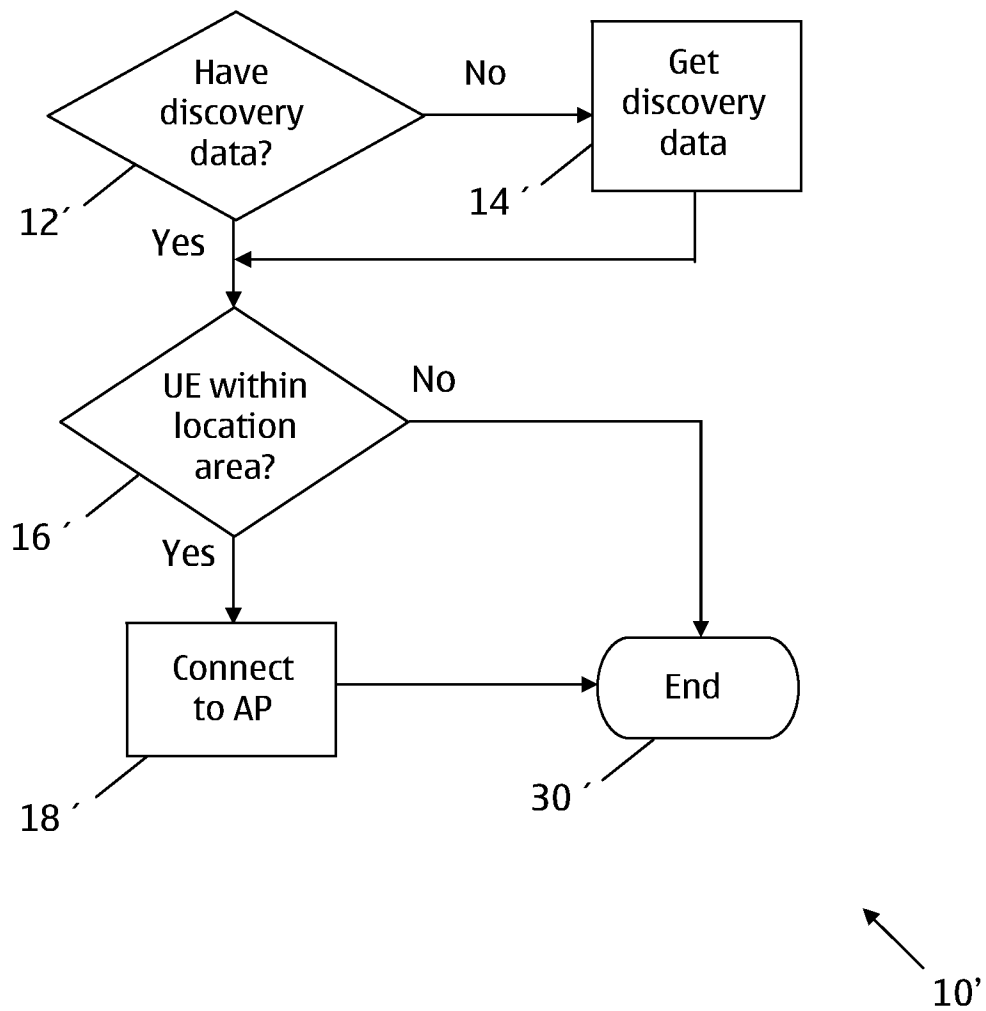


Fig. 5

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2009/058673

A. CLASSIFICATION OF SUBJECT MATTER

INV. H04W48/16 H04W48/18

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H04W

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

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

EPO-Internal, WPI Data, INSPEC, COMPENDEX

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	3rd Generation Partnership Project: "Access to the 3GPP Evolved Packet Core (EPC) via non-3GPP access networks Stage 3 (Release 8)" 3GPP vol. 24.302, no. V8.2.0, 1 June 2009 (2009-06-01), 30 June 2009 (2009-06-30), pages 1-44, XP002572976 650 Route des Lucioles - Sophia Antipolis Valbonne - FRANCE Retrieved from the Internet: URL:www.3gpp.org/ftp/Specs/html-info/24302.htm> [retrieved on 2010-03-11] page 10, paragraph 4.1 page 11, paragraph 5.1.1 - page 12, paragraph 5.1.2 page 15, paragraph 6.2.1 - paragraph 6.2.2 page 24, paragraph 6.8.1 - page 26, -/--	1-17

☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:

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

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

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

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

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

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

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

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

"&" document member of the same patent family

Date of the actual completion of the international search

12 March 2010

Date of mailing of the international search report

30/03/2010

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

Authorized officer

López García, J

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2009/058673

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	paragraph 6.8.2 page 36, paragraph Annex A – page 38 ----- TELECOM ITALIA ET AL: "Solutions to simplify the configuration and maintenance of the ANDSF" 3GPP DRAFT; S2-092592-DISCUSSION-ANDSF-CONFIGURATION, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE, no. Hangzhou; 20090330, 30 March 2009 (2009-03-30), XP050345840 [retrieved on 2009-03-30] page 1, paragraph 1 – page 2 -----	1-17
A	TELCORDIA ET AL: "UE reporting access network information discrepancies to ANDSF" 3GPP DRAFT; S2-093566_S2_73_TD_ANDSFDISCREPANCIES-V5, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE, no. Tallinn; 20090505, 5 May 2009 (2009-05-05), XP050346625 [retrieved on 2009-05-05] page 1, paragraph 1 page 3, line 3 – line 9 page 3, line 25 – line 33 -----	1-14
A	WO 2008/093046 A2 (BRITISH TELECOMM [GB]; JOVER APARICIO FERNANDO [GB]; REID GIDON MOSHE) 7 August 2008 (2008-08-07) page 9, line 12 – line 22 page 10, line 4 – line 21 page 14, line 19 – page 16, line 17 page 17, line 15 – line 23 -----	1-17
A	TAAGHOL P ET AL: "Seamless integration of mobile WiMAX in 3GPP networks" IEEE COMMUNICATIONS MAGAZINE, IEEE SERVICE CENTER, PISCATAWAY, US, vol. 46, no. 10, 1 October 2008 (2008-10-01), pages 74-85, XP011236262 ISSN: 0163-6804 page 80, left-hand column, line 27 – right-hand column -----	1-17

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2009/058673

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2008093046 A2	07-08-2008	NONE	