

NETWORK SELECTION

This invention relates to a method of network selection, in particular for wireless local area networks, such as IEEE 802.11.

5 In a wireless environment with overlapping networks (i.e. network coverage is provided by more than one operator), a wireless terminal needs to choose a network access point, such as an Access Point (AP) or Base Station (BS), to handover to, if mobility within the system is required, or change to a different network if the one it is currently with cannot provide the service it requires.

10 Current IEEE 802.11 wireless systems support the periodic broadcast, or probing of network identity, and other characteristics, that can be used by mobile terminals (MTs) to detect network coverage and to assess which access point they would like to connect to having made their network selection. However, it is not mandatory for access points to provide this information (unless responding to an
15 information request directed explicitly towards their network identity), and indeed, in some cases they are configured not to reply, for security and radio resource reasons. Therefore, MTs may not be able to detect all available points of attachment in a certain area. In addition, the information provided in a beacon from the access point does not provide much information about the characteristics of the network to support network
20 selection. Future standardisation is expected to add some additional information about network provision within IEEE 802.11 (Task Group u). However, one of the current problems with these state of the art techniques is that many messages are required to complete a neighbourhood scan, e.g. many IEEE 802.11 probe/response messages, together with possible re-tuning to scan all available channels. In the future IEEE
25 802.11y system, the number of channels may expand considerably and this current technique does not scale well in terms of the time taken to achieve the complete scan of all possible neighbours.

. In accordance with a first aspect of the present invention, a method of network selection for a wireless user device in radio communication with a first access point of
30 one or more networks, via at least one of a plurality of access points, the method comprising sending a network selection request from the wireless user device to the first access point; wherein if the network wishes to initiate a response from another access point in the same or another network, the first access point forwards the network

selection request to one or more neighbouring access points, in the same or another network; wherein if any of the neighbouring access points is able to communicate with the user device, that neighbouring access point sends a response directly to the wireless user device; and wherein the wireless user device chooses the most suitable network
5 from the responses sent.

The present invention addresses the problem of the number of messages involved in an expanded system, by allowing the wireless user device to communicate with a single access point with which it is already in radio communication, to carry out subsequent selection of a network. The access point either provides the required level
10 of service, or forwards the requirements to other neighbouring access points which reply to the wireless user device, only if they can satisfy the request. This way the number of messages from the user device is reduced and the user device may be able to obtain a service from an access point which is not immediately visible to it, due to restrictions having been placed on that access point, or the one which with the user
15 device has a radio connection.

Preferably, a token provided by the wireless user device is attached to the network selection request before it is forwarded by the first access point to neighbouring access point.

Preferably, the network selection request includes requirements relating to the
20 service that the wireless user device requires from any access point and its associated network.

This may include quality of service, available bandwidth, roaming information or cost. For example, if the user device wants to know of availability of resources for a voice or video call that it plans to make, or if it needs to handover because it is moving
25 out of range and has a particular requirement, then the user device can specify the criteria relating to a preferred roaming partner, QoS, bandwidth and cost and receive a response from the access point which is best able to match these.

Preferably, the associated network of the first access point forwards the network selection request to more than one neighbouring access point, in the same or another
30 network, simultaneously.

Preferably, an access point that is able to communicate with the wireless user device responds directly to the wireless user device indicating the level of support that

is available from the associated network of the access point for the service request from the wireless user device.

Preferably, the response is delivered via a unicast or multicast message delivery method, and includes the token provided by the wireless user device in the initial
5 request.

Preferably, the wireless user device is one of a laptop, a personal digital assistant, or any wireless device supporting the appropriate air interface.

An example of a method of network selection according to the present invention will now be described with reference to the accompanying drawings in which:

10 Figure 1 illustrates a scenario showing the typical deployment of apparatus for carrying out the method of the present invention;

Figure 2 represents an example of a typical message flow between a wireless device and three access points using the method of the present invention; and,

Figure 3 illustrates the format of typical request and response messages used in
15 the method of the present invention.

The present invention addresses the problems which arise from user devices having to send large numbers of requests and receive corresponding responses over air, without any certainty that the access point with which the user device is communicating
20 being able to provide the desired service. The user may have radio communication with the access point which had the strongest signal when the user device first switched on, or came within range, but that access point may be barred from the network which the user device needs, so the network request is passed on to another access point. Also, the wireless communications may be unreliable, giving rise to the possibility that
25 these requests and/or responses may get lost during transmission. This invention extends the standard procedures of request/response protocols to provide extra functionality in a more secure manner and to reduce the amount of over the air signalling for neighbour cell discovery.

Conventionally, a wireless user device has to transmit multiple messages,
30 covering all the possible channels within all possible neighbouring cells. Although this solves the problem of determining the most suitable network access point and cell, it is not an efficient mechanism, subject to long latencies and does not scale well. The

potential for lost messages is addressed by repeating requests, which adds to the scaling problem.

The mechanism of the present invention allows the wireless device to send a message to its current access point, e.g. an AP, or BS, asking the access point to inform
5 its neighbours whether the wireless device may possibly receive information from them directly. Typically, this is done through the reception of multicast frames. The wireless device attaches a unique token to this request, which is subsequently transmitted by any of the responding neighbour access points, enabling the original user device requesting the service to be identified and for the neighbouring access point to
10 respond to it directly, without sending messages back through the first access point. In this manner, a closed loop information exchange is established between the wireless device and its neighbouring cells.

Fig.1 shows a wireless device 1, or terminal, which transmits a request 2 to its current access point 3. This request 2 is processed by the network 4, which can be the
15 same network for all 3 access points shown, or one or more of these access points may belong to a different network, and a response 5 may be transmitted through the access point 3, or neighbouring access point 5, 6 using responses 7, 8, or indeed all three of them, if deemed necessary by the network.

In Fig. 2, the message sequence is shown in more detail. The wireless device,
20 or terminal 1 connects 11 in its usual manner to the access point 3, typically using key passing mechanisms, such as pairwise transient key (PTK) and group temporal key (GTK). The wireless device 1 transmits an inform message 12 to the access point 3, containing a locally generated unique token. Fig.3a shows an example of the request
18 message content including the token and Fig.3b shows the same for the response 23 message content. In the request message there is a header 19, token 20 and requests 21,
25 22 for information of type 1 and type 2. In the response message 23, again there is a header 19 and token 20, along with blocks 24, 25 with information of type 1 and type 2 respectively. The inform message is forwarded 13, 14 by the access point 3 to the access points 5, 6. If these access points 5, 6 decide that it is useful, or indeed possible,
30 to transmit information back to the wireless device, they do so using either a unicast or multicast message 15, 16 including action or beacon and containing a suitable hash of the neighbouring access point identity (#BSSID) in a particular network (SSID), together with the token, so that the wireless device 1 can correctly identity the message

and determine the identity of that neighbour access point 5, 6. The terminal can then associate with its preferred AP 5 after getting back the information, using the same message format as for the original connection 11, but with a different base station identified from the access point identifier, BSSID and the network identifier, SSID.

5 This invention provides a considerable advantage to the standardisation of IEEE 802.11 equipment. An engineering solution which reduces the number of over the air signalling messages is regarded as a key advance in this area. It is important to be able to minimise the amount of signalling (especially broadcast) traffic to allow the radio resources to be used for data transfer. The consequence of this is that network and
10 neighbour discovery latency times are reduced.

 Additional functionality is provided to the system in two respects, firstly that closed group information is provided to the wireless terminal (i.e. information received may be based on its credentials); and secondly that closed group information is provided to the access points, allowing load balancing and filtering of traffic to the
15 wireless device (i.e. policy control) and load balancing of existing wireless devices). Cross administrative domain information (e.g. cross IEEE 802.11 SSID information) can be passed and managed.

 The network can also manage all the network access points within the potential pool, achieving load balancing which would not occur purely with neighbourhood
20 reports (e.g. IEEE 802.11k/802.11v).

CLAIMS

1. A method of network selection for a wireless user device in radio communication with a first access point of one or more networks, via at least one of a plurality of access points, the method comprising sending a network selection request from the wireless user device to the first access point; wherein if the network wishes to initiate a response from another access point in the same or another network, the first access point forwards the network selection request to one or more neighbouring access points, in the same or another network; wherein if any of the neighbouring access points is able to communicate with the user device, that neighbouring access point sends a response directly to the wireless user device; and wherein the wireless user device chooses the most suitable network from the responses sent.
2. A method according to claim 1, wherein a token provided by the wireless user device is attached to the network selection request before it is forwarded by the first access point to neighbouring access points.
3. A method according to claim 1 or claim 2, wherein the network selection request includes requirements relating to the service the wireless user device would like to obtain from any access point and its associated network.
4. A method according to any preceding claim, wherein the associated network of the first access point forwards the network selection request to more than one neighbouring access point, in the same or another network, simultaneously.
5. A method according to any preceding claim, wherein an access point that is able to communicate with the wireless user device responds directly to the wireless user device indicating the level of support that is available from the associated network of the access point for the service request from the wireless user device.
6. A method according to any preceding claim, wherein the response is delivered via a unicast or multicast message delivery method, and includes the token provided by the wireless user device in the initial request,

7. A method according to any preceding claim, wherein the wireless user device is one of a laptop, a mobile phone or any wireless device supporting the appropriate air interface.