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(54) **NETWORK ACCESS AND PROFILE CONTROL**

(75) Inventors: **Andrew Baron**, Redmond, WA (US); **Taroon Mandhana**, Redmond, WA (US); **Amir Zohrenejad**, Seattle, WA (US)

(73) Assignee: **Microsoft Technology Licensing, LLC**, Redmond, WA (US)

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G06F 21/62 (2013.01)

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CPC ***H04L 63/102*** (2013.01); ***G06F 21/6209*** (2013.01); *G06F 2221/2137* (2013.01); *G06F 2221/2143* (2013.01)

(58) **Field of Classification Search**
USPC 726/6–7
See application file for complete search history.

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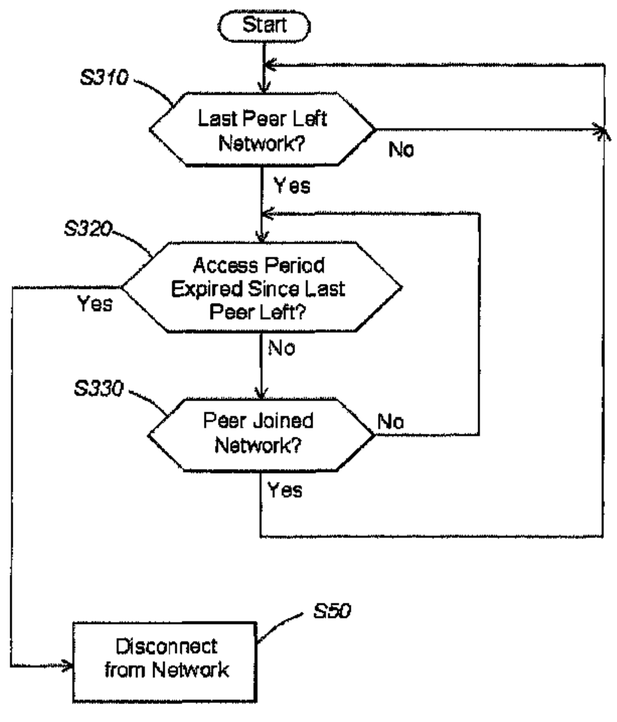
Primary Examiner — Taghi Arani
Assistant Examiner — Phy Anh Vu
(74) *Attorney, Agent, or Firm* — Ladislav Kusnyer; Judy Yee; Micky Minhas

(57) **ABSTRACT**

A method and apparatus for managing network profiles and/or access to a network. Network profiles stored in a computer may be deleted and/or a connection to a wireless network may be disabled when a corresponding access period for the network has been exhausted. The access period may define an amount of time, a number of connections, a number of bits or packets of information, or other measure of connectivity to a network and/or maintenance of profile information related to the network that may be limited in some fashion.

8 Claims, 3 Drawing Sheets



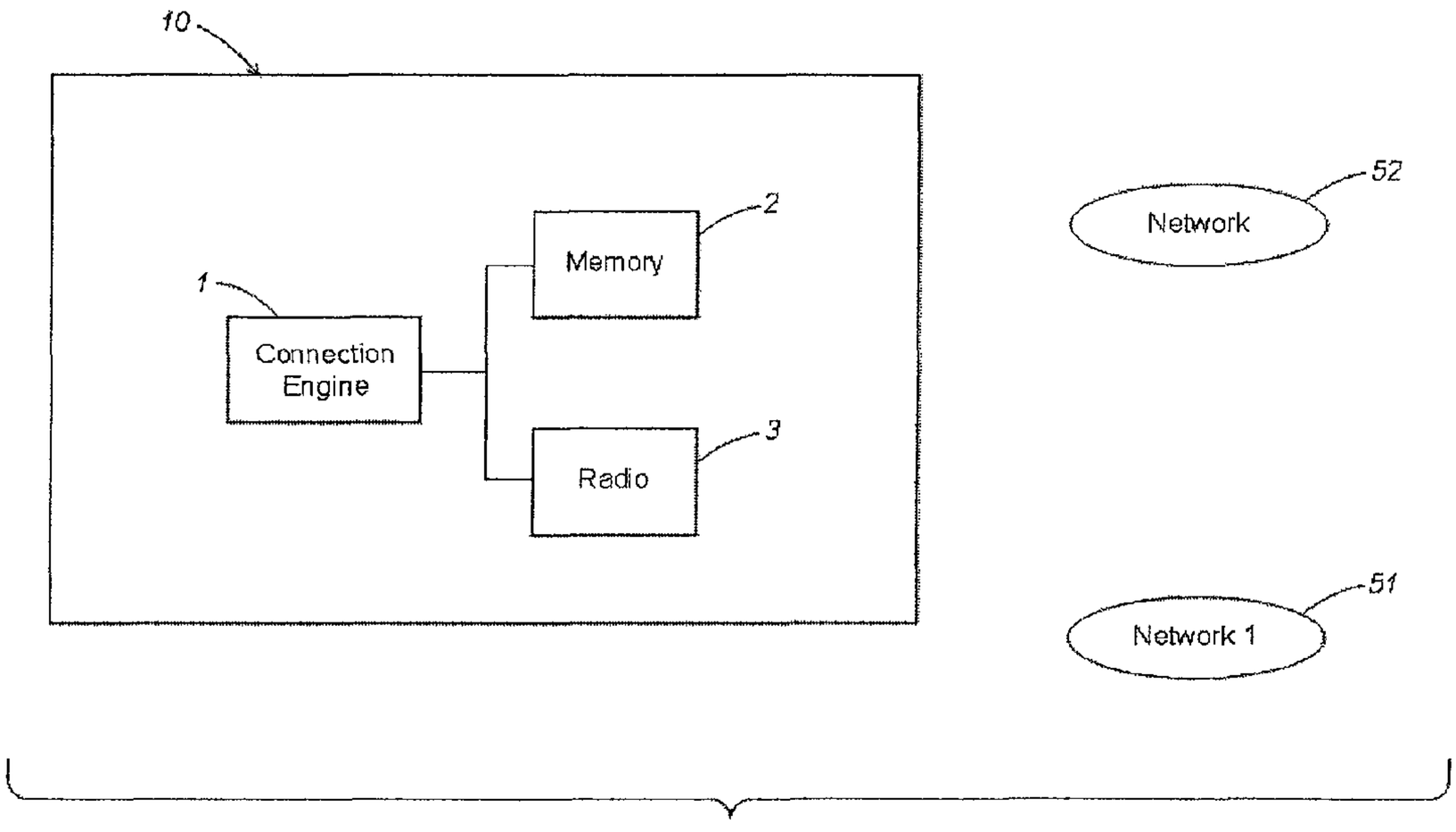

10
1
Connection Engine
2
Memory
3
Radio
52
Network
51
Network 1

FIG. 1

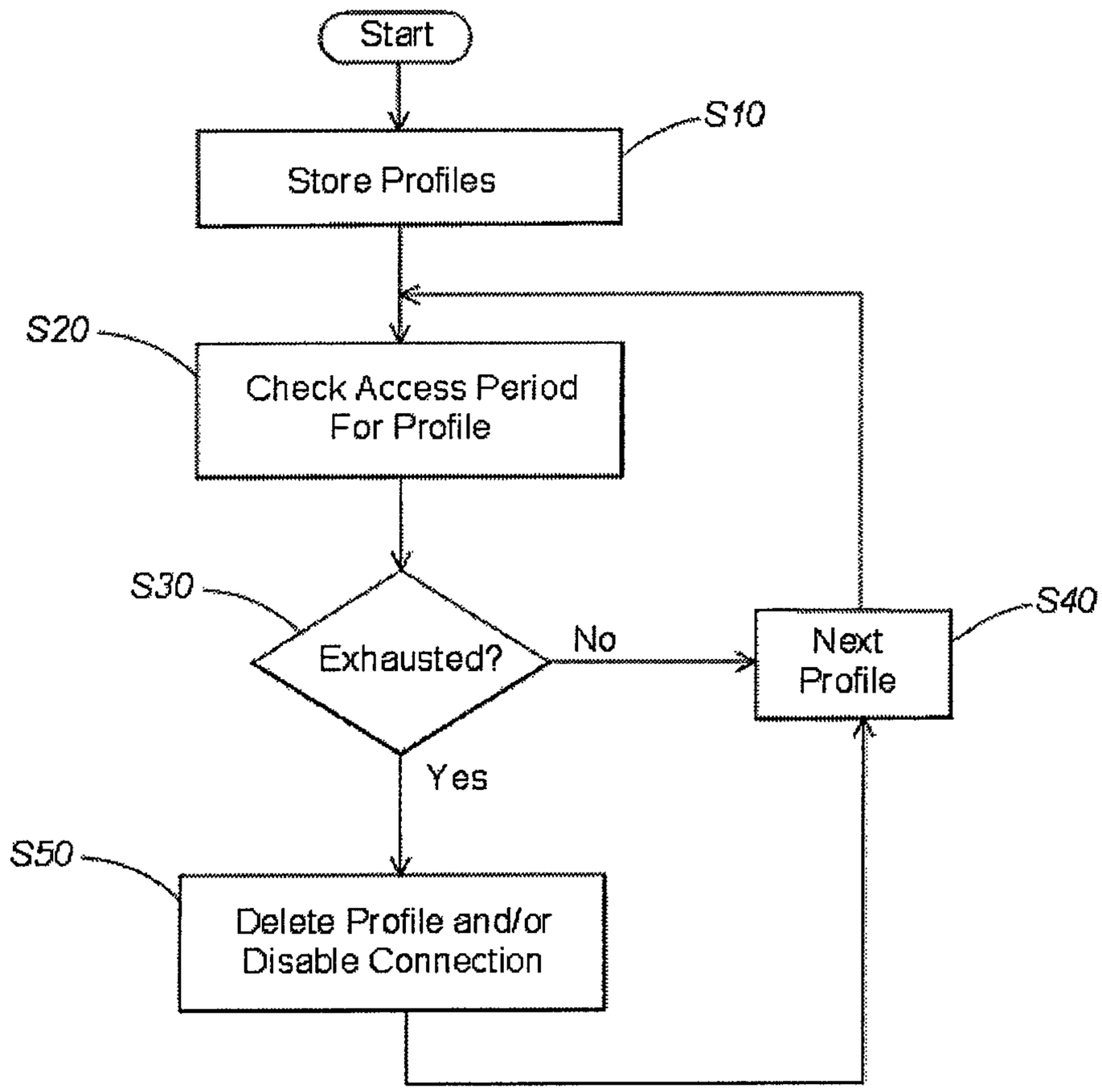

Start
S10
Store Profiles
S20
Check Access Period For Profile
S30
Exhausted?
No
S40
Next Profile
Yes
S50
Delete Profile and/or Disable Connection

FIG. 2

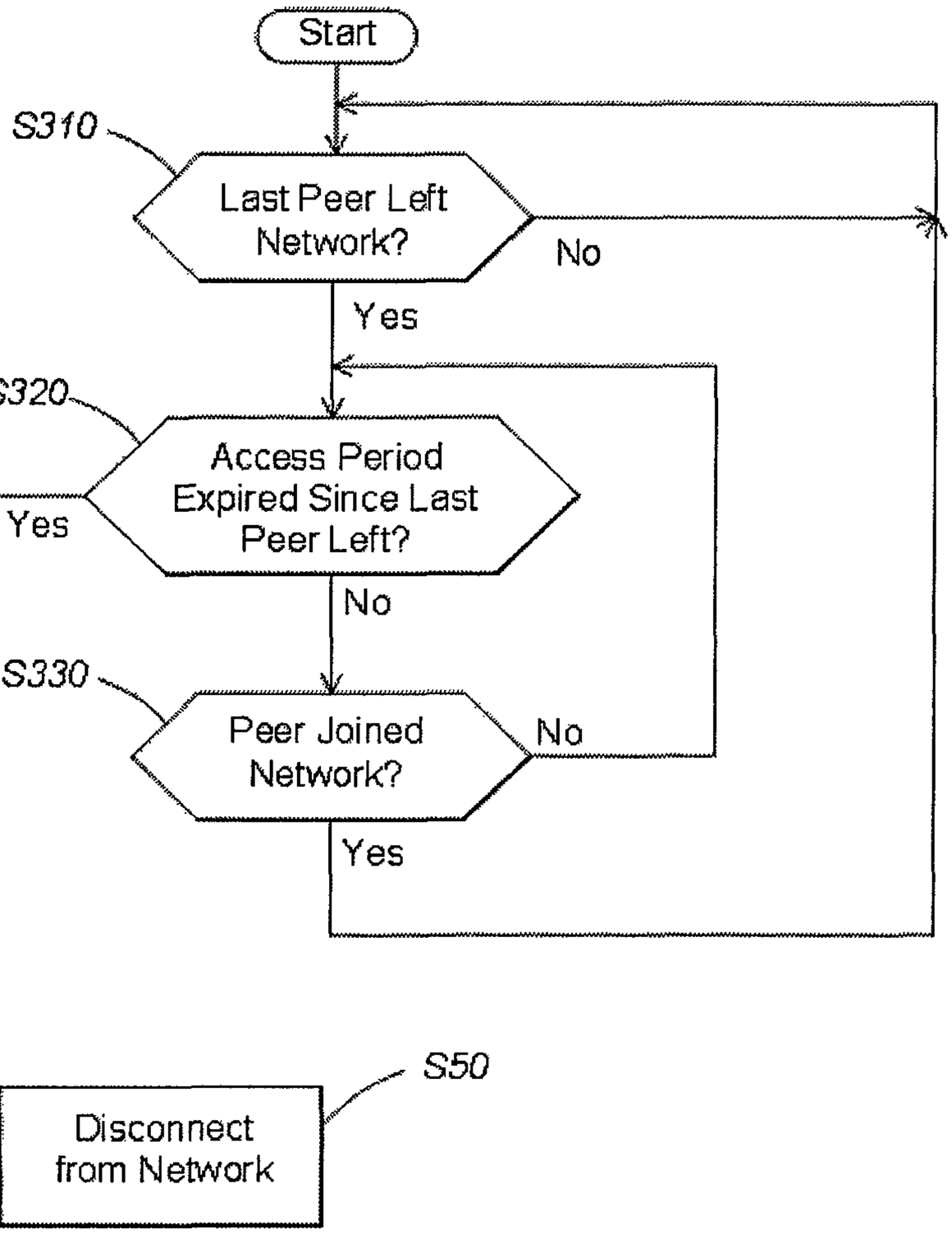

Start
S310
Last Peer Left Network?
No
Yes
S320
Access Period Expired Since Last Peer Left?
Yes
No
S330
Peer Joined Network?
No
Yes
S50
Disconnect from Network

FIG. 3

NETWORK ACCESS AND PROFILE CONTROL

BACKGROUND

1. Field of Invention

This invention relates to controlling access to a network and/or controlling stored network profiling information, e.g., information used to establish a connection with a wireless network.

2. Related Art

When connecting to a wireless network, such as a wireless network operating according to the IEEE 802.11 standard, client machines need certain parameters regarding the configuration settings of the network. A client machine may obtain this information in the process of establishing a connection with the network, and save the information for later use when reconnecting to the same network. These settings are commonly referred to as network profiles and are usually stored on the client machine indefinitely.

SUMMARY OF INVENTION

The inventors have appreciated that although storing network profiles on client machines for indefinite periods of time may work well for users that regularly and repeatedly connect to a limited number of networks, problems can arise for users that connect to many different networks. For example, some users of laptop computers may connect to several different wireless networks in a single day, many of which the user may never again use. The end result is that highly mobile users may have hundreds of network profiles stored on their computers. In some cases this can cause problems, for example where the computer detects the presence of a network having the same name as that in one of the stored network profiles, and in response connects to the network. However, many wireless networks are established with the same network name (such as the manufacturer name or model of the router), and thus the computer may connect to an unknown or unwanted network. Connection to such networks may jeopardize the security of the computer, especially if the network is being operated by a person seeking to gain unauthorized access to machines that connect to the network.

In another example, when users establish an adhoc peer-to-peer network, a network profile may be stored, and when the computer is not connected to the network, the computer may continuously beacon in an effort to reestablish contact with the network. This beaconing can be exploited by malicious users, e.g., by acting as another machine in the network and gaining access to the computer or receiving sensitive information. In another example, when a computer beacons to join a network, the beacon signal may include the name of the network that the computer is seeking to connect to. A malicious user may use this information to spoof the network, causing the computer to establish a connection in an unwanted way. A large set of stored network profiles may also slow down the computer's ability to connect to a suitable network, since the computer may cycle through a long list of "preferred" networks in an attempt to connect before finding an appropriate network.

Aspects of the invention provide for the establishment of an access period for each network profile stored on a client machine, such as a computer, personal digital assistant (PDA), cellular telephone, laptop computer, or other suitable device. (Such devices are referred to collectively herein as a "computer.") The access period may define an interval (such as a period of time, expiration date, number of connections,

number of bits, packets, or other units of information sent and/or received over the network, or other) over which the computer may connect to the network and/or after which the stored network profile is deleted. For example, in one embodiment, a network profile that is stored after an initial connection to a network may be deleted from the computer if the computer does not again establish a connection to the network within a certain number of days, weeks, years or other time period. Thus, the computer need not necessarily retain network profiles for networks longer than a specified period, such as two months, if no intervening connection to the network is made. However, if the computer establishes a connection to a network within the two month period, the access period may be reset, causing the computer to retain the network profile for at least another two months.

In another embodiment, exhaustion of the access period may cause the computer to disconnect from the network. For example, after establishing a connection with an adhoc peer-to-peer network and communicating in the network, the computer may be permitted to attempt to maintain a connection with the network for a certain period of time after the last peer in the network leaves. However, after the specified time period passes, the computer may be caused to automatically terminate further participation in the network. For example, after the last peer leaves a network, the computer may be permitted to attempt reconnection for another ten minutes. Thereafter, the computer may be prevented from attempting to establish further connection. In addition, or alternately, a network profile stored for the peer-to-peer network may be deleted once the access period has expired. Deletion of the network profile may essentially prevent the computer from attempting reestablishment of the connection to the network, since information needed for reconnection attempts may no longer be accessible to the computer.

In another embodiment, a network profile and corresponding access period may be established to provide a computer with temporary access to a network, e.g., to allow a visitor temporary access to the network that effectively expires when the visitor departs. For example, a network administrator may push a network profile along with a corresponding access period to a computer via a wired connection to the computer. The network profile may include information that enables the computer to connect with a wireless network under the control of the administrator. Thus, the computer, using the network profile received from the administrator, may establish a connection with the wireless network until the access period provided with the network profile is exhausted. Upon exhaustion of the access period, the network profile may be deleted and/or the computer may be caused to automatically disconnect from the network.

In one aspect of the invention, a method for managing wireless network profiles includes providing a computer constructed and arranged to communicate wirelessly with at least one other device in a wireless network, and storing one or more network profiles in a memory of the computer. Each network profile may include information regarding a corresponding wireless network that the computer has communicated with or is intended to communicate with and include at least a network name and a security setting of the wireless network. Information in the network profile may be used by the computer in initiating a connection with the corresponding wireless network. An access period may be established over which each of the network profiles will be maintained in the memory of the computer, and at least one network profile may be deleted and/or a connection to the corresponding wireless network may be disabled when a corresponding access period for the network profile has been exhausted.

In another aspect of the invention, a computer readable medium may include instructions that, when executed on a computer system, causes the computer system to perform a method for managing network access. One or more network profiles may be stored in the memory of the computer system, where each network profile includes information regarding a corresponding wireless network that the computer has communicated with or is intended to communicate with and includes at least a network name and a security setting of the network. Information in the network profile may be used by the computer in initiating a connection with the corresponding wireless network. An access period may be established over which each of the network profiles will be maintained in the memory of the computer, and at least one network profile may be deleted and/or a connection to the corresponding wireless network may be disabled when a corresponding access period for the network profile has been exhausted.

In another aspect of the invention, a computer includes a radio constructed and arranged to communicate with a wireless network, and a memory storing one or more network profiles. Each network profile may include information regarding a corresponding wireless network that the computer has communicated with or is intended to communicate with and include at least a network name and a security setting of the network. Information in the network provide may be useable by the computer in initiating a connection with the corresponding network. A connection engine may delete a network profile in the memory and/or disable the radio from communicating with a network that corresponds to a network profile in the memory if an access period for the network has been exhausted.

These and other aspects of the invention will be apparent from the following detailed description and claims.

BRIEF DESCRIPTION OF THE DRAWINGS

Aspects of the invention are described with reference to illustrative embodiments and the following drawings in which like numerals reference like elements, and wherein:

FIG. **1** shows a schematic block diagram of a computer arranged in accordance with aspects of the invention and illustrative networks to which the computer may connect;

FIG. **2** is a flow chart of steps in a method for managing network profiles and/or network connectivity; and

FIG. **3** shows steps in a method for managing an access period in a peer-to-peer network.

DETAILED DESCRIPTION

Aspects of the invention are described below with reference to illustrative embodiments. However, it should be appreciated that aspects of the invention are not limited to any of the particular embodiments. For example, examples are provided below regarding communication of a computer with one or more wireless networks. However, it should be appreciated that aspects of the invention may be employed in environments in which the computer communicates with one or more wired networks or other arrangements. In addition, the examples below include the computer acting as a client within the network. However, it should be understood that the computer may function as an access point or other similar device in a network, as well as functioning as a client in one or more other networks. Also, as mentioned above, illustrative embodiments are described using the term "computer" to refer to the device on which network profiles or other network access parameters are managed. However, it should be understood that the term computer as used herein may refer to a general purpose programmable computer, including a desktop or a laptop computer, as well as a wireless telephone, PDA, or other device.

FIG. **1** shows a schematic block diagram of a computer **10** that is arranged in accordance with aspects of the invention. Although in this illustrative embodiment, only selected portions of the computer **10** are identified as being included in the computer **10**, this is done for purposes of clarity and not to limit aspects of the invention in any way. For example, the computer **10** may include one or more additional volatile or non-volatile memories, a central processing unit, a display, a keyboard and/or other user input devices, as well as any suitable software or other instructions that may be executed by the computer **10** so as perform desired input/output or other functions.

In the illustrative embodiment, the computer **10** includes a connection engine **1** that can communicate with a memory **2** (e.g., a volatile or non-volatile RAM or other) and a radio **3** which may include a hardware controller such as a Network Interface Card (NIC) driver as well as suitable hardware such as a wireless radio card or other device. In the case where the computer **10** also communicates with wired networks, the radio **3** may also include a suitable driver and hardware for such communication.

FIG. **1** also shows two networks **51** and **52** with which the computer **10** may communicate via the radio **3**. These networks **51** and **52** may take any suitable form, such as 802.11 wireless networks, devices configured to operate in a peer-to-peer network (or adhoc network), etc.

In accordance with an aspect of the invention, the connection engine **1** may store information regarding networks with which the computer **10** has connected with and/or networks with which the computer **10** is intended to connect with for communications. Such information is referred to herein as a network profile and may include the network name, security settings for the network, an encryption key or other similar information, a network type, etc. The information in a network profile may be provided in any suitable way, such as by the connection engine **1** obtaining some or all of the information in a network profile from the network itself, by a user manually entering or otherwise providing the information, and/or by a network administrator or other device sending the information to the connection engine **1**, e.g., via a wired connection to the computer **10**. The connection engine **1** may store the network profiles in any suitable way in the memory **2**, such as in a database format, flat file, hierarchical file directory, etc.

In accordance with an aspect of the invention, one or more of the network profiles may be associated with an access period that defines how the network profile for the corresponding network will be maintained and/or define how the computer **10** will connect with the corresponding network. For example, the access period may define a period of time over which the network profile will be maintained in the memory **2** after a last connection of the computer **10** with the network. For example, the access period may define that the network profile is to be deleted from the memory **2** if more than a specified time period (such as one day, one week, one month, etc.) passes after the computer **10** last connected with the network. In one illustrative embodiment, the connection engine **1**, upon connecting with a network, may establish a future date and time that the network profile for the corresponding network will be deleted if the computer **10** does not again reconnect with the network before the established date and time. If the future date and time are reached without a reconnection to the network, the connection engine **1** may delete the network profile from the memory **2**. However, if the

computer **10** reconnects with the network before the date and time are reached, the connection engine **1** may establish a new future date and time at which the network profile will be deleted. In this way, the connection engine **1** can ensure that "stale" or otherwise unused network profiles are deleted from the memory **2**.

Those of skill in the art will appreciate that an access period established like that in the example above may be achieved in ways other than establishing a future date and time. For example, only a future date may be established and old network profiles may be deleted at any time after that date. For example, the connection engine **1** may only act to delete old network profiles at each time the computer **10** is started up. In such cases, the computer **10** may not actually be operating on the precise date and/or time on which a network profile is to be deleted. Instead, the connection engine **1** may determine that any network profile having an exhausted access period, whether on that day or on some past day, is to be deleted.

In another example, the access period may be established as an amount of time, such as one hour, ten hours, one day, etc. The connection engine **1** may count the access period time using a clock or other suitable means and take appropriate action, such as deleting the network profile, upon exhaustion of the access period. The clock regarding the access period may begin to count down (or up) when the network profile is first stored, when the computer **10** makes a first connection to the network, when the computer **10** disconnects from the network or based on any other suitable trigger.

In another example, the access period may establish a specified interval over which the computer **10** is permitted to connect with the corresponding network. For example, the access period may define a total amount of time that the computer **10** may be connected to the corresponding network, such as five minutes, thirty minutes, one day, etc. Thus, when the computer **10** is actually connected to the network, the connection engine **1** may count down (or up) the amount of connectivity time defined by the access period. Once the access period has been exhausted, the connection engine **1** may cause the computer **10** to disconnect from the network. Alternately, the connection engine **1** may delete the network profile for the network, potentially allowing the computer **10** to maintain its connection with the network (e.g., until the user causes a disconnection), but preventing any future reconnection with the network. Such an arrangement may be used, for example, with hotel guests who are provided with network profile information for a wireless or other network in a hotel room. The access period may allow for the computer's connection with the network for a specified amount of time, but prevent network access beyond that time. For example, the guest may be provided with an hour's worth of free network access, but may be required to pay for access beyond one hour. In another example, the interval defined by the access period may define a total number of bits, a total number of connections to the network, a total number of packets, that the computer **10** is to disconnect from a peer-to-peer network after a last peer has left the network for some period of time, and so on.

FIG. **2** shows a flow chart of steps and a method for managing network profiles and/or access periods for a network. In step S**10**, a network profile is stored for a plurality of networks. For example, the connection engine **1** in a computer **10** may receive profile information, such as the network name, security settings, authorization requirements, encryption codes, or other information, and store the network profile in any suitable way. The network profile information may be received by the connection engine **1** in the process of connecting with a network. Alternately, network profile information may be received from another source, such as a storage medium (e.g., an CD-ROM, flash memory, or other) via a wired network connection to an administrator which provides the profile information, or in other ways.

In step S**20**, an access period for a network profile may be checked. As discussed above, the access period may include a date and/or time at which the network profile is to be deleted. In other embodiments, the access period may define a total amount of time that the computer **10** may connect to the corresponding network, a total number of connections that may be made with the network, a total number of bits, packets or other measure of information sent and/or received over the network, and so on.

In step S**30**, the connection engine **1** may determine whether the access period for the network has been exhausted. For example, if the access period is defined by a date and time, the connection engine **1** may compare the current date and time to the access period date and time, and if the access period date and time has already passed, the connection engine **1** may delete the network profile. In another embodiment, if the access period defines a total number of connections that the computer **10** may make with the network, the connection engine **1** may compare the number of connections made with the network since the network profile was created to the number corresponding to the access period. (The connection engine **1** may keep track of network connections, incrementing a connection count variable for each connection.) If the number of connections actually made by the computer **10** to the network is equal to or exceeds the number in the access period, the connection engine **1** may delete the network profile and/or prevent the computer **10** from making future connections with the network. If the access period is not exhausted, flow continues to step S**40**, where the connection engine **1** continues step S**20** with a next network profile and corresponding network.

However, if the access period is exhausted, flow continues with step S**50**, where the network profile is deleted and/or the computer **10** is caused to disconnect from the network (if connected) or further connection to the network is prevented. In some cases, the deletion of the network profile may prevent future connection to the corresponding network, e.g., because the computer may not have sufficient information to establish a connection (such as a network name, security code, etc.). However, in other embodiments, deletion of the network profile may not necessarily prevent future connection with the network (e.g., for open, unsecured networks), but instead may simply help to reduce the total number of stored network profiles as well as prevent the computer **10** from attempting to connect to the network in the future. Once the network profile has been deleted and/or connection to the network has been terminated, flow may continue to step S**40** where a next network profile is assessed with respect to its access period.

The connection engine **1** may perform the steps shown in FIG. **2** at any suitable interval or event (such as each time the computer **10** is started, every day, every week, every time the computer disconnects from a network, and so on). In another embodiment, the steps shown in FIG. **2** may be performed every time the computer **10** attempts to connect with any network and/or at the command of a user.

FIG. **3** shows a flow chart of steps in a method for managing an access period related to a peer-to-peer network that may be implemented in accordance with aspects of the invention. The steps shown in FIG. **3** may be performed as part of the implementation of steps S**30** and S**50** in FIG. **2**. In step S**310**, a check may be made regarding whether the last peer in a peer-to-peer network has left the network. If at least one other peer aside from the computer **10** remains connected to the

network, flow may recursively jump back to step S**310**. However, if a last peer has left the network, flow may continue to step S**320** for a determination as to whether the access period for the network has been exhausted since the last peer left the network. For example, the access period may define that the computer **10** is to disconnect from the peer-to-peer network, zero seconds, ten seconds, one minute, ten minutes, etc., after a last peer has left the network. In this way, the computer **10** may be prevented from continually attempting to reconnect to other peers in the network even after all peers have departed. If the access period has not been exhausted, flow may jump to step S**330** where a determination is made whether a peer has joined the network or not. If so, flow may jump back to S**310**. If not, flow may continue back to S**320**, where the connection engine **1** again determines whether the access period for the network has been exhausted. If the access period has been exhausted, flow may continue at step S**50** where the computer may disconnect from the network and the network profile deleted from the system.

Aspects of the invention, including embodiments described above, can be implemented in any of numerous ways. For example, the embodiments may be implemented using hardware, software or a combination thereof. When implemented in software, the software code can be executed on any suitable processor or collection of processors, whether provided in a single computer or distributed among multiple computers. It should be appreciated that any component or collection of components that perform the functions described above can be generically considered as one or more controllers that control the above-discussed functions. The one or more controllers can be implemented in numerous ways, such as with dedicated hardware, or with general purpose hardware (e.g., one or more processors) that is programmed using microcode or software to perform the functions recited above.

In this respect, it should be appreciated that one implementation of the embodiments of the present invention comprises at least one computer-readable medium (e.g., a computer memory, a floppy disk, a compact disk, a tape, etc.) encoded with a computer program (i.e., a plurality of instructions), which, when executed on a processor, performs the above-discussed functions of embodiments in accordance with aspects of the present invention. The computer-readable medium can be transportable such that the program stored thereon can be loaded onto any computer environment resource to implement the aspects of the present invention discussed herein. In addition, it should be appreciated that the reference to a computer program which, when executed, performs the above-discussed functions, is not limited to an application program running on a host computer. Rather, the term computer program is used herein in a generic sense to reference any type of computer code (e.g., software or microcode) that can be employed to program a processor to implement the above-discussed aspects of the present invention. It should be appreciated that in accordance with several embodiments of the present invention wherein processes are implemented in a computer readable medium, the computer implemented processes may, during the course of their execution, receive input manually (e.g., from a user).

While aspects of the invention has been described with reference to various illustrative embodiments, the invention is not limited to the embodiments described. Thus, it is evident that many alternatives, modifications, and variations of the embodiments described will be apparent to those skilled in the art. Accordingly, embodiments of the invention as set forth herein are intended to be illustrative, not limiting. Various changes may be made without departing from the invention.

The invention claimed is:

1. A method for managing wireless network profiles, the method performed by a computer comprised of processing hardware, storage hardware, and a wireless network interface having communicated wirelessly with wireless networks, the method comprising:

storing, in the storage hardware, a connection engine, and executing the connection engine by the processing hardware;

storing, in the storage hardware, by the connection engine, a plurality of network profiles for the wireless networks, respectively, the network profiles having been automatically generated by the connection engine in association with connecting to the wireless networks, respectively, each network profile including at least a network name and a security code of a corresponding wireless network for authentication therewith, wherein the network name in each network profile is configured to be used by the connection engine in initiating a connection with the corresponding wireless network, wherein the security code in each of the network profiles is configured to be used by the connection engine to establish a connection with the corresponding wireless network by authenticating therewith;

storing and maintaining, in the storage hardware, by the connection engine, indications of last-departure times for the network profiles, respectively, last-departure time corresponding to when a last device departure of a corresponding wireless network occurred, wherein the connection engine updates the last-departure times responsive to respective determinations of last device departures of corresponding wireless networks; and

determining, by the connection engine, that, for at least one or more of the network profiles, a threshold amount of time has passed since their respective last-departure times, and in response deleting or disabling the at least some of the network profiles and disconnecting from the corresponding wireless networks, the deleting or disabling causing the at least one or more of the network profiles to not be able to be used by the connection engine to connect to the corresponding wireless networks.

2. The method of claim **1**, wherein the last-departure times include respective dates and times of day.

3. A method according to claim **1**, wherein the wireless networks comprise WiFi networks.

4. A method according to claim **3**, wherein the wireless networks comprise ad hoc networks.

5. A computer comprising:

a radio constructed and arranged to communicate with a wireless network;

a memory storing a plurality of network profiles for a plurality of different wireless networks, each network profile including information regarding a corresponding wireless network that the computer has communicated with or is intended to communicate with and including at least a network name and a security setting of the corresponding wireless network, information in the network profile is used by the computer in initiating a connection with the corresponding wireless network; and

a connection engine comprising:

first logic configured to determine that a last device connected to the wireless network has left the wireless network and in response store a corresponding time in

a network profile corresponding to the last device connected, in the memory;

second logic configured to, if a last device has left the wireless network, delete and/or disable the network profile corresponding to the last device connected to prevent the radio from establishing connections for the wireless network, the deleting and/or disabling performed responsive to determining that a threshold period of time has passed according to the time in the network profile; and

third logic configured to, if the second logic has not determined that the threshold period of time has passed according to the time in the network profile corresponding to the last device connected, determine whether a device has joined the wireless network and in response disable the second logic.

6. The computer of claim **5**, wherein the time corresponds to a date and time of day.

7. A computing device according to claim **5**, wherein the wireless networks comprises WiFi networks.

8. A method according to claim **7**, wherein the wireless networks comprise ad hoc networks.

* * * * *