US 20050136927A1

(19) United States

(12) Patent Application Publication

(10) Pub. No.: US 2005/0136927 A1

(43) Pub. Date: Jun. 23, 2005

Enzmann

(54) METHOD AND APPARATUS FOR PROVIDING SEAMLESS CALL HANDOFF BETWEEN NETWORKS THAT USE DISSIMILAR TRANSMISSION METHODS

(76) Inventor: **Mark J. Enzmann**, Blairsville, GA (US)

Correspondence Address:
GARDNER GROFF, P.C.
2018 POWERS FERRY ROAD
SUITE 800
ATLANTA, GA 30339 (US)

(21) Appl. No.: 10/742,153

(22) Filed: Dec. 19, 2003

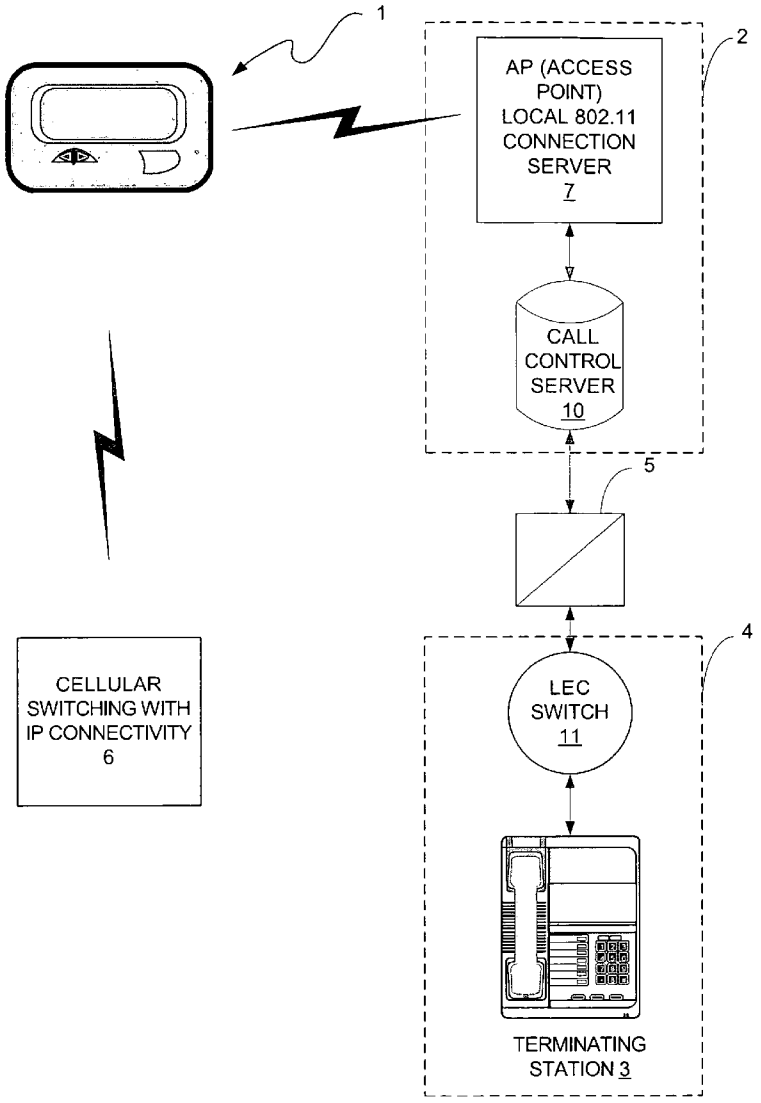
Publication Classification

(51) Int. Cl.[7] H04B 7/00

(52) U.S. Cl. 455/436; 455/41.2; 455/428

(57) ABSTRACT

Call handoff from an 802.1x network to a cellular network, and vice versa. A wireless device that has both cellular and 802.1x capability detects the strength of a cellular signal and of an 802.1x signal. If a call is taking place over the 802.1x network and the strength of the 802.1x signal drops below a particular level and the strength of the cellular signal is above a certain level, the call is handed off from the 802.1x network to the cellular network. If a call is taking place over the cellular network and the cellular signal strength drops below a certain level while the 802.1x signal strength is above a certain level, the call is handed off from the cellular network to the 802.1x network. In addition, the user of the wireless device can manually initiate the handoff by actuating a handoff selector of the wireless device.



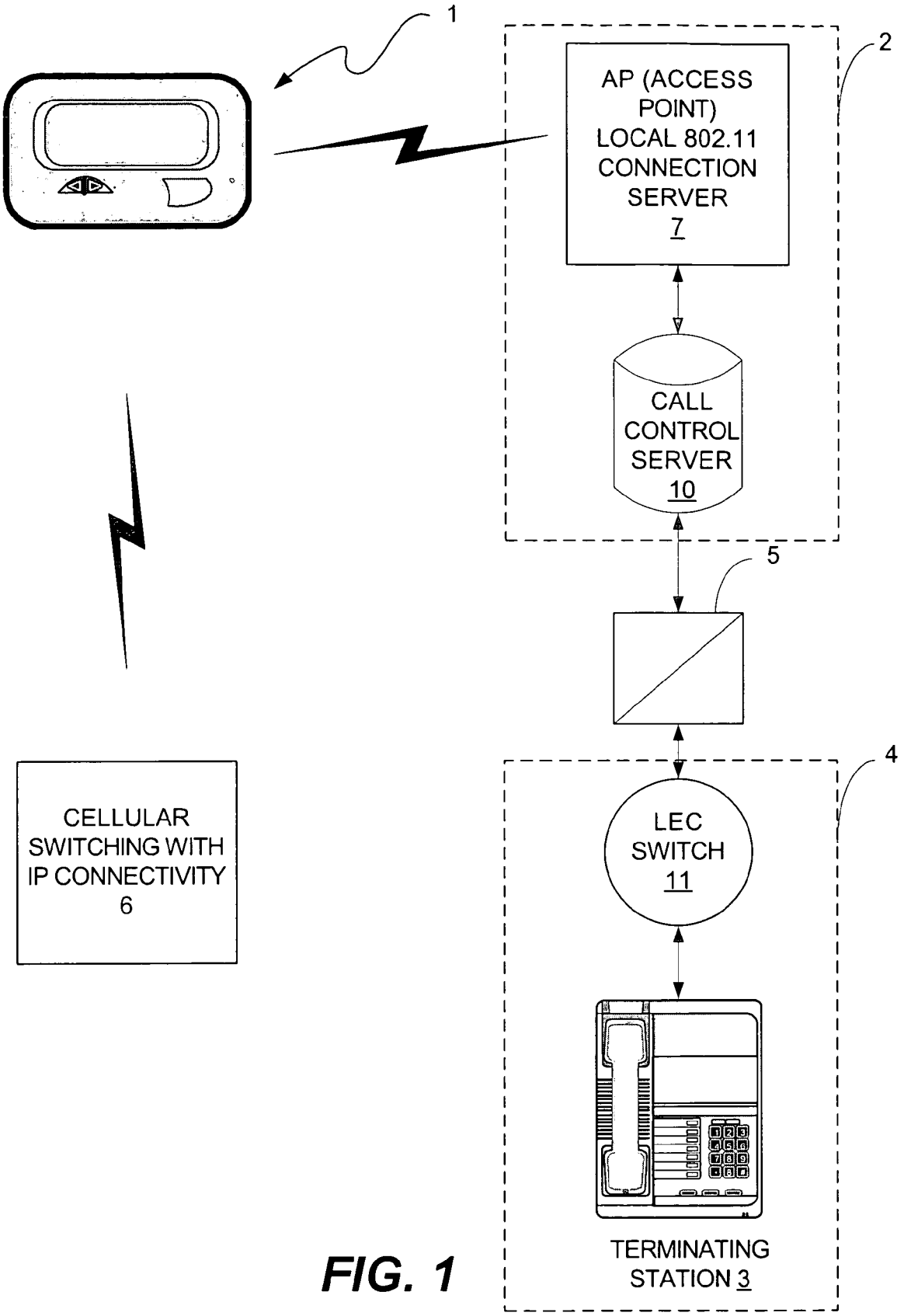

1
2
AP (ACCESS POINT) LOCAL 802.11 CONNECTION SERVER 7
CALL CONTROL SERVER 10
5
4
LEC SWITCH 11
CELLULAR SWITCHING WITH IP CONNECTIVITY 6
TERMINATING STATION 3

FIG. 1

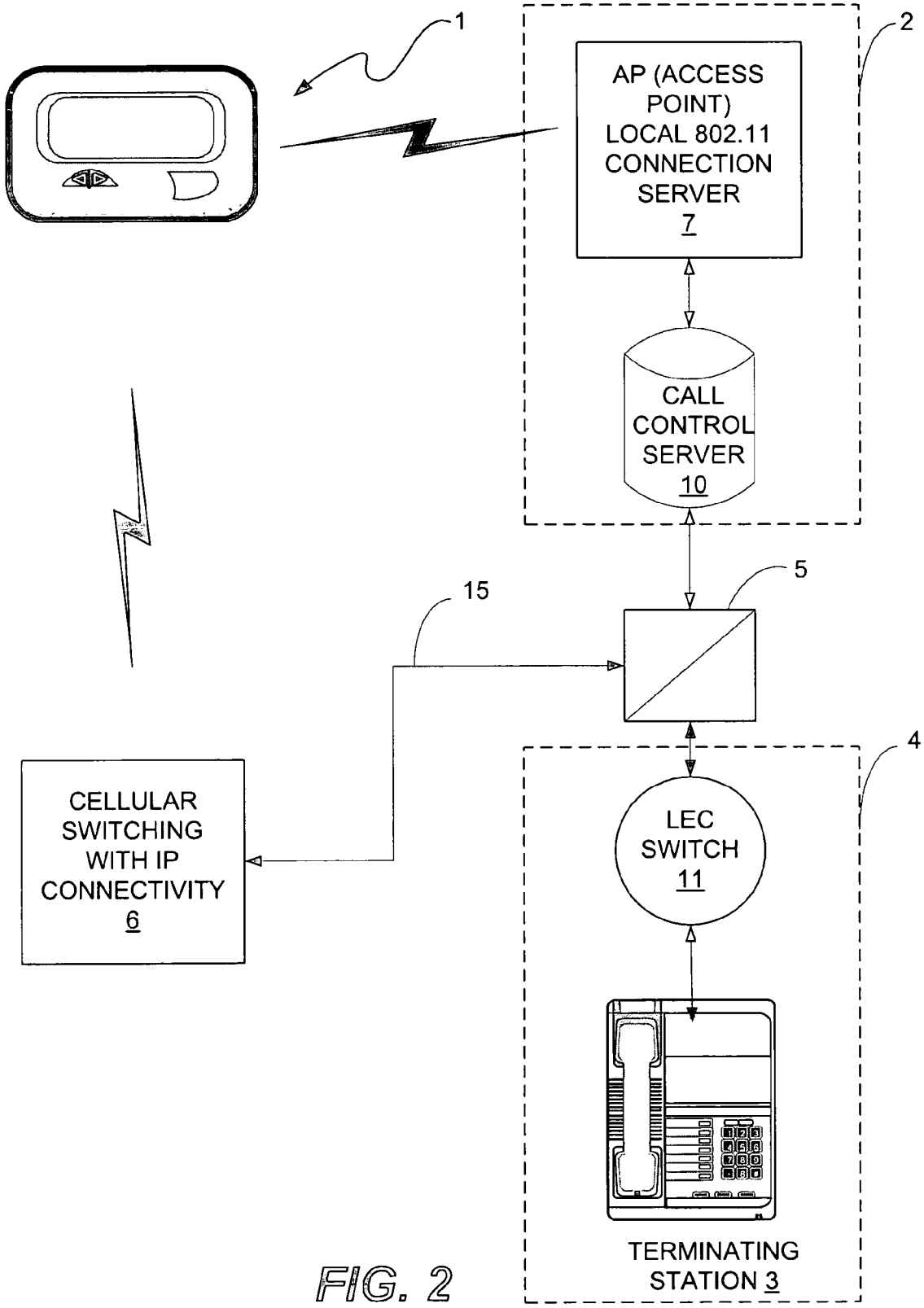

1
2
AP (ACCESS POINT) LOCAL 802.11 CONNECTION SERVER 7
CALL CONTROL SERVER 10
5
15
4
CELLULAR SWITCHING WITH IP CONNECTIVITY 6
LEC SWITCH 11
TERMINATING STATION 3

FIG. 2

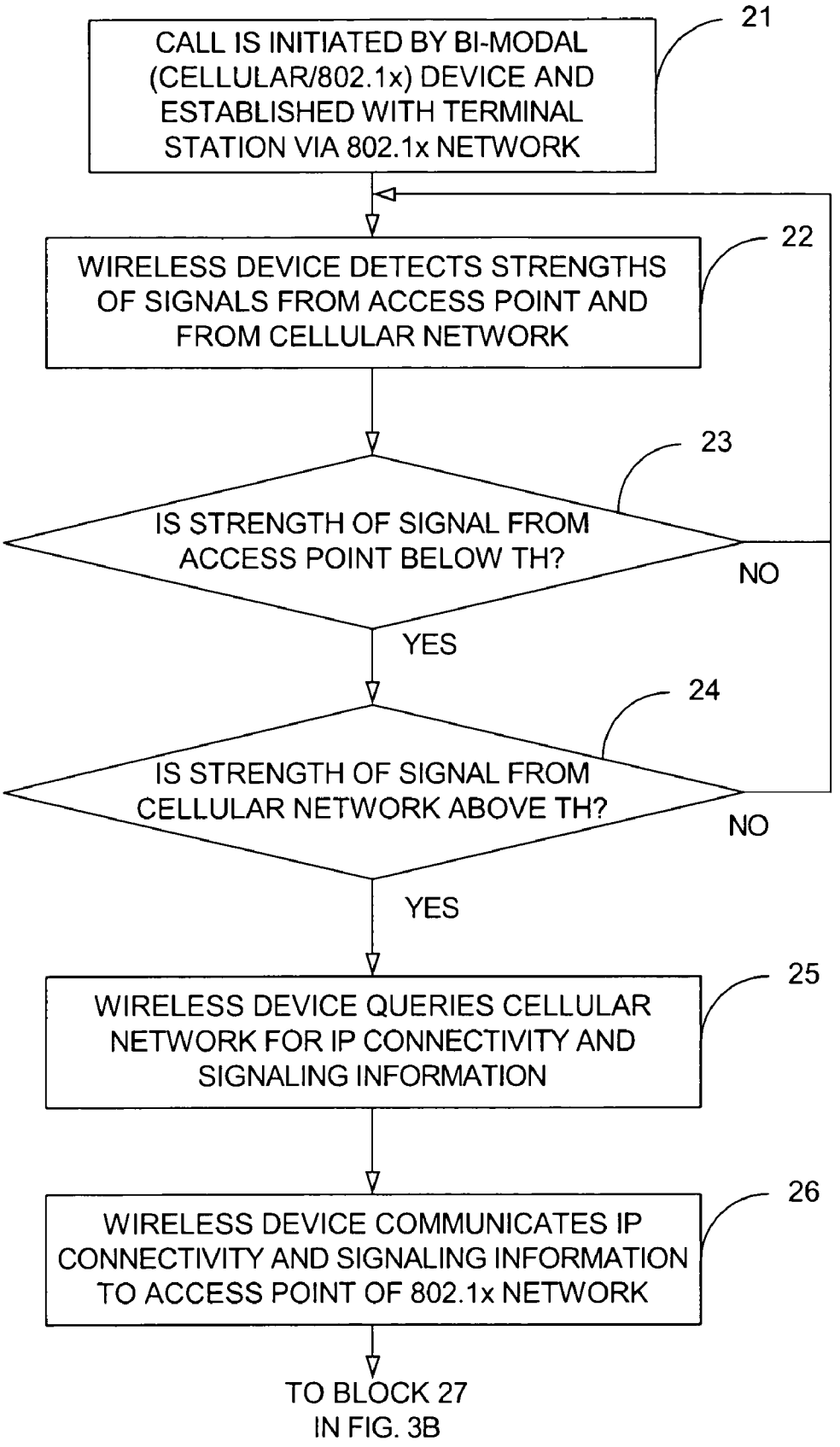

CALL IS INITIATED BY BI-MODAL (CELLULAR/802.1x) DEVICE AND ESTABLISHED WITH TERMINAL STATION VIA 802.1x NETWORK
21
WIRELESS DEVICE DETECTS STRENGTHS OF SIGNALS FROM ACCESS POINT AND FROM CELLULAR NETWORK
22
IS STRENGTH OF SIGNAL FROM ACCESS POINT BELOW TH?
23
NO
YES
IS STRENGTH OF SIGNAL FROM CELLULAR NETWORK ABOVE TH?
24
NO
YES
WIRELESS DEVICE QUERIES CELLULAR NETWORK FOR IP CONNECTIVITY AND SIGNALING INFORMATION
25
WIRELESS DEVICE COMMUNICATES IP CONNECTIVITY AND SIGNALING INFORMATION TO ACCESS POINT OF 802.1x NETWORK
26
TO BLOCK 27
IN FIG. 3B

FIG. 3A

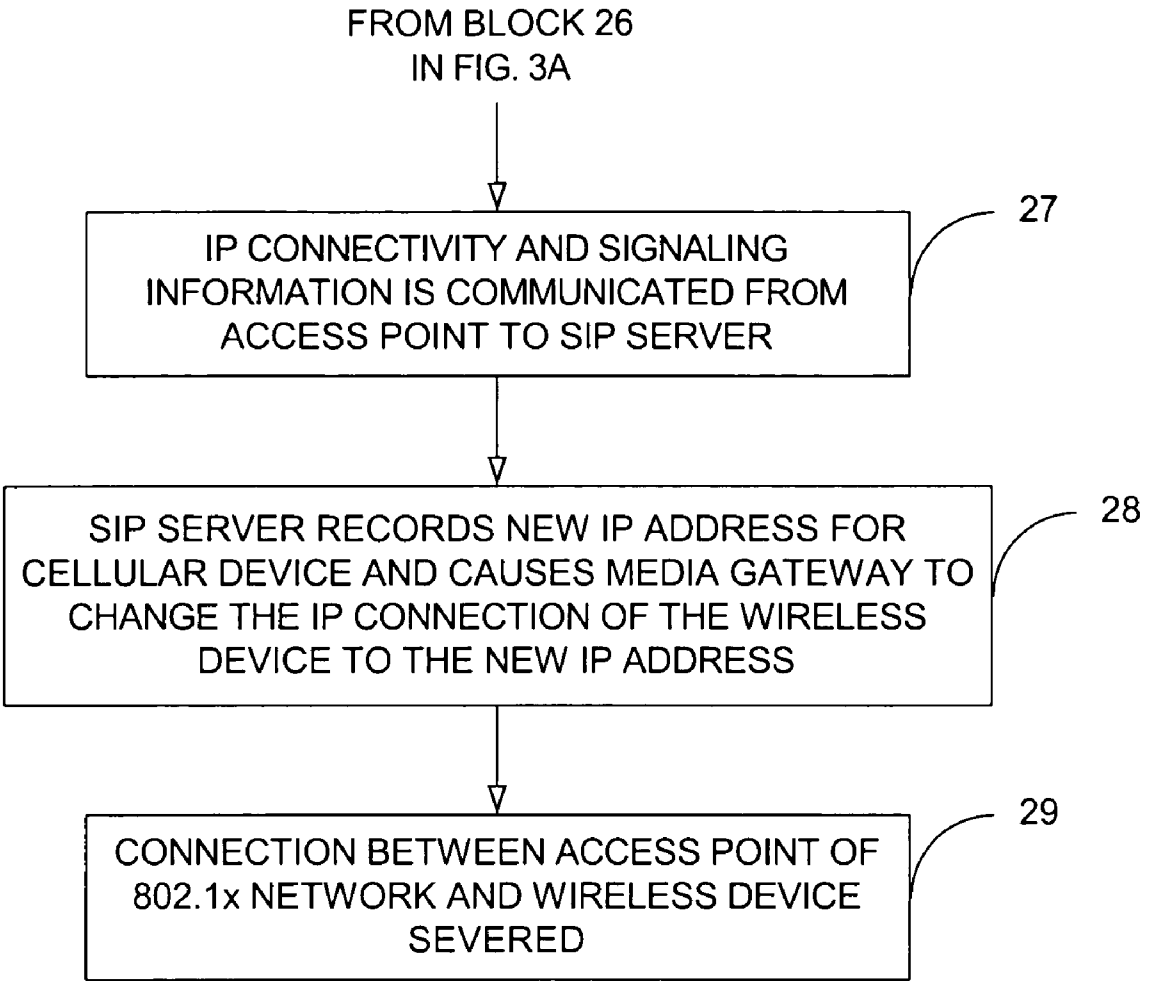

FROM BLOCK 26
IN FIG. 3A
IP CONNECTIVITY AND SIGNALING INFORMATION IS COMMUNICATED FROM ACCESS POINT TO SIP SERVER
27
SIP SERVER RECORDS NEW IP ADDRESS FOR CELLULAR DEVICE AND CAUSES MEDIA GATEWAY TO CHANGE THE IP CONNECTION OF THE WIRELESS DEVICE TO THE NEW IP ADDRESS
28
CONNECTION BETWEEN ACCESS POINT OF 802.1x NETWORK AND WIRELESS DEVICE SEVERED
29

FIG. 3B

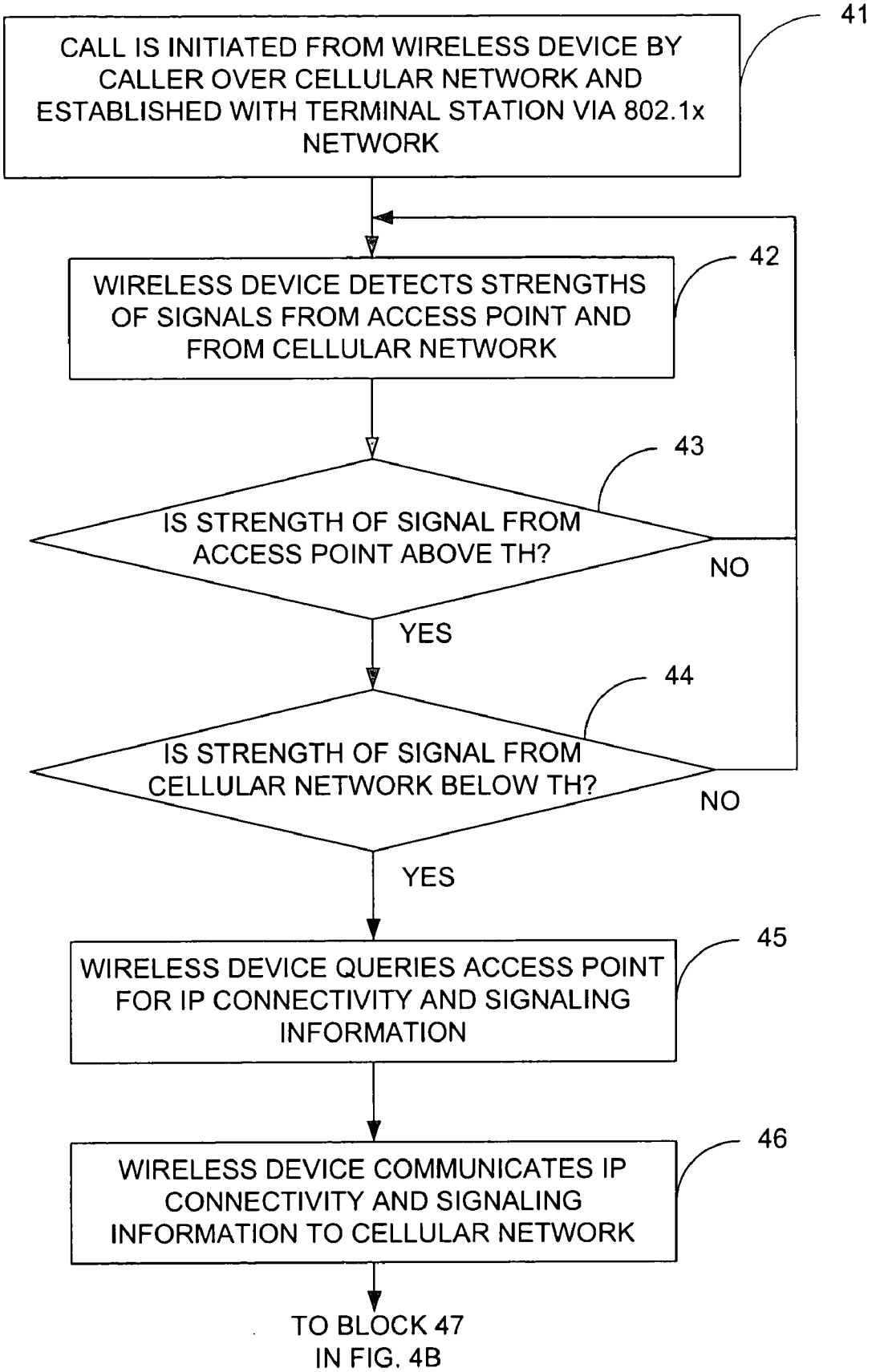

41
CALL IS INITIATED FROM WIRELESS DEVICE BY CALLER OVER CELLULAR NETWORK AND ESTABLISHED WITH TERMINAL STATION VIA 802.1x NETWORK
42
WIRELESS DEVICE DETECTS STRENGTHS OF SIGNALS FROM ACCESS POINT AND FROM CELLULAR NETWORK
43
IS STRENGTH OF SIGNAL FROM ACCESS POINT ABOVE TH?
NO
YES
44
IS STRENGTH OF SIGNAL FROM CELLULAR NETWORK BELOW TH?
NO
YES
45
WIRELESS DEVICE QUERIES ACCESS POINT FOR IP CONNECTIVITY AND SIGNALING INFORMATION
46
WIRELESS DEVICE COMMUNICATES IP CONNECTIVITY AND SIGNALING INFORMATION TO CELLULAR NETWORK
TO BLOCK 47
IN FIG. 4B

FIG. 4A

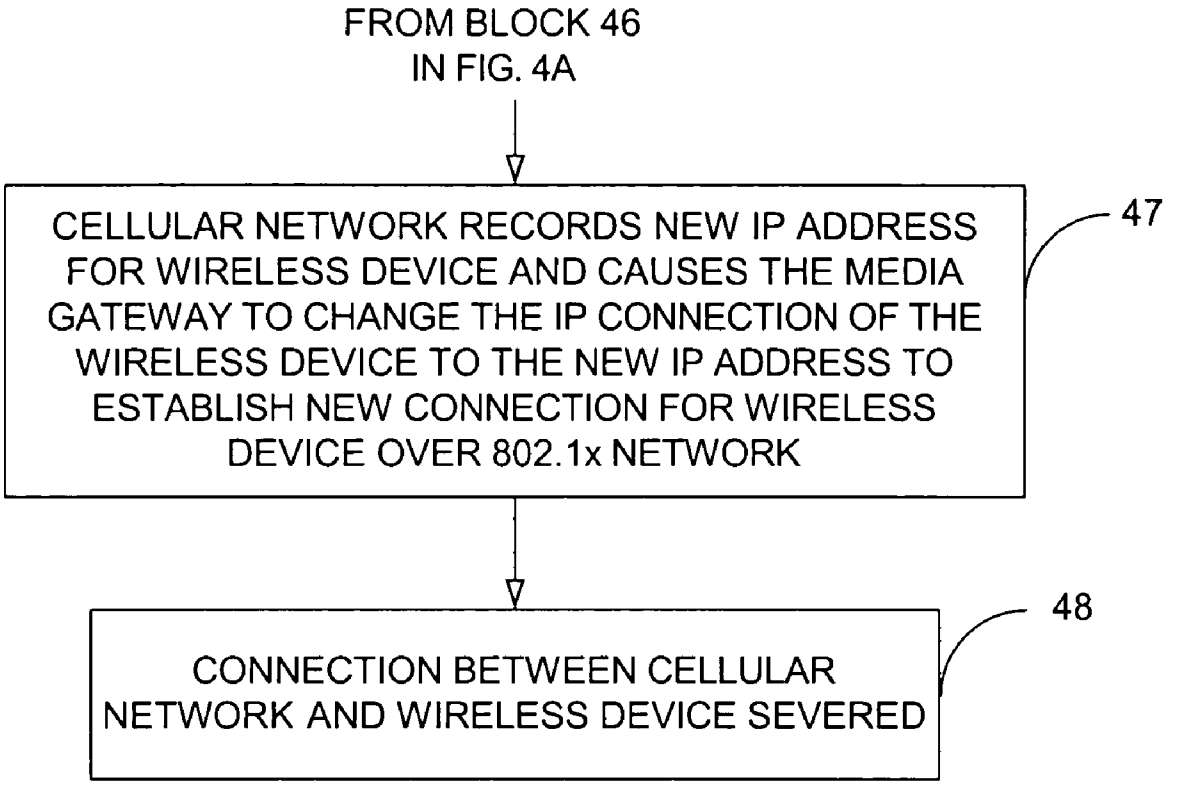

FROM BLOCK 46
IN FIG. 4A
CELLULAR NETWORK RECORDS NEW IP ADDRESS FOR WIRELESS DEVICE AND CAUSES THE MEDIA GATEWAY TO CHANGE THE IP CONNECTION OF THE WIRELESS DEVICE TO THE NEW IP ADDRESS TO ESTABLISH NEW CONNECTION FOR WIRELESS DEVICE OVER 802.1x NETWORK
47
CONNECTION BETWEEN CELLULAR NETWORK AND WIRELESS DEVICE SEVERED
48

FIG. 4B

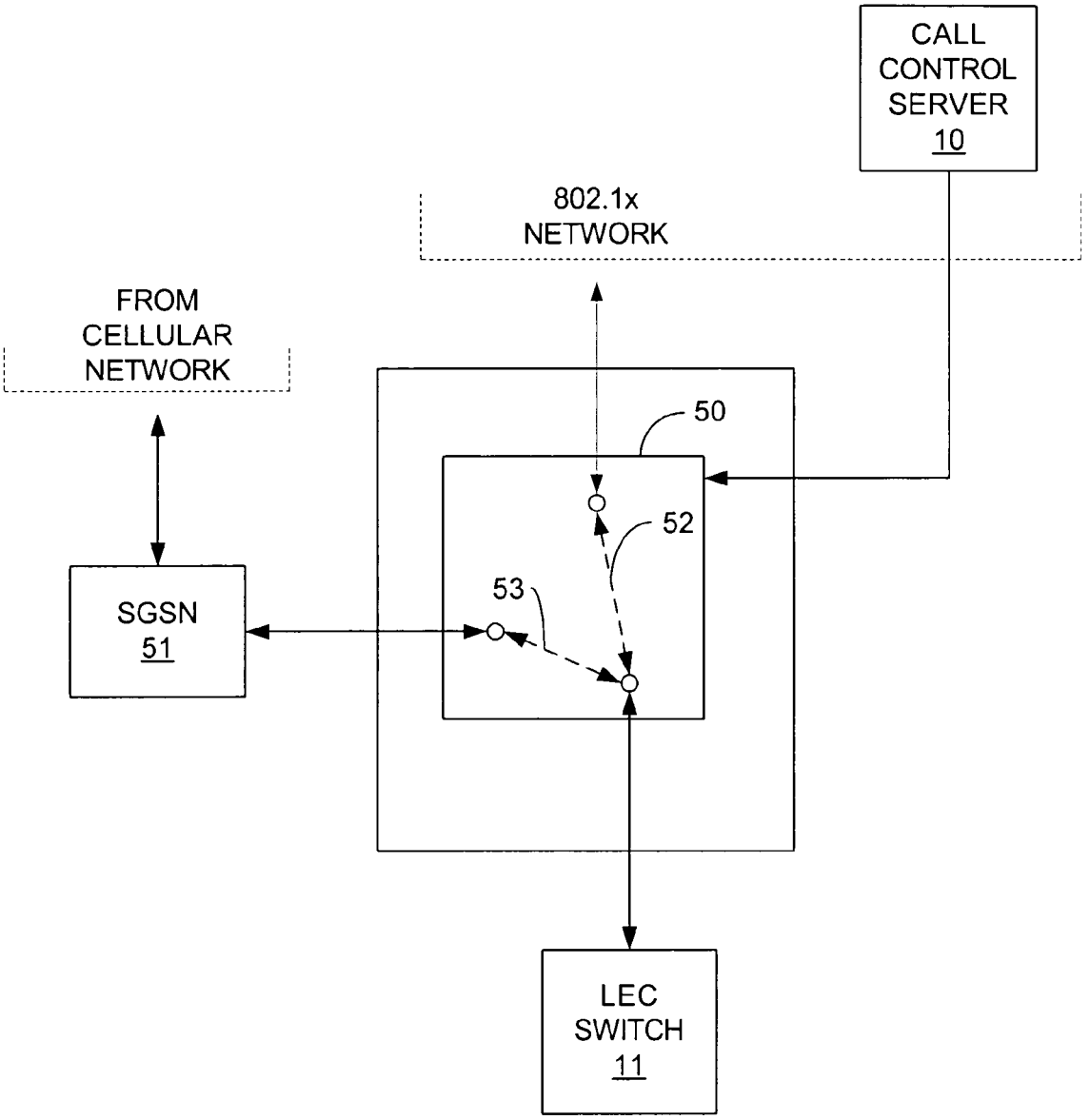

CALL
CONTROL
SERVER
10
802.1x
NETWORK
FROM
CELLULAR
NETWORK
50
52
53
SGSN
51
LEC
SWITCH
11

FIG. 5

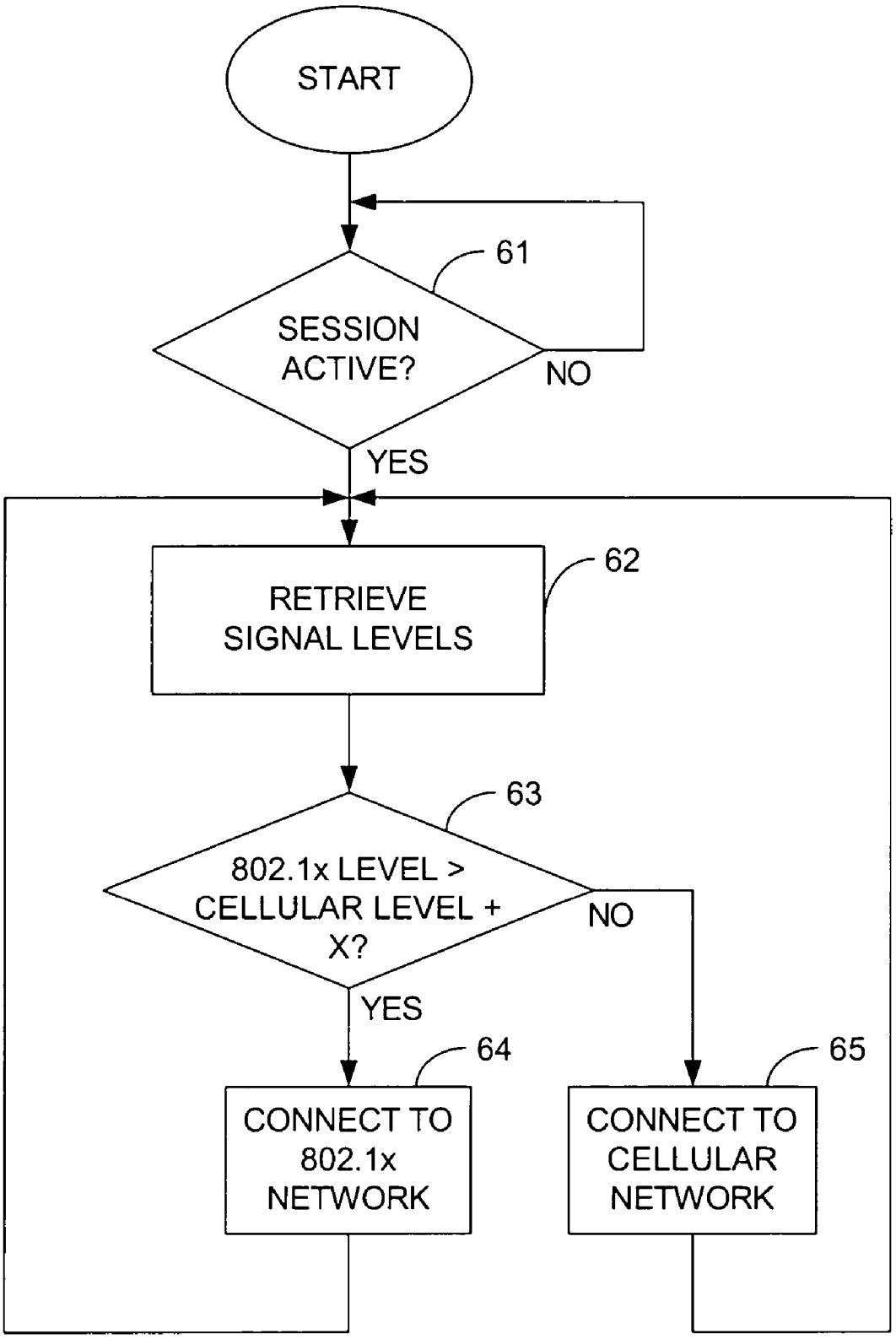

START
61
SESSION ACTIVE?
NO
YES
62
RETRIEVE SIGNAL LEVELS
63
802.1x LEVEL > CELLULAR LEVEL + X?
NO
YES
64
CONNECT TO 802.1x NETWORK
65
CONNECT TO CELLULAR NETWORK

FIG. 6

METHOD AND APPARATUS FOR PROVIDING SEAMLESS CALL HANDOFF BETWEEN NETWORKS THAT USE DISSIMILAR TRANSMISSION METHODS

BACKGROUND OF THE INVENTION

[0001] 1. Field of Invention

[0002] The present invention relates to wireless communications and, more particularly, to seamlessly handing off a call from one wireless network that uses a particular transmission method to a different wireless network that uses a different transmission method.

[0003] 2. Description of Related Art

[0004] Devices are available that have both cellular capability and capability to perform under the standard of the Institute of Electrical and Electronics Engineering (IEEE) known as the IEEE 802.1x standard. Such devices include, for example, laptop computers and personal digital assistants (PDAs). Cellular networks use transmission methods that are different from the transmission methods used in 802.1x networks. The transmission methods used by cellular networks are governed by standards such as WCDMA, GPRS, 1XRT, 3XRT and EDGE, for example. The transmission methods used by 802.1x networks are governed by the applicable IEEE 802.1x standard. The term 802.1x, as that term is used herein, means all of the IEEE standards that have the prefix 802.1, including, but not limited to, 802.11, 802.11a, 802.11b, 802.11c, 802.11d, 802.11e, 802.11f, 802.11g, 802.11h, 802.11i, etc. 802.1x networks use the Transport Control Protocol/Internet Protocol (TCP/IP) to enable wireless devices with 802.1x capabilities to wirelessly connect to access points of wired and wireless local area networks (LANs). Voice, data, video and audio are transmitted over 802.1x networks in TCP/IP packets.

[0005] An 802.1x network access point has a limited distance over which it can communicate with a wireless device. When the 802.1x device moves out of range of the access point, the call is dropped. The call may be communicating voice, data, video or audio at the time it is dropped. There may be times when an 802.1x-capable device, such as a PDA, for example, is out of range of a 802.1x access point, but within range of a cellular base station transmitter. However, even though devices exist that have both cellular and 802.1x capabilities, such devices do not have the capability to seamlessly switch from communicating over an 802.1x network to communicating over a cellular network, or vice versa. Therefore, the user is faced with having to manually establish communication with the cellular network after the call has been dropped. Of course, resuming a call in this manner may result in information being lost, regardless of whether voice, data, video or audio is being communicated. An analogous situation occurs when a device moves out of range of a cellular network and within range of an access point of an 802.1x network.

[0006] It would be desirable to provide the capability of performing a seamless handoff of a call from an 802.1x network to a cellular network, and vice versa.

SUMMARY OF THE INVENTION

[0007] The present invention provides for seamless call handoff from an 802.1x network to a cellular network. The wireless device of the present invention has both cellular and 802.1x capability. In order for handoffs to occur automatically and seamlessly, signal strength detection circuitry in the wireless device detects the strength of a cellular signal being transmitted by a cellular network and of an 802.1x signal being transmitted from an access point of an 802.1x network. If a call is taking place over the 802.1x network and the strength of the 802.1x network signal drops below a particular level while the strength of the cellular signal is above a certain level, the call is handed off from the 802.1x network to the cellular network. The wireless device preferably also comprises a handoff selector that allows the user to manually initiate a handoff and to manually override a handoff.

[0008] In accordance with the preferred embodiment, not only is it possible to perform a seamless handoff from an 802.1x network to a cellular network, but also from a cellular network to an 802.1x network. In accordance with the preferred embodiment, seamless handoffs occur in both directions. If a call is taking place over the cellular network and the cellular signal strength drops below a certain level while the 802.1x signal strength is above a certain level, the call is handed off from the cellular network to the 802.1x network. If a call is taking place over the 802.1x network and the strength of the 802.1x network signal drops below a particular level while the strength of the cellular signal is above a certain level, the call is handed off from the 802.1x network to the cellular network.

[0009] In accordance with the preferred embodiment, when a call is to be handed off from the 802.1x network to the cellular network (i.e., when the strength of the signal from available access points has dropped below a certain level), the wireless device queries the cellular network for signaling and IP connectivity information. When the wireless device receives this information, the wireless device communicates it to the SIP or equivalent server of the 802.1x service providing network. The server communicates with the media gateway to set up the new connection between the terminating station and the wireless device over the cellular network connection. When communication between the media gateway and the cellular carrier is given preference, the call on the 802.1x network may be terminated. This termination occurs after the "voice" path has been established and determined to be stable.

[0010] When a call is to be handed off from the cellular network to the 802.1x network, the wireless device queries the 802.1x network for signaling and IP connectivity information. When the wireless device receives this information, the wireless device communicates it to the call control server (e.g., an SIP or equivalent server) of the service providing network. The call control server communicates with the media gateway to set up the call on the 802.1x network with the new connection between the terminating station and the wireless device over the 802.1x network.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] **FIG. 1** is a block diagram showing the connectivity between a wireless device and an 802.1x network when a call is established between the wireless device and a terminating station that is connected to the 802.1x network via a Plain Old Telephone Service (POTS) network, also commonly known as Public Switched Telephone Network (PSTN), and a media gateway.

[0012] **FIG. 2** is a block diagram showing the connectivity between a wireless device and a cellular network when a call that was initially established over the 802.1x network is handed off to the cellular network to maintain a connection between a wireless device and the terminating station that is connected to the cellular network via a POTS network and a media gateway.

[0013] **FIGS. 3A and 3B** together illustrate a flow chart of the method of the present invention in accordance with a preferred embodiment for seamlessly handing off a wireless device call from an 802.1x network to a cellular network.

[0014] **FIGS. 4A and 4B** together illustrate a flow chart of the method of the present invention in accordance with a preferred embodiment for seamlessly handing off a wireless device call from a cellular network to an 802.1x network.

[0015] **FIG. 5** is a block diagram of a media gateway connected to a cellular network and to an 802.1x network.

[0016] **FIG. 6** is a flow chart illustrating an embodiment of the method performed by the call control server shown in **FIG. 2** to cause a call handoff from an 802.1x network to a cellular network to occur, and vice versa.

DETAILED DESCRIPTION OF THE EXEMPLARY EMBODIMENTS

[0017] **FIG. 1** is a diagram of an 802.1x network that illustrates connections made over the 802.1x network when a call from a wireless device **1** is being serviced by the 802.1x network **2**. In the example shown, the wireless device **1** is a PDA that initiates a call to a terminating station **3** of a plain old telephone service (POTS) network **4**. The wireless device **1** could be any type of wireless device. A media gateway **5** provides the necessary connectivity between the 802.1x network **2** and the POTS network **4**. The terminating station **3** is shown as being a telephone in this example, although it could be any type of terminating device. Also, although the call is shown in this example as terminating at a POTS terminating station **3**, the call could instead terminate at a wireless device (not shown) in communication with a cellular network, such as cellular network **6**, for example, having cellular switching with Internet Protocol (IP) connectivity.

[0018] The media gateway **5** also interfaces the cellular network **6** with the 802.1x network **2**. It should also be noted that the call could be initiated by a wireless device communicating over the cellular network **6**, in which case the media gateway would route the call over the 802.1x network **2** to the wireless device **1**. Similarly, the call could be initiated by the terminating station **3** and directed to the wireless device **1**, in which case the media gateway **5** would route the call from the POTS network **4** to the wireless device over the 802.1x network **2**. The present invention is equally applicable to each of these scenarios, as described below in more detail.

[0019] In accordance with the present invention, the wireless device **1** has both cellular and 802.1x capabilities. The wireless device **1** also has intelligence that enables it to sense the strength of the signal between the wireless device **1** and the access point **7** of the 802.1x network **2** and the strength of the signal between the wireless device **1** and the cellular network **6**. In accordance with the preferred embodiment, when the wireless device **1** is communicating over the 802.1x network **2** (i.e., the 802.1x network **2** is servicing the call), it is also querying the cellular network **6** so that it can measure the strength of the response to the query from the cellular network **6**. Simultaneously, while the wireless device **1** is communicating with the access point **7**, it is also measuring the strength of the signal received from the access point **7**. When the strength of the signal received from the access point **7** drops below a certain level and the strength of the signal received from cellular network **6** is above a certain level, the call is handed off from the 802.1x network **2** to the cellular network **6**. Once the call is being serviced by the cellular network **6**, the connection between the wireless device **1** and the 802.1x network **2** preferably is severed.

[0020] Similarly, when the wireless device **1** is communicating over the cellular network **6** (i.e., the cellular network **6** is servicing the call), it is also querying the 802.1x network **2** so that it can measure the signal strength of the response to the query from the access point **7**. Simultaneously, while the wireless device **1** is communicating with the cellular network **6**, it is also measuring the strength of the signal received from the cellular network **6**. When the strength of the signal received from the cellular network **6** drops below a certain level and the strength of the signal received from access point **7** is above a certain level, the call is handed off from the cellular network **6** to the 802.1x network **2**. Once the call is being serviced by the 802.1x network **2**, the connection with the cellular network **6** preferably is severed. The term "severed", as that term is used herein, means that the resources that were being used to handle the call prior to the handoff are released.

[0021] Because the call is not severed until the new connection is established, no information is lost and there is no discontinuity with the call, regardless of whether voice, data, video or audio is being transmitted. A call control (e.g., session initiation protocol (SIP)) server **10** of the network **2** handles call signaling, call routing, capabilities exchange, media control and supplementary services. As an alternative to a SIP server, an equivalent type of server could be used, such as, for example, an H.323 server. When the wireless device **1** initiates a call to the 802.1x network **2**, the access point **7** communicates information to the server **10** that the server **10** records, including the IP address of the wireless device **1**, the "IP" address of the terminating station **3**, the connect time of the wireless device **1** and the ID of the wireless device **1**. The connect time is recorded for billing purposes and the IP address of the wireless device **1** that originates the call, the "IP" address of the terminating station **3** and the ID of the wireless device **1** are needed for call signaling and call routing. The server **10** then communicates information to the media gateway **5** that allows the media gateway **5** to make the connection between the IP address of the wireless device **1** and the IP address of the local exchange switch **11** that corresponds to the terminating station **3**.

[0022] At the local exchange switch **11**, the IP address associated with the terminating station **3** is converted into a physical POTS address and a physical connection is made between the terminating station **3** and the local exchange switch **11**. The media gateway **5** comprises intelligence for converting the signals from the TCP/IP addressing format into signals conditioned for the POTS network **4**, and vice versa.

[0023] **FIG. 2** is identical to **FIG. 1** except that it shows a connection **15** between the cellular network **6** and the media gateway **5** to represent the wireless device **1** communicating with the terminating station **3** when the media gateway **5** receives the IP connectivity information sent from the cellular network **6** and transmitted by the wireless device **1** to the access point **7** and makes the new connection. The wireless device **1** preferably consistently take samples of ambient signals available in the spectrum (i.e., the access point transmissions). When the wireless device **1** determines that the strength of the signal received from the access point **7** has dropped below a certain level and that the strength of the signal received from the cellular network **6** is at or above a certain level, the wireless device **1** queries the cellular network **6** to obtain the signaling and IP connectivity information needed for the handoff from the 802.1x network **1** to the cellular network **6**. The wireless device **1** will first recognize an available signaling network, and then attempt to access data service (e.g., GPRS, EDGE, 1XRT, etc.). If these fail, another network will be interrogated. This does not widely vary from current cellular attachment to data networks.

[0024] The wireless device **1** communicates the signaling and IP connectivity information to the access point **7**, which communicates the information to the SIP or equivalent (e.g., H.323) call control server **10**. The server **10** records this information, which includes the IP address that the cellular network **6** has assigned to the wireless device **1** for it to use in the handoff. The server **10** changes the IP address of the wireless device **1** from the one that was recorded when the call was initiated to the new IP address assigned by the cellular network **6**. The server **10** then provides the media gateway **5** with the new IP address of the wireless device **1** on the cellular network **6**, thereby causing the new communication link between the wireless device **1** connected to the cellular network **6** and the terminating station **3** connected to the POTS network **4** to be established. Once the new connection is established, the server **10** causes the access point **7** to severe its wireless connection with the wireless device **2**. Alternatively, the wireless device **1**, rather than the server **10**, will terminate the 802.1x connection and release the resources. Because, the original connection is not severed until after the new connection has been established, the handoff is seamless. The line **15** from the cellular network **6** to the media gateway **5** represents the new connection.

[0025] **FIGS. 3A and 3B** illustrate a flow chart of the method of the present invention in accordance with the preferred embodiment for performing a seamless handoff from the 802.1x network **2** to the cellular network **6**. The call is initiated by the wireless device **1** and established between the wireless device **1** and the terminating station **3**, as indicated by block **21**. While the call is being service by the 802.1x network **2**, the strengths of the signals from the access point **7** and from the cellular network **6** are detected by the wireless device **1**, as indicated by block **22**. A determination is made as to whether the strength of the signal from the access point **7** has dropped below a certain threshold level, as indicated by decision block **23**. If so, a determination is made as to whether the strength of the signal from the cellular network is at or above a certain threshold level, as indicated by decision block **24**. If the answer to either of these questions is no, the process returns to block **22**. The order in which steps **23** and **24** are performed can be reversed.

[0026] If the answer to both of the questions of blocks **22** and **23** is yes, then the wireless device **1** queries the cellular network **6** for signal and IP connectivity information, as indicated by block **25**. The wireless device **1** receives the signal and IP connectivity information from the cellular network **6** and communicates it to the access point **7**, as indicated by block **26**. The access point **7** communicates the information, which includes the new IP address that will be used for the wireless device **1**, to the SIP server **10**, as indicated by block **27** in **FIG. 3B**. The SIP server **10** then records the new IP address of the wireless device **1** and causes the media gateway **5** to establish the new connection, as indicated by block **28**. The access point **7** then severs the connection with the wireless device **2**, as indicated by block **29**. The step represented by block **29** is optional, but preferred.

[0027] **FIGS. 4A and 4B** illustrate a flow chart of the method of the present invention in accordance with the preferred embodiment for performing a seamless handoff from the cellular network **6** to the 802.1x network **2**. The method is very similar to the method for performing the handoff from the 802.1x network **2** to the cellular network **6**. The call is initiated by the wireless device **1** on the cellular network **6** and established between the wireless device **1** and the terminating station **3** via the media gateway **5** and the LEC switch **11**, as indicated by block **41**. While the call is in progress, the strength of the signals from the access point **7** and from the cellular network **6** is measured by the wireless device, as indicated by block **42**. A determination is made as to whether the strength of the signal from the cellular network **6** has dropped below a certain threshold level, as indicated by decision block **43**. If so, a determination is made as to whether the strength of the signal from the 802.1x network **2** is at or above a certain threshold level, as indicated by decision block **44**. If the answer to either of these questions is no, the process returns to block **42**. As with blocks **23** and **24**, the steps represented by blocks **43** and **44** can be reversed.

[0028] If the answer to both of these questions is yes, then the wireless device **1** queries the access point **6** for signal and IP connectivity information, as indicated by block **45**. The wireless device **1** receives the signal and IP connectivity information from the access point **7** and communicates it to the cellular network **6**, as indicated by block **46**. The cellular network **6** communicates the new IP address of the wireless device **1** to the media gateway **5**, which establishes the new IP connection for the wireless device **1** on the 802.1x network **2**, as indicated by block **47**. The connection between the cellular network **6** and the wireless device **1** preferably is then severed, as indicated by block **48**.

[0029] As stated above, the wireless device **1** preferably also comprises a handoff selector switch that allows the user to initiate the handoff and to override a handoff. In some cases, the detected strength levels of the signals from both the cellular network **6** and the 802.1x network **2** may be sufficiently high to enable the call to be handled by either network. The user may desire, for one or more of a variety of reasons (e.g., technology, speed, convenience, money, etc.), to switch from communicating over one of these networks to communicating over the other. To accomplish this, the user actuates the handoff selector switch, which causes the operations represented by blocks **25-29** or **45-48** in **FIGS. 3A-4B** to occur. The selector switch may be any

type of input device that enables a user to make a selection. For example, the selection could be made by depressing a key on a keypad, by highlighting and selecting an item in a menu, etc.

[**0030**] The selector switch may also be used to override an impending handoff. For example, if an automatic handoff from the 802.1x network **2** to the cellular network **6** is impending due to the fact that the threshold conditions in blocks **23** and **24** of **FIG. 3A** have been met, the handoff will be prevented if the selector switch has been activated. This is useful where the user wishes to continue communicating over the 802.1x network **2** rather than switch to communicating over the cellular network **6**.

[**0031**] **FIG. 5** is a block diagram of the media gateway **5** shown in **FIG. 1**. The switching logic in the media gateway **5** that enables the call session to be switched from the 802.1x network **2** to the cellular network **6**, and vice versa, is represented by the box labeled **50**. The gateway **5** is shown as being interfaced with the call control server **10** and with the LEC switch **11** shown in **FIG. 1**. As indicated above, the call control server **10** is part of the 802.1x network **2** and the LEC switch **11** is part of the POTS network **4**. The cellular network **6** interfaces to the gateway **5** via a serving GPRS support node (SGSN) **51**, which provides the IP interface between the cellular network **6** and the gateway **5**. The dashed arrows **52** and **53** in block **50** represent the connections in the gateway **5** that are switched when a handoff occurs. When a call is handed off from the 802.1x network **2** to the cellular network **6**, connection **53** is made and connection **52** is eliminated. When a call is handed off from the cellular network **6** to the 802.1x network **2**, connection **52** is made and connection **53** is eliminated. **FIG. 6** is a flow chart illustrating an embodiment of the method performed by the call control server **10** in conjunction with the media gateway **5** to enable handoffs to occur.

[**0032**] The server **10** determines whether or not a call session is active, as indicated by block **61**. Until a session is active, a handoff cannot occur. Once a determination is made that a session is active, the process proceeds to block **62** and the server **10** retrieves both the cellular and 802.1x signal levels. A determination is then made at block **63** as to whether the 802.1x signal level is exceeds the cellular level plus an amount "X". The value of X can be 0 or any other value, positive or negative. When a determination is made at block **63** that the 802.1x signal level exceeds the cellular level plus X, the call control server **10** causes the media gateway **5** to switch the call from connection **53** to connection **52** unless connection **52** already exists, as indicated by block **64**. If connection **52** already exists, no handoff needs to occur, and so connection **52** will continue to be maintained. If connection **52** does not yet exist because the call is currently being handled by the cellular network, connection **52** will be made and connection **53** will be eliminated to free up the resources that were being used for the call over the cellular network.

[**0033**] If a determination is made at block **63** that the 802.1x signal level does not exceed the cellular signal level plus X, the call control server **10** causes the media gateway **5** to switch the call from connection **52** to connection **53** unless connection **53** already exists, as indicated by block **65**. If connection **53** already exists because the call is currently being handled by the cellular network, no handoff needs to occur. In that case, connection **53** will continue to be maintained. If connection **53** does not yet exist because the call is currently being handled by the 802.1x network, connection **53** will be made and connection **52** will be eliminated to free resources that were being used to service the call over the 802.1x network.

[**0034**] In an embodiment, the value of X can be altered manually by activating the aforementioned selector switch. For example, activation of the selector switch could cause the value of X to increase to prevent the condition in block **63** from being true, which would prevent a handoff from the cellular network to the 802.1x network from occurring. If the cellular network is currently handling the call, the cellular network will continue to handle the call. Alternatively, actuation of the selector switch could cause the value of X to decrease or become negative, thereby ensuring that the condition of block **63** is true. This would ensure that a handoff from the cellular network to the 802.1x network occurs or, if the call is currently being handled by the 802.1x network, the connection with the 802.1x network would continue to be maintained. As another alternative, the selector switch could have multiple states so that selection of one sate would cause the value of X to increase whereas selection of another state would cause the value of X to decrease. Alternatively, multiple selector switches could be provided. It should be noted that the method shown in **FIG. 6** is only one of a variety of methods that could be used to accomplish the objectives of determining when a handoff is to occur, handing the call off when a determination has been made that a handoff should occur, and/or overriding the handoff.

[**0035**] It should be noted that although the present invention has been described with reference to particular embodiments, the present invention is not limited to the embodiments described herein. Modifications can be made to the embodiments described herein and all such modifications are within the scope of the invention.

What is claimed is:

1. A wireless device having both cellular capability and 802.1x capability, the wireless device comprising:

a signal strength detection circuit configured to detect when a strength of an 802.1x signal transmitted by an access point of an 802.1x network drops below a certain level and when a strength of a cellular signal transmitted by a cellular network is above a certain level; and

a handoff initiation circuit configured to initiate a handoff of a call from the 802.1x network to the cellular network.

2. The wireless device of claim 1, wherein the handoff initiation circuit initiates the call handoff upon receiving an indication from the signal strength detection circuit.

3. The wireless device of claim 1, wherein the handoff initiation circuit initiates the call handoff upon determining that a handoff selector has been activated by a user of the wireless device.

4. The wireless device of claim 1, wherein the signal strength detection circuit is configured to detect when a strength of a cellular signal transmitted by a cellular network drops below a certain level and when a strength of an 802.1x signal transmitted by an 802.1x network is above a certain level, and wherein the handoff initiation circuit initiates a

call handoff from the cellular network to the 802.1x network upon receiving an indication from the signal strength detection circuit.

5. A method for handing off a call from an 802.1x network to a cellular network, the method being performed by a wireless device, the method comprising:

measuring the strength of an 802.1x signal received by the wireless device from an access point of the 802.1x network;

determining whether the strength of the 802.1x signal has dropped below a certain level;

measuring a strength of a cellular signal being received by the wireless device from a cellular network;

determining whether the strength of the cellular signal is above a certain level; and

wherein if the 802.1x signal strength is determined to be below a certain level and the cellular signal strength is determined to be above a certain level, initiating a call handoff of the wireless device from the 802.1x network to the cellular network.

6. The method of claim 5, further comprising:

after the handoff has occurred, severing the connection between the wireless device and the access point of the 802.1x network.

7. The method of claim 6, further comprising:

if a determination is made that the strength of the 802.1x signal has dropped below a certain level and that the strength of the cellular signal is above a certain level, the wireless device querying the cellular network for signaling and IP connectivity information; and

communicating the signaling and IP connectivity information from the wireless device to the 802.1x network.

8. A method for initiating a call handoff from a cellular network to an 802.1x network, the method being performed by a wireless device, the method comprising:

measuring the strength of a cellular signal being received by a wireless device from a cellular network;

determining whether the strength of the cellular signal has dropped below a certain level;

measuring a strength of an 802.1x signal being received by the wireless device from an access point of an 802.1x network;

determining whether the strength of the 802.1x signal is above a certain level; and

wherein if the cellular signal strength is determined to be below a certain level and the 802.1x signal strength is determined to be above a certain level, performing a call handoff from the cellular network to the 802.1x network.

9. The method of claim 10, further comprising:

after the handoff has occurred, severing the connection between the wireless device and the cellular network.

10. A computer program for initiating a call handoff from a 802.1x network to a cellular network, the program being embodied on a computer-readable medium, the program comprising:

a first code segment, the first code segment determining whether the strength of an 802.1x signal being received by a wireless device from an access point of an 802.1x network has dropped below a certain level;

a second code segment, the second code segment determining whether the strength of a cellular signal being received by the wireless device from a cellular network is above a certain level; and

a third code segment, if the 802.1x signal strength is determined to be below a certain level and the cellular signal strength is determined to be above a certain level, the third code segment initiating a call handoff from the 802.1x network to the cellular network.

11. A computer program for performing initiating a call handoff from a cellular network to an 802.1x network, the computer program being embodied on a computer-readable medium, the program comprising:

a first code segment, the first code segment determining whether the strength of a cellular signal being received by a wireless device from a cellular network while the wireless device is participating in a call over the cellular network has dropped below a certain level;

a second code segment, the second code segment determining whether the strength of an 802.1x signal being received by the wireless device from an access point of an 802.1x network is above a certain level; and

a third code segment, if the cellular signal strength is determined to be below a certain level and the 802.1x signal strength is determined to be above a certain level, the third code segment initiating a call handoff from the cellular network to the 802.1x network.

12. An 802.1x network comprising:

an access point; and

a server, the server comprising logic configured to determine when a call handoff switch from the 802.1x network to a cellular network is to occur and to communicate with a media gateway to cause the call handoff switch to occur.

13. A cellular network comprising:

call handoff circuitry configured to determine when a call handoff switch from an 802.1x network to the cellular network is to occur and to communicate with a media gateway to cause the call handoff to occur.

14. A server in communication with a media gateway, the server comprising logic configured to determine when a call handoff switch from a cellular network to the 802.1x network is to occur and to communicate with a media gateway that causes the media gateway to make appropriate connections to cause the call handoff switch to occur.

15. The server of claim 14, wherein said logic determines whether or not a signal level of a signal of a signal being transmitted from the 802.1x network to a wireless device exceeds a signal level of a signal being transmitted from the cellular network to the wireless device, said logic determining that a handoff from the 802.1x network to the cellular network should occur when the signal level of the signal being transmitted from the 802.1x network to the wireless device does not exceed the signal level of the signal being transmitted from the cellular network to the wireless device.

16. A cellular network comprising:

logic configured to perform a call handoff switch from the cellular network to the 802.1x network so that a call being carried on the cellular network can be switched from the cellular network to the 802.1x network.

17. A call handoff switching circuit of a media gateway, the switching circuit being in communication with an 802.1x network and with a cellular network, the switching circuit comprising:

first logic configured to determine if a call handoff is to occur from an 802.1x network to a cellular network and to determine if a call handoff is to occur from a cellular network to an 802.1x network; and

second logic configured to switch a call connection from an address associated with the 802.1x network to an address associated with the cellular network when the first logic determines that a call handoff is to occur from the 802.1x network to the cellular network, and configured to switch a call connection from an address associated with the 802.1x network to an address associated with the cellular network when the first logic determines that a call handoff is to occur from the cellular network to the 802.1x network.

* * * * *