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(54) **WIRELESS COMMUNICATIONS HANDSET FOR FACILITATING LICENSED AND UNLICENSED WIRELESS COMMUNICATIONS, AND METHOD OF OPERATION**

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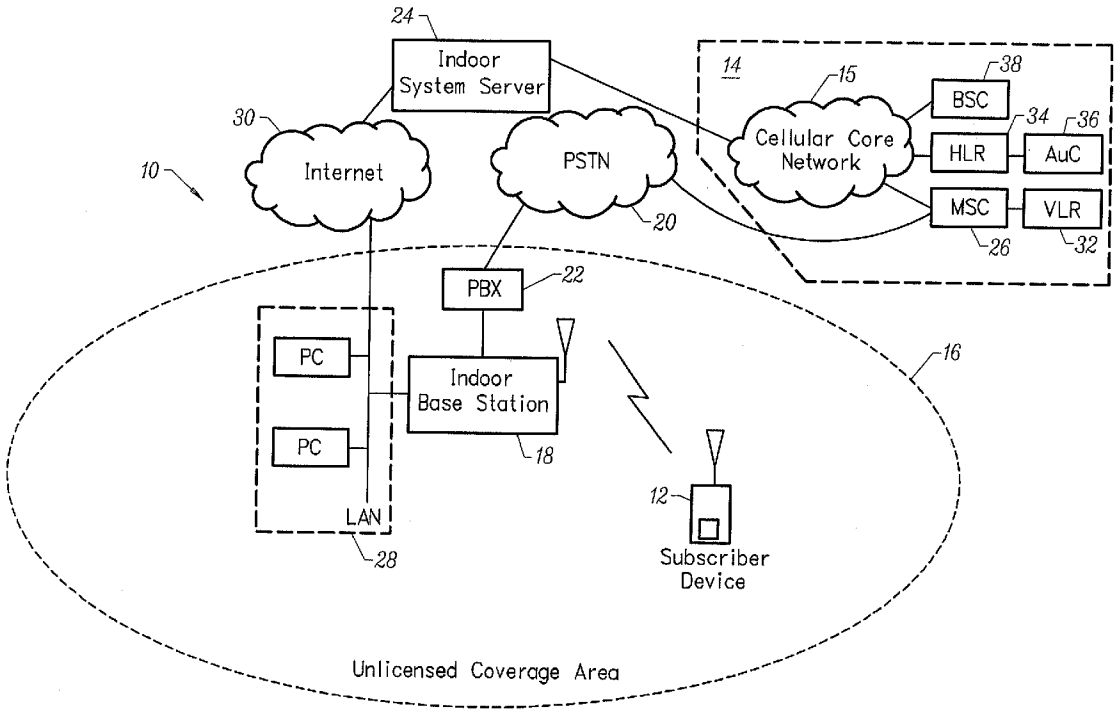
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(51) **Int. Cl.**[7] **H04M 1/68**

(52) **U.S. Cl.** **455/414**; 455/403

(57) **ABSTRACT**

A wireless communication handset includes licensed wireless communication signal processing circuitry and unlicensed wireless communication signal processing circuitry. A control circuit is connected to the licensed wireless communication signal processing circuitry and the unlicensed wireless communication signal processing circuitry. The control circuit transitions a communication session without interruption from the licensed wireless communication signal processing circuitry to the unlicensed wireless communication signal processing circuitry.



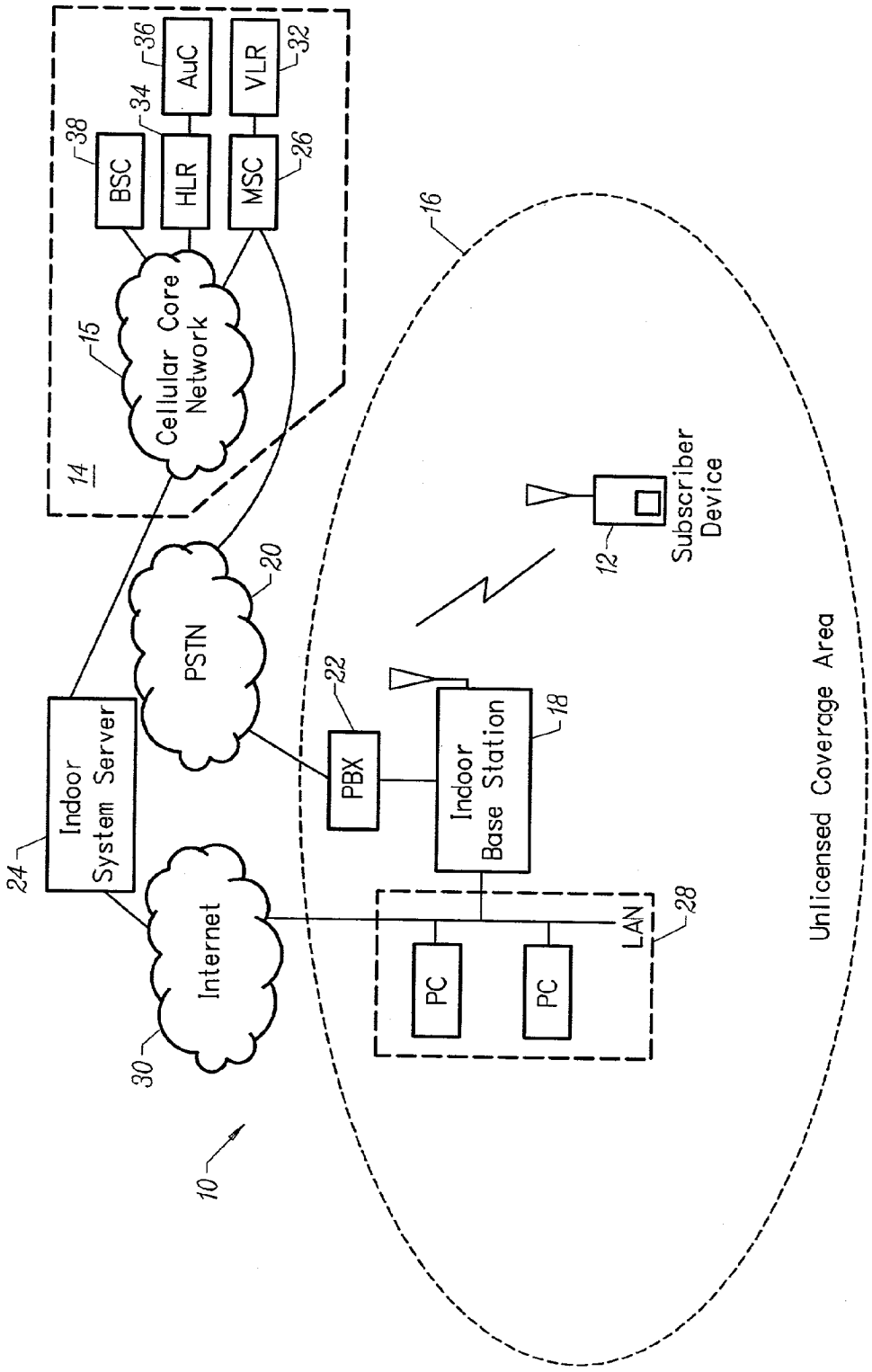

AuC
VLR
BSC
HLR
MSC
Cellular Core Network
PSTN
Indoor System Server
Internet
PBX
Indoor Base Station
Subscriber Device
LAN
PC
PC
Unlicensed Coverage Area
10
12
14
15
16
18
20
22
24
26
28
30
32
34
36
38

FIG. 1

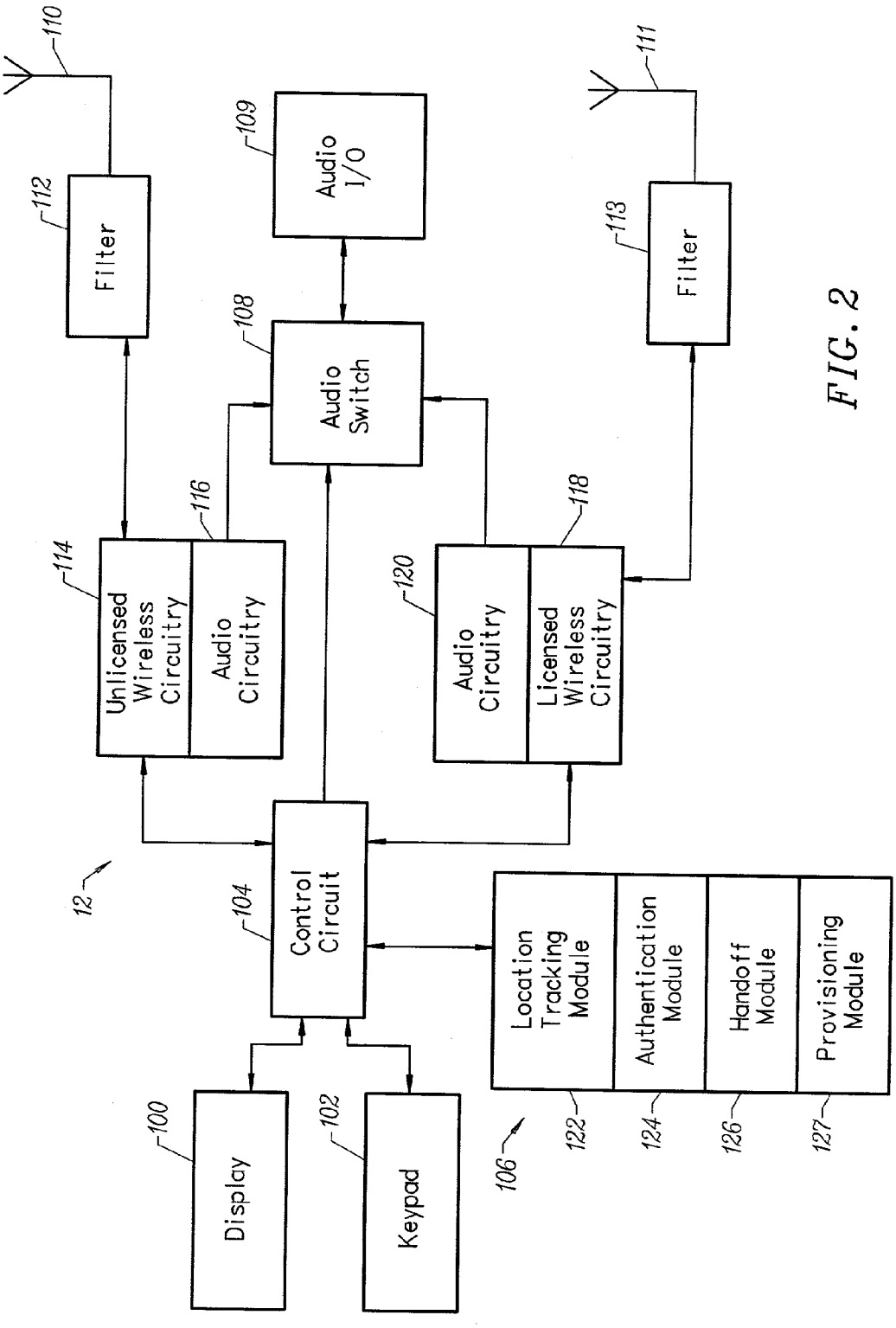

110
111
112
Filter
109
Audio I/O
113
Filter
108
Audio Switch
116
114
Unlicensed Wireless Circuitry
Audio Circuitry
118
120
Audio Circuitry
Licensed Wireless Circuitry
12
104
Control Circuit
Location Tracking Module
Authentication Module
Handoff Module
Provisioning Module
100
Display
102
Keypad
106
122
124
126
127

FIG. 2

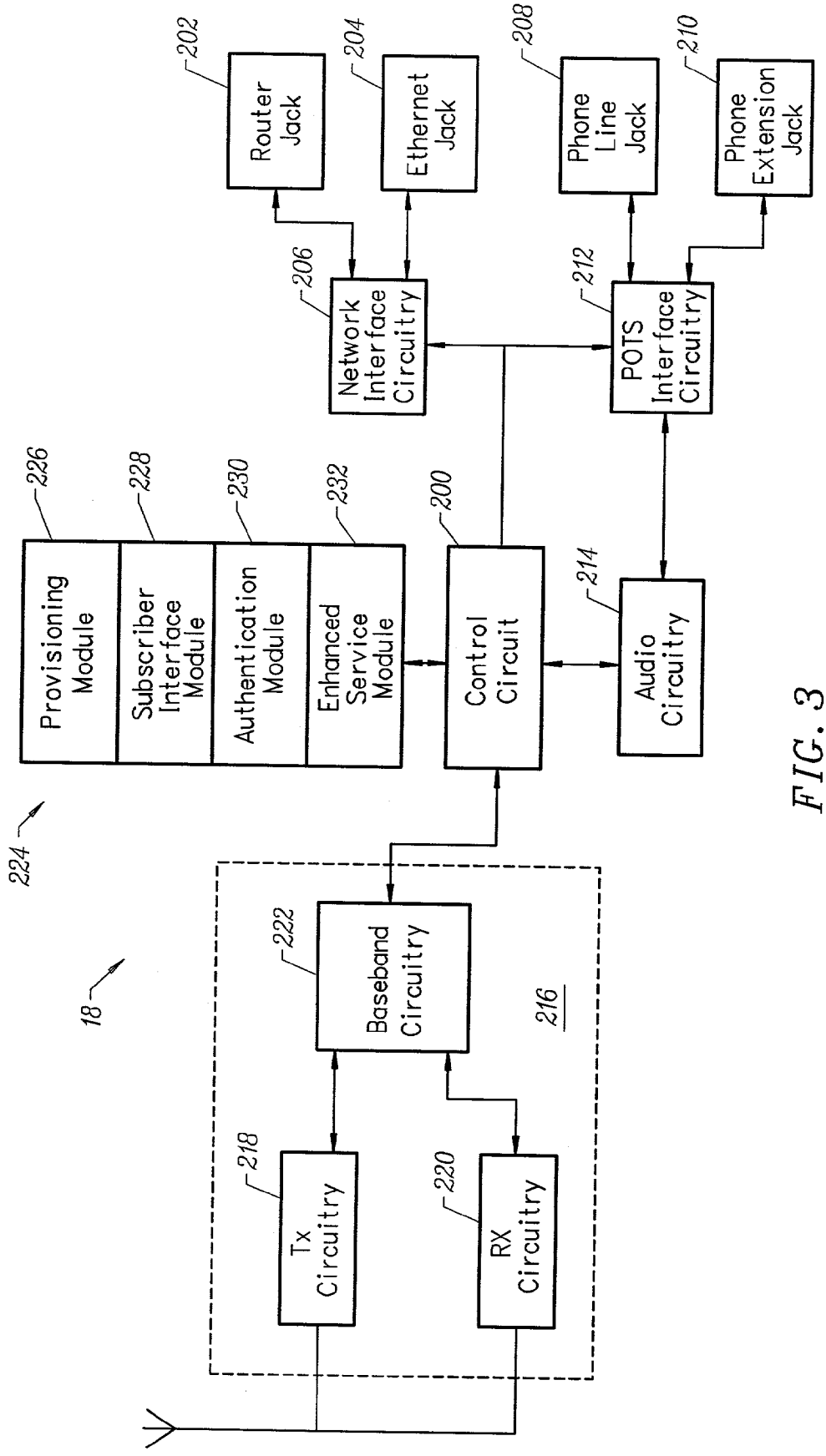

202
Router Jack
204
Ethernet Jack
208
Phone Line Jack
210
Phone Extension Jack
206
Network Interface Circuitry
212
POTS Interface Circuitry
226
Provisioning Module
228
Subscriber Interface Module
230
Authentication Module
232
Enhanced Service Module
200
Control Circuit
214
Audio Circuitry
224
18
222
Baseband Circuitry
216
218
Tx Circuitry
220
RX Circuitry

FIG. 3

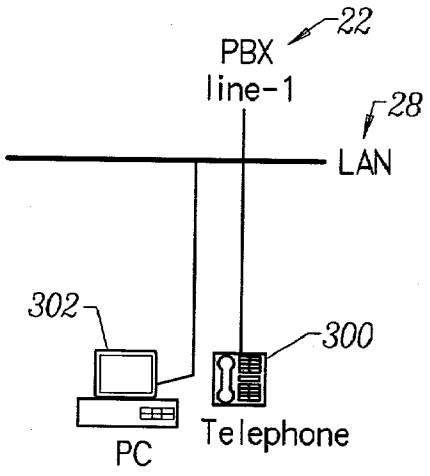


FIG. 4A

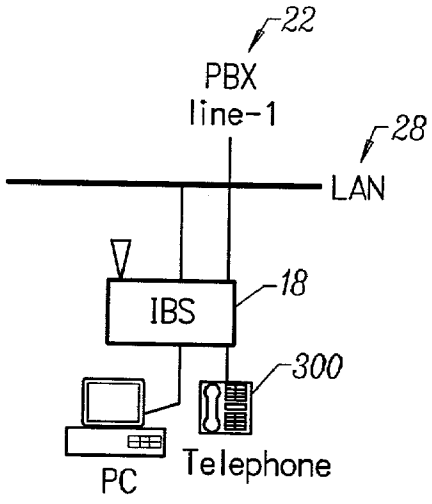


FIG. 4B

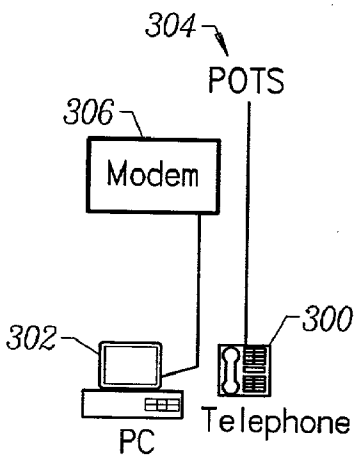


FIG. 4C

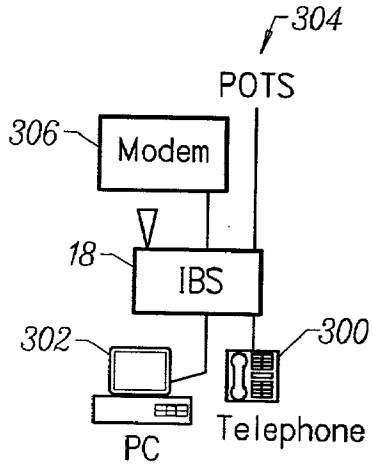


FIG. 4D

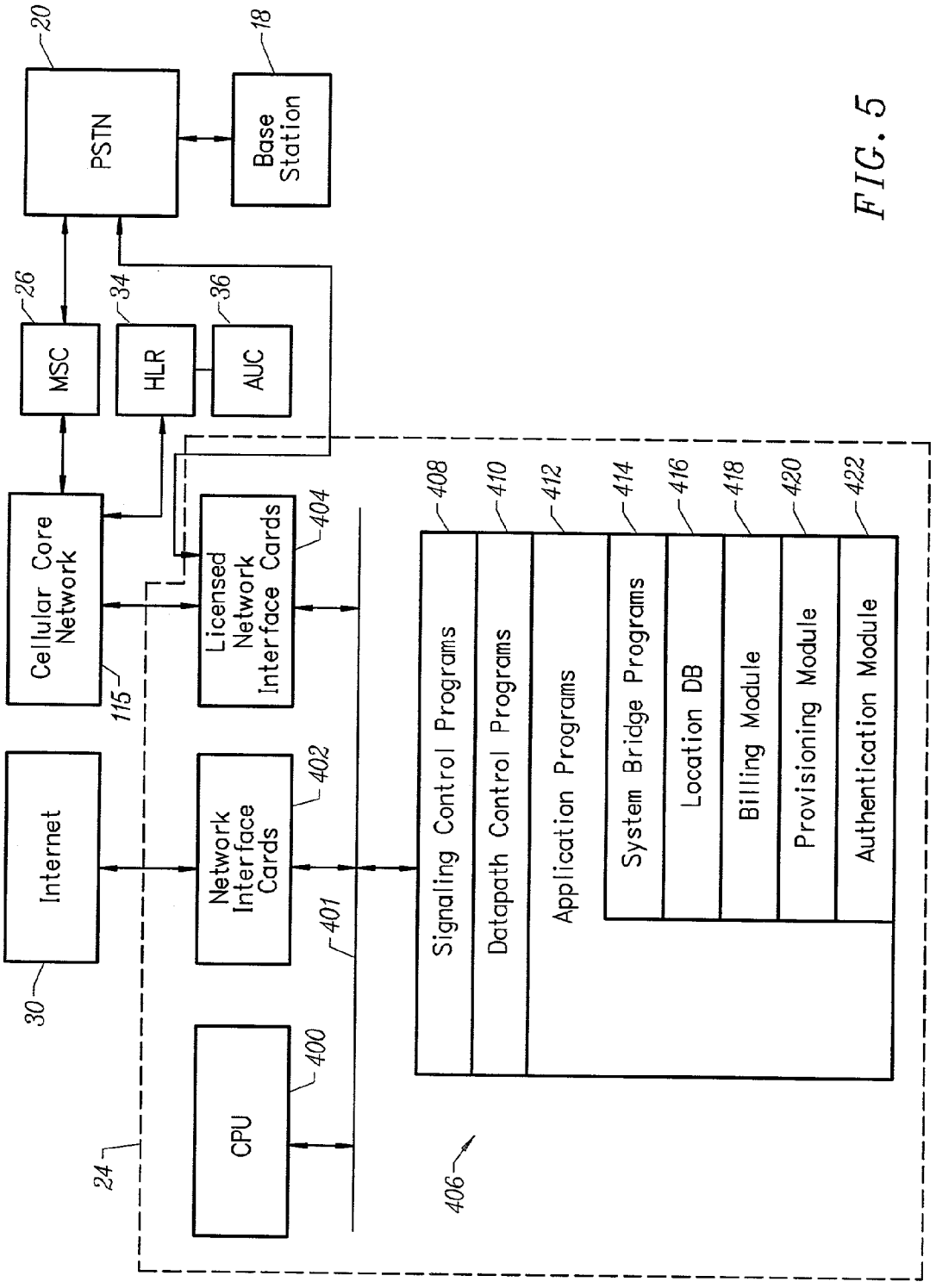

20
PSTN
18
Base Station
26
MSC
34
HLR
36
AUC
Cellular Core Network
115
Licensed Network Interface Cards
404
408
410
412
414
416
418
420
422
Signaling Control Programs
Datapath Control Programs
Application Programs
System Bridge Programs
Location DB
Billing Module
Provisioning Module
Authentication Module
Internet
30
Network Interface Cards
402
401
CPU
400
24
406

FIG. 5

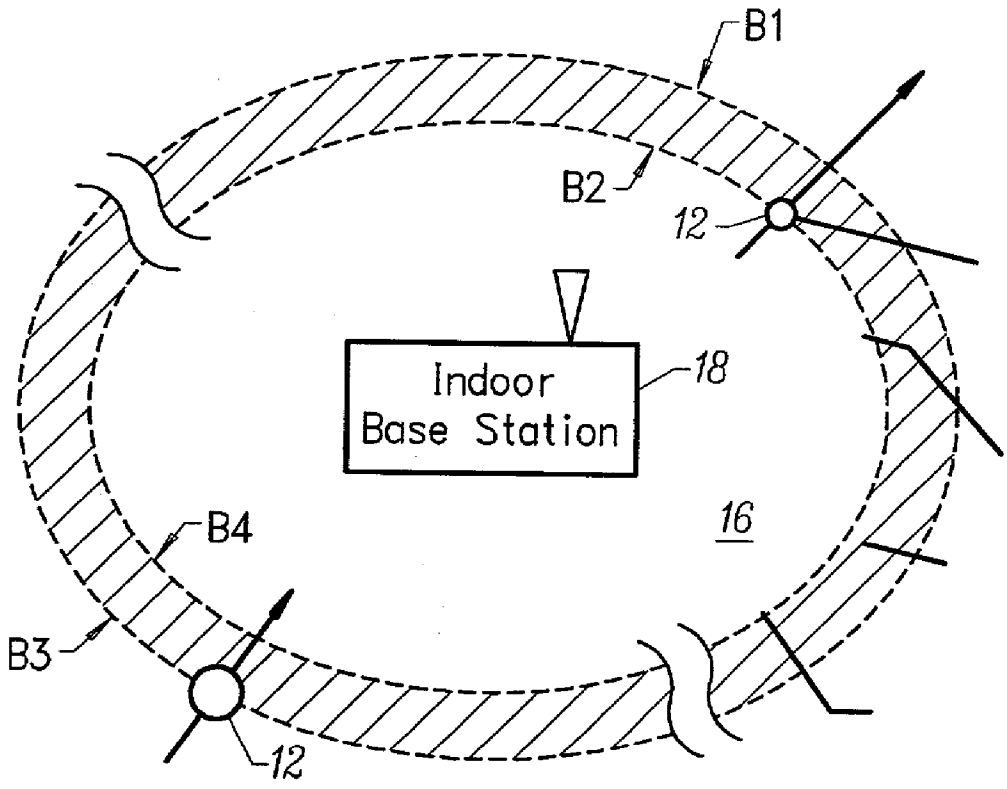


FIG. 6

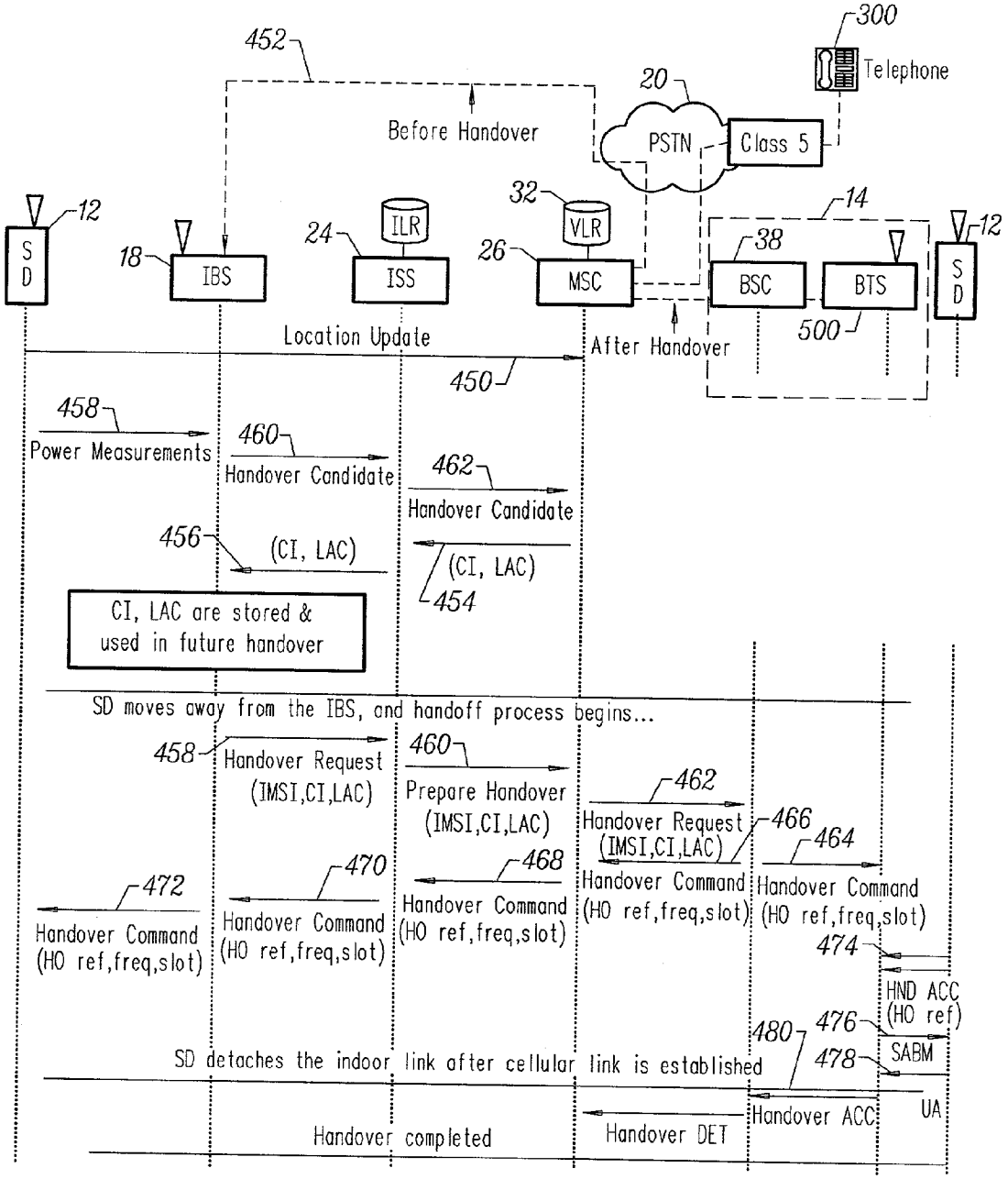

452
Before Handover
300
Telephone
20
PSTN
Class 5
32
VLR
14
12
S D
18
IBS
24
ILR
ISS
26
MSC
38
BSC
BTS
500
Location Update
After Handover
450
458
Power Measurements
460
Handover Candidate
462
Handover Candidate
456
(CI, LAC)
(CI, LAC)
454
CI, LAC are stored & used in future handover
SD moves away from the IBS, and handoff process begins...
458
Handover Request (IMSI,CI,LAC)
460
Prepare Handover (IMSI,CI,LAC)
462
Handover Request (IMSI,CI,LAC)
466
464
Handover Command (HO ref,freq,slot)
Handover Command (HO ref,freq,slot)
Handover Command (HO ref,freq,slot)
Handover Command (HO ref,freq,slot)
472
470
468
474
HND ACC (HO ref)
476
480
SABM
478
SD detaches the indoor link after cellular link is established
Handover ACC
UA
Handover completed
Handover DET

FIG. 7

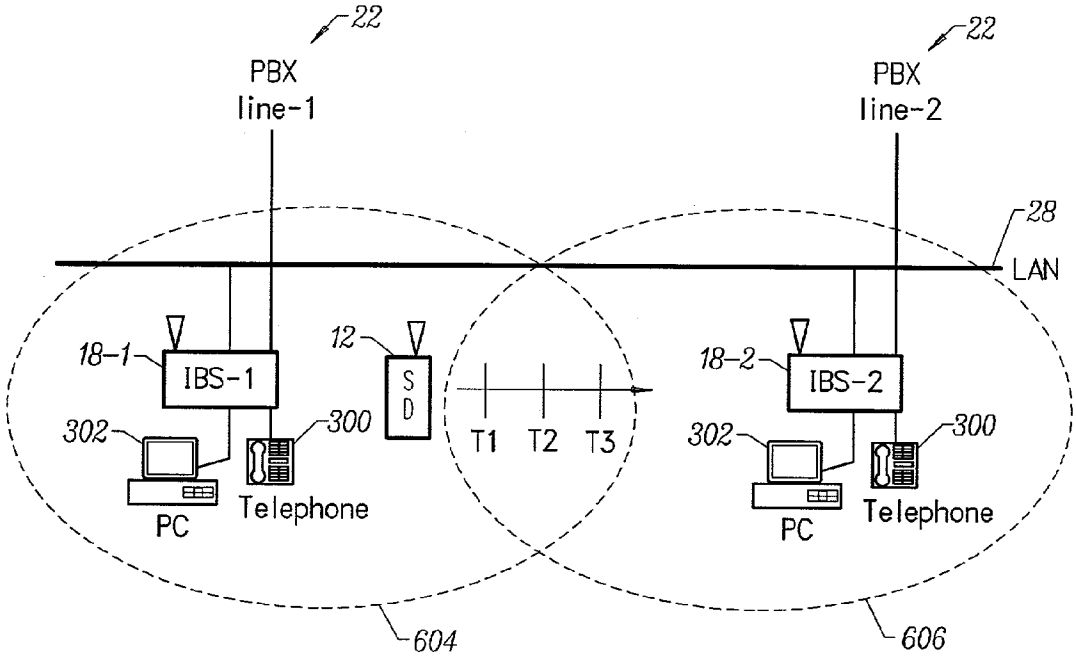

22
PBX
line-1
22
PBX
line-2
28
LAN
18-1
IBS-1
12
S
D
T1
T2
T3
18-2
IBS-2
302
300
PC
Telephone
302
300
PC
Telephone
604
606

FIG. 8

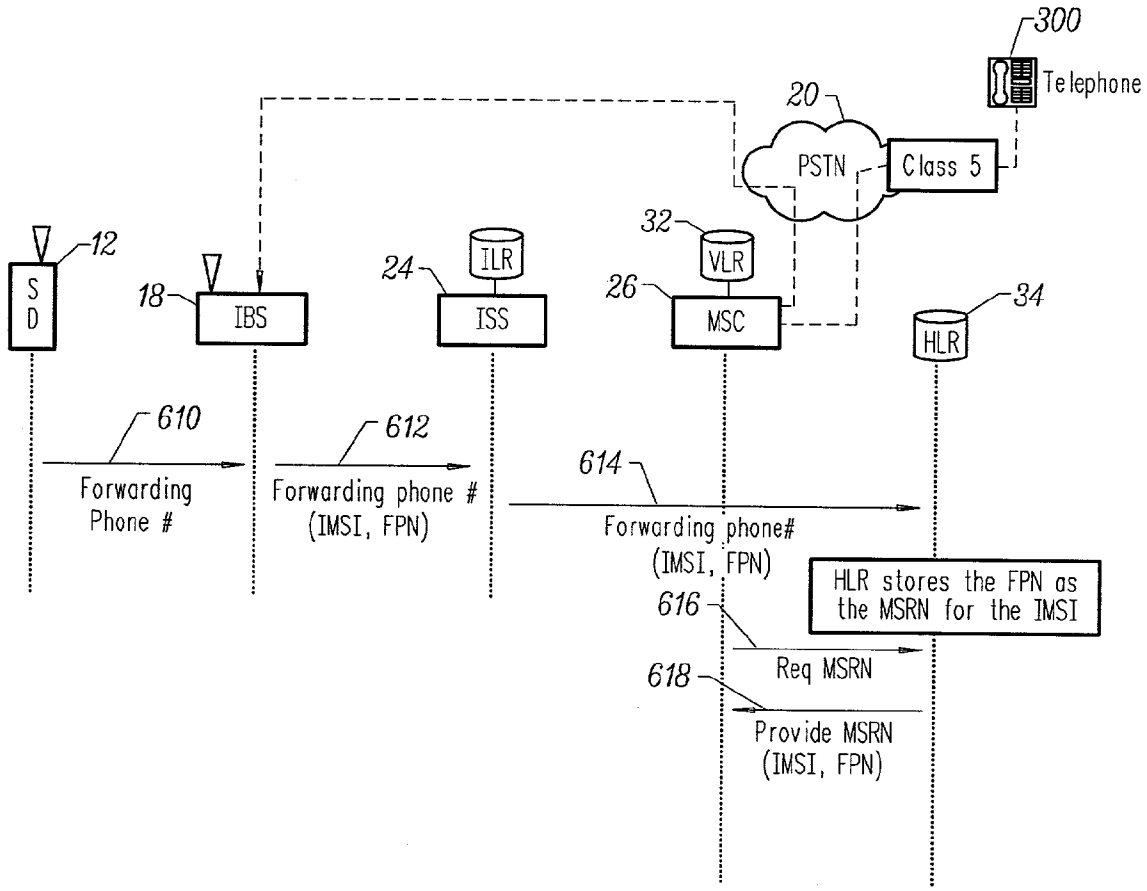

300
Telephone
20
PSTN
Class 5
32
VLR
24
ILR
26
MSC
34
HLR
12
S
D
18
IBS
ISS
610
Forwarding
Phone #
612
Forwarding phone #
(IMSI, FPN)
614
Forwarding phone#
(IMSI, FPN)
HLR stores the FPN as
the MSRN for the IMSI
616
Req MSRN
618
Provide MSRN
(IMSI, FPN)

FIG. 9

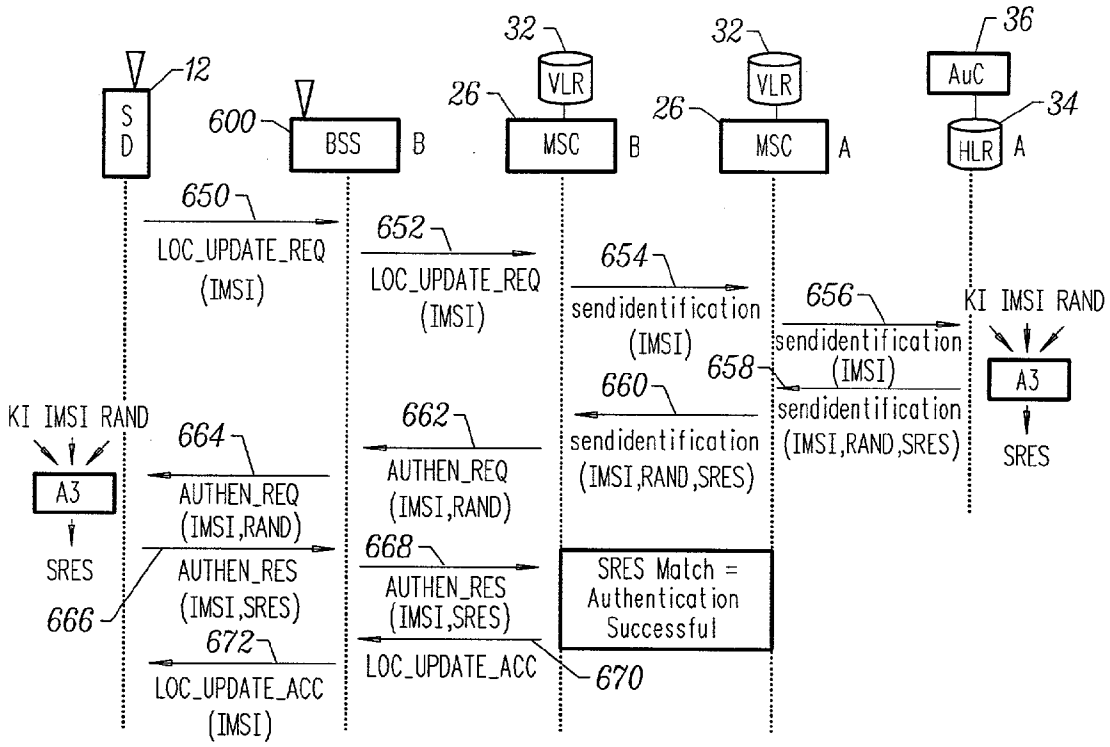


FIG. 10
(Prior Art)

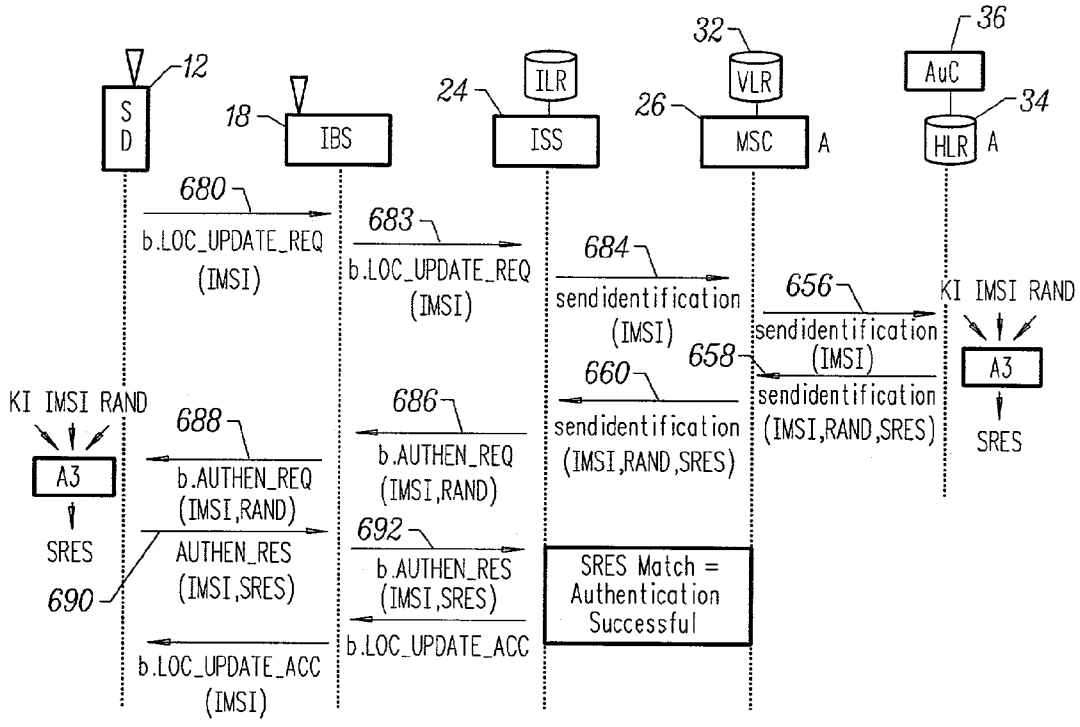

12
S
D
18
IBS
24
ILR
ISS
32
VLR
26
MSC
A
36
AuC
34
HLR
A
680
b.LOC_UPDATE_REQ
(IMSI)
683
b.LOC_UPDATE_REQ
(IMSI)
684
sendidentification
(IMSI)
656
sendidentification
(IMSI)
KI IMSI RAND
A3
SRES
658
660
sendidentification
(IMSI,RAND,SRES)
KI IMSI RAND
A3
SRES
686
b.AUTHEN_REQ
(IMSI,RAND)
688
b.AUTHEN_REQ
(IMSI,RAND)
692
b.AUTHEN_RES
(IMSI,SRES)
AUTHEN_RES
(IMSI,SRES)
690
SRES Match =
Authentication
Successful
b.LOC_UPDATE_ACC
b.LOC_UPDATE_ACC
(IMSI)

FIG. 11

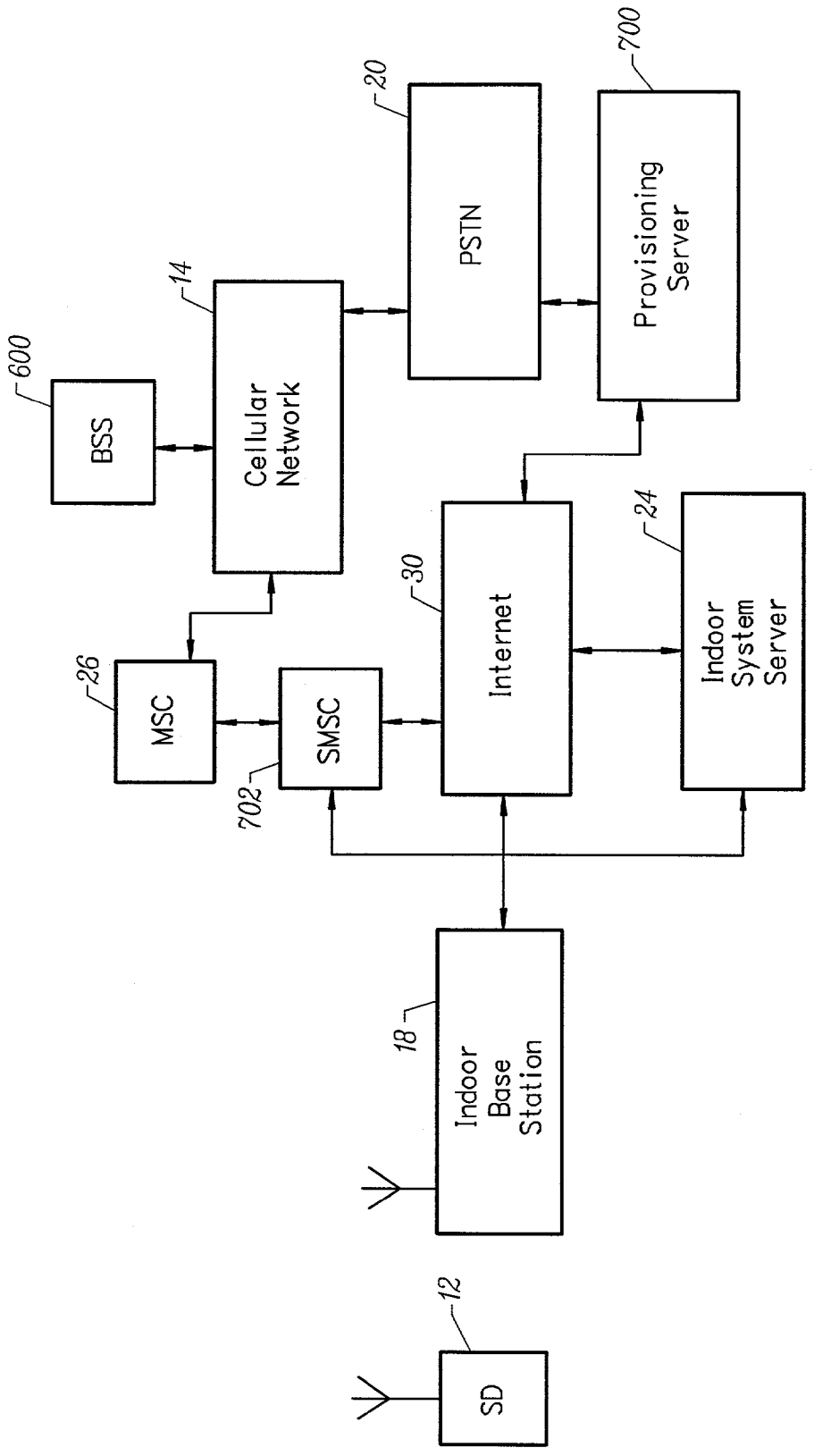

600
BSS
14
Cellular Network
20
PSTN
700
Provisioning Server
26
MSC
702
SMSC
30
Internet
24
Indoor System Server
18
Indoor Base Station
12
SD

FIG. 12

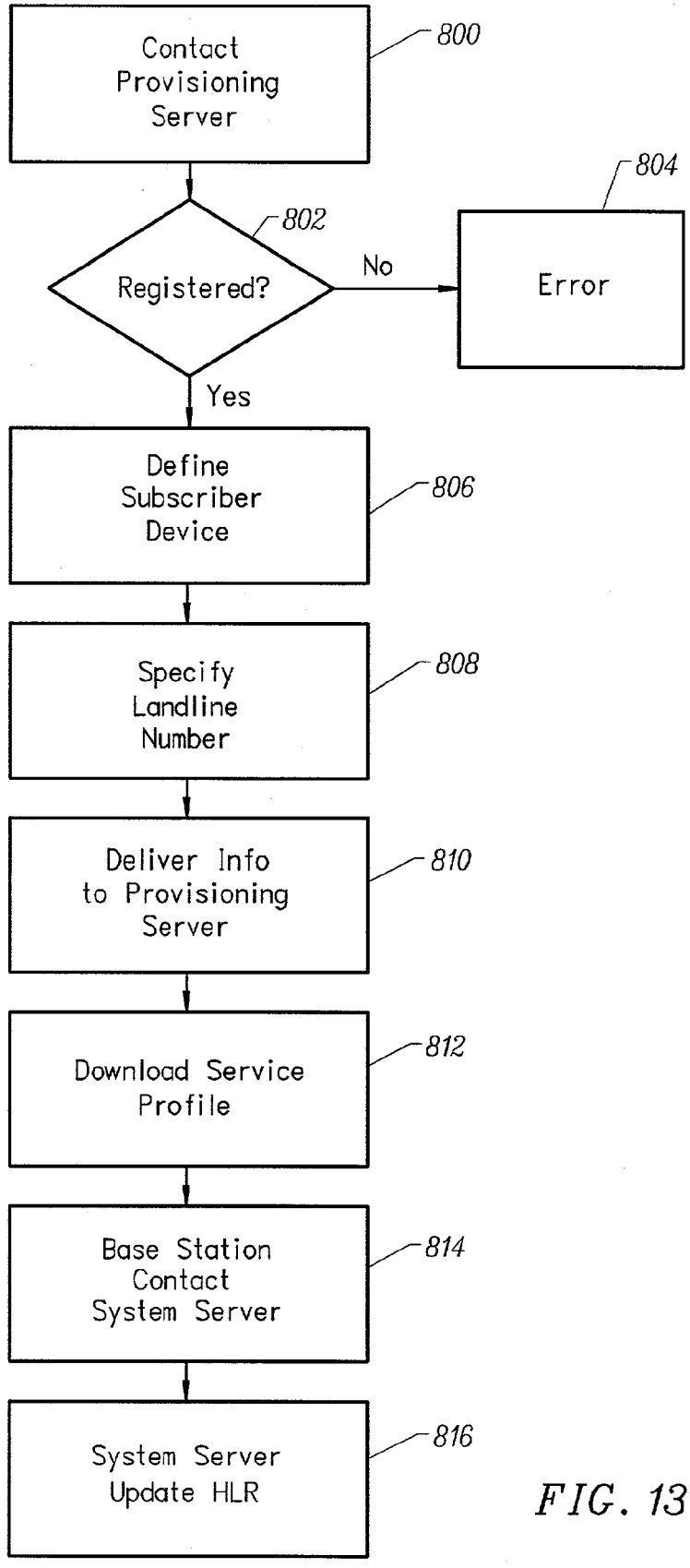

Contact Provisioning Server
800
Registered?
802
No
Error
804
Yes
Define Subscriber Device
806
Specify Landline Number
808
Deliver Info to Provisioning Server
810
Download Service Profile
812
Base Station Contact System Server
814
System Server Update HLR
816

FIG. 13

WIRELESS COMMUNICATIONS HANDSET FOR FACILITATING LICENSED AND UNLICENSED WIRELESS COMMUNICATIONS, AND METHOD OF OPERATION

[0001] This application claims priority to the following provisional patent applications: Nos. 60/271,766; 60/271,767; 60/271,768; and 60/271,769, each of which was filed on Feb. 26, 2001.

BRIEF DESCRIPTION OF THE INVENTION

[0002] This invention relates generally to telecommunications. More particularly, this invention relates to a technique for seamlessly integrating voice and data telecommunication services across a licensed wireless system and an unlicensed wireless system.

BACKGROUND OF THE INVENTION

[0003] Licensed wireless systems provide mobile wireless communications to individuals using wireless transceivers. Licensed wireless systems refer to public cellular telephone systems and/or Personal Communication Services (PCS) telephone systems. Wireless transceivers include cellular telephones, PCS telephones, wireless-enabled personal digital assistants, wireless modems, and the like.

[0004] Licensed wireless systems utilize wireless signal frequencies that are licensed from governments. Large fees are paid for access to these frequencies. Expensive base station equipment is used to support communications on licensed frequencies. Base stations are typically installed approximately a mile apart from one another. As a result, the quality of service (voice quality and speed of data transfer) in wireless systems is considerably inferior to the quality of service afforded by landline (wired) connections. Thus, the user of a licensed wireless system pays relatively high fees for relatively low quality service.

[0005] Landline (wired) connections are extensively deployed and generally perform at a lower cost with higher quality voice and higher speed data services. The problem with landline connections is that they constrain the mobility of a user. Traditionally, a physical connection to the landline was required. Currently, unlicensed wireless communication systems are deployed to increase the mobility of an individual using a landline. The mobility range associated with such systems is typically on the order of 100 meters. A common unlicensed wireless communication system includes a base station with a physical connection to a landline. The base station has a RF transceiver to facilitate communication with a wireless handset that is operative within a modest distance of the base station. Thus, this option provides higher quality services at a lower cost, but the services only extend a modest distance from the base station.

[0006] Thus, there are significant shortcomings associated with current landline systems and licensed wireless systems. For this reason, individuals commonly have one telephone number for landline communications and one telephone number for licensed wireless communications. This leads to additional expense and inconvenience for an individual. It would be highly desirable if an individual could utilize a single telephone number for both landline communications and licensed wireless communications. Ideally, such a system would allow an individual, through seamless handoffs between the two systems, to exploit the benefits of each system.

SUMMARY OF THE INVENTION

[0007] A wireless communication handset includes licensed wireless communication signal processing circuitry and unlicensed wireless communication signal processing circuitry. A control circuit is connected to the licensed wireless communication signal processing circuitry and the unlicensed wireless communication signal processing circuitry. The control circuit transitions a communication session without interruption from the licensed wireless communication signal processing circuitry to the unlicensed wireless communication signal processing circuitry.

[0008] Advantageously, services that would typically be provided via a licensed wireless system can be delivered to the unlicensed base station using inexpensive and high quality landline networks. The unlicensed base station subsequently provides service to a handset using unlicensed, free spectrum (e.g., spectrum around 2.4 GHz or 5 GHz). Thus, when a subscriber is within range of the unlicensed base station, the subscriber enjoys low cost, high speed, and high quality voice and data services. In addition, the subscriber enjoys extended service range since the handset can receive services deep within a building. This type of service range is not reliably provided by a licensed wireless system.

[0009] The invention also allows the subscriber to roam outside the range of the unlicensed base station without dropping communications. Instead, roaming outside the range of the unlicensed base station results in a seamless handoff (also referred to as a hand over) wherein communication services are automatically provided by the licensed wireless system.

[0010] While the invention provides advantages to the subscriber, the invention also provides advantages to the wireless system service provider. First, the unlicensed base stations are relatively low cost and therefore the wireless system service provider is in a position to extend services without incurring significant infrastructure expense. Further, the integration of the landline and wireless systems allows a single communication service provider to secure fee-paying accounts for both landline and wireless services. Finally, since the invention relies upon installed wireless system infrastructure for services such as authentication, expensive system upgrades are not required.

BRIEF DESCRIPTION OF THE FIGURES

[0011] The invention is more fully appreciated in connection with the following detailed description taken in conjunction with the accompanying drawings, in which:

[0012] **FIG. 1** illustrates an apparatus for integrating a licensed wireless system and an unlicensed wireless system in accordance with an embodiment of the invention.

[0013] **FIG. 2** illustrates a subscriber device configured in accordance with an embodiment of the invention.

[0014] **FIG. 3** illustrates a base station configured in accordance with an embodiment of the invention.

[0015] FIGS. **4A-4D** illustrate various base station configurations utilized in accordance with embodiments of the invention.

[0016] **FIG. 5** illustrates a system server for integrating unlicensed and licensed wireless communication systems in accordance with an embodiment of the invention.

[0017] **FIG. 6** illustrates a base station service region and associated transition points between licensed and unlicensed wireless communication services.

[0018] **FIG. 7** illustrates a transition between an unlicensed wireless service and a licensed wireless service in accordance with an embodiment of the invention.

[0019] **FIG. 8** illustrates transitions between unlicensed wireless base stations in accordance with an embodiment of the invention.

[0020] **FIG. 9** illustrates the forwarding of a licensed wireless call to a base station in accordance with an embodiment of the invention.

[0021] **FIG. 10** illustrates a prior art licensed wireless authentication procedure.

[0022] **FIG. 11** illustrates an unlicensed wireless authentication procedure utilized in accordance with an embodiment of the invention.

[0023] **FIG. 12** illustrates system components utilized in a provisioning operation associated with an embodiment of the invention.

[0024] **FIG. 13** illustrates provisioning operations performed in accordance with an embodiment of the invention.

[0025] Like reference numerals refer to corresponding parts throughout the several views of the drawings.

DETAILED DESCRIPTION OF THE INVENTION

[0026] **FIG. 1** illustrates a system **10** that may be operated in accordance with an embodiment of the present invention. The system **10** includes a subscriber device **12**, which is a wireless transceiver, such as a cellular telephone, a PCS telephone, a wireless data modem, a wireless enabled Personal Digital Assistant, a wireless enabled computer, and the like. This subscriber device **12** is in wireless electronic communication with a licensed wireless communication service that provides voice and/or data services. By way of example, the invention is disclosed in connection with a licensed wireless communication service in the form of a cellular network **14**. When the subscriber device **12** is within an unlicensed wireless service coverage area **16**, the licensed wireless service is substituted, without interruption, with an unlicensed wireless service that is facilitated through a base station **18**.

[0027] The base station **18** wirelessly transmits telephone signals from a standard Public Switched Telephone Network (PSTN) **20** and, if necessary, a standard Private Base eXchange (PBX) **22**, to a subscriber device **12**. Specifically, when a device **12** is within an unlicensed wireless service coverage area **16**, the originating base station **18** provides the device **12** with wireless telephone service originating from a PSTN **20** rather than a cellular network **14**. Since the PSTN **20** is used, the subscriber device **12** receives high quality voice or data services at a relatively low cost. If the user of the subscriber device **12** roams outside of the unlicensed wireless service coverage area **16**, the same communication session can be maintained without interruption by transitioning to the licensed wireless service provided by the cellular network **14**. Techniques for implementing seamless transitions of this type are discussed in detail below.

[0028] A system server **24** facilitates seamless transitions between the licensed wireless service and the unlicensed wireless service. The system server **24** is in electronic communication with the standard cellular network **14**. In one embodiment of the invention as shown in **FIG. 1**, the system server **24** is also in electronic communication with the base station **18** through a Local Area Network (LAN) **28** and a larger network **30**, such as the Internet. The system server **24** and the base station **18** may be linked through any number of communication services, including Digital Subscriber Line (DSL), cable, satellite, and the like.

[0029] **FIG. 1** illustrates that the cellular network **14** includes standard components, such as a cellular core network **15**, a Mobile Switching Center (MSC) **26**, Visitor Location Register (VLR) **32**, a Home Location Register (HLR) **34**, an Authentication Center (AC) **38**, and a Base Station Controller (BSC) **38**. As discussed below, these standard components are utilized in a novel manner in order to provide extended functionality for a subscriber device **12**.

[0030] **FIG. 2** illustrates a subscriber device **12**. As previously indicated, the subscriber device **12** may be a wireless telephone or a wireless modem. In the case of a wireless telephone, the subscriber device **12** includes a display **100**, keypad **102**, and a control circuit **104**. The display **100** may be used to provide a visual indication to a user when the subscriber device **12** is within the service range of the base station **18**. The keypad **102** is used in a conventional manner. The control circuit **104** may be in the form of a processor, a hardwired circuit, a programmable logic device, an application specific integrated circuit, and the like.

[0031] The control circuit **104** is also connected to a memory module **106** and, via audio switch **108**, to an audio input/output circuit **110**. Wireless signals in the unlicensed spectrum are received by an antenna **110** and are filtered by a filter **112** to improve signal clarity and/or strength. The wireless signals are then processed by unlicensed wireless circuitry **114**, which is also referred to as unlicensed wireless communication signal processing circuitry. The unlicensed wireless circuitry operates as a standard transceiver for processing unlicensed wireless signals. The circuitry **114** may support any number of unlicensed wireless standards. For example, currently in the U.S., unlicensed wireless signals may be sent at frequencies around 900 MHz, 2.4 GHz, or 5 GHz. Unlicensed wireless communication may be implemented in accordance with the invention utilizing any number of unlicensed spectrum communications protocols, including Bluetooth, IEEE 802.11a, IEEE 802.11b, and Hyper-LAN. Advantageously, many licensed wireless subscriber devices are currently being configured to include unlicensed wireless circuitry for such applications as remote microphones and speakers. In accordance with the invention, this circuitry is used for a new application, namely, communicating with a base station, as discussed below.

[0032] Selected signals, such as location update data or signal strength data, are sent to the control circuit **104**. Audio data is converted to an audio signal by audio circuitry **116** and is sent to an audio switch **108** for broadcast by an audio input/output circuit **109**. Audio signals transmitted to the

audio input/output circuit **109** are transmitted by audio switch **108** to the control circuit **104**, which is capable of sending audio and other data to unlicensed wireless circuitry **114**. Unlicensed spectrum signals are then sent through the filter **112** and on to the antenna **110**, where they are broadcast to the base station **18**.

[**0033**] In similar manner, wireless signals from a licensed cellular network **14** are transmitted to the antenna **111**, filtered by the filter **113**, and are then processed by the licensed wireless circuitry **118**, also referred to as licensed wireless communication signal processing circuitry. These signals are subsequently converted to an audio signal by audio circuitry **120** or are processed by control circuit **104**. As above, signals originating from the device **12** can also be sent out, but here the destination is a licensed wireless communication network (e.g., cellular network **14**) rather than a base station **18**. In the event of a data modem, the audio input/output circuit **109** is omitted and a data source is applied directly to the control circuit **104**. Audio signals transmitted from the audio input **109** are transmitted by audio switch **108** to the control circuit **104**, which is capable of sending audio and other data to licensed wireless circuitry **118**. Wireless signals are then sent through the filter **113** to the antenna **111**, where they are broadcast to the licensed wireless network **14**.

[**0034**] The individual subscriber device components discussed up to this point are standard. The combination of these devices is believed to be novel, as is the operation of these devices in accordance with a set of executable programs stored in memory **106**. The executable programs within memory **106** are shown by way of example. The same functionality may be realized through hardwired circuits, application specific integrated circuits, programmable logic devices, and the like. Indeed, the various components of the subscriber device **12** may be combined or integrated in any number of ways. The embodiment of **FIG. 2** is for the purpose of illustration.

[**0035**] The executable programs **106** reside on top of standard licensed wireless system call processing software. In addition, the programs **106** reside on top of standard unlicensed wireless link protocol software (e.g., standard Bluetooth or 802.11b software). The programs **106** bridge these systems by exchanging messages between the separate software stacks. Advantageously, this approach allows a large portion of the existing software protocols in the subscriber device **12** to be reused without any changes.

[**0036**] The memory module **106** contains a location tracking module **122** that records the current location of the device **12** (i.e., whether the device is within an unlicensed coverage area **16**). In addition, the module **106** contains an authentication and authorization module **124** to coordinate an authentication procedure for validating that the device **12** is licensed for use within the unlicensed coverage area **16**. As discussed below, the invention utilizes the authentication infrastructure associated with the licensed wireless system to authenticate and authorize a subscriber device for unlicensed wireless system services. The memory **106** also includes a handoff module **126** to coordinate seamless service exchanges between a base station **18** supporting unlicensed wireless communications and a licensed wireless communications network, such as a cellular network **14**. The operations associated with each of the modules stored in memory **106** are discussed in further detail below.

[**0037**] **FIG. 3** illustrates an embodiment of a base station **18** in accordance with an embodiment of the present invention. When the subscriber device **12** is within the coverage area **16** of the base station **18**, the base station **18** can be used to provide the subscriber device **12** with landline quality data and voice service via an unlicensed wireless communication link. In particular, the base station **18** interconnects to the existing telephone network to provide a final link to a subscriber device **12** through a short-range two-way radio link.

[**0038**] In one embodiment of the invention, the base station **18** is controlled by a control circuit **200**, which is in communication with the LAN **28** and therefore the system server **24** via router jack **202** and/or Ethernet jack **204**. The control circuit **200** may be a processor, a hardwired circuit, a programmable logic device, an application specific integrated circuit and the like. Signals from the system server **24** travel through one of these jacks into network interface circuitry **206** and on to the control circuit **200**. This allows the base station **18** to communicate with the system server **24**. As discussed below, the server **24** determines whether and when to route phone service over the unlicensed wireless system (e.g., via the PSTN **20** and base station **18**) or the licensed wireless system (e.g., via cellular network **14**).

[**0039**] The control circuit **200** is also in communication with a landline (PSTN **20** and, in the typical business context, PBX **22**) via a phone line jack **208** and/or phone extension jack **210**. These jacks transmit information between the PSTN **20** and control circuit **200** through Plain Old Telephone Service (POTS) interface circuitry **212**. Audio data is translated by audio circuitry **214**, while other data can be directly exchanged with the control circuit **200**.

[**0040**] The base station **18** communicates wirelessly with devices **12** using a radio frequency circuit **216**. This circuit **216** includes standard circuitry to receive and transmit electronic voice and/or data in an unlicensed wireless signal format. For example, currently in the U.S., unlicensed wireless signals may be sent in the frequency range between 2.4 GHz and 5 GHz. Unlicensed wireless communication may be implemented in accordance with the invention utilizing any number of unlicensed spectrum communications protocols, including Bluetooth, IEEE 802.11a, IEEE 802.11b, and Hyper-LAN.

[**0041**] A typical circuit **216** consists of transmission circuitry **218** for transmitting signals to a device **12**, receiving circuitry **220** for receiving signals from the device **12**, and base band circuitry **222**. The baseband circuitry **222** contains standard circuitry for down converting unlicensed wireless signals to base band signals, which allows for the extraction of relevant information by the control circuit **200**. The base band circuitry **222** also contains standard circuitry for up converting base band data from the control circuit **200** to unlicensed wireless signals for broadcast by transmission circuitry **218**.

[**0042**] The control circuit **200** is also connected to a memory module **224**. The memory module **224** contains a provisioning module **226** that is used to facilitate the initial configuration and servicing of the base station **18** and subscriber device **12**. The module **224** also includes a subscriber interface module **228**. The subscriber interface module **228** instructs the control circuit **200** to periodically broadcast a signal (e.g., an unlicensed wireless communi-

cation base station identification signal). If a subscriber device **12** responds to the signal, then the-base station **18** knows that the subscriber device **12** is within the unlicensed coverage area **16**. The module **224** also contains an authentication module **230** to coordinate the authentication of a subscriber device **12** that has entered the unlicensed coverage area **16**. In one embodiment of the invention, the memory **224** includes an enhanced service module **232**. The enhanced service module may be used to provide improved services to a subscriber device. For example, if the user of a subscriber device is playing a low latency on-line game, different screen displays can be cached in the base station **18** and then be quickly downloaded to the subscriber device **12**. Each of the modules stored in memory **224** can also be implemented as hardwired circuits, application specific integrated circuits, programmable logic devices, and the like.

[**0043**] The enhanced service module **232** may also be used to implement other advanced features. For example, the enhanced service module **232** can be configured to append a set of prefix digits before dialed digits to instruct the server **24** to route long distance calls on a specific service provider network.

[**0044**] The enhanced service module **232** can also be used to simultaneously support multiple subscribers. For example, the base station **18** may support multiple subscriber devices through a single or multiple landline connections.

[**0045**] Preferably, the subscriber interface module **228** of the base station **18** is configured to advise a subscriber device when the landline associated with the base station **18** is occupied. In such a case, the handoff module **126** of the subscriber device will no longer attempt to make contact with the base station **18**, but will continue to utilize the licensed wireless system for call servicing.

[**0046**] In order to provide landline-quality service to subscriber devices **12**, a base station **18** is installed directly in the path of a typical phone system. **FIG. 4A** illustrates a typical office or workplace, where a telephone **300** is connected to a PBX **22**. The PBX **22** is installed between the telephone **300** and PSTN **20** to provide a private telephone network in which a number of telephones **300** share a certain number of outside lines from the PSTN **20**. **FIG. 4A** illustrates that a Personal Computer (PC) **302** can be connected to the LAN **28** for communication with the Internet **30**.

[**0047**] **FIG. 4B** illustrates the workplace environment of **FIG. 4A** modified to incorporate the base station **18** of the invention. The base station **18** is placed in electronic communication with both the telephone **300** (e.g., via phone line jack **208**) and the LAN **28** (e.g., via Ethernet jack **204**). This configuration allows base station **18** to receive landline voice and data from a PSTN **20** and broadcast it to subscriber devices **12** when they are within the coverage area **16**. The base station **18** is also connected to a LAN **28**, which allows it to communicate with the system server **24** in order to coordinate handoffs between the licensed wireless and unlicensed wireless systems. Advantageously, the base station **18** operates transparently with respect to the PBX **22**, the LAN **28**, the telephone **300**, and the PC **302**. In the event that the PBX **22** is Internet Protocol based, the base station **18** can be connected solely to the LAN **28**.

[**0048**] **FIG. 4C** illustrates a typical home setting, which is usually similar to the workplace setting of **FIG. 4A** minus the LAN **28** and PBX **22**. The telephone **300** is ordinarily connected directly with Plain Old Telephone Service (POTS) **304**, which is simply another term for PSTN **20**. Connection to the Internet **30** is provided by a modem **306** in communication with a PC **302**. **FIG. 4D** illustrates the placement of base station **18** within this typical home setting. Here, the base station **18** is placed in electronic communication with both a telephone **300** and modem **306**, allowing it to communicate directly with the POTS **304**/PSTN **20** and, through modem **306**, with the Internet **30** and system server **24**. Once again, the base station **18** operates transparently with respect to the modem **306**, the POTS **304**, the telephone **300**, and the PC **302**.

[**0049**] In both the workplace and home settings, the base station **18** can be in simultaneous communication with both a telephone landline and a system server **24**. When a subscriber device **12** roams inside the coverage area **16**, the base station **18** can thus provide landline-quality service to device **12**. The invention should thus be construed to include an apparatus and method for the seamless switching of telephone service between a cellular network **14** and a landline-based base station **18** that can be used in either a residential or commercial setting.

[**0050**] As mentioned above, for purposes of this invention a landline can be interchangeably referred to as a POTS **304** or PSTN **20**. However, the invention should not be construed as limited to simply the POTS or PSTN context. Rather, the invention discloses a base station **18** that can provide landline-quality service to a subscriber device **12** by communicating with any landline network. Examples of such networks include, but are not limited to, DSL, cable or cable modem networks.

[**0051**] **FIG. 5** illustrates a system server **24**, which manages the mobility of subscriber devices **12** between a landline-based unlicensed wireless service from a base station **18** and a licensed wireless service, such as from a cellular network **14**. A typical system server **24** is controlled by a central processing unit (CPU) **400**, which is connected to a bus **401**. Network interface cards **402** (e.g., Ethernet cards) for communicating with the Internet **30** are also connected to the bus **401**. Licensed network interface cards **404** (e.g., SS7 cards) for communicating with cellular networks **14** are also connected to the bus **401**. This allows the system server **24** to use Internet Protocol (IP) and/or SS7 protocol and/or MAP & IS-41 protocols to connect to the Internet and cellular core networks.

[**0052**] The system server **24** also contains a memory module **406** that stores a number of programs, databases and other assorted modules. More specifically, the module **406** contains signaling control programs **408**. The signaling control programs **408** are standard programs for establishing communications with the licensed wireless network. Therefore, for example, the signaling control programs **408** may include a Transaction Capability Application Part (TCAP) module, a Message Transfer Part (MTP) module, and an Interim Standard (IS41) module to support Time Division Multiple Access (TDMA) and Code Division Multiple Access (CDMA). Memory **46** may also store datapath control programs **410**. By way of example, the datapath control programs may include standard programs to facilitate computer network data transfers. By way of example,

the datapath control programs may include an Internet Protocol (IP) module and a Gateway Tunnel Protocol (GTP) module.

[0053] The memory **406** also stores various system server application programs **412**. These application programs include system bridge programs **414** for handling transitions in service from licensed to unlicensed wireless services and vice versa. The memory **406** also stores a location database **416** for storing the current location of devices **12** and indicating whether they are within the coverage area **16**. Also included is a billing module **418** for recording usage statistics for billing purposes. The billing module **418** distinguishes between charges for licensed wireless services and unlicensed wireless services. A provisioning module **420** is included to facilitate the installation of new base stations. An authentication module **422** is used to facilitate the authentication of a subscriber device within an unlicensed wireless service area. As discussed below, the authentication module **422** includes data and executable instructions to emulate certain components of a licensed wireless network. For example, the authentication module emulates a mobile switching center during the authentication process.

[0054] The major components of the invention—the subscriber device **12**, the base station **18**, and the system server **24**—have now been described. The operations of these devices are more fully appreciated with the following discussion.

[0055] The invention's facilitation of seamless transitions between licensed and unlicensed wireless services is more fully appreciated in connection with **FIG. 6**. Base station **18** broadcasts within a set of boundaries B1, B2, B3 and B4. A subscriber device **12** located outside these boundaries is serviced by a licensed wireless system, such as a standard cellular network **14**. However, once the device **12** crosses boundary B3, the handoff from the licensed wireless service to the unlicensed wireless service begins. That is, at the B3 boundary the base station **18** is able to recognize the presence of the subscriber device **12**. As previously indicated, the base station **18** includes a subscriber interface module **228** that coordinates the transmission of a service range signal that is identified by a subscriber device **12**. That is, the location tracking module **122** of the subscriber device **12** is used to coordinate the identification of a base station signal. In the presence of such a signal, the location tracking module **122** coordinates the transmittal of an acknowledgment signal to the base station **18**.

[0056] Preferably, the subscriber interface module **228** of the base station **18** identifies the boundary points of the service area **16** by using the received signal strength and the transmit-power level setting from the subscriber device **12**. In particular, an automated process is preferably used to learn the boundary distances through heuristically measuring the success rate and adjusting the boundary distance for optimal handoff success rates.

[0057] In one embodiment, the location tracking module **122** of the subscriber device **12** is implemented to periodically wake the unlicensed wireless circuitry **114** to sniff and thereby determine whether it is within the range of a base station. If so, the subscriber device registers with the base station **18**, if not, the unlicensed wireless circuitry **114** is activated at a later time.

[0058] Under the control of the subscriber interface module **228**, the base station **18** identifies the acknowledgement signal and transmits a subscriber device present signal to the router jack **202**, the Ethernet jack **204**, the phone line jack **208**, or the phone extension jack **210**. The subscriber device present signal is subsequently directed through a network (e.g., the LAN **28** and Internet **30**) to the system server **24**, which notes that the subscriber device **12** is now within the service area of the base station **18**. In particular, the system server **24** logs this information in the location database **416**.

[0059] Once the system server **24** logs the fact that the subscriber device **12** is within the service range of the base station **18**, it contacts the cellular network **14** to initiate a call to the landline associated with the base station **18**. It is known in the art to utilize a cellular network **14** to establish a call to a landline number. For example, **FIG. 1** illustrates a link between the Mobile Switch Center (MSC) **26** and the PSTN **22**. In the prior art, this feature is used to direct a call intended for a mobile device to a landline telephone when the user of the mobile device has advised the cellular system that the landline telephone can be used to receive calls. Observe in this situation that the transition from the cellular network to the landline telephone is established prior to the call being placed. This prior art scenario stands in sharp contrast to the present invention where during the course of an already established communication session control is transferred from a licensed wireless service to an unlicensed wireless service or vice versa. This aspect of the invention is more fully appreciated in connection with the following discussion.

[0060] As previously indicated, when the subscriber device **12** crosses the boundary B3, a landline call to or from the base station **18** is initiated. Once the landline call is received at the base station **18**, the base station **18** begins transmitting to the subscriber device **12** using the unlicensed wireless spectrum. These transmissions are processed by the unlicensed wireless circuitry **114** of the subscriber device **12** (See **FIG. 2**). At this point, the licensed wireless circuitry **118** is also active and the audio switch **108** is responsive to the licensed wireless circuitry **118**. Thus, the subscriber device **12** is processing both licensed wireless signals and unlicensed wireless signals at this point. The handoff module **126** can coordinate this operation.

[0061] The subscriber interface module **228** of the base station **18** continues to monitor the signal strength from the subscriber device **12**. When the signal strength reaches a threshold corresponding to the crossing of boundary B4, the subscriber interface module **228** initiates a handoff command, which is applied to the RF circuit **216**. The handoff command is received at the subscriber device **12** and is processed by the handoff module **126**, which generates a handoff signal that is applied to the audio switch **108**. The handoff signal causes the audio switch **108** to process information from the audio circuitry **116** associated with the unlicensed wireless circuitry **114**.

[0062] At this point, the licensed wireless circuitry **118** can be turned off. The ability to turn this circuitry off is a significant advantage because it preserves battery life. Typically, the licensed wireless circuitry remains active in order to provide location information to the licensed wireless system infrastructure. However, as discussed below, this location information is available in accordance with the

invention. Therefore, the licensed wireless circuitry can be shut down to obtain a significant extension in battery life. Alternately, the licensed wireless circuitry **118** can remain in a low power state to receive signaling or messages from the licensed wireless system, while voice is carried over the unlicensed system.

[**0063**] The spacing between boundaries B**3** and B**4** allows time for the establishment of simultaneous connections between the subscriber device **12** and both the licensed network and unlicensed network. This allows for the immediate switching of service to the unlicensed network once the subscriber device **12** crosses boundary B**4**, thus creating a seamless transition to base station service that is transparent to the user.

[**0064**] Once the device **12** is within boundary B**4**, service is originated within the PSTN **20** and broadcast wirelessly to the device **12** by the base station **18**. If the device **12** travels away from this base station **18**, service is handed off from the base station **18** to a licensed wireless network **14** in a manner similar to the process described above. Specifically, once the device **12** crosses boundary B**2**, a simultaneous link is established with a licensed wireless network (e.g., cellular network **14**). When the device **12** further crosses boundary B**1**, a seamless handoff is made from the unlicensed wireless service originating over the PSTN **20** to the licensed wireless network (e.g., cellular network **14**). At this point, the subscriber device **12** receives wireless services from the cellular network **14** in a standard manner.

[**0065**] **FIG. 7** provides a more detailed characterization of this handoff process from an unlicensed wireless service to a licensed wireless service. When the subscriber device **12** is within the service area **16** of the base station **18**, the subscriber device **12** transmits to the base station **18** information on the signal strengths of the frequencies of the nearby licensed wireless base stations. The base station **18** forwards this information to the system server **24**, which in turn sends the information to the Visitor Location Register (VLR) **32**. This operation is shown with arrow **450** in **FIG. 7**.

[**0066**] In response to this message, the licensed wireless system provides the parameters that are needed when the subscriber device **12** needs a handoff from the unlicensed wireless system to the licensed wireless system. This information includes the identity of the base station to which the handoff should be made. By way of example, in a GSM cellular system, these parameters are CI (Cell Identity) and LAC (Location Area Code). This handoff information may be obtained and stored in the base station **18** before a call is made or when a call is made. In any event, the handoff information can be secured well before the subscriber device **12** roams outside the coverage area of the base station **18**. The availability of this information allows the subscriber device **12** to quickly transition to the licensed wireless system. In addition, this information allows the licensed wireless circuitry **118** to be shut down for the purpose of extending battery life.

[**0067**] The licensed wireless system connection information may be delivered to the base station **18** via a landline connection as shown with line **452**. Alternately, the information may be delivered through a communication session between the system server **24** and the mobile switch center **26** and then the system server **24** and the base station **18**, as shown with arrows **454** and **456**.

[**0068**] As shown with arrow **458** in **FIG. 7**, the base station **18** continuously makes power measurements of signals that are received from the subscriber device **12**. When the power measurements begin to grow weak, the base station may notify the system server **24** to initiate a handoff to the licensed wireless system. In turn, the system server **24** may advise the Mobile Switch Center (MSC) **26** of the hand over candidate, as shown with arrows **460** and **462**.

[**0069**] When the power measurements at the base station **18** become sufficiently weak, indicating that the subscriber device **12** is moving away from the base station **18** (e.g., crossing boundary B**2**) a formal hand over request is initiated. In particular, the base station **18** transmits to the system server **24** the base station identity (e.g., CI, LAC, etc.) to which the handoff should be transferred, as shown with arrow **458**. The system server **24** contacts the MSC **26** to initiate a handoff, as shown with arrow **460**. The MSC **26** contacts the Base Station Controller (BSC) **38**, as shown with arrow **462**. In response, the BSC **38** generates a channel number, a slot number and a handoff reference. As shown with arrow **464**, this information is passed to the Base Station Transceiver System (BTS) **500**. The information is also passed back to the subscriber device **12** through the MSC **26**, the system server **24**, and the base station **18**, as shown with arrows **466**, **468**, **470**, and **472**.

[**0070**] In response to this information, the BTS **500** turns on a transmitter and receiver at the specified channel number and slot number. Similarly, the subscriber device **12** turns on its transceiver circuitry **118**. The BTS **500** seeks a response from the subscriber device with a matching reference number, as shown with arrow **474**. Once the subscriber device **12** receives the BTS transmission, it sends a message to the BTS with the handoff reference, as shown with arrow **476**. At this point, a new licensed wireless link is established on the given channel and slot number, as shown with arrow **478**. Once the licensed wireless link is established, the unlicensed wireless link is turned off, as shown with line **480** in **FIG. 7**. Thereafter, the BTS **500**, the BSC **38**, and the MSC **26** operate in a standard manner to supply licensed wireless services to the subscriber device **12**. The foregoing operations may be implemented using the handoff module **126** of the subscriber device **12**, the subscriber interface module **228** of the base station **18**, and the system bridge programs **414** of the system server **24**.

[**0071**] As previously indicated, a handoff from a licensed wireless service to an unlicensed wireless service occurs in a similar but reverse fashion. When the subscriber devices **12** cross boundary B**3** from a remote location the base station **18** initiates a handoff operation by sending a request to the system server **24**, which conveys the request to the MSC **26**. The MSC **26** then hands off the call to the landline number assigned to the base station **18**.

[**0072**] Between boundaries B**3** and B**4**, both the licensed wireless (e.g., cellular) link and unlicensed wireless (e.g., landline originated) link are simultaneously active. After a period in which both links are simultaneously active, control of the communication session is switched from the licensed wireless circuitry **118** to the unlicensed wireless circuitry **114**. The handoff module **126** may coordinate this handoff in response to a handoff command initiated at the subscriber interface module **228** of the base station **18**. As above, the

maintenance of simultaneous licensed and unlicensed wireless links for a period of time ensures a successful seamless handoff. This reduces the number of dropped calls, and allows for successful handoffs even when the signaling messages among different elements of the cellular and landline-based systems experience delays or latency.

[0073] The foregoing discussion was directed toward handoffs between licensed wireless services and unlicensed wireless services. The invention also includes a technique for seamless handoffs between unlicensed wireless service base stations. Such a technique would be valuable, for example, in the case where an office building has a large number of base stations **18** to supply unlicensed wireless services to a user that would otherwise receive poor quality licensed wireless service within the office building.

[0074] Thus, the invention includes a system wherein a plurality of base stations **18** exist with overlapping coverage areas **16**. This allows a subscriber device **12** to roam freely among the coverage areas **16**.

[0075] **FIG. 8** illustrates such a system. The subscriber device **12** is registered with base stations **600** and **602**. Base stations **600** and **602** communicate with each other using LAN **28**. The base stations **600** and **602** are shown installed in a typical workplace setting, with telephones **300** and PCs **302** connected to a LAN **28** and PBX **22** in a standard fashion. Note that the coverage areas **604** and **606** of the base stations **600** and **602** overlap. As a device **12** moves from one area **604** to another area **606**, voice and data signals from the first base station **600** are seamlessly handed off to the second base station **602**.

[0076] Periodically, the base stations **600** and **602** broadcast a message over the LAN **28** to all other base stations connected to the LAN **28**. This message includes a time stamp, a signal indicating the particular base station, the subscriber number, and a range number indicating the distance between that base station and the device **12**. A separate message is broadcast for each base station on the LAN **28**. A range number can be calculated by relying upon the ability of the base station **18** to measure the signal strengths emitted from the subscriber device or vice versa.

[0077] In accordance with this feature of the invention, there is no centralized control mechanism for handling handoffs. Instead, the subscriber interface module **228** of each base station **18** is used to coordinate handoffs between base stations based upon signal strengths and/or range numbers. For example, in **FIG. 8**, at position T1 the base station **600** would transmit a time stamp, a base station number, a subscriber number, and a range number indicating that the subscriber device **12** is relatively close to the base station **600**. At T2 the base station **600** would transmit the same information except a different range number indicating that the signal between the base station **18** and the subscriber device **12** is weaker. By position T3, the base station **602** would send a signal on the LAN **28** indicating that it has a range number indicating that the subscriber device **12** is now closer to it than to base station **600**. Accordingly, both base stations would recognize that a transition from base station **600** to base station **602** should transpire. Under these circumstances, the second base station **602** transmits a signal over LAN **28** to the first base station **600** requesting a transition. Once the first base station **600** acknowledges this request, it forwards the call to the second base station **602** and service is continued without disruption. For example, the call may be forwarded over LAN **28** using Voice Over Internet Protocol (VOIP) techniques.

[0078] The discussion up to this point has been directed toward seamless transitions between licensed and unlicensed wireless services. Attention now turns to other aspects of the invention. Another aspect of the invention is a technique for assigning a base station to a landline telephone number. Another aspect of the invention is a technique for authenticating a user for unlicensed wireless services. Advantageously, authentication is implemented through reliance upon existing authentication infrastructure associated with the licensed wireless network. Thus, a separate authentication scheme need not be implemented. Another aspect of the invention that is discussed below is the provisioning of a base station into the overall licensed wireless network. As discussed below, the provisioning operation is automatically performed and therefore does not require technical sophistication or expertise on behalf of the user.

[0079] **FIG. 9** illustrates a technique for assigning a landline number to a base station **18**. Upon installation and power-up, the base station **18** queries the subscriber device **12** for the local landline phone number to which the base station is connected. In some embodiments, the base station **12** will also solicit the Internet Protocol (IP) address for the system server **24**. After the user enters the phone number and/or IP address into the subscriber device **12**, the information is transmitted to the base station **18**, as shown with arrow **610** of **FIG. 9**. The base station **18** forwards the same information to the system server **24**, as shown with arrow **612**. The system server **24** then transmits this information for storage in the HLR **34**, as shown with arrow **614**. Once stored in the HLR **34**, the MSC **26** can access the number as a mobile system roaming number (MSRN), as shown with arrows **616** and **618**. Thereafter, the mobile system roaming number can be used in a conventional manner to route a call to the base station **18**. Alternately, the MSRN may be a number corresponding to a number associated with the system server **24**. In which case, the system server **24** sends the call to the base station **18**.

[0080] Another aspect of the invention is authentication. As previously indicated, the invention utilizes the authentication infrastructure associated with the licensed wireless network to authenticate users for the unlicensed wireless network.

[0081] **FIG. 10** illustrates a licensed wireless system authentication process utilized in accordance with the prior art. In this example, the subscriber device **12** moves from the coverage area served by its home MSC (referred to as MSC-A) to the coverage area served by MSC-B. As soon as the subscriber device **12** enters a cell that is served by MSC-B, it registered with the system by sending an authentication request and a location update to BSS **600**, as shown with arrow **650**. The location update request includes an international mobile subscriber identity (IMSI).

[0082] BSS **600** forwards this information to the VLR **32** associated with MSC-B, as shown with arrow **652**. The VLR of MSC-B in turn sends a message to the VLR and HLR of the SMC-A, as shown with arrows **654** and **656**. This information serves as a request for authentication of the subscriber device **12** as well as to inform the HLR **34** of the

current location of the subscriber device **12** as served by the MSC-B. The authentication is performed as follows.

[**0083**] The authentication center (AuC) **36** generates a parameter called SRES (signed response). In order to generate the SRES, it uses an authentication algorithm **A3**, such as a public key/private key algorithm. The algorithm **A3** processes a secret key Ki, a random number RAND, and the IMSI to produce the SRES. The IMSI, RAND, and SRES are passed to the MSC-A (arrow **658**) and MSC-B (arrow **660**). The SRES is temporarily stored at the MSC-B until the authentication operation is completed. The MSC-B passes the IMSI and the RAND to the BSS, which passes the information to the subscriber device **12**. Based upon the IMSI and the RAND that it receives (referred to herein as licensed wireless communication system security information), along with the secret key Ki that it stores, the subscriber device **12** executes the same authentication algorithm **A3**. This results in the subscriber device **12** producing a SRES, which is referred to as an authentication result. If the subscriber device is legitimate, it has the same secret key Ki encoded in it as the one in the HLR. The service provider encodes this key at the time of activating the subscriber. This key is known only to the subscriber device and to the HLR.

[**0084**] The SRES, or authentication result, generated by the subscriber device **12** is passed with the IMSI to the BSS-B (arrow **666**), which passes it to the MSC-B (arrow **668**). The MSC-B compares the SRES generated by the subscriber device **12** to the SRES generated by the HLR. Authentication is only successful if the two numbers match. The SRES generated by the HLR can be referred to as an authentication value. If the authentication value from the HLR matches the authentication result from the subscriber device **12**, then an authentication command is generated.

[**0085**] The above process assists in understanding the authentication process included in the present invention, as the new method is designed to utilize the existing authentication process already existent in the licensed wireless system. **FIG. 11** illustrates an authentication process in accordance with the present invention. In accordance with the invention, the base station **18** is designed to emulate a BSS **600**, and the system server **24** is designed to emulate an MSC **26**.

[**0086**] When the subscriber device **12** enters the service area of the base station **18**, it registers with the base station. The authentication module **124** of the subscriber device **12** subsequently intercepts the registration message that is typically sent to the licensed wireless base station (e.g., BSS **600**). This information, referred to as a licensed wireless authentication request, is sent to the base station **18**, as shown with arrow **680**. The base station **18**, at the direction of the authentication module **230**, routes the information to the system server **24**. In particular, the authentication module **230** of the base station **18** forms an Internet Protocol (IP) packet containing the information and routes it to the system server **24**. As shown with arrow **684**, the system server **24** forwards the information to the MSC-A. The authentication module **422** of the system server **24** may be used for this purpose. In this capacity, the authentication module **44** assists the system server **24** in its operation of emulating a VLR. The operations at arrows **656**, **658**, and **660** are identical to the operations performed in the prior art system of **FIG. 10**.

[**0087**] At this point, the system server **24** stores the SRES, instead of an MSC. The system server **24** forwards the IMSI and RAND information to the base station **18**, as shown with arrow **686**. The base station **18**, emulating a BSS, passes this information to the subscriber device **12**. The authentication operation performed at the subscriber device is conventional, with the subscriber device returning an authentication result (e.g., an IMSI and a. SRES) to the base station **18**, as shown with arrow **690**. The base station **18** passes this information to the system server **24**, as shown with arrow **692**. The system server **24** then checks for an SRES match. That is, the system server compares the authentication result produced by the subscriber device **12** to the authentication value (e.g., SRES) received from the MSC-A. Recall that this operation was performed by the MSC **26** in the prior art system of **FIG. 10**. In the event of a match between the computed SRES values, an authentication command is produced and unlicensed wireless services may be delivered to the subscriber device **12** through the base station **18**.

[**0088**] Preferably, authentication is not performed every time the subscriber device registers with the base station **18**. Instead, the authentication module **230** of the base station **18** preferably stores previous authentication information and locally re-authenticates without accessing the system server **24**. This implementation is faster and otherwise reduces network traffic.

[**0089**] Yet another aspect of the invention involves provisioning of a base station in order to facilitate the licensed-to-unlicensed wireless communications achieved in accordance with the invention. By way of overview, the provisioning operation of the invention entails the base station **18** automatically configuring itself. In one embodiment, provisioning is accomplished by initially accessing a provisioning server. Subsequently, the base station registers with the system server. In the event that Internet access is available to the base station, the base station uses the Internet to access the provisioning server and the system server. If Internet access is not available, a Short Message Service Center may be used during the provisioning operation.

[**0090**] **FIG. 12** illustrates equipment utilized during the provisioning operation. In particular, the figure illustrates a subscriber device **12** and a base station **18**. In one embodiment, the base station **18** uses the Internet **30** to access a provisioning server **700**. For example, the base station **18** may access the Internet through a broadband modem, such as DSL. The provisioning server **700** supplies a service profile to the system server **24**, as discussed more fully below. In another embodiment of the invention, the base station **18** is provisioned through a wireless connection. In particular, a wireless link is established using a Short Messaging Service or packet data services supported by the cellular system. For example, a short messaging service message can be sent from the base station **18** to the subscriber device **12**, which then delivers the message to the BSS **600**. The BSS **600** delivers the message to the cellular network **14**, which delivers the message to the MSC **26**. The MSC **26** routes the message to the Short Message Service Center (SMSC) **702**, which routes the message over the Internet **30** to the provisioning server **700**. Information from the provisioning server **700** is delivered to the system server **24** and the base station **18** through a reverse path.

[0091] **FIG. 13** illustrates the process steps involved when the system of **FIG. 12** carries out the provisioning process. The process is typically initiated upon installation and activation of a new base station **18**, and will be discussed in that context, but those of skill in the art will see that it can be performed any time that provisioning information must be updated.

[0092] When a base station **18** is initially powered up it contacts the provisioning server **700** (step **800**). The provisioning module **226** of the base station **18** coordinates this operation. In one embodiment, contact is made through the Internet **30** using one or more preprogrammed IP addresses for the provisioning server. Alternately, the provisioning server may be accessed through the SMSC, as discussed above. The base station **18** then identifies itself to the provisioning server **700**, for example, using a code preprogrammed at the time of manufacture. If the provisioning server **700** does not recognize the base station, the base station preferably provides an error indication. If the provisioning server **700** recognizes the base station, that processing proceeds to block **806**.

[0093] At this point, the base station broadcasts a signal to the subscriber device **12** instructing it to define itself (block **806**). For example, the subscriber device **12** may define itself by sending to the base station **18** an electronic serial number or a portion of an electronic serial number. This defining information is used to establish an association between the base station **18** and the subscribe device **12**. This local association is mapped with a local authentication procedure. Thereafter, whenever the subscriber device and the base station come into contact, they identify each other by passing the local authentication procedure. The two devices can only communicate if the local authentication procedure is successful.

[0094] The provisioning module **127** of the subscriber device **12** prompts the user to enter the landline telephone number associated with the base station **18** (block **808**). This information is then passed to the base station **18**. The base station then delivers information to the provisioning server (block **810**). For example, the base station will typically deliver the landline telephone number and a base station identification number to the provisioning server. The provisioning server then downloads a service profile to the base station and the system server (block **812**). The service profile can include the landline telephone number and caller services, such as call waiting, caller identification, and the like. The service profile may also include an IP address for the base station. The IP address allows packet data to be delivered to the base station. The service profile also includes the IP address of a system server **24** assigned to the base station **18**. Typically, the system server **24** is selected based upon proximity to the base station, as derived from the area code associated with the landline telephone number.

[0095] Observe that the provisioning server operates as a central registration point for all devices within the system. This central point makes it easier to modify system wide services. In addition, the provisioning server provides the benefit that a single address is programmed into each base station.

[0096] The base station takes the IP address of the system server from the service profile and contacts the system server (block **814**). If the service profiles match, an association is established between the system server, the base station, and the subscriber device. The system server subsequently updates the HLR of the subscriber device with contents of the service profile (block **816**). At this point, the authentication process of **FIG. 11** would typically be performed. This provisioning process can be repeated whenever a new device **12** or base station **18** is introduced into the system.

[0097] Another aspect of the invention allows licensed wireless service users to seamlessly change between a desktop phone and a subscriber device **12** during a call, thus allowing them to use the most comfortable device at a given time. Thus, when a subscriber device **12** is located within a coverage area **16**, a user can simply pick up the desktop phone and continue their conversation. The subscriber device **12** can then be disconnected without any interruption in service. In this embodiment, the desktop phone and the base station are connected to the same landline, thereby providing this interchangeability. Likewise, when a caller is using a desktop phone within an area **16**, he or she can activate a subscriber device **12** and continue a call from there. In this instance, a button on the subscriber device is used to initiate communication with the base station that is connected to same landline. Subsequently hanging up the desktop phone will not interrupt service. Observe in this context that when the subscriber device is within the coverage area **16** of the base station **18**, both the subscriber device **12** and a desktop telephone may simultaneously ring in response to a call. The user can then pick up either device.

[0098] The foregoing description, for purposes of explanation, used specific nomenclature to provide a through understanding of the invention. However, it will be apparent to one skilled in the art that specific details are not required in order to practice the invention. Thus, the foregoing descriptions of specific embodiments of the invention are presented for purposes of illustration and description. They are not intended to be exhaustive or to limit the invention to the precise forms disclosed; obviously, many modifications and variations are possible in view of the above teachings. The embodiments were chosen and described in order to best explain the principles of the invention and its practical applications, the thereby enable other skilled in the art to best utilize the invention and various embodiments with various modifications as are suited to the particular use contemplated. It is intended that the following claims and their equivalents define the scope of the invention.

1. A wireless communication handset, comprising:

licensed wireless communication signal processing circuitry;

unlicensed wireless communication signal processing circuitry; and

a control circuit connected to said licensed wireless communication signal processing circuitry and said unlicensed wireless communication signal processing circuitry, said control circuit transitioning a communication session without interruption from said licensed wireless communication signal processing circuitry to said unlicensed wireless communication signal processing circuitry.

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