CELL TOWER FUNCTIONALITY WITH SATELLITE ACCESS TO ALLOW A CELL DEVICE TO ROAM ON A SATELLITE NETWORK

BACKGROUND

The prior art teaches an electronic device that has duplex satellite communication ability (e.g., to communicate voice or data over a satellite communications network, such as the Globalstar satellite communication network) where the electronic device also has the capability to interface (by wire or wirelessly, but not over a cellular network) with a cellular enabled device, such as a smart phone, cell enabled tablet, computer or other cellular enabled device. As used, "cell enabled" or "cellular enabled" means that the device can communicate as a mobile device on a cell based communications network. A non-cellular device is a device that cannot communicate as a mobile device on a cell network. The cellular communication functionality does not enable satellite capability, as the communications frequencies for satellites networks are different from cellular communications, and in general, formatting of satellite communications is different from cellular communications (for instance satellite communications can be TDMA or CDMA) and handshaking signaling protocols can be different. The electronic device is designed to allow the cellular device to communicate over a satellite network, by using the electronic device as the conduit or pipe to the satellite network. The cellular enabled device (such as a smart phone or tablet) will have an software application loaded on it for communication with the electronic device (such as using short range WIFI communications for WLAN, or Bluetooth communications (Bluetooth SIG standards) for a PAN. An electronic interface, in conjunction with the electronic device, allows the cellular device, in combination with the electronic device, to function as a duplex satellite communications device. One such prior art device is disclosed in publication "SATELLITE COMMUNICATION DEVICE FOR ROUTING TERRESTRIAL SIGNALS THROUGH A SATELLITE NETWORK", PCT/US2012/024177, publication WO2012/109269, attached and incorporated by reference. That electronic device includes a transceiver for satellite communications, a suitable antenna, an onboard processing and formatting capability. For reference, the electronic device will be referred to herein as an "emulator" or "satellite communications emulator." The emulator allows outgoing calls from the cellular device to be carried over the satellite network. The emulator also allows for the cellular device to receive incoming

calls over the satellite network, via the emulator, provided that the calling party or an intermediate network element, knows in advance the emulator's satellite "phone" number or "address" (e.g., the identifier associated with the satellite transceiver in the emulator).

Another prior art device is a system that allows transfer of an ongoing communication, where the communication is through a cell enabled device, between a satellite communications network and a cellular communications network. In general, the distinguishing features of the networks are the radio frequencies, modulation schemes, formatting schemes and handshaking protocols (for instance, for call set up and tear down). This system uses paired SIM cards (Subscriber Identity Module, a smart microprocessor chip for cellular devices, standard, micro or nano etc.) or SIM card equivalent such as a removable user identity module (RUIM), or a UMTS or UICC (Universal Integrated Circuit Card) or a USIM (universal subscriber identity module) all generically referred to as a "SIM card." In this system, one SIM card is resident in the cellular device, and a second SIM card (or equivalent) is located in a remote processing center that contains a "SIM bank," a device that enables multiple SIM cards to interface to the cellular network (e.g., to be located by the cellular system)(the SIM bank could be located across various cells). The SIM bank may be a device for holding multiple hardware SIM cards, or a software SIM embodiment). The system allows an ongoing cellular call (for instance) to automatically transfer to the satellite network (for instance, when cell signal strength degrades) and vice versa. The satellite leg is established in this system using an emulator. The prior art system is described in "Apparatus, method and system for integrating mobile and satellite phone service" PCT/US2013/031746, publication WO2013/142284, attached hereto and incorporated by reference. This system also allows for both incoming and outgoing calls to the cellular device through the satellite communications network. However, one disadvantage of this system is that the SIM card located in the remote cellular device is not the SIM card that is usually associated with the cellular device (the identifier provided by the mobile device's carrier company), but instead, is the paired SIM card. Consequently, the "phone" number or identity associated with the SIM card located on the cellular device is not that number or identity normally associated with the subscriber. The emulator may have its own SIM card or SIM card equivalent or use CDMA/IS-41, to allow authentication/registration of the emulator with the satellite communications system.

SUMMARY OF THE INVENTION

Embodiments of the invention allow a mobile device to communicate over a satellite network and to be located using the cellular mobile phone number associated with the cellular device.

According to a first aspect of the present invention, there is provided a method of roaming in a system comprising a mobile cellular enabled device that has an associated home base comprising a home registry, said mobile cellular device further comprising a short range non-cellular radio transceiver; a satellite communications emulator that comprises an antenna, a transceiver for two way communications over a satellite communications network, said emulator further comprising a short range non-cellular radio transceiver for communication with a mobile cellular device, said emulator associated with a home gateway comprising a gateway registry; a Back office comprising a processor and database, said Backoffice capable of communication with a satellite communications network and a public switched telephone network or a packet network; the method comprising the steps of: the Backoffice processor receiving a communication from said mobile cellular device requesting communication service through said satellite emulator; said Backoffice associating said satellite emulator with said mobile cellular device in said Backoffice database; said Backoffice sending notification to said cellular enabled mobile device home registry of the status of said mobile cellular device as a roaming device on said Backotfice.

According to a second aspect of the present invention, there is provided a method of forwarding calls to a cellular enabled device in a system comprising a cellular enabled device having a home base comprising a home registry, said cellular enabled device further comprising a short range non-cellular radio transceiver; a satellite communications emulator that comprises an antenna, a transceiver for two way communications over a satellite communications network, said emulator further comprising a short range non-cellular radio transceiver for communication with a mobile cellular device; a Backoffice comprising a processor and associated databases, said Backoffice in communications with a satellite communications network and a public switched telephone network or a packet network; the method comprising the steps of: the Backoffice processor receiving a communication from said cellular enabled device to communicate through said emulator; said Backoffice determining a routing number for communications with said emulator over said satellite communications network; said Backoffice sending a call forward request to said home network of said cellular enabled device, said call forwarding request including said routing number.

According to a third aspect of the present invention, there is provided a method of establishing a cellular device terminating call over a satellite network using the cellular device phone number or ISDN in a system comprising a cellular enabled device that has an associated home base comprising a home registry, said cellular enabled device further having an associated telephone number or ISDN, said cellular enabled device further comprising a short range non-cellular radio transceiver; a satellite communications emulator that comprises an antenna, a transceiver for two way communications to a satellite in a satellite communications network, said satellite communications emulator further comprising a short range non-cellular radio transceiver for communication with said cellular· enabled device, said emulator associated with a home satellite gateway comprising a gateway registry; a Backoffice comprising a processor and database, said Backoffice in communication with a satellite communications network and a public switched telephone network or a packet network; the method comprising the steps of receiving a request for a cellular device terminating call to said cellular enabled device, said request including either the cellular enabled device's MSISDN, or the ISDN or an IP address of said cellular enabled device, but said request lacking satellite communications emulator address 6r identification information; identifying said emulator associated with said cellular enabled device or identifying an address of said emulator associated with a satellite gateway serving said satellite communications emulator; routing said cellular device terminating call through said servicing satellite gateway to said satellite to said satellite communications emulator; said satellite communications emulator routing said cellular device terminating call to said cellular device over said non-cellular short range transceiver in said satellite communications emulator.

According to a fourth aspect of the present invention, there is provided a system comprising mobile cellular enabled device that has an associated home base comprising a home registry, said mobile cellular device further comprising a short range non-cellular radio transceiver; a satellite communications emulator that comprises an antenna, a transceiver for two way communications over a satellite communications network , said emulator further comprising a short range non-cellular radio transceiver for communication with a mobile cellular device, said emulator associated with a home gateway comprising a gateway registry; a Backoffice comprising a processor and database, said Backoffice capable of communication with a satellite communications network and a public switched telephone network or a packet network; said Backoffice processor configured to: associate said satellite emulator with said mobile cellular device in said Backoffice database and to send notification to said cellular enabled mobile device home registry of the status of said mobile cellular device as a roaming device on said Backoffice

when said Backoffice processor receives a communication from said mobile cellular device requesting communication service through said satellite emulator.

In one embodiment, each emulator functions as a cell tower, providing an "access" point for cellular enabled devices, but the access point provided access to via a satellite communications network. While a normal "cell tower" is networked into the standard terrestrial telephone system or internet or public switch telephone network (PSTN), for one of the methods herein, the emulator communicates over a global satellite network (and its associated satellite gateways and/or network operations centers or earth stations), utilizing the Backoffice of the satellite system to route calls from the satellite system to the PSTN or Internet (a packet network). The emulator has satellite modem(s) and/or transceivers), each with an associated satellite identifier (e.g., address such as. a· satellite phone number (that may be stored on a SIM card like device j), and associated processor, antenna, and necessary equipment to place and receive satellite calls over a satellite communications network, as is well known in the prior art. The emulator has the satellite communication capabilities of a satellite phone, but data or voice received from the satellite network is passed through the emulator to the cellular device (call signaling may also pass through the emulator to the cellular device to set up/tear down and connect a communications channel). The emulator also has the equipment and ability to communicate wirelessly over short range radio communications with one or more cellular user devices> such as using. standard WIFI communications, to allow the cellular device to pass data/voice over the satellite network via the emulator. The emulator will have a processor and associated equipment and may include the ability to reformat data received/transmitted via short range communications for uplink/downlink communications with the satellites in the satellite communications network (including handling protocol translators) (note the application residing on the cellular device may need similar reformatting and protocol translation ability also), The emulator can have media gateway functionality for interfacing different communications networks. One such emulator is the Sat-Fi satellite hotspot device marketed by Globalstar. In the Sat-Fi, an incoming call cannot be send over the satellite network to the user using the user's cell phone id (telephone number), but is placed using the Sat-Fi satellite identifier (satellite phone · number). In embodiments of the present invention, the

emulator may have the ability to place several calls at once (for instance, multiplexing several calls over the same satellite transceiver using packet technology or other multiplexing methods; or by placing each call over a separate transceiver).

In one embodiment, a cellular device (which may be a cell phone, cell modem, computer, tablet, sensor, data logger or other device having the ability to communicate over a cellular network, but the invention is not so limited) will have a software or firmware application installed thereon to allow communications with an emulator. The mobile device will generally contain a visual display, an input device (such as a touchpad), a microphone and a speaker. The cellular device will have the chosen local communications capability with the emulator. When the application on the cellular device is started, the application will seek to locate and connect with a nearby emulator (the preferred communications is standard WIFI communications (IEEE 802.11), Blue Tooth or other short range radio communications can be used with standard interface protocols or handshaking to establish two way communications). For instance, the cellular device may seek out an emulator when cellular signal strength drops below a predetermined level. In some embodiments, the communications between the cellular device and the emulator may be wired communications, such as through an ethernet cable, a USB cable or other wired communications. A number of emulators may operate in the same area, in which event each emulator may use a different radio frequency to reduce interference from another, and each emulator will preferable use handshaking with the registered cellular devices that identifies the emulator.

Several embodiments of the invention also include a Backoffice that has an associated database that can function as a home location register (HLR) and visitor location register (VLR) for the back office (in one embodiment). The Backoffice communicates with a satellite communications network, a PSTN circuit switched network, and/or a packet switched network, to enable the Backoffice to access and communicate, particularly via signaling channels, with other carrier's HLR and with the emulators communicating over the satellite network.

In some embodiments, instances or configurations, the HLR may be referenced as a the home agent or the HSS, and the VLR as the visitor agent. Other nomenclature can be used to reference the databases and functionality of a HLR and VLR. The Backoffice is a computer processing facility that interfaces the PSTN and/or a packet switched network, such as the Internet. The Backoffice may be a included in a satellite gateway and may

directly access the satellite network, as opposed to routing calls to the satellite network over the PSTN or through the Internet. In one embodiment the Backoffice may have an associated SIM bank with stored SIM cards or SIM card equivalents.

BRIEF DESCRIPTION OF THE FIGURES

Figure 1 is a block schematic diagram of the base architecture of a GMS network with the Backoffice as the visitor MSC.

Figure 2 is a block schematic diagram of the base architecture of a GPRS network with the Backoffice as the Serving GSN.

Figure 3 is a block schematic diagram of the base architecture for IMS voice packet communications, with the Backoffice as the visited P-SCSF.

Figure 4 is a block diagram of the base architecture of a GPRS packet switched data and circuit switched voice communications.

Detailed Description of the Invention

To interface with an emulator, a cellular device "registers" with one emulator, and that emulator will initially handle the interfacing of that cellular device to the satellite communications system. Each emulator may have a series of cellular devices registered with that particular emulator. The cellular device, for instance, may identify several emulators near-by, and request registration with the emulator having the strongest signal (such as WIFI or other short range radio signal), or may register with the emulator first responding to the request to register. Other schemes may be used to select an emulator for several available (for instance, the emulators may communicate with each other and have a protocol or procedure for selection).

CELLULAR MOBILE DEVICE EMULATOR REGISTRATION

The "emulator registration" process results in the "subscriber" being identified as a roaming cellular device, where the mobile device is "roaming" on the emulator as the base transceiver station (BTS) (the functions of the base station controller (BSC) needed for a typical cellular access point will generally be carried out by the emulator, but some functionality may be shared with the Backoffice) and the Backoffice functioning as the visitor MSC (in a 2G embodiment). To register, the application on the mobile device will establish communications with a nearby emulator, and pass subscriber information to the emulator for transmission to the Backoffice. The emulator transmits the subscriber information as well as a unique emulator identifier via the satellite network to the Backoffice. The subscriber information can include the information normally contained

on the mobile device's SIM card, such as integrated circuit card identifier (ICCID), international mobile subscriber identity (IMSI) (generally used by the HLR to index into the database), Authentication Key (Ki), and may include carrier-specific data such as the SMSC (Short Message Service Center) number, Service Provider Name (SPN) and Service Dialing Numbers (SDN) and Mobile Station ISDN number (MSISDN (the "phone number"). The Backoffice receives the subscriber cellular device information and emulator information and stores it on a database, associating the particular subscriber with the relevant emulator. The Backoffice is a processing data center with associated databases, and communicates with the PSTN, the satellite communication network (either through a gateway or through a gateway via PSTN) and may also communicate with the cellular networks. The cellular device is then registered with the Backoffice, and is associated or "located" or "present"{ at specified emulator. The Backoffice can recognize the registration process generally acts as a request to communicate over the satellite network through the emulator; however registration can be a separate function from a request to active the services (e.g., request communication service over the satellite network via the emulator).

REGISTRATION AS A ROAMING DEVICE – LOCATION UPDATE

The following first describes one embodiment of the system in a 2G type of environment. In one embodiment, when the service is activated, that subscriber cellular device will appear to the communications network as "roaming" or "visiting" on the emulator/Backoffice. In essence, the Backoffice will appear to be a visited "cellular network" MCS (in a 2G environment) on which the remote cellular device is located or present. Roaming agreements will need to be in place with the various carriers.

To establish the device as a roaming device in a 2G (GMS) environment, the Backoffice will inform the home HLR of the cellular device of the presence of the cellular device on the "Backoffice" network. This communication with the subscriber's home network will generally be over signal channels via the PSTN or packet network. The Backoffice (acting as a visited network MSC) contacts the cellular devices home network and requests service information (including whether or not the mobile should be allowed to roam), generally using the mobile phone number or international mobile subscriber identity (IMSI) number of the user's cellular device. If successful, the visited network (the emulator/Backoffice, functioning as a BST and a visited mobile switching center or MSC) begins to maintain a temporary subscriber record for the "roaming" cellular device in the

Backoffice database (functioning as a visitor location registry). Likewise, the home network of the subscriber updates its information in the home location register (HLR) or home network register (HNR) to indicate that the cellular device is located on the visited network (the emulator/ Backoffice) so that any information sent to that mobile cellular device can be correctly routed, as next described, to the emulator (via a satellite communication) and then to the cellular device. In order that a subscriber is able to register on to a visited network (e.g., Backoffice), a roaming agreement needs to be in place between the visited network (the Backoffice) and the home network. The general component configuration of a GSM "2G" type of network, with the Backoffice operating as the visited MSC, is shown in figure 1.

INCOMING CALLS TO THE MOBILE DEVICE WITH SERVICE ACTIVATED

The "visiting" subscriber acquires an entry in a subscriber database of the visited network (e.g., the Backoffice database, functioning like a Visited Network Location Register) and an entry in the cellular devices HLR or home agent, that indicates that the subscriber (the mobile device) is roaming or present on the Backoffice "network" MSC. If an incoming call is now placed to the cellular device, the mobile cellular device's home MSC (sometimes referred to as the gateway MSC or GMSC) will check its associated HLR to locate the cellular device. As indicated above, the HLR points to the Backoffice. The home network MSC/HLR (over signal channels generally via PSTN) will request a mobile station roaming number (MSRN) (2G) or a IP address (3G data) for the cellular device. In one embodiment, the Backoffice may dynamically assign or allocate a temporary directory number (or IP address for 3G) and may also assign an international mobile subscriber identity (IMSI). In one embodiment, the Backoffice will allocate or *assign one of the SIM cards stored in the SIM bank and use the identifiers associated with* the selected SIM card. In another embodiment, the Backoffice dynamically assigns a mobile station routing number (MSRN)(2G or 3G voice (non IMS)) or IP address (3G data) from a database of available MSRNs or IP addresses (a SIM card or SIM Bank is not required in this embodiment). Note that for 3G IMS voice, there is no need to request an IP address as the home network will maintain the cellular device information, including the IP address assigned when registering at the Backoffice via PDP context. The Backoffice will notify the cellular device's home network HLR of this temporary routing number as the mobile station routing number (the MSRN), or the Routing IP address (obtained in a PDP context)(both considered a temporary routing number). The temporary

routing number may be assigned by the visited network (e.g., the Backoffice) upon initial registration, or it may be assigned on a per call basis (as described above). In the latter case, the temporary routing number has to be requested by the home network HLR for each incoming call before it can route the call to the visitor network.

This temporary routing number may be maintained by the subscriber's home MSC location register for a period of time, or eliminated after the call/communication is complete. Both the Backoffice and the subscribers' home network will undertake accounting functions with the cell number (e.g., Backoffice will make sure the cellular device is a subscriber to the service) and the subscriber's home network will make sure the cellular device is in its system and has routing or roaming privileges to the Backoffice. The Backoffice functions as the visited network mobile switching center. The assigned temporary routing number will route the incoming call to the satellite network via the suitable satellite gateway that is servicing the emulator.

For instance, each emulator has a home satellite gateway, and the home gateway keeps a visitor gateway identifier to identify the actual satellite gateway that will service satellite communications to the emulator. The servicing satellite gateway may be the home gateway or another satellite gateway. Consequently, the temporary MSRN assigned by the Backoffice and sent to the cellular devices HLR should point to the satellite gateway servicing the emulator. The assignment of an MSRN for a servicing gateway will preferably be handled by the satellite Backoffice.

At this point, for the incoming call, the cell device's home HLR will forward the temporary routing number to the cell devices' home network MSC, and the home network MSC will use the temporary routing number to route the incoming call to the visitor network (e.g., to the emulator servicing satellite gateway). Location management (mobility management) and call set up are established though control or signaling channels, while the call circuit is generally physically established when off hook condition is present at the mobile cellular device. That is, control signaling is undertaken between the calling party's home network (the Backoffice may be involved if temporary routing number is established at the time of a call), the emulator and the cellular device to set up the call between the calling party and the called mobile device. The communications channels through the network are reserved in a 2G environment, waiting for off hook condition at the cellular device. When this condition is established, the communication path is set up between the calling party and called party, through the satellite network to

the emulator and then to the cellular device preferably over an air interface (short range radio communications. In a 3G environment, data communications can be via SIP protocol, FTP, HTTP or other protocol, while voice communications can be handled by switched circuits or IMS or VOIP communications.

If the particular emulator has several assigned satellite numbers, the Backoffice will pick a number that is available (e.g., not tied up on another call), or if a multiplexing scheme is in use, the scheme will be employed to multiplex the new incoming call for delivery to the emulator via the satellite communications network. On receipt by the emulator, the emulator also receives the called cellular device number or identifier (via control signaling), and can identify the proper cellular device to which to direct the call. The emulator, if servicing more than one cellular device, will route the incoming communication to the proper addressed cellular device. The emulator is acting much like a bent pipe system for an incoming call once the communications channel is established, but includes the ability to process the incoming communication data for reformatting if necessary for communications over the emulator air interface or hard wired communications to the cell device. To set up the communications channel, the emulator will notify the proper cellular device (such as over the WIFI connection) of an incoming call (including providing calling party identifying information (e.g., caller id)) and if the cellular device responds (goes "off hook"), the circuit from the calling party through the satellite to the emulator to the cellular device will be established.

One embodiment of signaling for call set up in a GSM Environment (call terminating at a mobile device)

1. The calling party (such as from within the public telephone network) dials the mobile subscriber's MSISDN (the telephone number) of the roaming cellular device.
2. Based on the information contained in the MSISDN (including the national destination code and the country code), the call is routed to the mobile switching center (MSC) of the mobile network gateway (GMSC). It is done generally with an IAM (Initial Address Message).
3. To locate the mobile station, the GMSC sends to the HLR a SRI (Send Routing Information) message. The SRI message contains the MSISDN number and with this MSISDN the HLR will obtain the IMSI.

4. Because of prior notification from the Backoffice, the HLR knows the VLR (i.e. the Backoffice) that currently "serves" the subscriber. The HLR will send to the VLR a PRN (Provide Roaming Number) message to obtain the MSRN of the roaming cellular device for routing of the incoming call.
5. With the IMSI contained in the PRN message, the VLR (Backoffice) assigns a SIM card and its associated identifiers as the mobile station roaming number . This MSRN number is sent back to the HLR in a RIA (Routing Information Acknowledgement) message.
6. Now with the MSRN number, the GMSC knows how to route the call to reach the roaming cellular device. Then, the call is made using signaling between the GMSC and the visited MSC (the Backoffice). The GMSC will generate an IAM message with the MSRN as the called party number (and NOT the MSISDN as the called party number).
7. When the Backoffice (the visitor network) receives the IAM, it recognizes the MSRN and knows the cellular device and the emulator serving that cellular device (by checking its database), and sends routing information to the home base to route the incoming call to the servicing satellite gateway of the emulator for delivery to the emulator and finally, from the emulator to the associated cellular device.
8. When the call is terminated, the Backoffice returns the MSRN to the Backoffice pool for future use on another call.

In one embodiment, the Backoffice may send as the MSRN the identification of the emulator. That is, the Backoffice sends routing information so that the call can be routed from the calling party, through the PSTN, to the satellite gateway that is servicing the emulator.

The emulator can also function as a local network or PBX, to route calls from one cellular device registered with that emulator to another cellular device registered with the emulator. In this instance, the call does not need to be routed over the satellite network, but can be handled through the emulator alone. In this embodiment, the emulator may have its own database of subscribers to track registered subscribers, or the emulator may obtain this information from the Backoffice of signaling channels. Preferably, as long the emulator service is enabled, the Backoffice will periodically notify the cellular device's home network that the cellular device remains "present" on the Backoffice visited network.

The advantage of this system is that the SIM card resident on the cellular device is the cellular device SIM assigned by the home network: a foreign SIM card is not resident on the cellular device. As described, the SIM bank can also be replaced with a logical digital database of temporary routing numbers; physical SIM cards, and a SIM card bank are not required.

Use in a 3G Environment is similar, with an added complexity that packet core networks (a "packet network") are used for data communications instead of a circuit switched network, including the serving gateway GPRS support node (SGSN) and the gateway GPRS support node (GGSN). Additionally, the circuit core network can be replaced, in some instances, with an IMS (Internet Multimedia Subsystem) core network consisting primarily of the CSCF and HSS. One embodiment of 3G roaming functionality using the emulator is as follows.

3G Inbound Roaming Subscriber – data communications

The 3G core network (also referred to as Universal Mobile Telecommunications System or UMTS) has two primary core components : the packet core (SGSN and GGSN) used for data communications, and the voice components (which can be packet core switched). A diagram of the 3G core network (GPRS) network of the packet switched side is shown in Figure 2, where the Backoffice functions as the visited SGSN. In certain 3G environments, the network can maintain voice communications over a circuit switched network and the circuit core (MSC/VLR) used for voice call management. This combined functionality is depicted in figure 4.

Location management (pack core registration) for a packet network generally consists of GPRS attach. Communications or call set up generally is initiated by a packet data protocol context (PDP Context).

GPRS Attach procedure (registration or location) signaling in abbreviated form

- The Mobile device sends GPRS attach request with its identity to the visited SGSN (e.g., transmissions via the emulator to the Backoffice over the satellite communication). The Backoffice sends authentication to the GGSN Home HLR of the mobile device (MAP protocol can be used) and on successful authentication, the Backoffice sends "Update GPRS Location" to the Home HLR.
- Home HLR responds with "Insert Subscriber Data". The message consists of the GPRS subscription data for PDP context.

- Both visited SGSN (the Backoffice) and Home HLR respond to each other with acknowledgements.
- Visited SGSN (Backoffice) sends "Attach accept" to the mobile device via the emulator which responds with "Attach complete".
- At this point, the HLR knows that the mobile device is "roaming" on the Backoffice as the visited SGSN. The SGSN may also update the location of the mobile device at the MDC-VLR, if IMS (packet switched) voice communications are not used.
- PDP Context procedure (provide temporary routing number (IP address) signaling for communications in abbreviated format):
- The Mobile device (sometimes referred to as a user agent, or UA) or a PDP network (for a MS terminated communication) sends "Activate PDP context" request to the Visited SGSN (the Backoffice)
- The Backoffice, acting as both visited SGSN and visited GGSN) responds with the "Activate PDP context Accept" to the mobile device (all occurring over the satellite network to the emulator, to the mobile device). The message includes the assigned Backoffice P-CSCF IP address.
- The mobile device or emulator saves the P-CSCF IP address,
- SIP communications for voice are now possible with the mobile device with the IP address of the P-CSCF . SIP data communications (such as FTP, or HTTP) are also enabled by an IP address assigned during PDP context.
- Activating a PDP address sets up an association between the terminal's current SGSN (the Backoffice) and the GGSN that anchors the PDP address. A record is kept regarding the associations made between the GGSN and SGSN. This record is known as a PDP context. PDP context can be initiated by the mobile device, or an incoming request from a packet data network.

In a 3G telecommunication core network, the voice circuit switched core is often replaced with the IMS core network, which includes the CSCF (call session control function) (server computers) and HSS (home subscriber server). In general, the CSCF consists of 3 main components: P-CSCF (Proxy), S-CSCF (serving) and I-CSCF (interrogating). The architecture of an IMS core network is shown in Figure 3, with the Backoffice acting as the proxy CSCF.

For an IMS interconnection, the P-CSCF contains a database (similar to the VLR) on the visited public land mobile network (PLMN), while the HSS contains a database of the subscriber information, much like a HLR.

When IMS voice service is present, location management (Registration) signaling is as follows in abbreviated overview:

IMS Registration (for mobile initiated)

- Mobile device starts a connection to the P-CSCF that belongs to the IMS visited domain (that is different than its home domain).
- mobile device sends SIP register message to the visited P-CSCF (the Backoffice)
- Backoffice will resolve the request URI home domain (using DNS query) to get the IP address of the Mobile device's home I-CSCF
- Mobile device authentication request , the visited P-CSCF forwards the SIP register message to the Home I-CSCF of the UE's home domain
- Home I-CSCF sends "User Authorization Request" to the home Home Subscriber Server (HSS)
- Home HSS responds with "User Authorization Answer". The message includes the address of Home S-CSCF
- Home I-CSCF forwards SIP register to the home S-CSCF
- Home S-CSCF performs authentication to the home HSS by sending "Multimedia Authentication Request"
- Home HSS answers with a set of authentication keys.
- Upon receiving the keys, the home S-CSCF will forward the keys all the way back to the mobile device (and the back office) inside the "401 Unauthorized" message
- The mobile device will use the keys to calculate the authentication algorithm
- The mobile device resends the SIP register back to the home S-CSCF along with the authentication value
- Home S-CSCF sends "Server Assignment Request" to the HSS
- Upon receiving the answer from HSS, the home S-CSCF will compare the authentication value from the mobile device
- If the value matches, the S-CSCF will send "200 OK" all the way back to the UA to indicate that the mobile device has been registered.

- Note: The S-CSCF is seen as the registrar for the network, although the HSS holds the data against which the S-CSCF checks the authenticity of the subscriber requesting entry.

IMS Set Up for an Incoming Communications (Mobile terminated communications)

- The mobile device's home IMS receives a call request to the mobile device (i.e. Home Media gateway control function (MGCF) receives ISUP IAM)
- Home MGCF sends "terminating" INVITE request to the home I-CSCF
- Home I-CSCF sends "Location Info Request" to home HSS (the home location registry will have the data)

E.g., The I-CSCF interrogates the HSS to obtain the address of the relevant S-CSCF to process the SIP initiation request.

- The home S-CSCF forwards the INVITE message to the Visited P-CSCF (Backoffice) that was recorded at the time of the registration
- The visited P-CSCF forwards INVITE to the roaming mobile device via the emulator.

When the user disconnects from the emulator service, if the cellular device is located in a cell network, that cell network may then inform the cellular device's home network that the cellular device is now "present" or roaming in that particular cell (in, for instance, a new visited network) and the cellular device's HLR is updated accordingly so that calls will be routed over the cell network instead of through the emulator/satellite communications network.

In use, when the emulator service is activated, the software application on the cellular device may disable the cellular device from registering or sending registration requests to cell base stations (other than to the emulator over an air interface (WIFI or other short range wireless communications). This will prevent possible ambiguities of the location of the cellular device – it will always be located in the emulator/Backoffice network as long as the emulator service is active. The cellular device would still have the ability to monitor signal strengths of nearby cell towers, and if signal strength is sufficient, the application on the cell may discontinue the emulator satellite service (sending notification to the Backoffice of termination of service). The application may be structured to restart emulator communications if cellular signal strength falls below a predetermined level.

Alternatively, the application software could be configured to select one service or the other, or to allow automated mode switching between the cellular and satellite networks in a controlled fashion, in such a way as to prevent possible ambiguities.

In the above sequences, the Backoffice notifies the relevant HLR (associated with the Home network MCS or home network GGSN or HSS) of the "location" or presence of the mobile device on the Backoffice as a visited network. Once the location of the mobile device is known to the network (via HLR), for an incoming call, the home HLR is queried for the location of the mobile device. The HLR then points to the Backoffice, and the HLR will either contain or request a temporary routing number from the Backoffice. That temporary routing number is provided to the HLR for routing of the call or packets to the proper gateway servicing the emulator.

OUTGOING COMMUNICATIONS (Mobile originated)

An outgoing call (mobile originated call) is handled somewhat similarly. The mobile user dials an outgoing call (or tries to send data to an IP address), which the application on the mobile device communicates to the emulator over the air link. The emulator notifies the Backoffice via the communications satellite of the request to place a call or data communications. The Backoffice will signal over the circuit switched network or the packet network to the called party's HLR for a location of the called party (assuming the called party is a mobile device), and the standard location management and call set up procedures usually followed by the network are undertaken with the Backoffice as the visited MSC or SGSN, to route the outgoing call through the servicing satellite gateway to the PSTN or Internet to connect the mobile device, to the desired termination location.

This same functionality can be used with a mobile device that has both cell and satellite functionality (for instance, a dual configured mobile device). With an integrated device, having two identities (a satellite identity and a cellular identity), the user can be reached over either network using only one of the identities (for instance, the user can give out only the cellular number). The user can then control which network should be used for incoming calls (satellite or cellular) by activating or deactivating an application on the device that will register the device with the Backoffice and allow the HLR to point to the Backoffice. For an integrated device, the emulator is not needed as the integrated device has the satellite phone functionality.

ALTERNATIVE IMPLEMENTATIONS:

1. Instead of identifying itself as a "visited cellular network," the emulator Backoffice could use Call Forward functions to route calls terminating at the mobile device through the emulator. In this configuration, when the emulator Backoffice receives the registration information from the emulator, or the request to active emulator service, the emulator Backoffice uses standard cellular signaling commands to send Call Forward requests (such as Unconditional call forward) to the home HLR of the cellular device. The call forward request would include the call forward routing number (the temporary routing number), such as either a Backoffice assigned routing number that is associated with the emulator and/or the emulator servicing satellite gateway, or a MSRN, phone number or IMSI number (such as provided by the emulator when the subscriber registers the mobile device for satellite service). That is, the Backoffice (for instance, at mobile device registration), notifies the mobile device home network that calls to the mobile device are to be forwarded to a temporary routing address (e.g., MSRN or emulator identifier or address, such as phone number (MSISDN) or IMSI, or IP address) associated with the emulator. The temporary routing number can be a number associated with the servicing satellite gateway (the visited satellite gateway) or can be a number assigned to the emulator (MSISDN, phone number etc.). Mobile terminate calls will be call forwarded to the routing number held in the mobile's home HLR, and usual location management, call the satellite communications system will be responsible for routing communications to the emulator (generally via the satellite gateway VLR and HLR associated with the emulator). For instance, the emulator home satellite gateway's HLR points to the servicing satellite gateway. A call directed to the mobile will be redirected (call forwarded) to the call forward routing address, and the emulator home satellite gateway (in conjunction with the Backoffice) will undertake location management of the emulator, and routing of the redirected call will proceed as a call forward to a satellite phone. Note, the Backoffice may provide a temporary routing number for the emulator as a call forward number at time of either registration or service activation. The emulator call forward routing address may be provided by the emulator itself (such as during mobile device registration for the service) or the Backoffice may provide a corresponding emulator address by associating or mapping an address with the

emulator. For instance, the Backoffice may send an address associated with the serving satellite gateway as a call forward address, and sending notification of the assigned call forward number and emulator address to the serving satellite gateway, so the serving satellite gateway can route the communication incoming to the serving gateway to the emulator address provided by the Backoffice. The emulator/Backoffice may reset the CFU (Call Forward Unconditional destination phone number) of the cellular device subscription to its default either when the cellular device de-registers from the emulator, or when the cellular device has been unresponsive to emulator communications for a defined period of time. The advantage of the CFU approach is that it does not require any roaming agreements with other phone networks. The CFU can be implemented automatically as described, or the user can configure call forwarding manually (or the application on the phone can be configured to accomplish this.

In the call forwarding embodiment, the call forwarding request is transparent to the user/subscriber, that is, the user does not know the call forward number being associated with her mobile cellular device, or that call forward has been activated. The user /subscriber only knows that she can receive incoming calls from a third party, where the third party's communications are addressed to the MSISDN or phone number of the mobile device (that is, the system is transparent to a third party also).

2. As described above for call forwarding, but the user device does not have to be a cellular device. It can be a wired device or a wireless device not associated with cellular networks, but which has been assigned a phone number, a pseudo phone number or other satellite address (either temporary or permanent) by the emulator Backoffice and its associated HLR.
3. Same as the general description of the services in the detailed description of the invention, but the application software that interfaces to the emulator is actually in a separate standalone interface device, such as a tablet or additional cellular device. In the description listed above, wherever "cellular device" is mentioned, substitute "user device interface unit." An alternative here is that when the user downloads the application, the application has the user register its hardware which allows the application software to know the identity of the user's equipment, be it cell device, computer, or tablet.

4. As a modification of the roaming solution, the Backoffice can assign multiple identities to a single subscription. In this way, the Backoffice can keep track of the multiple services or multiple peripherals attached to a single device on the emulator for mobile terminated communications.

An additional function that all of these solutions can provide is for insertion of the originating caller identity so that when a user initiates a call from within the emulator network, their cell phone subscriber identity shows up on the caller ID and not the satellite subscription identity of the emulator. This functionality ("caller id spoofing") can be provided by the emulator or Backoffice.

In a 2G or 3G environment, there is a home base or home network that contains a database where the "location" of the mobile device is maintained. For 2G, the home network includes the home MSC and the associated Home Location Register; for a 3G environment, the home network includes the an HLR associated with the home GGSN, and for IMS, the Home network includes the home S-CSCF and I-CSC, and a database associated with the HSS. To generically refer to both 2G and 3G environments, the term "home base" will be used for the home network components, and "home registry" or "visitor registry" will reference the associated databases for a visitor network or a home network, such as the HLR, associated with a home MSC or home GGSN, or the database associated with the HSS. A "call" as used can be either voice or data communications, and the voice communication can include switched circuit calls or packet calls, such as VOIP or IMS communications.

As described, the techniques include the capability for a cell device to communicate over a satellite network, and to addressed for mobile terminating calls by use of the cell phone number. The third party trying to reach the cellular device does not need to know the satellite phone number of the emulator, but only needs to know the cell phone number of the mobile cellular device that the third party is trying to reach. The fact that the satellite network is being used to route calls to the cell device is completely transparent to the third party caller.

As described, a Backoffice is used, but more than one Backoffice can be employed. Each satellite gateway can be associated with a single Backoffice, or several satellite gateways can coordinate traffic with a single Backoffice. As used, a cellular enabled device or a cell device is a device that is designed to communicate with/to a cellular base transmitter mobile base station in a mobile communications network (public land mobile

radio, PLMR, or public land mobile network PLMN, or even a non-public private network, such as a military only network, such as a defense switched network, or a defense packet network).

The emulator appears to the satellite system Backoffice as a satellite phone (hence, the nomenclature of "emulator." However, the emulator, to a user, is not a phone, it generally lacks a microphone and speaker as would be necessary in a true cellular or satellite phone. The emulator may induce an input device (such as a virtual or real keyboard) and a display device to allow a user to configure the emulator as needed for a particular application.

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(54) Title: SATELLITE COMMUNICATION DEVICE FOR ROUTING TERRESTRIAL SIGNALS THROUGH A SATELLITE NETWORK

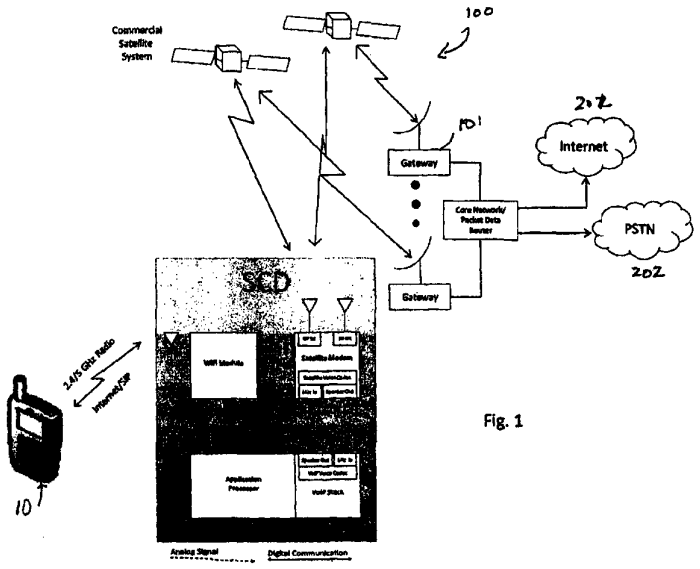

Fig. 1

(57) Abstract: A interface device and a method of allowing communication is provided to allow a wireless mobile communications device to interface with a satellite communication system. The interface includes a satellite modem (including antenna), a communications link to communicate with the wireless communications device (such as a Wifi link using VoIP) and an applications processor (with associated memory) to handle control and handshaking functions between the communications link and satellite modem and the related interfaced equipment (mobile communications device and satellite system) and to assist and reformat as needed transmission of data between the interfaced equipment.

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Title: Satellite Communication Device for Routing Terrestrial Signals Through a Satellite Network.

Priority Claim: This application claims priority to U.S, Provisional application number 61/44076, the contents of which are incorporated by reference in its entirety.

Background of the Invention: Cell phones communicate via a wireless connection to interface the mobile communications network or the public switched telephone network. Satellite phones communicate over a separate satellite network to eventually route a call to an end user attached, for instance, through the public switched telephone network or the mobile communications network. It would be desirable to provide the capabilities of a satellite phone to a cellular phone, or vice versa.

Technical Field:

This invention relates to systems and methods to relay information from devices using *terrestrial short-range wireless technologies* (or certain wired technologies) over satellite communication systems, optimizing the bandwidth required for voice calls over satellite networks. It addresses the advantage to use different types of terminal equipments to provide data and voice services in areas where there is no major communications infrastructure over a satellite constellation without any major re-development of the wireless end user device.

Summary of the Invention: A device that enables a cellular phone to communicate over a satellite communications network. A method and device to provide voice and data services to moble device users by accessing short distance access technologies (for instance, IEEE 802.11 WiFi, a/g/n, or using short wavelength radio transmissions in the ISM band from 2400-2480 MHz from fixed and mobile devices, creating personal area networks (PANs) (such as Bluetooth) , GSM transmission, etc) over a satellite communications system is provided . The wireless system connects to and controls processing of sessions from different types of personal communication devices (handsets, smartphones, PDAs and computers) through any short range wireless technologies and backhauls them over a satellite network. In areas where such infrastructure is inexistent only satellite communication systems are available to carry the information to the Internet or to the Public Switched Telephone Network (PSTN).

Brief Description of Drawings.

Figure 1 illustrates one embodiment of a communications network implemented by the current invention.

Figure 2 illustrates the components of a conventional satellite phone.

Figures 3 to 8 illustrate various steps in call handling.

Figure 9 is a flowchart of steps in handling an outbound call.

Figure 10 is a flowchart of steps in handling an inbound call.

Figure 11 illustrates an alternative embodiment implementing Internet data connectivity.

Figure 12 illustrates an alternative embodiment of direct VoIP transmission.

Figure 13 illustrates an alternative embodiment for connectivity with a femtocell network.

Figure 14 illustrates an alternative embodiment where voice data is digitally transcoded.

Figure 15 illustrates a satellite communication device slightly modified from Figure 1.

Description of Selected Embodiments.

Figure 1 illustrates one example of a communications network implemented by the present invention. The network generally includes one or more hand-held portablecommunication devices 10, examples of which could be smart-phones, conventional cell phones, PDAs, portable PCs, computing tablets, and the like. Many of these devices, e.g., smart-phones, are capable of converting an analog voice signal into a VoIP data stream and sometimes will be referred to as "VoIP transmitting devices." VoIP is not required, as will be later described.

The Figure 1 communications network further includes a conventional satellite network 100 which communicates through satellite gateways 101 to a core network (including packet data routing systems) which ultimately transfers information to the Internet 201 or a public switched telephone network 202 (or PSTN). As explained in detail below, the satellite communications device of the current invention functions to transmit data from the hand-held communication devices 10 across the satellite network 100 to the core network 201 or 202, and also in the reverse direction from the core network to the hand-held communication devices through the satellite network 100 . Although Figure 1 only shows one hand-held device 10, it will be understood that multiple hand-held devices could be part of a network having at least one satellite communication device.

As background information, Figure 2 illustrates the principle components of a conventional satellite phone 50. In conventional satellite phones, the application processor 51 takes in information from the keypad interface 52 and drives the display screen 53 for the

user. When the user is ready to make a call, the application processor 51 generates the required information and serial commands to cause the satellite modem 54 to connect to the satellite network 100 and route the call appropriately. When the call is connected, the speaker 60 and microphone 61 bring and send analog voice information for the user. The satellite modem 65 within the phone contains a voice codec that converts this information from analog to digital and vice versa. The call is terminated by the satellite phone user by pushing a button on the keypad 52 and the application processor 51 sending suitable information and serial commands to the modem 54 to close the connection. If the call is terminated by the other call participant, the satellite modem 54 receives a signal informing it of this event via the satellite and sends serial commands to the application processor 51 that the connection is closed, to allow the processor 51 to complete termination of the call (for instance, notifying the user that the call has ended) .

Figure 3 illustrates one embodiment of the satellite communication device 1000 (often referred to in this description as an "SCD" or as a "Button") and the steps taken to initiate a call. This embodiment of the SCD includes (i) an application processor 1001, (ii) a satellite modem 1002, iii) a communications linkage to communicate between the SCD and the mobile device, such as an radio band wireless transceiver 1004, (for instance, a industrial, scientific and medical (ISM)transceiver (in Figure 3 a Wifi module), and (iv) a VoIP 1005 stack which provides process instructions to the application processor (the VoIP stack can be integrated in the application processor, either as hardware, firmware of software). In alternate embodiments, the VoIP stack could be replaced with a VoIP module (i.e., chip or chip set). Likewise, the Wifi module 1004 could be effectively replaced with a software stack directing the application processor to perform the functions of the Wifi module. As described below, the communications link between the SCD and mobile device is described as Wifi using VoIP, as implemented in the Wifi module 1004. However, the inventions is not so limited. Instead, a PAN communications line can be established between the SCD and mobile device using, for instance, Bluetooth, Alternatively, net communications link could be used, such as by employing a femtocell, such as shown in Figure 13. indeed, wireless communication may be replace with aired communications, for instance, if a tablet is the mobile device, direct wired communications can be established to the SCD, such as using Ethernet, UCB, firewire, or other communications link.

Most of the following embodiments are described a uning a wireless communications link, primarily using WiFi VoIP.

In one embodiment the application processor 1001 of the SCD sends commands to the Wifi module 1004 for setup and configuration for wireless communication between the SCD to communicate and the mobile device. In other embodiments, the SCD and mobile device may both access an existing wireless network (for instance, a WLAN) (where SCD and mobile device have identifiers that enable the routing of communication between them), or the WiFi module 1004 creates a wireless access point, or waits for creation of ad hoc. The options can be user selected, or configuration defaults may be established in the SCD or mobile device. For the remaining discussion, it will be assumed that the wireless network is established by the SCD.

Figure 4 indicates how the VoIP stack 1005 can direct a request from the mobile device to place a satellite call.. The mobile phone communicates with the SCD through the wireless network to the WiFi module on the SCD. For instance, the mobile may communicate via a VoIP application on the mobile phone, or transmit an "identifier" that is sent to the WiFi module amnd recognized by the applications processor as a request for service, or some other handshaking between the mobile device and SCB via wireless communication that indicates a satellite call is to be placed. The VoIP stack 1005 alerts the application processor 1001 of an incoming call request, usually via serial communication. The application processor 1001 then sends commands (per the VoIP stack) to accept the call from the mobile device. Viewing Figure 5, the application processor 1001, for instance, receives a DTMF signal (or other signal) containing the call destination identifier, transmitted by the user over the wireless communications link between the mobile phone and the SCB (via the WiFi module 1004) The identifier may be interpreted or reformatted by the application processor 1001, as needed. In Figure 6, the application processor 1001 sends commands and/or handshaking signals (usually by serial communication) to the satellite modem 1002 for establishing the phone call to the desired call destination identifier (e.g. phone number).

Figure 7 suggests one embodiment where the VoIP stack (or the application processor) takes in digital (VoIP) voice information from the WiFi module 1004, converts it back to analog, and then pushes it through its "speaker port" (analog output) to the analog input port of the satellite modem 1002 (labeled a microphone input port) . The satellite modem 1002 takes analog voice signal from its microphone input, uses its voice codec to convert the analog lvoice signal, back to digital for transmission over the satellite network. The same operation will take place in the reverse direction when the SCD is receiving voice information from the satellite network. Figure 8 indicates how the application processor sends appropriate commands to either the satellite modem or processes through the VoIP

stack based on where the call is closed. These A-D steps can be eliminated by having the application processor 1001 converted the received digital data from one component (the WiFi module or the Satellite modem) and transforming that signal to the proper digital format for the other component. Indeed, the digital data may be properly formatted and no conversion is necessary. The remaining discussion assumes that the A_D conversions are employed.

Figure 9 generally illustrates the steps carried out when the SCD is handling an outbound (i.e., from the smart-phone to the satellite network) call, while Figure 10 generally illustrates the steps carried out when the SCD is handling an inbound call (i.e., from the satellite network to the mobile device) . As shown in figure 9, the smart phone or other mobile device is in communication with the SCD WiFi modem via wireless network. In step A, the user will enter the desired number on the smart-phone. For example, the user can use DTMF (Touch Tone) dialing to enter their desired call destination, or speak the phone number and the application processor can be used to perform voice recognition on the signal. In the case of a smart-phone or other programmable device, a custom VoIP application could be installed on the phone, and the user could search through his/her contact list and chose the desired call destination. Preferably, an application on the smart phone initiates a link and handshaking with the SCB, and transfers the number to be dialed to the SCD. This process can be transparent to the user, (e.g. the establishing of communications between the SCD and the smart phone) so the user never notices that, in effect, two "calls" or communication links are actually being placed, one communication link to between the mobile device and SCD (as shown, via VoIP) and one, via the SCD, to the satellite system and thence to the PSTN and final destination

In step B of figure 9, the SCD hands the received number from the VoIP source (e.g., smart-phone) to the satellite modem for call placement. Regardless of the method used to receive the destination phone number from the mobile device, eventually the application processor 1001 must take that information and wrap it in the appropriate protocol needed in order to request the satellite modem1002 to place the call.

In step C of figure 9, after the call has been established between the mobile and end user via satellite, the SCD routes the voice signal received by the VoIP stack to the satellite modem 1002. To implement these steps, in one embodiment, the VoIP stack receives digital call information using VoIP protocol via the WiFi connection from the smart-phone. The VoIP stack uses its voice codecs to generate an analog voice signal from this information. That signal is put out over the speaker output port. The analog signal is then routed into the microphone input of the satellite modem where the satellite modem's own voice codecs re-

digitize the signal with a satellite specific, more bandwidth efficient, protocol. The satellite gateway once again breaks this signal down and routes it to the PSTN to the called number . As shown in figure 9, the voice signal is indicated as analog, which is sent form the A-D convereted in the application processor to the microphone input of the satellite modem. As discussed above, these A-D conversions are only for one embodiment of the inventions

In the reverse direction, a voice signal comes in via the PSTN from the a third party calling the smart-phone user ("third party caller" or "User B" in the figure 10). The satellite gateway sends the signal to the satellite network in digitized form using the satellite codec. Once received by the satellite modem 1002 (which has a identifier in the satellite system), the voice data (in one embodiment) is converted to analog and put out over the satellite speaker output, and then to the VoIP stack's 1005 microphone input where it is digitized using its codec and transmitted to the smart-phone over the via the WiFI module 1004. The applications processor handles handshaking and control between the components of the SCD. The VoIP application on the smart-phone converts the signal to the appropriate format so that it can drive the speaker on the smart-phone.

Figure 10 emphasizes the steps in handling an incoming call from a third party caller. Step A involves the third party caller initiating the phone call. In one basic embodiment, the third party caller will actually dial the SCD's satellite phone number when the third party caller wishes to contact the smart-phone user (if the SCD is dedicated to a single mobile devide, no other idenrtifier is needed; however, if the SCD interfaces multiple mobile devices, the SCD number must be accompanied with the desired mobile identifier, such as the mobile phone number). In another embodiment, when the smart-phone user connects to the WiFi network and opens a custom VoIP application on the smart-phone, his phone number can be sent of the WiFI network to register his satellite number as a call foreward number, or send over the SCD wireless link to be sent over the satellite network, also registered the satellite number with the cell phone service provider as a call forwarded number. This alternative eliminates the need for the third party caller to know two phone numbers or recognize when the smart-phone user is out of cell range.

In step B of Figure 10, the application processor 1001 makes a VoIP "call" to the appropriate smart-phone user on the associated WiFi network. For instance, if the cell phone service provider has associated the SCD's number and the smart-phone user's number, then the service provider could supply the satellite gateway with the original destination (the mobile number to be reached) before the call is forwarded. The gateway could relay this information to the SCD for routing. For instance, the information could be relayed to the

SCD via an internet connection to the satellite modem 1002. Once received by the satellite modem1002, the SCD can use this information to route the incoming satellite call to the appropriate smartphone via a VoIP/Wifi connection.

In another embodiment, the third party caller "places" two calls – first, the third party caller would call the SCD via the SCD satellite number, and the SCD could transmit back a request to idenrtify the desired mobile subscriber. For instance, the third party caller could be greeted with a menu system once the satellite modem receives the call, then via DTMF or voice commands, the third party caller could enter the desired mobile device identifier (e.g.. phone number or "extension") on the SCD's Wifi network to which the third party caller wishes to be connected (for instance, when the SCD acts as a PBX system for multiple to access a satellite system). This could be either a list of currently connected users, or just the third party caller entering the phone number of their desired call destination.

Figure 11 illustrates an embodiment which incorporates Internet or general connectivity as well as voice capability in the SCD. In this embodiment, when the smart-phone user connects to the Wifi network (possibly using an app that indicated internet connectivety is requested0, the application processor 1001 configures the satellite modem 1002 to establish a PPP Internet connection over the satellite network. As one example, this could be accomplished by configuring a GSP-1700 (model no.) satellite modem available from Globalstar, Inc. for a PPP data call and having the application processor perform the necessary data conversions to pass smart-phone wirelessly transmitted Internet data from the Wifi module over the PPP connection (and likewise to transmit Internet data to the smart-phone via the Wifi module from a PPP source).

Figure 12 illustrates an alternate embodiment which, if provided with a sufficiently high connection speed, will allow the satellite modem to operate with conventional (e.g., DSL) modem functionality. The smart-phone user connects to a Wifi hotspot, places a VoIP call to the SCD in the manner described. and the call is routed using a VoIP server (for example, a SIP server instead of using a VoIP stack) on the SCB, and the SCD configures the satellite modem 1002 for a point-to-point protocal (PPP) Internet connection. The SCD receives the data over the Wifi connection and passes the data stream directly to the satellite modem 1002. At the core network (the satellite gateway), the VoIP call is registered with a SIP server in the conventional manner. The third party answer to the call is likewise transmitted across the satellite network via the PPP Internet connection.

Figure 13 is another alternative embodiment. Conceptually this embodiment involves substituting the Wifi link with a femtocell. A femtocell is a local range cellular network

(similar to a conventional tower network, but for local area use). Femtocell networks are used to extend the cell network in office buildings or to save on airtime charges because femtocell networks typically allow a user to place a standard cell phone call over the network, but instead of getting to the PSTN via the cell towers, the femtocell network intercepts the signal and routes it over the Internet as VoIP. In the Figure 13 embodiment, rather than the call being intercepted and routed as VoIP through a standard internet connection, the SCD would intercept the call and route it via a satellite internet connection (i.e., via the satellite modem) to allow for remote use. The user would not be charged for conventional cell phone minutes, nor would the user need to execute the connection steps required in previously discussed embodiments.

Figure 14 represents an alternative embodiment wherein the conversion of VoIP voice data does not take place by bringing the signal down to analog then to digital again inside the satellite modem, but instead takes place through digital conversion inside the application processor. The call management information is still handled the same as in the descriptions of figures 2-10, but the voice signal is passed differently.

Figure 15 shows some of the control and/or information signals that may be sent through the SCD for purposes of handling or processing a call. These signals will vary based on the type of call being placed (voice, data, video, etc) and on the type or manufacturer of equipment being interfaced, and is simply an example of transmission of control signals through the SCD.

Although certain embodiments were described in reference to the figures, those skilled in the art will recognize many alternate uses for SCD devices similar to those described herein. Such alternative uses could include:

1) Speaker and microphone arrangement on a SCD giving it voice conferencing ability (like a Polycom);

2) A camera and monitor on a SCD giving it video teleconferencing ability;

3) Interactive gaming with one or more participants at a SCD, interacting with remote participants either at a SCD or on public networks (without delays of geo satellites);

4) Secure communications ("off the grid") of voice or data from SCD to SCD, or SCD to public networks, using encryption;

5) Interrogatable transponders for tracking of hazardous materials, with wired or wireless sensors, interrogatable transponders for tracking of assets, with wired or wireless sensors;

6) SCDs incorporated into roadside emergency phones, with or without video;

7) SCDs incorporated into roadside video camera monitoring of traffic;

8) SCDs integrated with toll station data relays;

9) A portable bar code scanners wirelessly or wired to an SCD for inventory management and asset tracking;

10) Point-of-sale terminals using a SCD for pricing and charging;

11) SCDs integrated with remote polling stations vote collection and processing;

12) SCDs integrated with remote security access for opening gates or doors with password entry or biometrics;

13) Multiple wireless device animal tracking using one SCD for data collection and transmission;

14) Multiple wireless or wired asset tracking using one SCD for data collection and transmission;

15) SCDs employed for motion-based, sound-based, or video scene recognition-based remote monitoring;

16) SCDs employed for remote computer file back-up;

17) Concatenation of multiple SCDs to increase bandwidth, data processing on both ends to make one data stream out of several circuits;

18) Wi-Fi roaming from SCD to SCD while preserving session;

19) SCDs connected to PBX for call routing;

20) SCDs employed in border security monitoring;

21) Remote public address systems (speaker at SCD);

22) SCDs employed in weapons activation or detonation;

23) SCDs employed in vehicle telemetry monitoring with remote control of vehicle parameters (e.g.. trucking directions, speed control, fuel usage);

24) SCDs employed in advanced AIS type maritime applications; and

25) SCD's employed as battlefield replacement of HF radios.

Claims:

1. A satellite communication device comprising:

a. a housing including (i) a processor, (ii) satellite modem, (iii) an ISM wireless transceiver, and (iv) a VoIP stack;

b. wherein the processor directs the communication device to perform the following steps:

(i) establish a wireless connection with a VoIP transmitting device;

(ii) receive a VoIP stream from the VoIP transmitting device;

(iii) decode the VoIP stream into a format readable by the satellite modem and transfer the decoded stream to the satellite modem;

(iv) establish a connection through the satellite network to a terrestrial network;

(v) transmit the decoded stream through the satellite network to the terrestrial network.

2. The satellite communication device of claim 1, wherein a phone number from the VoIP transmitting device is used to establish the connection to the terrestrial network.

3. The satellite communication device of claim 1, wherein the VoIP stack decodes the VoIP stream into an analog stream and the satellite modem encodes the analog stream into a digital stream prior to transmitting.

4. The satellite communication device of claim 3, wherein the VoIP stack uses a voice codec to decode the VoIP stream into the analog stream and the satellite modem encodes the analog stream using a satellite voice codec.

5. The satellite communication device of claim 1, wherein the satellite modem receives an incoming call stream, the VoIP stack converts the call stream into a VoIP stream, and the ISM wireless transceiver transmits the VoIP stream to the VoIP transmitting device.

6. The satellite communication device of claim 5, wherein the VoIP stream is transmitted with an "identifier code" unique to a particular VoIP transmitting device.

7. The satellite communication device of claim 1, wherein the satellite communications device has a phone number associated with it which is different from the phone number associated with the VoIP transmitting device.

8. The satellite communication device of claim 1, wherein the ISM transceiver receives a non-VoIP stream and the non-VoIP stream is transmitted by the satellite modem without decoding by the VoIP stack.

9. The satellite communication device of claim 8, wherein the non-VoIP stream is an Internet data stream.

10. The satellite communication device of claim 1, wherein the VoIP stream is digitally transcoded into the protocol of the satellite modem without intermediately being converted into analog.

11. The satellite communication device of claim 1, wherein the VoIP transmitting device is one of a smart-phone, a portable PC, or a computing tablet such as an i-Pad..

12. The satellite communication device of claim 1, wherein (i) the processor is a Freescale Coldfire MCF53281, (ii) the satellite modem is a Globalstar GSP-1720, (iii) the ISM wireless transceiver is a iChip C02144, and (iv) the VoIP stack is an Arcturus brand software SIP client running on the processor;

13. The satellite communication device of claim 1, wherein the ISM wireless transceiver operates in a WiFi standard or a bluetooth standard.

14. The satellite communication device of claim 1, wherein the housing is a portable housing having a volume of less than about 1000 cubic centimeters.

15. A satellite communication network comprising:

a. a hand-held voice/data transmission device; and

b. a separate satellite communication device having a processor, a satellite modem, and a wireless transceiver communicating with the hand-held device;

c. wherein voice/data streams to and from the hand-held device are relayed to and from a satellite network through the satellite modem and wireless transceiver.

16. The satellite communication network of claim 15, wherein the hand-held device transmits a VoIP stream and the satellite communication device includes a VoIP stack which converts the VoIP stream into an analog stream prior to feeding to the satellite modem.

17. The satellite communication network of claim 15, wherein:
(i) the network further comprises a core network communicating with satellite communication device; and
(ii) the hand-held device transmits an outgoing call number to the satellite communications device and the satellite modem establishes a connection through the core network with a device associated with outgoing call number.

18. *The satellite communication network of claim 17, wherein:*
(i) a separate call number is associated with each of the hand-held device and the satellite communication device;
(ii) a call server communicating with the core network associates the two call numbers and *automatically forwards to the satellite communication device calls to the hand-held device.*

19. The satellite communication network of claim 15, wherein the wireless transceiver is an ISM transceiver and the satellite communication device further comprises a VoIP stack.

20. The satellite communication network of claim 19, wherein the satellite communication device receives Internet data from the hand-held device and feeds the Internet data to the satellite modem without the Internet data being decoded by the VoIP stack.

21. The satellite communication network of claim 19, wherein the satellite modem establishes a PPP connection with a core network and a VoIP stream is transmitted across the PPP connection.

22. A satellite communication device comprising:

a. a housing including (i) a processor, (ii) satellite modem, (iii) a Femtocell module, and (iv) a VoIP stack;

b. wherein the processor directs the communication device to perform the following steps:

(i) the Femtocell module receives a cell phone signal and creates a Femtocell output stream;

(ii) feed the Femtocell output stream to the satellite modem; this would happen after step iii

(iii) establish a connection through the satellite network to a terrestrial network;

(iv) transmit the stream through the satellite network to the terrestrial network.

23. The satellite communication device of claim 22, wherein the processor converts the Femtocell output stream into Internet data prior to feeding to the satellite modem.

24. The satellite communication device of claim 22, wherein the processor converts the Femtocell output stream into a VoIP stream and the VoIP converts the VoIP stream into an analog stream prior to feeding to the satellite modem.

25. The satellite communication device of claim 22, wherein the processor converts the Femtocell output stream into a VoIP call and places the VoIP call over the satellite modem's Internet connection.

26. A satellite communication network comprising:

a. a satellite communication device (SCD) including a processor, a satellite modem, and a wireless transceiver; and

b. a plurality of cameras transmitting a compressed video stream to the SCD wireless transceiver and the SCD transmitting the video stream to a satellite network.

27. The satellite communication network of claim 26, wherein the SCD is located with a monitor receiving a video stream from one of the video cameras.

28. A satellite communication network comprising:

a. a satellite communication device (SCD) including a processor, a satellite modem, and a wireless transceiver;

b. a back-office network communicating with the SCD through a satellite network;

c. wherein when a user call is transmitted by the SCD over the satellite network, the SCD directs the user's phone number to the back-office network which records call information for billing to the user's account.

29. The satellite communication network of claim 28, wherein the users cell number is utilized to facilitate billing to the user's credit card.

36. The satellite communication network of claim 28, wherein the users cell number is utilized to facilitate billing to the user's credit card.

31. A satellite communication network comprising:

a. a satellite communication device (SCD) including a processor, a satellite modem, and a wireless transceiver;

b. a back-office network communicating with the SCD through a satellite network;

c. wherein when a user device requests an Internet connection over the satellite network, the SCD directs the users computer/device ID to the back-office network for pay-by-the-minute charging, administered at the SCD, with credit card charging and authorization.

32. The satellite communication network of claim 45, wherein the pay-by-the-minute charging is administered at the back-office network.

33. The satellite communication network of claim 31, wherein the pay-by-the-minute charging is administered at SCD with phone account charging.

34. The satellite communication network of claim 31, 32, or 33, wherein pay-by-the-byte charging is utilized.

35. A satellite communication network comprising:

a. a satellite communication device (SCD) including a processor, a satellite modem, and a wireless transceiver;

b. a back-office network communicating with the SCD through a satellite network;

c. wherein at least one call routed through the SCD and satellite network is merged with or conferenced with other calls through the back-office network.

36. A satellite communication network comprising:

a. a satellite communication device (SCD) including a processor, a satellite modem, and a wireless transceiver;

b. a back-office network communicating with the SCD through a satellite network;

c. wherein a document routed through the SCD and satellite network is routed to a remote printer connected via the Internet to the back-office network.

37. The satellite communication network of claim 36, wherein the document is routed to a remote fax.

38. The satellite communication network of claim 36, wherein the document is received at the SCD and printed at a device in short range wireless contact with the SCD.

39. A satellite communication network comprising:

a. a satellite communication device (SCD) including a processor and a satellite modem;

b. a back-office network communicating with the SCD through a satellite network;

c. wherein multimedia electronic news is routed through the SCD and satellite network is transmitted to a remote station through the back-office network.

40. The satellite communication device of claim 1, wherein the ISM wireless transceiver is replaced by either an optical data connection, a bluetooth connection, or a non-ISM radio connection.

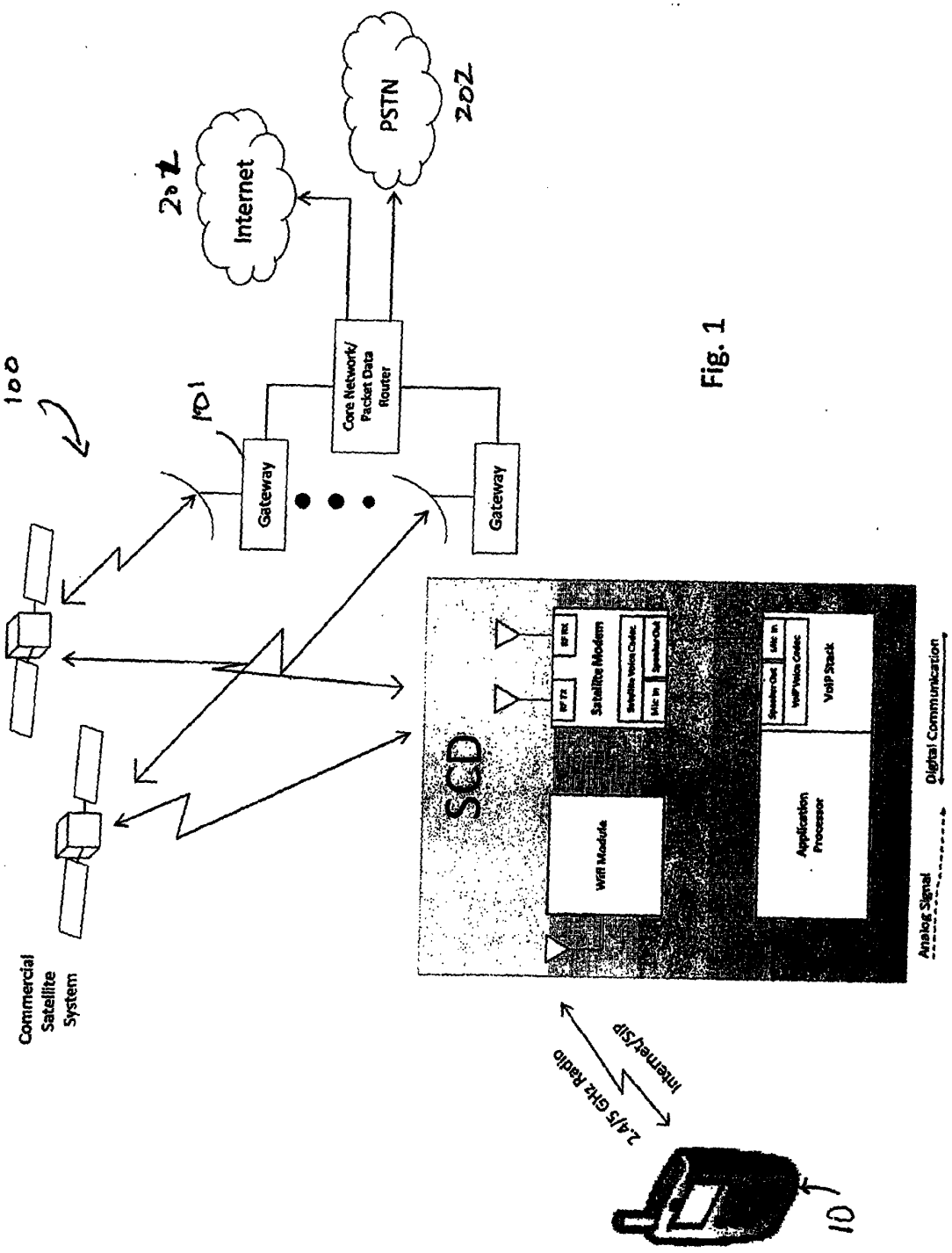
100
101
Internet
PSTN
202
Core Network/ Packet Data Router
Gateway
Gateway
Commercial Satellite System
SGD
Satellite Modem
Wifi Module
Application Processor
VoIP Stack
Digital Communication
Analog Signal
Internet/SIP
2.4/5 GHz Radio
10

Fig. 1

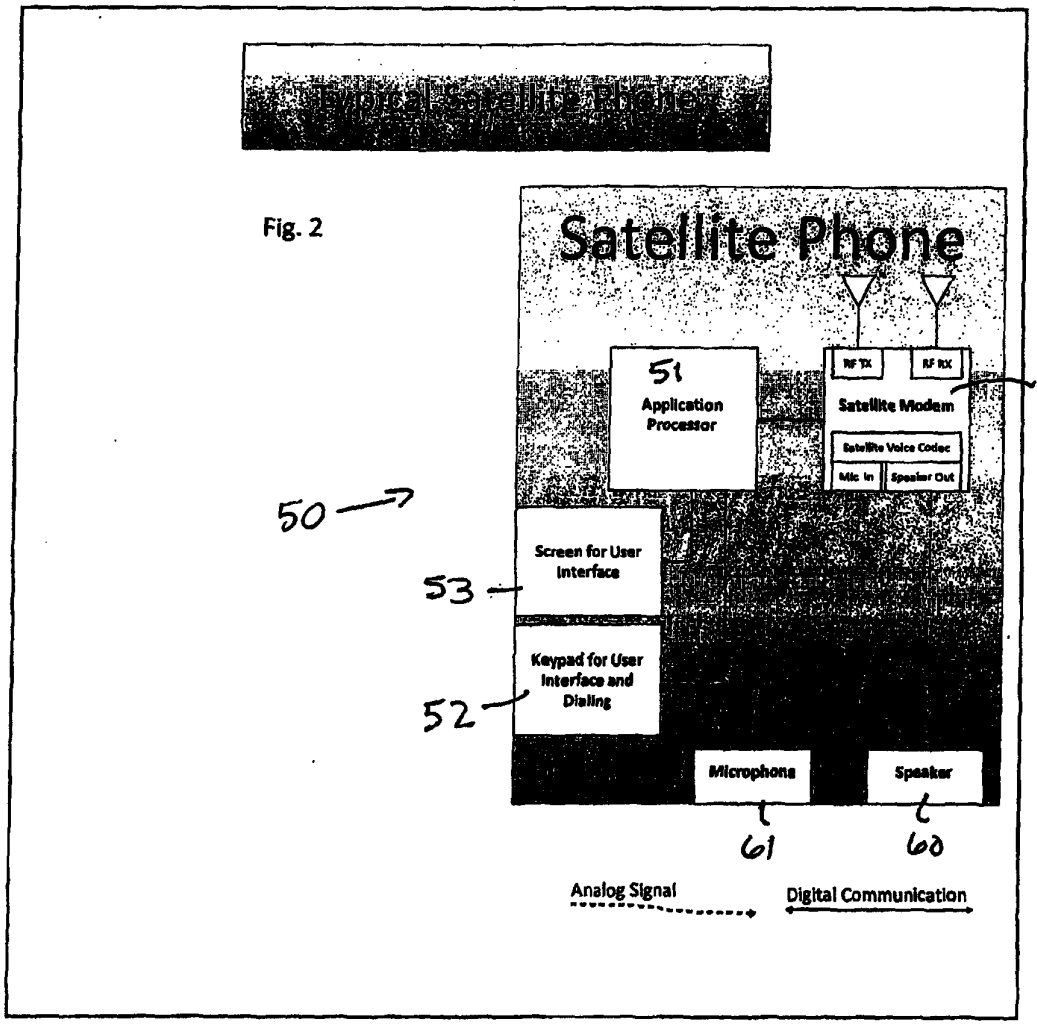
Typical Satellite Phone
Satellite Phone
RF TX
RF RX
51
Application Processor
Satellite Modem
54
Satellite Voice Codec
Mic In
Speaker Out
50
Screen for User Interface
53
Keypad for User Interface and Dialing
52
Microphone
Speaker
61
60
Analog Signal
Digital Communication

Fig. 2

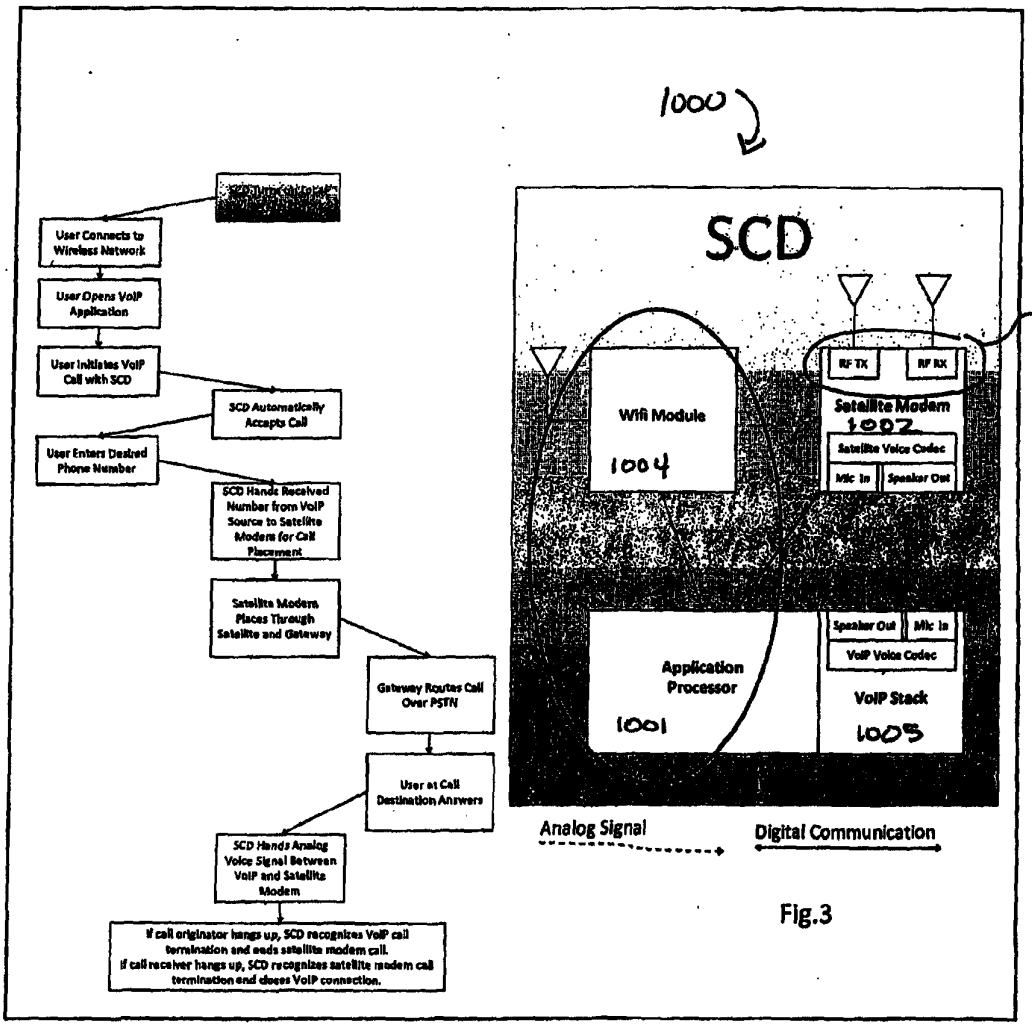
1000
SCD
User Connects to Wireless Network
User Opens VoIP Application
User Initiates VoIP Call with SCD
SCD Automatically Accepts Call
User Enters Desired Phone Number
SCD Hands Received Number from VoIP Source to Satellite Modem for Call Placement
Satellite Modem Places Through Satellite and Gateway
Gateway Routes Call Over PSTN
User at Call Destination Answers
SCD Hands Analog Voice Signal Between VoIP and Satellite Modem
If call originator hangs up, SCD recognizes VoIP call termination and ends satellite modem call.
If call receiver hangs up, SCD recognizes satellite modem call termination and closes VoIP connection.
Wifi Module
1004
RF TX
RF RX
Satellite Modem
1002
Satellite Voice Codec
Mic In
Speaker Out
Application Processor
1001
Speaker Out
Mic In
VoIP Voice Codec
VoIP Stack
1005
Analog Signal
Digital Communication

Fig.3

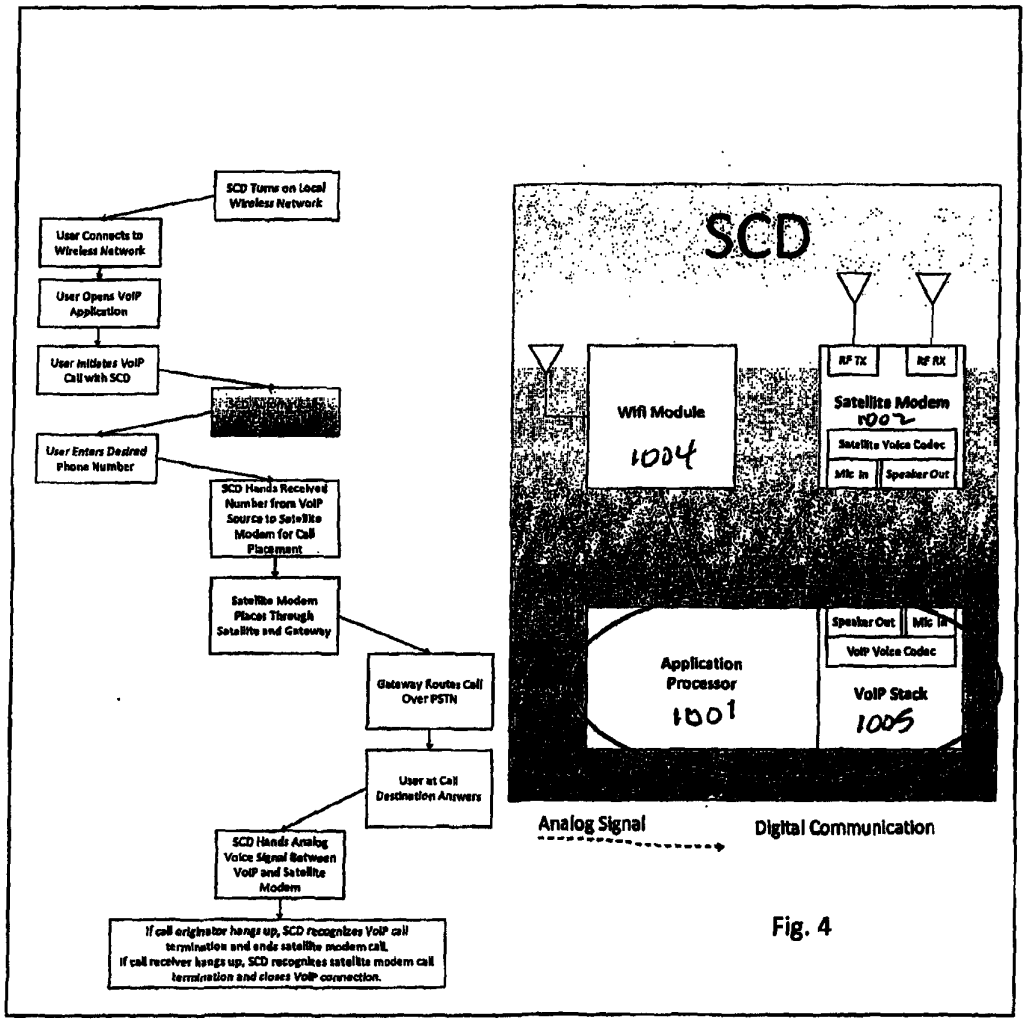
SCD Turns on Local Wireless Network
User Connects to Wireless Network
User Opens VoIP Application
User Initiates VoIP Call with SCD
User Enters Desired Phone Number
SCD Hands Received Number from VoIP Source to Satellite Modem for Call Placement
Satellite Modem Places Through Satellite and Gateway
Gateway Routes Call Over PSTN
User at Call Destination Answers
SCD Hands Analog Voice Signal Between VoIP and Satellite Modem
If call originator hangs up, SCD recognizes VoIP call termination and ends satellite modem call.
If call receiver hangs up, SCD recognizes satellite modem call termination and closes VoIP connection.
SCD
Wifi Module
1004
RF TX
RF RX
Satellite Modem
1002
Satellite Voice Codec
Mic In
Speaker Out
Application Processor
1001
Speaker Out
Mic In
VoIP Voice Codec
VoIP Stack
1005
Analog Signal
Digital Communication

Fig. 4

BSM

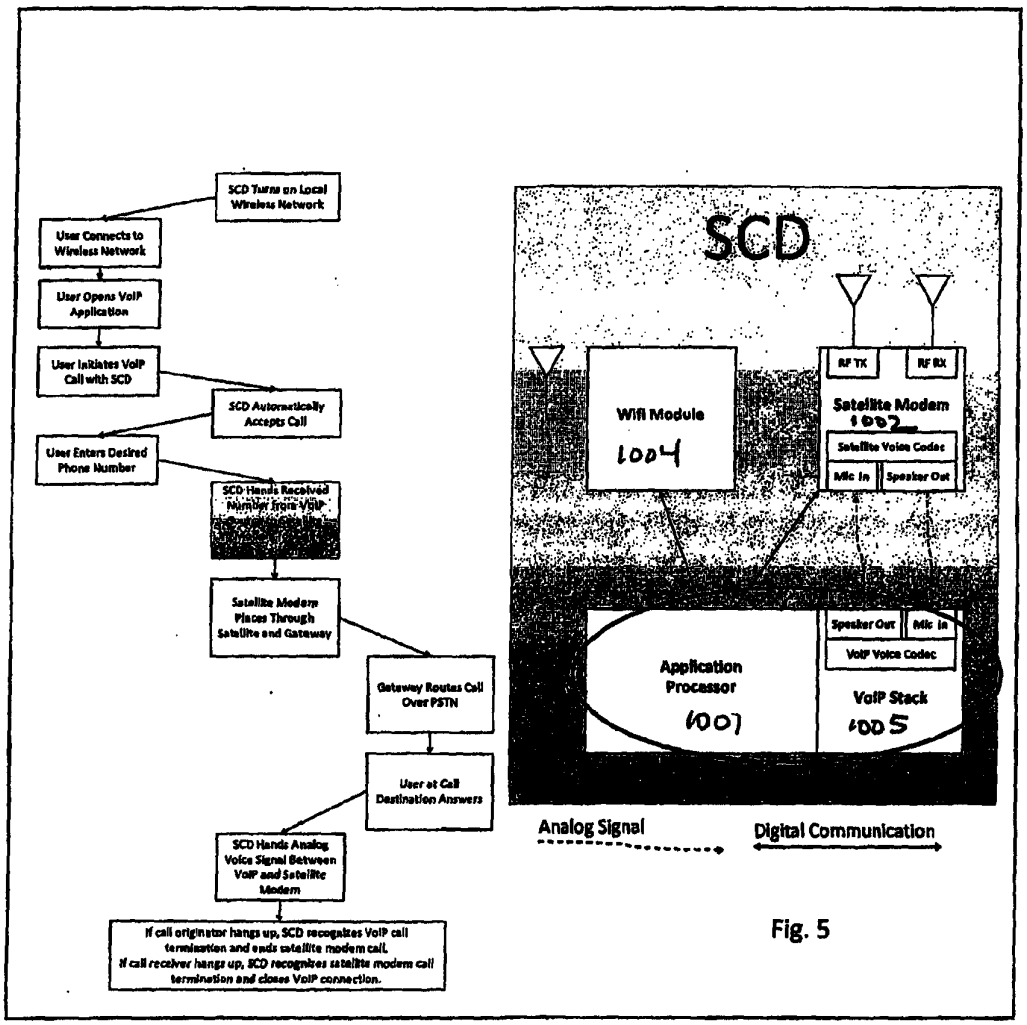
SCD Turns on Local Wireless Network
User Connects to Wireless Network
User Opens VoIP Application
User Initiates VoIP Call with SCD
SCD Automatically Accepts Call
User Enters Desired Phone Number
SCD Hands Received Number from VoIP
Satellite Modem Places Through Satellite and Gateway
Gateway Routes Call Over PSTN
User at Call Destination Answers
SCD Hands Analog Voice Signal Between VoIP and Satellite Modem
If call originator hangs up, SCD recognizes VoIP call termination and ends satellite modem call.
If call receiver hangs up, SCD recognizes satellite modem call termination and closes VoIP connection.
SCD
Wifi Module
1004
RF TX
RF RX
Satellite Modem
1002
Satellite Voice Codec
Mic In
Speaker Out
Speaker Out
Mic In
VoIP Voice Codec
Application Processor
1001
VoIP Stack
1005
Analog Signal
Digital Communication

Fig. 5

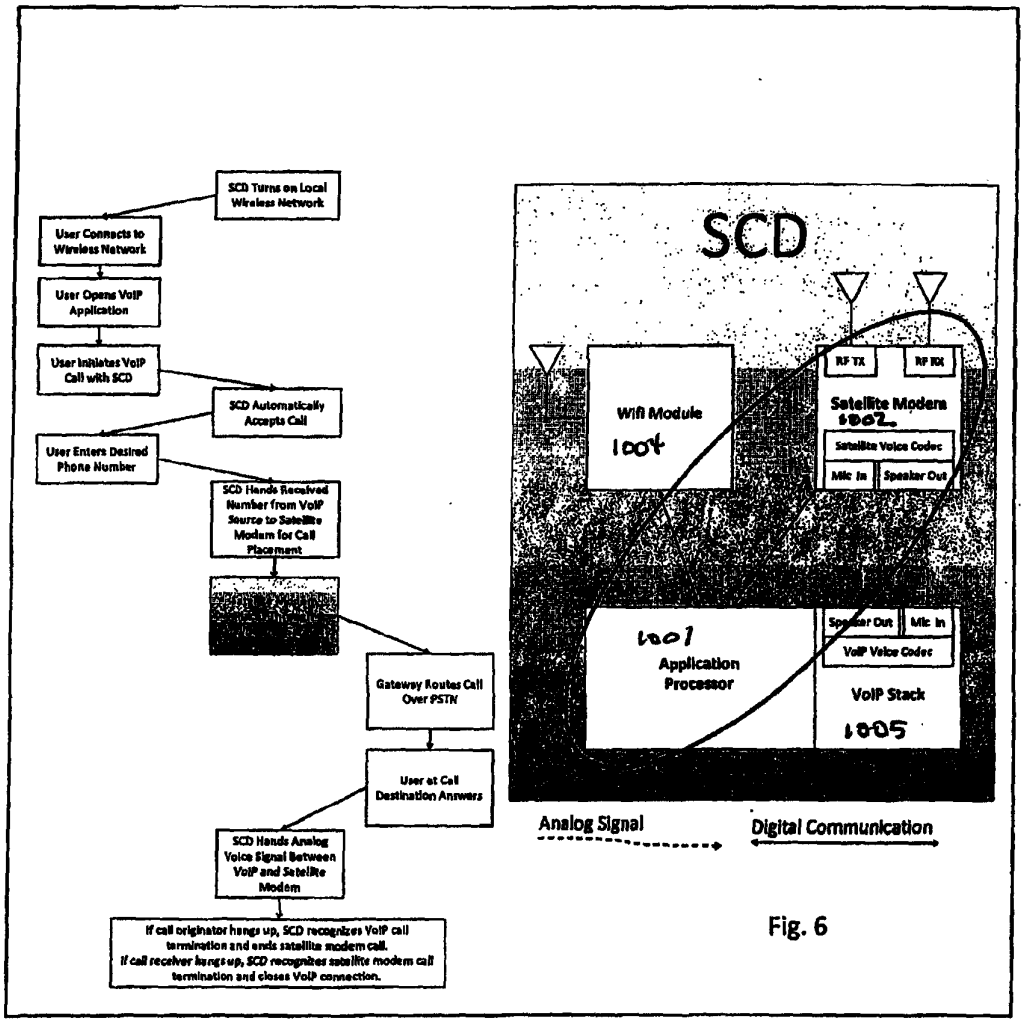
SCD Turns on Local Wireless Network
User Connects to Wireless Network
User Opens VoIP Application
User Initiates VoIP Call with SCD
SCD Automatically Accepts Call
User Enters Desired Phone Number
SCD Sends Received Number from VoIP Source to Satellite Modem for Call Placement
Gateway Routes Call Over PSTN
User at Call Destination Answers
SCD Sends Analog Voice Signal Between VoIP and Satellite Modem
If call originator hangs up, SCD recognizes VoIP call termination and ends satellite modem call.
If call receiver hangs up, SCD recognizes satellite modem call termination and closes VoIP connection.
SCD
Wifi Module
1004
RF TX
RF RX
Satellite Modem
1002
Satellite Voice Codec
Mic In
Speaker Out
1001
Application Processor
Speaker Out
Mic In
VoIP Voice Codec
VoIP Stack
1005
Analog Signal
Digital Communication

Fig. 6

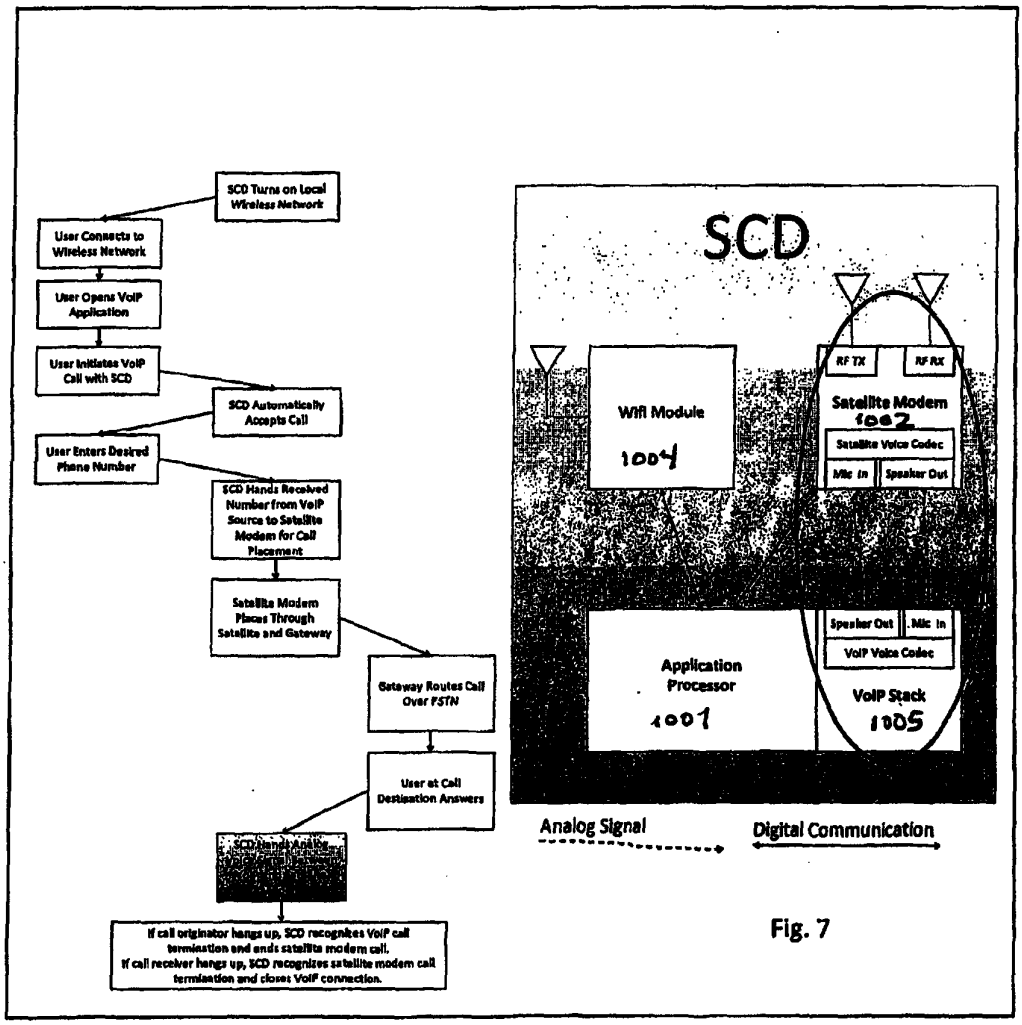
SCD Turns on Local Wireless Network
User Connects to Wireless Network
User Opens VoIP Application
User Initiates VoIP Call with SCD
SCD Automatically Accepts Call
User Enters Desired Phone Number
SCD Hands Received Number from VoIP Source to Satellite Modem for Call Placement
Satellite Modem Places Through Satellite and Gateway
Gateway Routes Call Over PSTN
User at Call Destination Answers
If call originator hangs up, SCD recognizes VoIP call termination and ends satellite modem call.
If call receiver hangs up, SCD recognizes satellite modem call termination and closes VoIP connection.
SCD
Wifi Module
1004
RF TX
RF RX
Satellite Modem
1002
Satellite Voice Codec
Mic In
Speaker Out
Speaker Out
Mic In
VoIP Voice Codec
Application Processor
1001
VoIP Stack
1005
Analog Signal
Digital Communication

Fig. 7

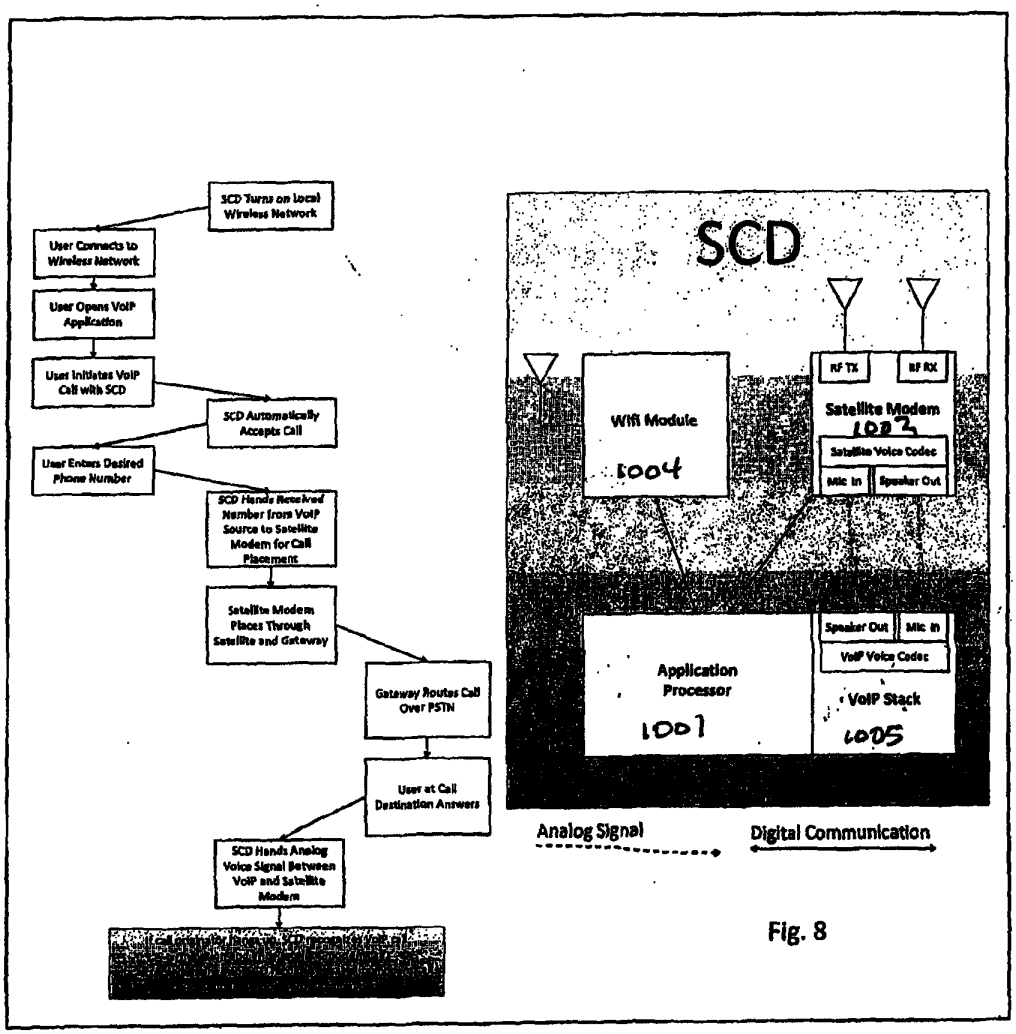
SCD Turns on Local Wireless Network
User Connects to Wireless Network
User Opens VoIP Application
User Initiates VoIP Call with SCD
SCD Automatically Accepts Call
User Enters Desired Phone Number
SCD Hands Received Number from VoIP Source to Satellite Modem for Call Placement
Satellite Modem Places Through Satellite and Gateway
Gateway Routes Call Over PSTN
User at Call Destination Answers
SCD Hands Analog Voice Signal Between VoIP and Satellite Modem
SCD
Wifi Module
1004
RF TX
RF RX
Satellite Modem
1002
Satellite Voice Codec
Mic In
Speaker Out
Application Processor
1001
Speaker Out
Mic In
VoIP Voice Codec
VoIP Stack
1005
Analog Signal
Digital Communication

Fig. 8

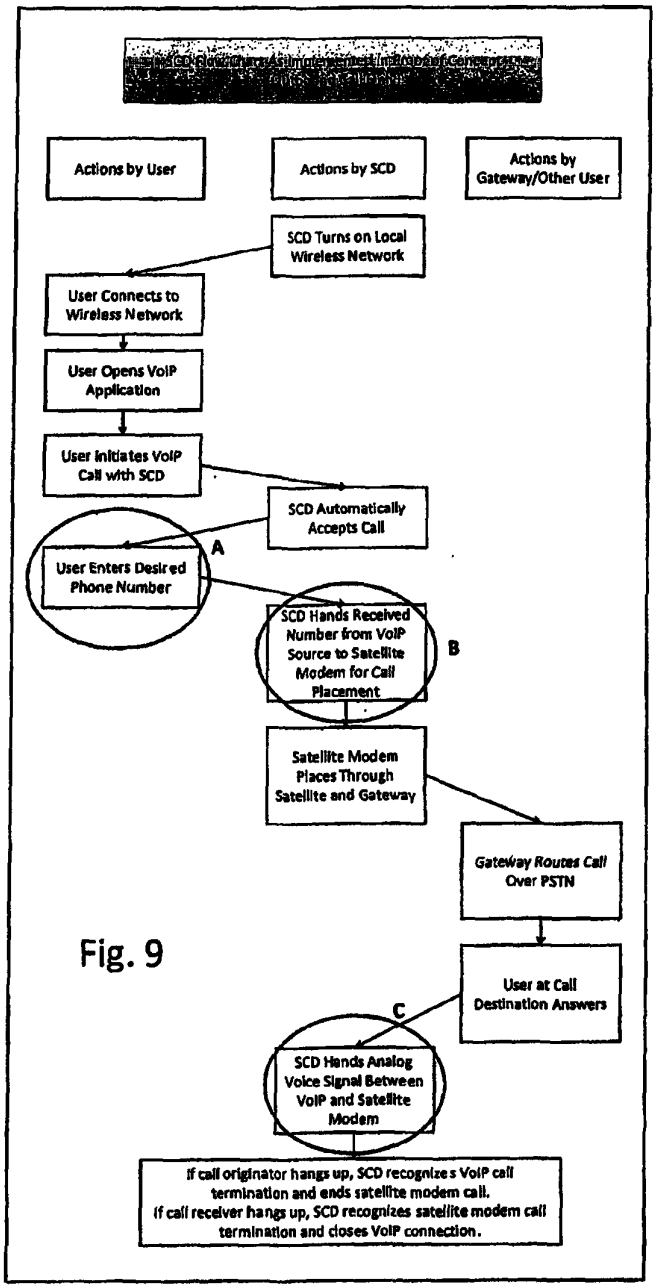
Actions by User
Actions by SCD
Actions by Gateway/Other User
SCD Turns on Local Wireless Network
User Connects to Wireless Network
User Opens VoIP Application
User Initiates VoIP Call with SCD
SCD Automatically Accepts Call
A
User Enters Desired Phone Number
SCD Hands Received Number from VoIP Source to Satellite Modem for Call Placement
B
Satellite Modem Places Through Satellite and Gateway
Gateway Routes Call Over PSTN
User at Call Destination Answers
C
SCD Hands Analog Voice Signal Between VoIP and Satellite Modem
If call originator hangs up, SCD recognizes VoIP call termination and ends satellite modem call.
If call receiver hangs up, SCD recognizes satellite modem call termination and closes VoIP connection.

Fig. 9

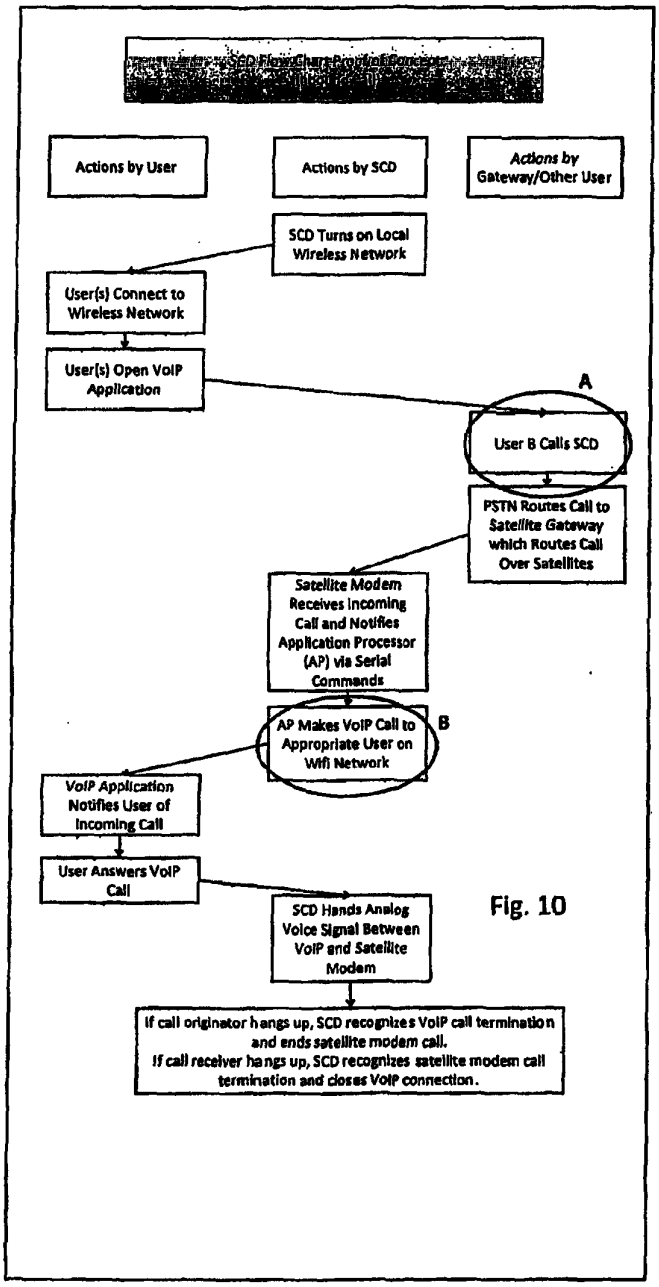
Actions by User
Actions by SCD
Actions by Gateway/Other User
SCD Turns on Local Wireless Network
User(s) Connect to Wireless Network
User(s) Open VoIP Application
A
User B Calls SCD
PSTN Routes Call to Satellite Gateway which Routes Call Over Satellites
Satellite Modem Receives Incoming Call and Notifies Application Processor (AP) via Serial Commands
AP Makes VoIP Call to Appropriate User on Wifi Network
B
VoIP Application Notifies User of Incoming Call
User Answers VoIP Call
SCD Hands Analog Voice Signal Between VoIP and Satellite Modem
If call originator hangs up, SCD recognizes VoIP call termination and ends satellite modem call.
If call receiver hangs up, SCD recognizes satellite modem call termination and closes VoIP connection.

Fig. 10

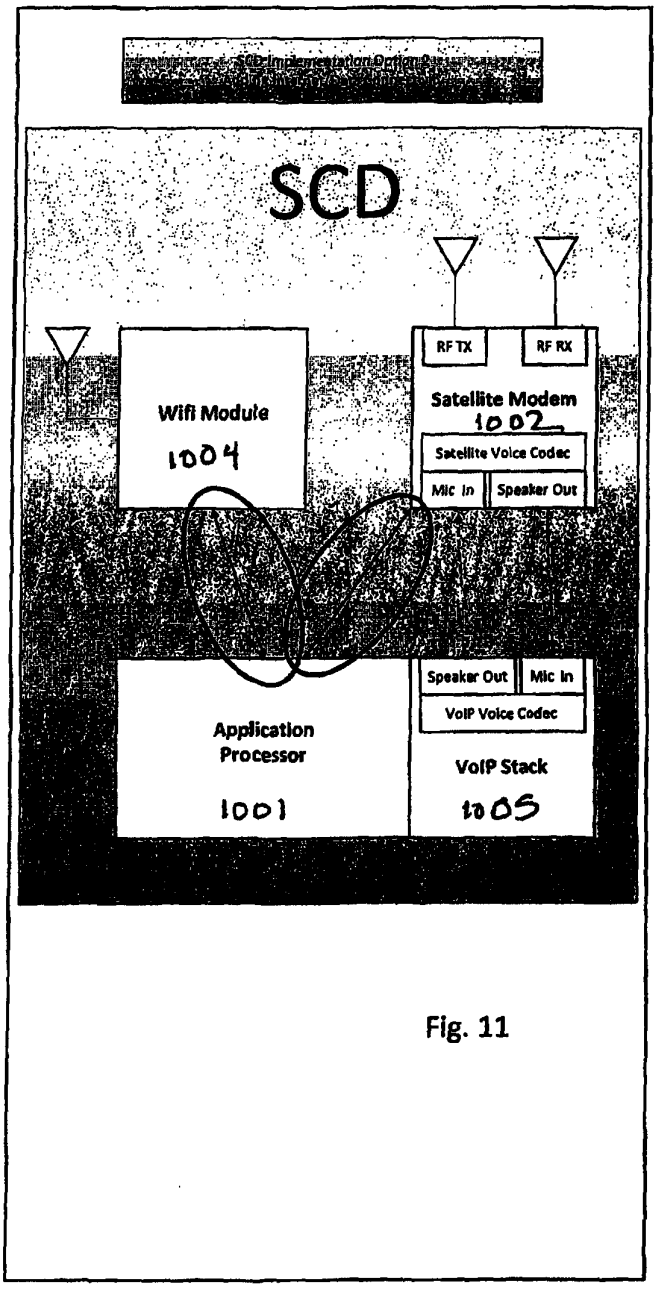
SCD
RF TX
RF RX
Satellite Modem
1002
Satellite Voice Codec
Mic In
Speaker Out
Wifi Module
1004
Speaker Out
Mic In
VoIP Voice Codec
Application Processor
1001
VoIP Stack
1005

Fig. 11

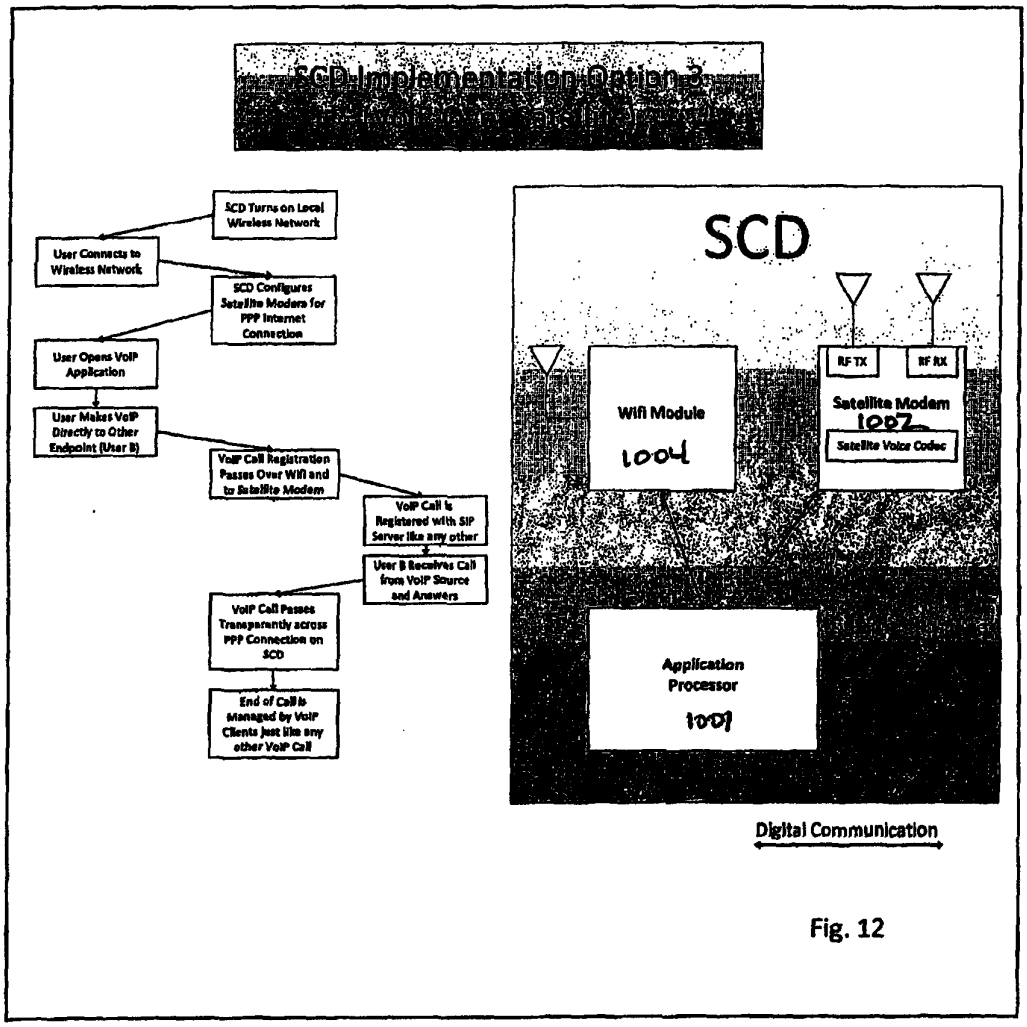
SCD Implementation Option 3
SCD Turns on Local Wireless Network
User Connects to Wireless Network
SCD Configures Satellite Modem for PPP Internet Connection
User Opens VoIP Application
User Makes VoIP Directly to Other Endpoint (User B)
VoIP Call Registration Passes Over Wifi and to Satellite Modem
VoIP Call is Registered with SIP Server like any other
User B Receives Call from VoIP Source and Answers
VoIP Call Passes Transparently across PPP Connection on SCD
End of Call is Managed by VoIP Clients just like any other VoIP Call
SCD
RF TX
RF RX
Wifi Module
1004
Satellite Modem
1002
Satellite Voice Codec
Application Processor
1001
Digital Communication

Fig. 12

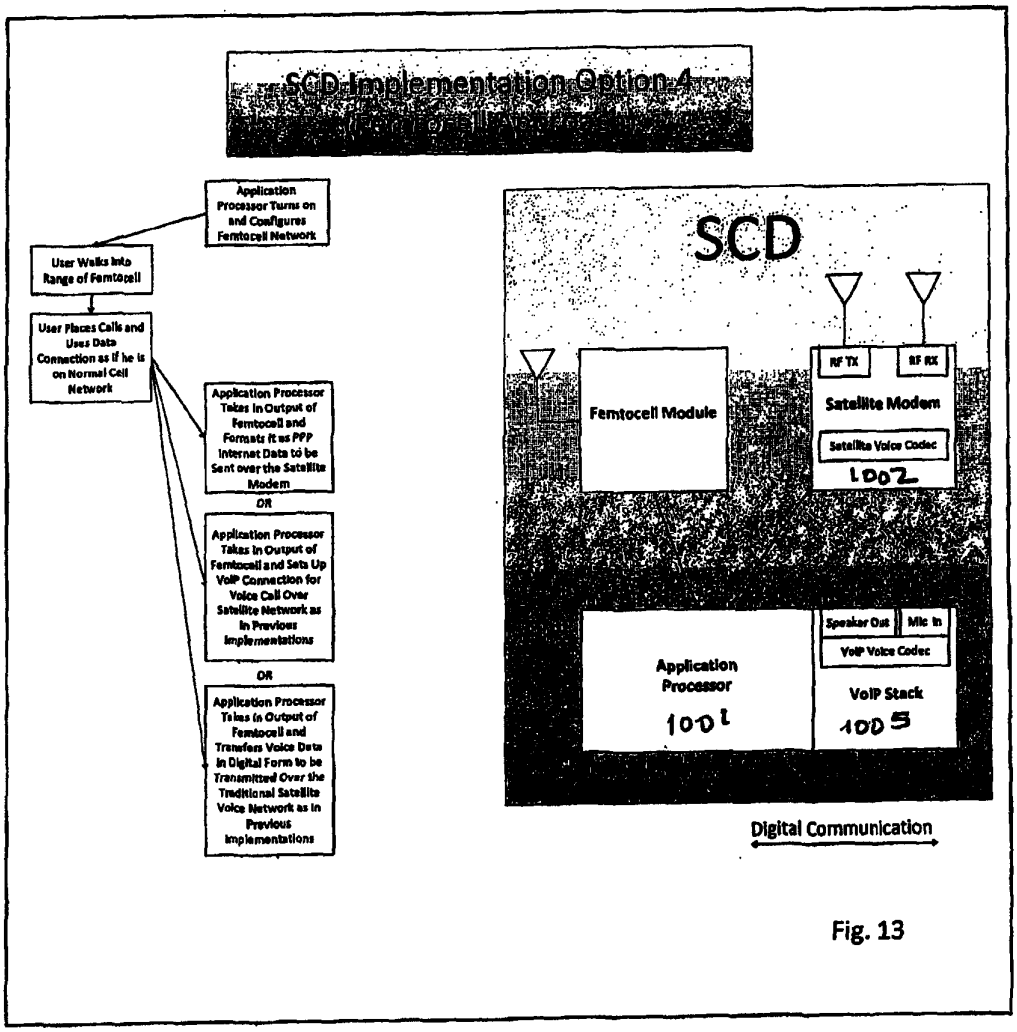
SCD Implementation Option 4
Application Processor Turns on and Configures Femtocell Network
User Walks Into Range of Femtocell
User Places Calls and Uses Data Connection as if he is on Normal Cell Network
Application Processor Takes in Output of Femtocell and Formats it as PPP Internet Data to be Sent over the Satellite Modem
OR
Application Processor Takes in Output of Femtocell and Sets Up VoIP Connection for Voice Call Over Satellite Network as in Previous Implementations
OR
Application Processor Takes in Output of Femtocell and Transfers Voice Data in Digital Form to be Transmitted Over the Traditional Satellite Voice Network as in Previous Implementations
SCD
Femtocell Module
RF TX
RF RX
Satellite Modem
Satellite Voice Codec
1002
Application Processor
1001
Speaker Out
Mic In
VoIP Voice Codec
VoIP Stack
1005
Digital Communication

Fig. 13

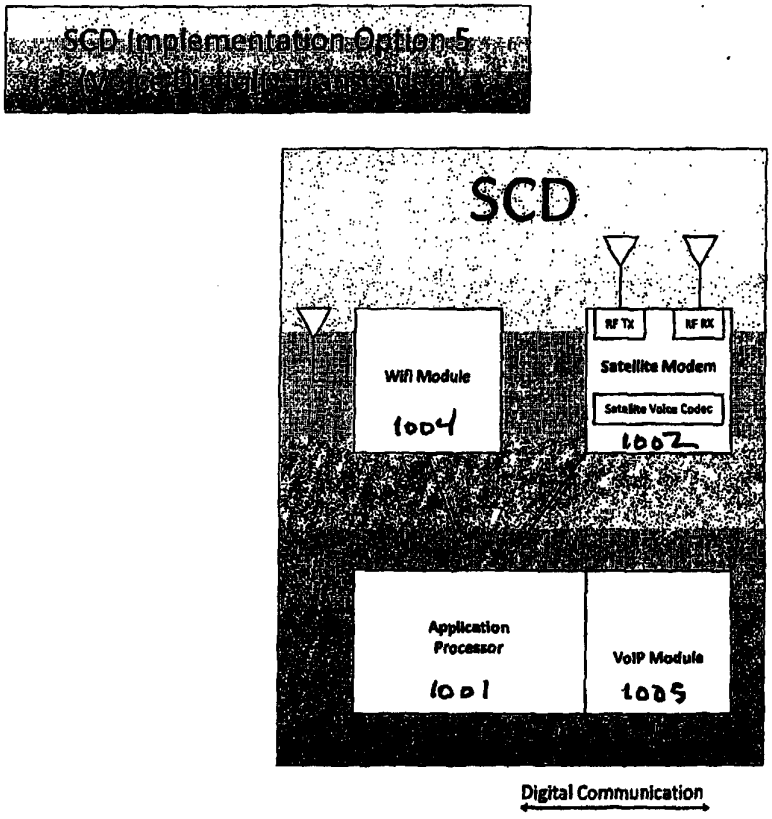
SCD
RF TX
RF RX
Satellite Modem
Satellite Voice Codec
1002
Wifi Module
1004
Application Processor
1001
VoIP Module
1005
Digital Communication

Fig. 14

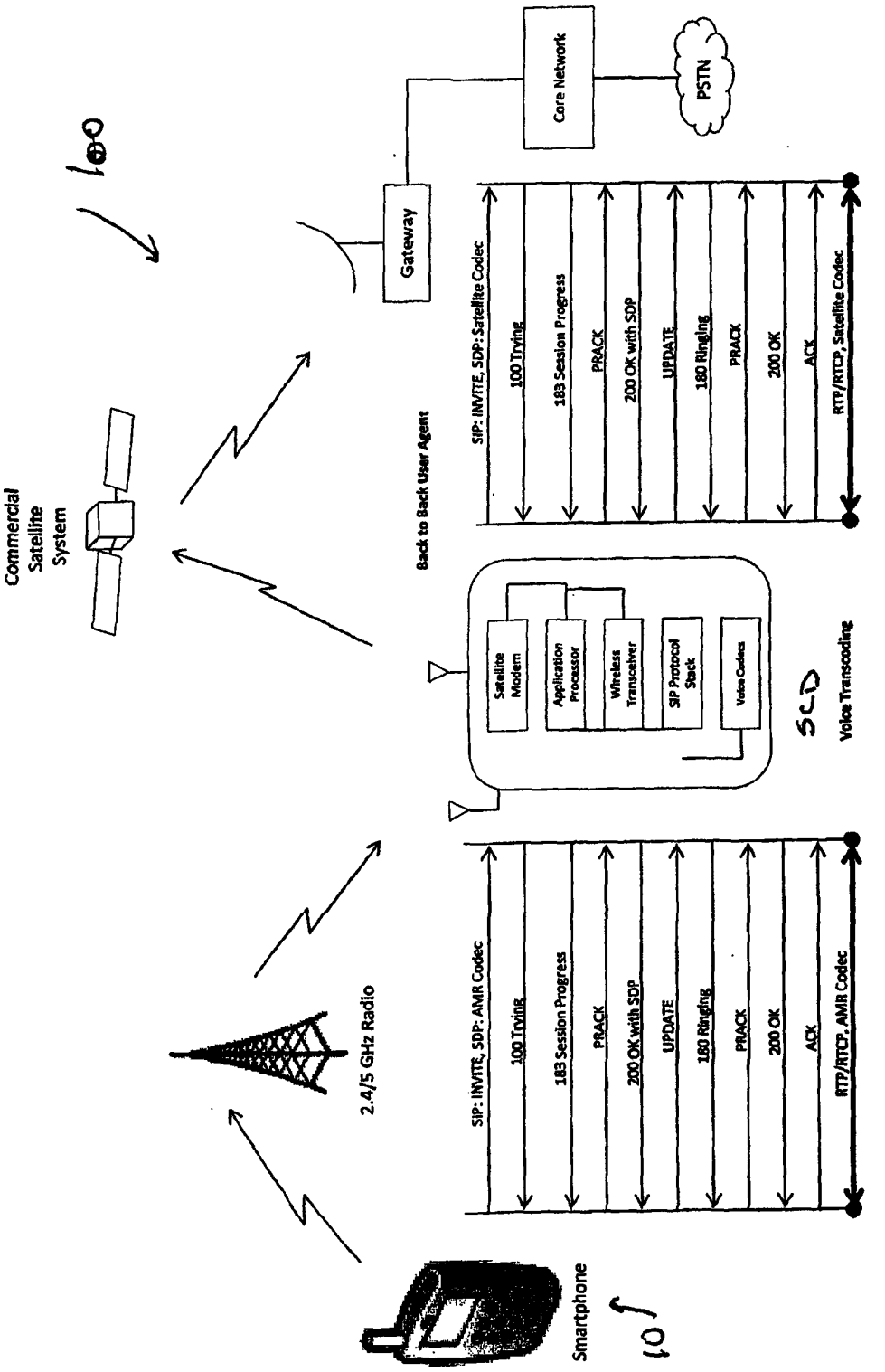
100
Core Network
PSTN
Gateway
Commercial Satellite System
Back to Back User Agent
SIP: INVITE, SDP: Satellite Codec
100 Trying
183 Session Progress
PRACK
200 OK with SDP
UPDATE
180 Ringing
PRACK
200 OK
ACK
RTP/RTCP, Satellite Codec
Satellite Modem
Application Processor
Wireless Transceiver
SIP Protocol Stack
Voice Codecs
SCD
Voice Transcoding
2.4/5 GHz Radio
SIP: INVITE, SDP: AMR Codec
100 Trying
183 Session Progress
PRACK
200 OK with SDP
UPDATE
180 Ringing
PRACK
200 OK
ACK
RTP/RTCP, AMR Codec
Smartphone
101

Fig. 15

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2012/024177

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - H04B 7/204 (2012.01)
USPC - 370/325
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC(8) - H04B 7/185, 204; H04Q 7/00 (2012.01)
USPC - 370/319, 325, 328, 341

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

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 7,693,101 B2 (GERNERT et al) 06 April 2010 (06.04.2010) entire document	1-14, 40
Y	US 2008/0025249 A1 (KUPPUSWAMY et al) 31 January 2008 (31.01.2008) entire document	1-14, 40
Y	US 7,463,882 B2 (TUOMELA et al) 09 December 2008 (09.12.2008) entire document	7
Y	THOMASNET NEWS. Globalstar Launches Satellite Data and Voice Module in the United States. 29 May 2007 (29.05.2007) [retrieved on 2012-06-01]. Retrieved from the Internet: <URL:http://news.thomasnet.com/companystory/Globalstar-Launches-Satellite-Data-and-Voice-Module-in-the-United-States-521501> entire document	12
Y	EE TIMES INDIA. Freescale unveils embedded VoIP reference platform solution. 08 October 2007 (08.10.2007) [retrieved on 2012-06-01]. Retrieved from the Internet: <URL: http://www.eetindia.co.in/ART_8800482580_1800001_NP_d8a9f35a.HTM> entire document	12
Y	CONNECT ONE. iChip C02144. 25 February 2010 (25.02.2010) [retrieved on 2012-06-01.] Retrieved from the Internet <URL:http://web.archive.org/web/20100225021143/http:/www.connectone.com/products.asp?did=40&pid=75>	12

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
01 June 2012	12 JUN 2012
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Authorized officer: Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2012/024177

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2009/0260004 A1 (DATTA et al) 15 October 2009 (15.10.2009) entire document	14
A	US 7,667,643 B2 (HANDERMANN et al) 23 February 2010 (23.02.2010) figures 1A, 1B, 2A, 2B; abstract; column 5, lines 48-62; column 6, lines 27-39, 51-54; column 8, lines 61-64; column 14, line 63 to column 15, line 18.	1-14, 40
A	US 2006/0259416 A1 (JOHNSON) 16 November 2006 (16.11.2006) paragraphs [0021], [0024]	1-14, 40

Form PCT/ISA/210 (continuation of second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2012/024177

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☒ Claims Nos.: 32, 34
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

See extra sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
1-14, 40

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

Form PCT/ISA/210 (continuation of first sheet (2)) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2012/024177

Continuation of Box III.

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I, claims 1-14, 40, drawn to a satellite communication device comprising a housing including an ISM wireless transceiver and a VoIP stack, and decoding a VoIP stream into a format readable by a satellite modem.
Group II, claims 15-21, drawn to a satellite communication network comprising a handheld voice/data transmission device and a separate satellite communication device.
Group III, claims 22-25, drawn to a satellite communication device comprising a housing including a Femtocell module and a VoIP stack, where the Femtocell module receives a cell phone call and creates a Femtocell output stream.
Group IV, claims 26-27, drawn to a satellite communication network, comprising a plurality of cameras transmitting a compressed video stream to a transceiver.
Group V, claims 28-30, 31, 33, drawn to a satellite communication network, comprising wherein when a user device requests an Internet connection, the satellite communication device directs the users computer/device ID to a back office network for billing or charging.
Group VI, claim 35, drawn to a satellite communication network, comprising wherein at least one call routed through the SCD and satellite network is merged or conferenced with other calls.
Group VII, claim 36-38, drawn to a satellite communication network, comprising wherein a document routed through the SCD and satellite network is routed to a remote printer.
Group VIII, claim 39, drawn to a satellite communication network, comprising wherein multimedia electronic news is routed through the SCD and satellite network to a remote station.

The inventions listed as Groups I-VIII do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons: the special technical feature of the Group I invention: an ISM wireless transceiver as claimed therein is not present in the invention of Groups II-VIII. The special technical feature of the Group II invention: a handheld voice/data transmission device as claimed therein is not present in the invention of Groups I, III-VIII. The special technical feature of the Group III invention: a Femtocell module as claimed therein is not present in the invention of Groups I, II, IV-VIII. The special technical feature of the Group IV invention: a plurality of cameras transmitting a compressed video stream as claimed therein is not present in the invention of Groups I, II, III or V-VIII. The special technical feature of the Group V invention: when a user device requests an Internet connection, the satellite communication device directs the users computer/device ID to a back office network for billing or charging as claimed therein is not present in the invention of Groups I-IV, VI-VIII. The special technical feature of the Group VI invention: merging or conferencing callis as claimed therein is not present in the invention of Groups I-V, VII-VIII. The special technical feature of the Group VII invention: routing a document to a remote printer as claimed therein is not present in the invention of Groups I-VI or VIII. The special technical feature of the Group VIII invention: multimedia electronic news is routed through the SCD and satellite network as claimed therein is not present in the invention of Groups I-VII.

Groups I, II, III, IV, V, VI, VII and VIII lack unity of invention because even though the inventions of these groups require the technical feature of a satellite communication device comprising a housing including a processor, a satellite modem, a wireless transceiver, and VoIP capabilities, wherein the processor directs the communication device to perform the following steps: establish a wireless connection with a transmitting device, receive a stream from the transmitting device, transfer the stream to a satellite modem, establish a connection through the satellite network to a terrestrial network, and transmit the stream through the satellite network to the terrestrial network, this technical feature is not a special technical feature as it does not make a contribution over the prior art in view of US 7,667,643 B2 (HANDERMANN et al) 23 February 2010 (23.02.2010) figures 1A, 1B, 2A, 2B; abstract; column 5, lines 48-62; column 6, lines 27-39, 51-54; column 8, lines 61-64; column 14, line 63 to column 15, line 18.

Groups V-VIII lack unity of invention because even though the inventions of these groups require the technical feature of communication through the satellite network to a back office network, this technical feature is not a special technical feature as it does not make a contribution over the prior art in view of US 2006/0259416 A1 (JOHNSON) 16 November 2006 (16.11.2006) paragraphs [0021], [0024].

Since none of the special technical features of the Group I, II, III, IV, V, VI, VII or VIII inventions are found in more than one of the inventions, unity of invention is lacking.

Note: There are two claims numbered claim 36. For the purpose of the international opinion, the first recitation of claim 36 is interpreted as claim 30, as it follows claim 29 and there is no claim 30. The second recitation of claim 36 is unchanged.

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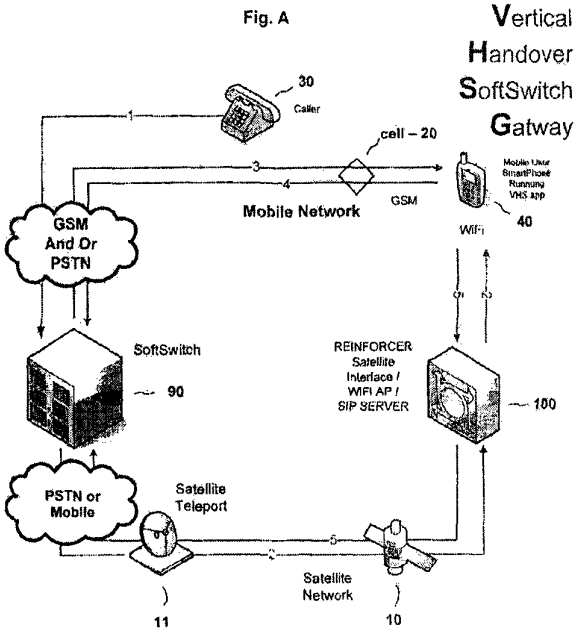
— *with international search report (Art. 21(3))*

(54) Title: APPARATUS, METHOD AND SYSTEM FOR INTEGRATING MOBILE AND SATELLITE PHONE SERVICE

Fig. A



(57) Abstract: A communications system which allows for the integration of mobile and satellite communication networks, which includes an interface device configured to bi-directionally communicate with a mobile device (preferably wirelessly), that includes a satellite antenna on the communications device and a voice/data modem configured to bi-directionally communicate with a satellite network via the antenna.

WO 2013/142284 A1

APPARATUS, METHOD, AND SYSTEM FOR INTEGRATING MOBILE AND SATELLITE PHONE SERVICE

Robert K. Buckle and Thomas Hafley

FIELD OF THE INVENTION

The present disclosure relates generally to mobile phones, and more particularly to an apparatus, method, and system for integrating mobile and satellite telephone service.

BACKGROUND

Various types of wireless communication systems are in global use, including a satellite phone network and a mobile or cellular phone network. Although satellite phones are well known, these types of devices possess a number of limitations regarding range of use, telephone number portability to non-satellite networks, extended development time, cost and the like. The range of use of existing satellite phones is likewise limited as these devices will not transmit or receive phone calls if the operator is located indoors. Accordingly, an operator of a satellite phone must be located outdoors in order to access the satellite and to utilize the device for its intended purpose.

Existing satellite phones are further limited regarding telephone number portability to non-satellite networks. More specifically, telephone numbers assigned to a satellite handset device cannot be ported for use on non-satellite networks (e.g., public mobile networks). Conversely, mobile phones presently enjoy telephone number portability between different mobile networks.

Similar to satellite phones, mobile devices likewise posses a number of limitations that constrict their usage. For example, the user must be in the vicinity of a cellular tower associated with the network in order to receive and place calls. Dropped phone calls may occur while switching between cellular towers. If the user is located in a remote location outside the range of a cellular tower, then the mobile device will not function as a communications device.

A consumer in need of broad phone coverage would have to use both a cellular phone and a satellite phone, each having a separate phone number. Thus, there is a need in the art for a system to allow a mobile phone to emulate a satellite phone and in addition, to have an option to transfer an ongoing call from the satellite system to the mobile system (and back) without the user's intervention and without interrupting the ongoing call.

SUMMARY OF THE DISCLOSURE

A communications system provided herein which allows for the integration of mobile and satellite communication networks. The communication system device includes

an interface device configured to bi-directionally communicate with a mobile device (preferably wirelessly), that includes a satellite antenna on the communications device and a voice/data modem configured to bi-directionally communicate with a satellite network via the antenna. The communications system may or may not also include a softswitch device that interfaces both satellite systems and accesses mobile networks via either the internet or via the mobile network.

DESCRIPTION OF THE DRAWINGS

Figure A depicts the system used to transfer calls between networks.

Figure B shows the flow of an outbound call from a mobile device in one embodiment of the system.

Figure C depicts the flow of an inbound call to the mobile device in one embodiment of the system.

Figure D is a block diagram of depicting some of the components of one embodiment of a VHSG.

Figure E is a block diagram depicting some of the components of one embodiment of a reinforcer.

Figure F depicts the flow for an inbound call in an alternative embodiment.

DESCRIPTION OF THE *PREFERRED EMBODIMENT*

Traditional cellular or mobile networks include mobile devices (cell enabled devices) such as smart phones, that communicate wirelessly to cellular towers 20, which then route received calls to another communications device, such through a gateway to the public switched telephone network, or another mobile network. As used herein, a mobile communications network is a radio enabled cellular network where the mobile device 40 directly communicates though a cell 20 which interfaces with the public switched telephone network, another cell network, or the internet). A satellite communications network includes satellite communications devices, such as a satellite phone, that communicates directly to a satellite 10, which then redirects the call to a satellite gateway 11 for routing the satellite call via the public switched telephone network to another communications device. A systems diagram of an integrated wireless phone communications network is illustrated in Figure A. The integrated wireless phone communications network bridges the gap between cellular phone coverage via a network of cellular towers and satellite phone coverage via a network of satellites. The communications network further includes a conventional satellite network (depicted by the satellite 10 and satellite gateway 11) which communicates through satellite gateways 11 to a core network (including packet data routing systems) which

ultimately transfers information to the Internet or a public switched telephone network (or PSTN). As background information, for both mobile and satellite communication devices, information is transmitted across the respective communications network digitally. In conventional satellite and mobile cell phones, the processor in the phone converts the analog voice signal for transmission to a digital outgoing signal, and vice versa for incoming digital voice data.

The present system includes a softswitch 90 or vertical handover softswitch gateway (VHSG) (sometimes referred to as a switch device) that interfaces between a mobile network and a satellite network (and may access these networks though PSTN, a mobile network, the internet or intranet, or some other connection) as later described. The system includes the use of a mobile device, such as a mobile "smart" phone. Various examples of a smart phone include iPhone®, Blackberry®, Android® or the like. The mobile device may be a laptop, tablet or other device that can communicate wirelessly over a mobile network. Many of these devices, e.g., smart-phones, are capable of converting an analog voice signal into a VoIP data stream and sometimes will be referred to as "VoIP transmitting devices." In the description that follows, the mobile device is referenced as a mobile phone for convenience, but the invention is not so limited. The mobile phone is capable of wireless communications via a public mobile network. The public mobile network includes a plurality of cellular towers 20 geographically positioned in order to provide cellular phone coverage within range of the cellular tower. A mobile number is associated with the mobile phone for identification purposes, as is conventionally deployed in a Subscriber Identity Module (SIM) card (for GSM networks) or Re-Useable Identification Module (RUIM) cards (for CDMA networks) (both referred to herein as "SIM" cards) or some other type of SIM-like device (all referred to herein as a "SIM card"). The system also uses an adapter 100 for each associated mobile device, also referred to as a signal reinforcer or reinforcer, in operative communications with the mobile phone (or other mobile device) in a manner to be later described.

The communications system may include a softswitch 90 and related equipment that communicates with the public telephone switched network (PTSN) and mobile networks, and via either networks, to a satellite network. The softswitch 90 enables an ongoing "call" to or from a mobile device to be switched from the satellite network to mobile network (and vice versa) without "dropping" the call. Advantageously, the softswitch 90 can operate over any public communications network without special agreements or arrangements. As such,

the selection of which network operator to use to interconnect with for outbound calls is very flexible.

Softswitch or Vertical Handover SoftSwitch Gateway (VHSG).

The purpose of the VHSG or Softswitch 90 is to enable in-progress calls to be seamlessly transferred from one communications network to another without dropping the call. In telecommunication terms this process is known as soft "Hand-Over" or "Hand-Off." The handover pertinent to this invention is from a mobile network to a satellite network, or vice versa. The conventional way for Public Mobile Operators (PMO) to interconnect together is via an SS7 inter-MSC link, however this link protocol does not support handover of live calls from one network to another. Aspects of the Softswitch are shown in block diagram in Figure D.

The ability of the Softswitch 90 to achieve handover lies in its ability to continually "anchor" or monitor all in-progress inbound and outbound calls to or from the mobile device through the Softswitch's processor or central controller. One of the benefits of the VHSG system is that while the subscriber is connected to the PMO's network, all calls are routed directly to the subscriber via the Softswitch 90 and not "tromboned" through a switch, that is, the call is multiplexed within the public mobile operator's network. This ensures the quality and latency of the call remains the same as normal. Note that the "anchoring" described is not the same as routing all calls through the Softswitch.

Set Up.

In order for the VHSG to control calls, a user or subscriber must first have a mobile device that is serviced by a PMO. Each subscriber is then able to register with the System that includes the VHSG. Once registered and set up, as described, calls to or from the mobile device will be directed (if the call is placed via the PMO network) or routed (if the call is placed via the satellite network) by the VHSG. To set up the subscriber with the VHSG, at least two SIM cards are used. One SIM card is located at the mobile device 40, another located at or in communication with the processor of the VHSG. 90 The subscriber user may have an additional optional identifier, used to enable the subscriber's mobile device to access the VHSG, preferably via a satellite network, and this is designated as their User Access Number (UAN), and can be, for instance, an IP address, a land phone number, or an third SIM card. The UAN appears to the PMO and PSTN as a valid destination or identifier for routing calls.

The subscriber's mobile device 40 has a PMO associated with the device, and a subscriber identifier (such as a cell telephone number) associated with that device (stored

on a SIM card or other similar device). A second identifier (such as a second cellular phone number) will be associated with the subscriber, preferably associated with the subscriber's PMO (but not necessarily), and stored on a device such as a SIM card. The SIM card located on the mobile 40 device will be denoted the "secondary SIM," while the SIM card located or associated with the VHSG 90 will be denoted the "primary SIM " (generally, the primary SIM will be associated with the user's original mobile phone number). The primary SIM subscriber identifier (e.g. mobile phone number) is designated as their User Gateway Number (UGN), while the secondary SIM has a second subscriber identifier and is designated the User Mobile Number (UMN). The primary and secondary SIM identifiers can be from any PMO, and will be "paired" together or associated in the system (e.g. system database). In practice, it is preferred that (1) the two SIM cards are related to each other in a database for call management purposes and (2) they are paired via a friends and family type payment plan so that there is a cost effective plan to cover the fact that two SIM cards will be active on the PMOs network instead of one.

In the discussion which follows, the secondary SIM will be located with the user's mobile phone 40, while the primary SIM will be stored and in communications with the Softswitch's 90 central processor. The primary SIMs of all subscribers to the service will be described as stored in a "SIM Bank," a facility that plugs each subscriber's primary SIM into a storage device that enables the banked SIM card to communicate with each subscriber's PMO (such as through a pico cell, a micro cell, femto cell, gnac or other such device. (e.g. the secondary SIM looks to the PMO as an "active mobile device" to which it can communicate via a cell tower)). The Softswitch central processor also is able to communicate with each SIM card, and the processor monitors communications and handshaking at and through the banked SIM cards. The SIM bank will generally be collocated with the softswitch, but this in not required. If UAN's are utilized, the VHSG can employ the UAN through an IP gateway (for IP addresses), or an exchange, such as a private branch exchange (PBX), for land line numbers.

Another additional identifier is also allocated or associated to the subscriber, the satellite identifier (e.g. a satellite phone number) and is designated as their User Satellite Number (USN).

Operation.

Once the subscriber is set up and registered with the communications system, the database associated with the Softswitch's processor will cross reference or associate all of a subscribers identifiers (primary and secondary SIM, satellite, USN and if applicable, UAN).

Additionally, the VHSG may have modems or other hardware/software to assist in proper communications to the PSTN, the mobile network or the internet, as needed, such as A/D converters, modems, codecs, reformatting algorithms, session initiation protocol servers (SIP) for Voiceover IP (VoIP) communications, etc. This communications equipment is generally referred to as a "Media Changer." In the discussion that follows, several different numbers and SIM cards are being used within the system, but these are completely transparent to the subscriber and a party calling that subscriber. The subscriber continues to make and receive calls using the subscriber identifier (the identifier associated with the primary SIM), as next described.

Inbound Calls (Figure A and Figure C).

In Figures B and C, a reference to a number in parenthesis, (such as (1), (3), (5)), reference a communications path shown in Figure A. For instance (2) is a communications path between the mobile device 40 and the Softswitch 90 (via the reinforcer 100 and satellite network SI (10,11)). When a call is the made to the subscriber's primary subscriber identifier, that call is routed, through the mobile network, to the primary SIM located at or in communication with the VHSG. The VHSG, monitoring calls at the primary SIM, is aware that a call is directed to the primary SIM, and will recognize this as a call from a third party to the primary SIM from the caller ID (that is, the caller ID does not indicate the calling party is identified with the secondary SIM or the USN) (step 1001). The Softswitch, detecting an inbound call, "answers" the call and then initiates two outbound calls (step 1002), each associated with the primary SIM – the first call is a conference call through the mobile network to the secondary SIM (i.e. to the UGN) leg Y (depicted as path 3 in Figure A), and the second call to the UGN, leg X (depicted as path 2 in Figure A), which preferably, is a call placed via the UAN. Alternatively, both calls may be a separate conference call, or each can be made as a leg of a single conference call through the primary SIM. The call to the USN (leg X) will be routed, over the PSTN to the satellite gateway 11 and thence over the satellite network, to the reinforcer 100 (later described) that is in communication with the mobile device 40. The reinforcer 40 allows the mobile device to operate or emulate as a satellite phone and manages satellite communications with the mobile device in conjunction with an applications program (an "app") on the mobile device. The reinforcer will notify the application program resident on the mobile device of an incoming satellite call from the softswitch (and may be identified by caller ID, (for instance, as identified as the UAN)). If the delays in establishing the calls are excessive, the Softswitch may optionally transmit a message to the third party (e.g. "attempting to reach

xxx-xxxx, or simply provide ring tone back to the third party) or place the third party on hold (step 1001A).

Generally, because the satellite network is slower in establishing a communications link, the first call to "reach" the subscriber's mobile device 40 will generally be the call directed over the mobile network to the UGN (unless the subscriber is not in good signal range of a cell tower). In any event, the subscriber answers one of the incoming calls. Because the call to the mobile device is "placed" by the VHSG via the primary SIM (or the UAN), the VHSG remains in the communications loop on the calls to the mobile device. While in the communications loop, the VHSG receives and/or provides handshaking information, such as that needed to establish and tear down a call. Hence, the VHSG is able to detect which outgoing call has been answered (the mobile call to the secondary SIM or the satellite call to the USN).

Once the subscriber "picks up" or answers one of the incoming calls at the mobile device, (step 1003X or 1003Y), the VHSG will either direct the call that was answered at the mobile device (1003X or 1003Y) to the third party caller, (if the call is answered via the secondary SIM card) (step 1005Y) or routes the answered call to the third party call (if the satellite call is answered) (step 1005X). The VHSG also drops or disconnects the non-answered call or the leg of the conference call that is not answered (step 1004X or 1004Y). However, as the softswitch 90 placed the call answered by the mobile device, the softswitch 90 remains a "participant" on the resulting call between the mobile device 40 and the third party 30, monitoring the call for handshaking or other pertinent call progress information.

Using conference calls via the primary SIM card also implies that the third party call is not being tromboned through the VHSG, instead, it is being multiplexed at the PMO.

Handing Over an Established On-going Call Between Networks (Figures A, B and C).

The mobile device 40 (and/or the reinforcer) will have an application software package (an "app") that monitors cellular signal strength of the mobile network or otherwise tracks expected signal strength. Based on the signal strength or expected signal strength, it may be desired to switch an ongoing call from one network to another. For instance, if a mobile call is in progress but cellular signal strength is failing, it may be desired to hand over the call to the satellite network. Conversely, if the ongoing call is over the satellite network, and mobile signal strength reaches a sufficient signal strength for a sufficient period of time, it may be desired to hand over the call to the mobile network. It is assumed that the subscriber will prefer to use the mobile network in lieu of the satellite network, primarily from a cost standpoint, but this can be an option that is user set.

"Hand over" between networks is established as follows, where the "active" network refers to the current network supporting the ongoing call, and the "passive" network refers to the network not currently supporting the ongoing call. In Figure C, the call would be transferred from leg Y to leg X, or vice versa.

The resident mobile application (app) determines that a change in signal strength has occurred and a hand over, from the active to the passive network, is desired (step 1006). Instead of, or as an backup to actively monitoring mobile signal strength, the mobile device may have stored thereon information correlating expected poor signal strength with geographic location (or vice versa - good signal strength versus geographic location). For instance, the app may be able to access a "map" of expected poor signal strength, and based upon the current location (or expected location based on trend info), determine that a transfer of networks is desirable. In any event, the app will trigger a call back the VHSG over the passive network (either via (4) or (5)), to the primary subscriber identifier (the primary SIM) (in one embodiment) or to the UAN (if UAN's are utilized). If the passive network is the mobile network (e.g. transfer is from leg X to leg Y), the call is placed via the secondary SIM to the VHSG as a mobile call (route (4); if the passive network is the satellite network (e.g. transfer is from leg Y to leg X), the call is place from the reinforcer to, for instance, the UAN (route(5)). The VHSG 90 will detect an incoming call to the primary SIM or the UAN, and will recognize that the incoming call is from the mobile device 40 or the reinforcer 100 (such as for instance, by using caller identification technology, referenced as "CLI" in the Figures). The VHSG 90, aware that a call to the user is already in progress via the primary SIM, will recognize this second call as a request to hand over or transfer the existing call between networks. The VHSG will then direct or bridge the incoming call from the secondary SIM or reinforcer, into the established ongoing call on the active network (step 1007). At this point, both networks are being utilized to support the call, and hence, both networks are "active." At a predetermined point, the VHSG will then disconnect or drop the leg of the conference call through the original "active" network, which now becomes the "passive" network (step 1008).

Alternatively, the app may send signals over the active network ongoing call (such as using data over voice) to be detected at the VHSG as a "request to hand over," in which event the VHSG may place a call back to the mobile device over the passive network, and let the resident app at the mobile device join both communications channels, and then disconnect the channel to the prior "active" network (not shown in the figures).

Before the VHSG undertakes to drop one of the calls, the reinforcer 100 and mobile app coordinate to hand over the call at the mobile device 40, between the mobile network (leg Y) and satellite network (leg X). For instance, suppose the primary network is the mobile network (leg Y, path (3)), and the satellite network (leg X) is passive. The resident app detects signal strength as failing (outside of set limits) or falling precipitously (trend of signal strength is downward quickly) (step 1009). The resident app on the mobile device 40 then communicates with the reinforcer 100 to establish an outgoing call over the satellite network (leg X path (5), for instance, an outgoing call to the UAN at the VHSG 90 (step 1009). When this outgoing call is "answered" (recognized via CLI) at the VHSG and routed to the currently established call (step 1010), the reinforcer 100 is notified by handshaking signals (such as a tone signal sent by the softswitch) or timing, that is used to reflect the status of the call. The reinforcer 100 notifies the application program resident on the mobile device 40 of the established satellite call, so that app may redirect the ongoing mobile call to the reinforcer 40, for satellite communications (the app may or may not directly move the call, but may wait to redirect based on further indications of signal strength). The redirection of the call at the mobile 40 from the mobile network (leg Y) to the satellite network (leg X), or the disconnection of the call over the mobile network, can be used by the softswitch 90 as an indicator that the mobile device has switched networks, and allow the VHSG to drop or disconnect the now non-used network call (e.g. the now passive network call) (step 1011).

In the example, at this point, the mobile device 40 is now in communication with the third party 30 over the previously passive network (i.e. leg X via the reinforcer and satellite network, to, for instance, the UAN). The call has successfully been handed over to the prior "passive" network (the satellite network) which is now the active network, while the prior active network (the mobile network), is now passive. This handoff is transparent to the subscriber.

Also shown in an optional procedure (which can be used on both the satellite leg or mobile leg) shown on the mobile leg. In this procedure, if the third party disconnects (e.g. the call is dropped, such as due to lack of cell signal to support the call, and not due to the third party hanging up, which would have handshaking associated with a call takedown), the softswitch can wait a predetermined time for the call to be reestablished, and if re-established, transfer the calls from the passive network to the active network, or if time expires, to tear down the remaining paths of the call.

Alternative Inbound Call Handling (Figures A and F).

In an alternative embodiment depicted in Figure F, an inbound call from a third party

to the UGN is received at the Softswitch. (step 3000). The softswitch initiates a satellite call to the mobile device (that is, the reinforcer) (step 3001). The reinforcer 100 initiates a session with the mobile app (step 3002 – shown as a SIP call via WIFI, as a non-limiting example). The mobile app on the mobile device recognizes that this is notice of a pending incoming call. The mobile app will test the cell signal strength, and based on this signal strength determine the communications network to initially employ for the call (step 3003). If signal strength is low (step 3003X), the mobile app allows the incoming call to be routed through to the mobile device (described as a handset in Figure E) (step 3005X). For instance, the mobile app may have the mobile provide notice to the user of an incoming call (e.g. ring the phone), and if the user answers, connect the call to the mobile via the reinforcer and mobile app.

If cell signal strength is high (step 3003Y), the mobile app can initiate a mobile communications call to the softswitch (step 3003Y). The softswitch detects the incoming call as coming from the mobile device (steps 3004 and 3005), and recognizes this call as a request to route the pending incoming call to the mobile network. The softswitch then bridges the incoming mobile call with the incoming third party call (step 3005Y) and drops the satellite leg of the incoming call. The remaining steps in Figure F are directed to transferring on ongoing call between networks (e.g. satellite – mobile) as s described above.

Outbound Calls (Figure A and Figure B).

For outbound calls from the, mobile device 40, the mobile app will initially determine over which network to place the initial call (again, depending on mobile network strength, or possibly on user preference). The resident mobile application program on the mobile device 40 can store the number dialed by the subscriber (the called number), and the app will initiate an outbound call to the VHSG via the UAN or the primary SIM, (depending on the embodiment), over the network selected by the app (step 2001).

The VHSG recognizes an incoming call to the primary SIM card or UAN as originating from the secondary SIM or the USN (for instance, via caller ID) (step 2002). The VHSG recognizes this call as a new outbound call, as there is not a currently active call to the primary SIM card or UAN from the secondary SIM or USN (if a current call was in place, such a new incoming call would function as an indicator to transfer networks) (step 2002). The VHSG 90 "answers" this call (step 2002), and the mobile app is made aware of the pickup by the VHSG 90 via handshaking signals, and the VHSG 90 waits to receive the dialed number from the mobile device (step 2003). The mobile app recognizes that the call has been "answered" and subsequently transmits the called number to the VHSG 90 over the

established call (such as sending IP packets, or frequency tones (e.g. DTMF tones)) (step 2004). The VHSG, upon receiving the dialed number via the secondary SIM, will initiate a conference call to the called number via the primary SIM or UAN (step 2004). If the dialed number was received, for instance, via the USN, the VHSG will initiate an outbound call via the primary SIM (step 2004X). Once the call is picked up by the dialed party, the VHSG bridges the call to the primary SIM card (or UAN) from the mobile device, with that to the dialed party placed by the VHSG (step 2005). The mobile application program may receive handshaking (for instance, forwarded by the reinforcer 100 as received through the active network, as appropriate) of the connection status in order for the mobile application program to make the call active on the mobile device 40. Alternatively, the call could be made active from the initial call, or after transmission of the designated number of the called party (not shown). In any event, at this point, a call is established with the called party, the mobile device (or mobile device via reinforcer) and the VHSG (step 2006). Transfer of a call between networks is handled similarly as in an incoming call, and is depicted in steps 2007 – 2010), and a second network switch depicted in steps 2011-2013.

The VHSG 90 processor anchors the call (remains on the conference call) and monitors the primary SIM (or UAN) for an incoming request to transfer to the passive network, as described above.

To facilitate communications over the various networks, the Softswitch will have suitable equipment and/or software, in communication with the processor, to allow communications via internet, mobile phone networks or PSTN, such as software to reformat incoming information into a form suitable to the outgoing transmission network (reformat, analog/digital converters, codecs schemes, a session initiated protocol server (SIP server) to format in IP packets, etc). This hardware/software is generally referred to as the reinforcer media changer, and the type of hardware and or software needed will depend on the particular satellite network, and the type of communication (e.g. voice, data, streaming media, packet switched, SMS, etc.).

The Reinforcer.

The reinforcer 100 is a hardware/software device that interfaces the satellite network and the mobile device, and includes a suitable antenna and radio transceiver, and may include a suitable satellite voice/data modem 34. Aspects of the reinforcer are shown in the block diagram of Figure E. An example, the signal reinforcer operatively communicates with a satellite network such as Globalstar's satellite network. To bi-directionally

communicate with the satellite network of this example, the voice/data modem of the signal reinforcer may be a Globalstar voice/data modem (model 1720 or 1700).

The reinforcer 100 includes an additional interface that allows the reinforcer to communicate bi-directionally with the mobile device (generally, with the resident app on the mobile device designed to interface the reinforcer) via the air interface 35. The air interface 30 for wireless communication, can utilize WiFi communications, SIP communications, Bluetooth, or other local wireless communication with the mobile device. In some mobile devices, such as a tablet, the reinforcer interface may be a wired interface, such as provided by a USB port or Ethernet port connector, with the associated Ethernet or USB hardware needed for communications also located in the reinforcer. For WiFi communications, the interface can be a session initiation protocol (SIP) server 38. A SIP server is preferred to enable a SIP client (the mobile phone app) to use a standard high quality / high speed PCMU session with the reinforcer. Without the SIP server situated within the reinforcer, poor voice quality may be present as heavy compression could be required to fit a SIP stream into the non-transparent 7.2k data async channel. The reinforcer 100, as a wireless communications device with the mobile device, provides functionality to the mobile device similar to that of a cellular phone tower. That is, the reinforcer creates an access point for wireless communication to the mobile device. The reinforcer, also contains the hardware/software to provide satellite communications, through the reinforcer, to the satellite network (not shown in Figure E).

By use of the reinforcer 100, the mobile device becomes an integrated mobile and satellite phone (note, for a prior integrated satellite/mobile phone, the reinforcer would not be needed, but an application would still be required on the mobile device to allow transfer between the mobile functionality and satellite functionality).

The reinforcer 100 also includes a processor (such as an ARM Core) 36 and associated memory which provides all of the needed routing tables and which assists in managing communications between the mobile device and satellite network. The processor 36 communicates with the interface 35. The reinforcer can include additional hardware and/or software to include integrated support for hosting one or more value added applications, such as SMS texting, email, internet web browsing, blue force tracking, or the like. The reinforcer 100 preferably includes a media changer 37 which is communicably connected to the satellite transceiver and or voice/data modem 34 and the processor 36. The reinforcer media changer 37 enables the reinforcer to format information for satellite

transmission, or receipt from satellite transmission, for communication with the mobile device.

When the user is ready to make an outgoing call (or initiate an internet session, for instance), the mobile device resident application program gathers the necessary information input by the user (e.g. phone number if a voice call) and transmits this information to the reinforcer 100. The reinforcer 100 then generates the required information and issues serial commands to cause the satellite modem to connect to the satellite network to establish the communications path through the satellite network.

When the call is connected, the reinforcer 100 relays handshaking information to the resident app (or creates its own signals) to notify the resident app of the connection and for handling of the call with the user interface on the mobile device, and then to transfer data (such as voice data) input to the mobile device (e.g. microphone) and converted by the mobile to a digital data stream (or it may use the A/D converter output of the digital device, if present), to the reinforcer 40 for transmission over the satellite network (and also to send received data from the satellite network back to the mobile device). The reinforcer media changer, in conjunction with the processor 36, may need to convert the data streams from one format to another for transmission through the various devices (e.g. reinforcer interface to/from mobile, satellite data to/from interface, etc.) such as by using a modem, A/D converter, etc.

When the call is terminated, the handshaking information to take down the call is communicated through the reinforcer 100 to allow the mobile app to communicate such to the mobile device 40 for closing the call. Similarly, for an incoming call, the handshaking information is received and transmitted (or new handshaking signals created by the processor) by the reinforcer to the mobile resident app. The mobile app then internally communicates with the mobile device to establish an incoming call for the user to answer (e.g. provide a ring signal). When answered, handshaking is transmitted from the mobile device, through the reinforcer, back to the satellite network to establish the call.

The Resident App.

The mobile device also need a resident application program to provide the needed functionally to (1) communicate with the reinforcer; and (2) communicate with the mobile device. The resident app is thus the intermediary on the mobile device to handle communications between the mobile device and reinforcer, just as the reinforcer is the intermediary to handle communications between the resident app and the satellite network.

As an example, when an outbound call is made from the mobile phone, the call is routed, via the WiFi link, to SIP Server on the reinforcer. Thereafter, the reinforcer's processor places an outbound call using the voice/data modem and routes the voice data via the media changer, using for instance, an analog interface. Conversely, when an inbound call is received by the voice/data modem, the reinforcer's processor receives the inbound call and initiates an outbound call to the SIP client of the mobile phone using its SIP server over the WiFi link.

As illustrated, the signal reinforcer 100 may be a standalone device that communicates with a mobile device, or alternatively, the reinforcer may be integrated into the hardware of the mobile device to provide satellite capability for an mobile device that lacks such capability to interface directly with a satellite communications satellite.

The signal reinforcer may include additional hardware or software features, such as security functionality to restrict non-authorized users from operating the device.

CLAIMS

1. A method of switching an active ongoing first electronic communication at a mobile device from a first network to a second network, where said first network is one of a mobile cellular communications network or a satellite communications network and said second network is the other of said mobile cellular communications network or a satellite communications network, using a switch device located remotely from said mobile device, and said switch device is configured to communicate with a mobile communications cellular network and a satellite communications network; said method comprising the steps of:

(1) receiving a notice from said mobile device at said switch device, said notice operating to indicate that a transfer is desired;

(2) said switch device initiating a second electronic communications directed to said mobile device, where said second electronic communication is configured to establish communications to said mobile device via said second network;

(3) said switch device moving said ongoing electronic communication through said first network to said second electronic communication established through said second network, where said switch device is in communication on said second electronic communication.

2. The method of claim 1 further including the step (4) termination said first electronic communication over said first network by said switch device.

3. The method of claim 1 where said mobile device further comprises a first SIM card and said switch device in in communication with said second SIM card, where said first and second SIM cards are associated at said switch device with said mobile device.

4. The method of claim 1 where said first mobile device comprises a mobile smart phone.

5. The method of claim 1 where said switch device comprises a computer processor and an associated memory device.

6. The method of claim 4 where said mobile device further includes a radio transceiver configured to operatively communicate with a mobile communications satellite transceiver, and a satellite transceiver configured to operatively communicate with a satellite communications network.

7. The method of claim 4 where said switch device further comprises a softswitch, said softswitch further comprising a computer processor and associated memory devices.

8. A method of transferring a switching an ongoing first electronic communication at a mobile device from a first network to a second network, where said first network is one of a mobile cellular communications network or a satellite communications network and said second network is the other of said mobile cellular communications network or a satellite communications network, and said mobile device comprises a mobile component configured to operatively communicate over said mobile cellular communications network and a satellite component configured to operatively communicate over said satellite communications network; said method comprising the steps of:

(1) determining at said mobile device the cellular signal strength of said mobile cellular communications network, and based on said cellular signal strength, determining to switch from said first network to said second network;

(2) sending a notice to a remotely located switch device, over said second network, said notice acting as a request to switch;

(3) receiving notice from said switch device that said ongoing communications is active on said second network;

(4) said mobile device transferring said ongoing communications from said mobile or satellite component associated with said first network, to the other of said mobile or satellite component associated with said second network.

9. The method of claim 8 wherein said mobile component comprises a radio transceiver configured to communicate with a mobile cellular communication network and said satellite component comprises a satellite transceiver configured to directly communicate with a satellite communications network.

10. The method of claim 8 wherein said mobile device further has an application program and a reinforcer, said reinforcer wirelessly communicating with said applications program, said reinforcer configured to receive/send data from said satellite transceiver to said applications program.

11. The method of claim 10 wherein said mobile device further has a user interface, said user interface operatively communicating with said applications program.

12. The method of claim 11 where said applications program is configured to transfer data received from said user interface to said reinforcer.

13. The method of claim 12 where said user interface comprises a microphone and speaker.

14. The method of claim 12 where said user interface comprises a keyboard.

15. The method of claim 14 where said keyboard is a virtual keyboard displayed on a smart phone.

16. The method of claim 11 where said applications program is adapted to transfer data routed to said radio transceiver, to said reinforcer.

17. The method of claim 10 where said reinforcer further comprises a SIP server.

18. A method of selecting at a mobile communications device, a network over which to receive an incoming first electronic communication from two networks, where said first network is one of a mobile cellular communications network or a satellite communications network and said second network is the other of said mobile cellular communications network or a satellite communications network, the method comprising the steps of:

(1) receiving at said mobile communications device a notice over said satellite communications system of a pending incoming call, said notice from a remotely located switch device, where said switch device is configured to communicate with a mobile communications cellular network and a satellite communications network;

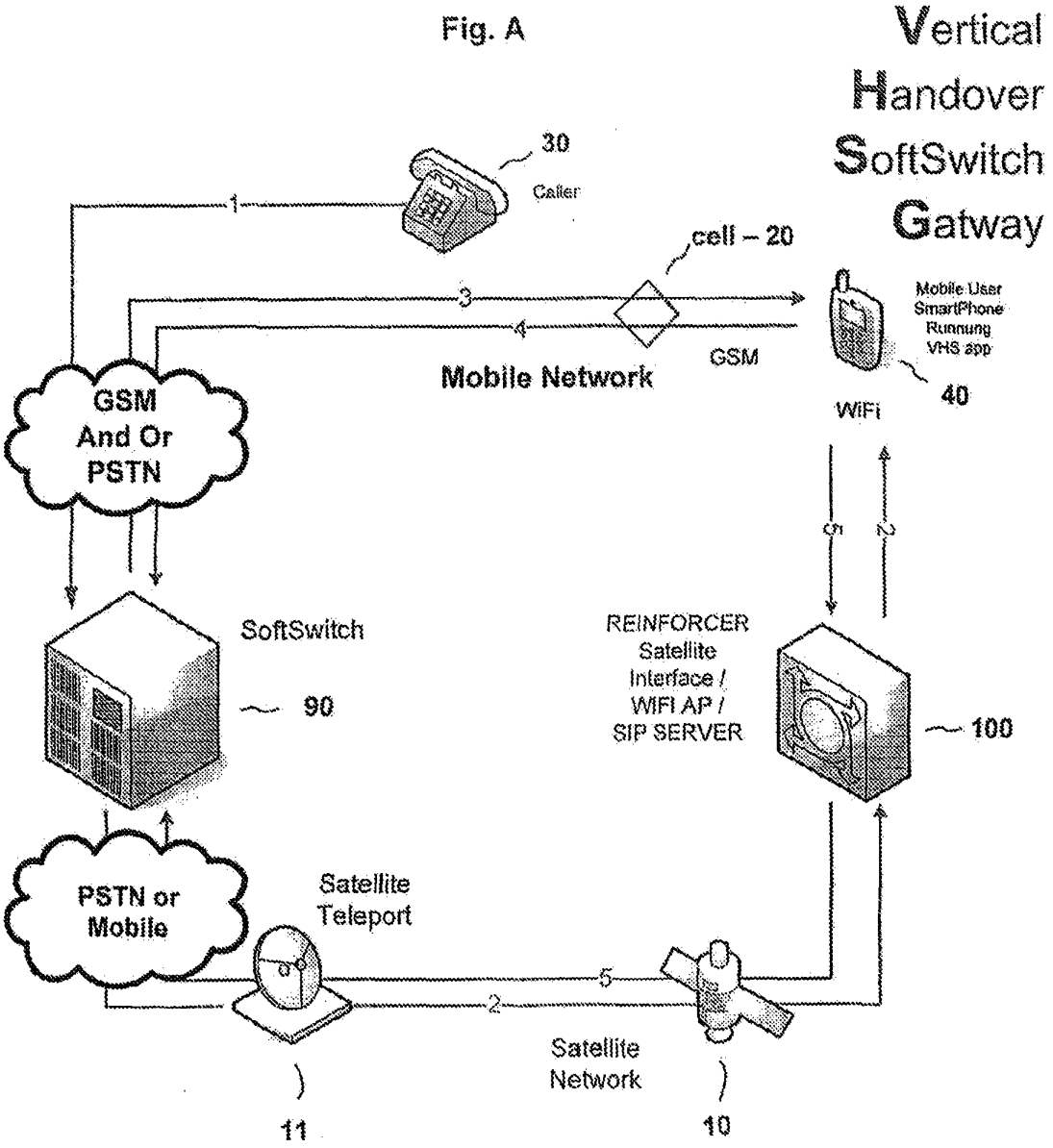
(2) receiving a notice from said mobile communications device over said satellite communications system of a pending incoming call over said satellite system;

(3) said mobile communications device determining if cellular signal strength is above or below a predetermined threshold limit;

(4) if said signal strength is above said threshold, routing said incoming call over said satellite network to said mobile communications device;

(5) if said signal strength is below said threshold, said mobile communications device sending a request to said remotely located switch to route said incoming call over said mobile communications device.

Fig. A


Vertical
Handover
SoftSwitch
Gatway
30
Caller
1
cell – 20
3
4
Mobile Network
GSM
Mobile User
SmartPhone
Running
VHS app
40
WiFi
GSM
And Or
PSTN
5
2
SoftSwitch
90
REINFORCER
Satellite
Interface /
WIFI AP /
SIP SERVER
100
PSTN or
Mobile
Satellite
Teleport
5
2
Satellite
Network
11
10

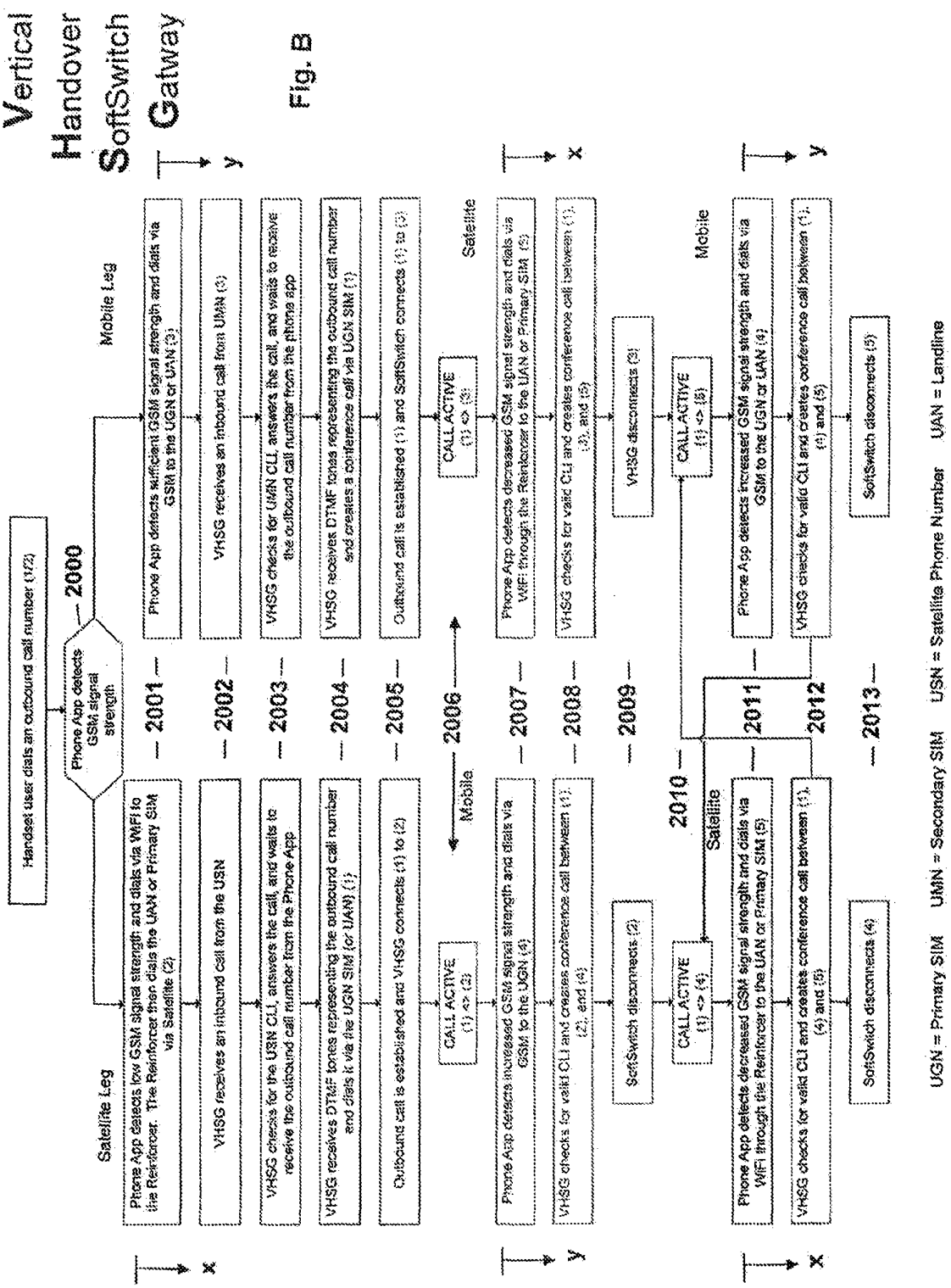

Vertical Handover SoftSwitch Gatway
Handset user dials an outbound call number (1/2)
Phone App detects GSM signal strength
2000
Satellite Leg
Mobile Leg
Phone App detects low GSM signal strength and dials via WiFi to the Reinforcer. The Reinforcer then dials the UAN or Primary SIM via Satellite (2)
Phone App detects sufficient GSM signal strength and dials via GSM to the UGN or UAN (3)
2001
VHSG receives an inbound call from the USN
VHSG receives an inbound call from UMN (3)
2002
VHSG checks for the USN CLI, answers the call, and waits to receive the outbound call number from the Phone App
VHSG checks for UMN CLI, answers the call, and waits to receive the outbound call number from the phone app
2003
VHSG receives DTMF tones representing the outbound call number and dials it via the UGN SIM (for UAN) (1)
VHSG receives DTMF tones representing the outbound call number and creates a conference call via UGN SIM (1)
2004
Outbound call is established and VHSG connects (1) to (2)
Outbound call is established (1) and SoftSwitch connects (1) to (3)
2005
CALL ACTIVE (1) <> (2)
CALL ACTIVE (1) <> (3)
2006
Mobile
Satellite
Phone App detects increased GSM signal strength and dials via GSM to the UGN (4)
Phone App detects decreased GSM signal strength and dials via WiFi through the Reinforcer to the UAN or Primary SIM (5)
2007
VHSG checks for valid CLI and creates conference call between (1), (2), and (4)
VHSG checks for valid CLI and creates conference call between (1), (3), and (5)
2008
SoftSwitch disconnects (2)
VHSG disconnects (3)
2009
CALL ACTIVE (1) <> (4)
CALL ACTIVE (1) <> (5)
2010
Satellite
Mobile
Phone App detects decreased GSM signal strength and dials via WiFi through the Reinforcer to the UAN or Primary SIM (5)
Phone App detects increased GSM signal strength and dials via GSM to the UGN or UAN (4)
2011
VHSG checks for valid CLI and creates conference call between (1), (4) and (5)
VHSG checks for valid CLI and creates conference call between (1), (4) and (5)
2012
SoftSwitch disconnects (4)
SoftSwitch disconnects (5)
2013
x
y
UGN = Primary SIM
UMN = Secondary SIM
USN = Satellite Phone Number
UAN = Landline

Fig. B

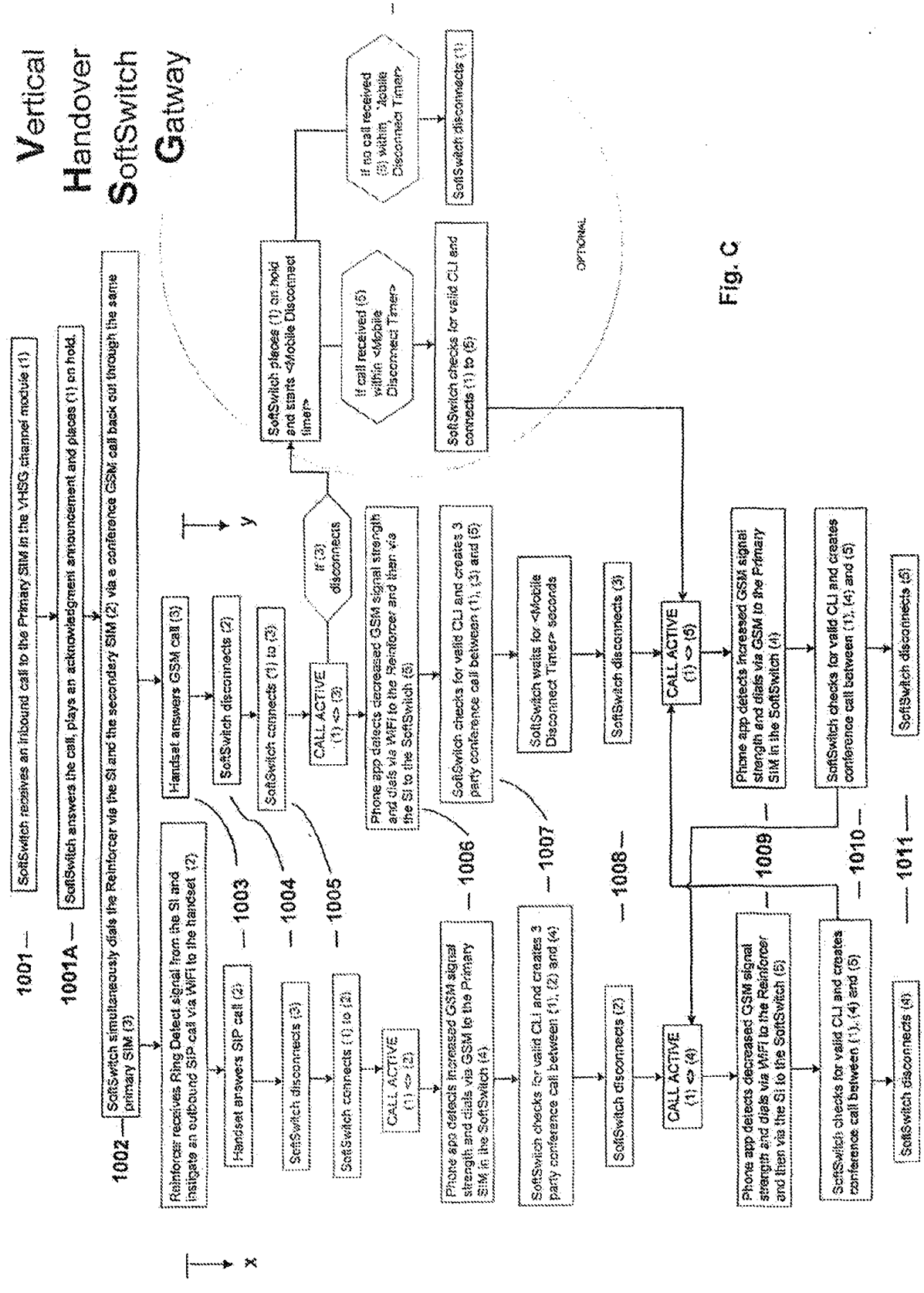

Vertical Handover SoftSwitch Gatway
1001
SoftSwitch receives an inbound call to the Primary SIM in the VHSG channel module (1)
1001A
SoftSwitch answers the call, plays an acknowledgment announcement and places (1) on hold.
1002
SoftSwitch simultaneously dials the Reinforcer via the SI and the secondary SIM (2) via a conference GSM call back out through the same primary SIM (3)
Reinforcer receives Ring Detect signal from the SI and instigate an outbound SIP call via WiFi to the handset (2)
Handset answers SIP call (2)
SoftSwitch disconnects (3)
SoftSwitch connects (1) to (2)
CALL ACTIVE (1) <> (2)
Phone app detects increased GSM signal strength and dials via GSM to the Primary SIM in the SoftSwitch (4)
SoftSwitch checks for valid CLI and creates 3 party conference call between (1), (2) and (4)
SoftSwitch disconnects (2)
CALL ACTIVE (1) <> (4)
Phone app detects decreased GSM signal strength and dials via WiFi to the Reinforcer and then via the SI to the SoftSwitch (5)
SoftSwitch checks for valid CLI and creates conference call between (1), (4) and (5)
SoftSwitch disconnects (4)
1003
Handset answers GSM call (3)
1004
SoftSwitch disconnects (2)
1005
SoftSwitch connects (1) to (3)
CALL ACTIVE (1) <> (3)
If (3) disconnects
1006
Phone app detects decreased GSM signal strength and dials via WiFi to the Reinforcer and then via the SI to the SoftSwitch (5)
1007
SoftSwitch checks for valid CLI and creates 3 party conference call between (1), (3) and (5)
1008
SoftSwitch disconnects (3)
CALL ACTIVE (1) <> (5)
1009
Phone app detects increased GSM signal strength and dials via GSM to the Primary SIM in the SoftSwitch (4)
1010
SoftSwitch checks for valid CLI and creates conference call between (1), (4) and (5)
1011
SoftSwitch disconnects (5)
SoftSwitch places (1) on hold and starts <Mobile Disconnect timer>
If call received (3) within <Mobile Disconnect Timer>
SoftSwitch checks for valid CLI and connects (1) to (5)
SoftSwitch waits for <Mobile Disconnect Timer> seconds
If no call received (3) within <Mobile Disconnect Timer>
SoftSwitch disconnects (1)
OPTIONAL
x
y

Fig. C

Fig. D

Vertical Handover SoftSwitch Components

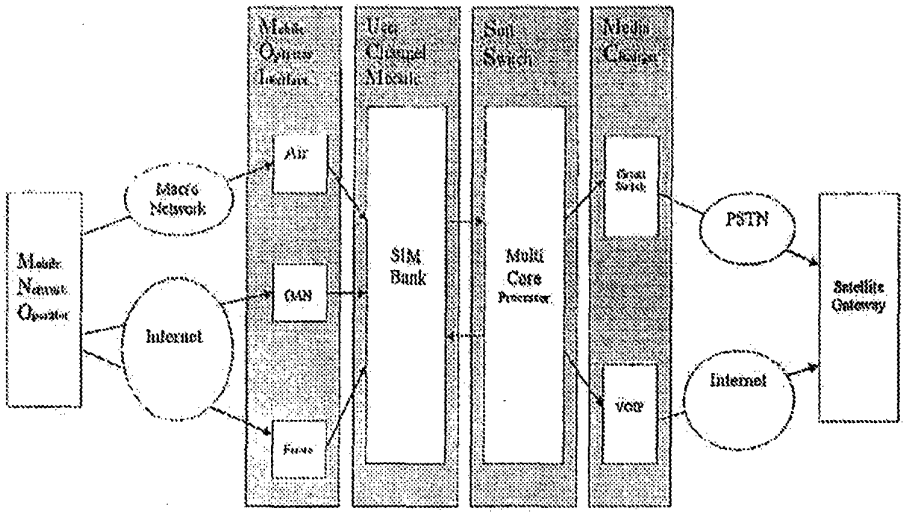
The VHSG is a combination of four separate sub-systems, they are: Mobile Operator Interface (MOI), Users Channel Module (UCM), SoftSwitch (SS) and the Media Changer (MC)

MOI
The MOI is to allow the UCM to connect directly to the MNO via one of three ways; UMA (GANC), Femotocell or Air-Interface. This enables the VHSG to have a direct connection with the MNO using standard user agreements and without needing any special roaming contracts.

UCM
The UCM consists of multiple channel modules which hold the user's Subscriber Identity Module (SIM) cards. Each subscriber is allocated a SIM card which holds their ported UGN.

SS
The SoftSwitch is a multi process which runs all the core functions

MC
The media changer is a combination of hardware and software which allow the SS to interface with different media such as PSTN, ISDN, and IP



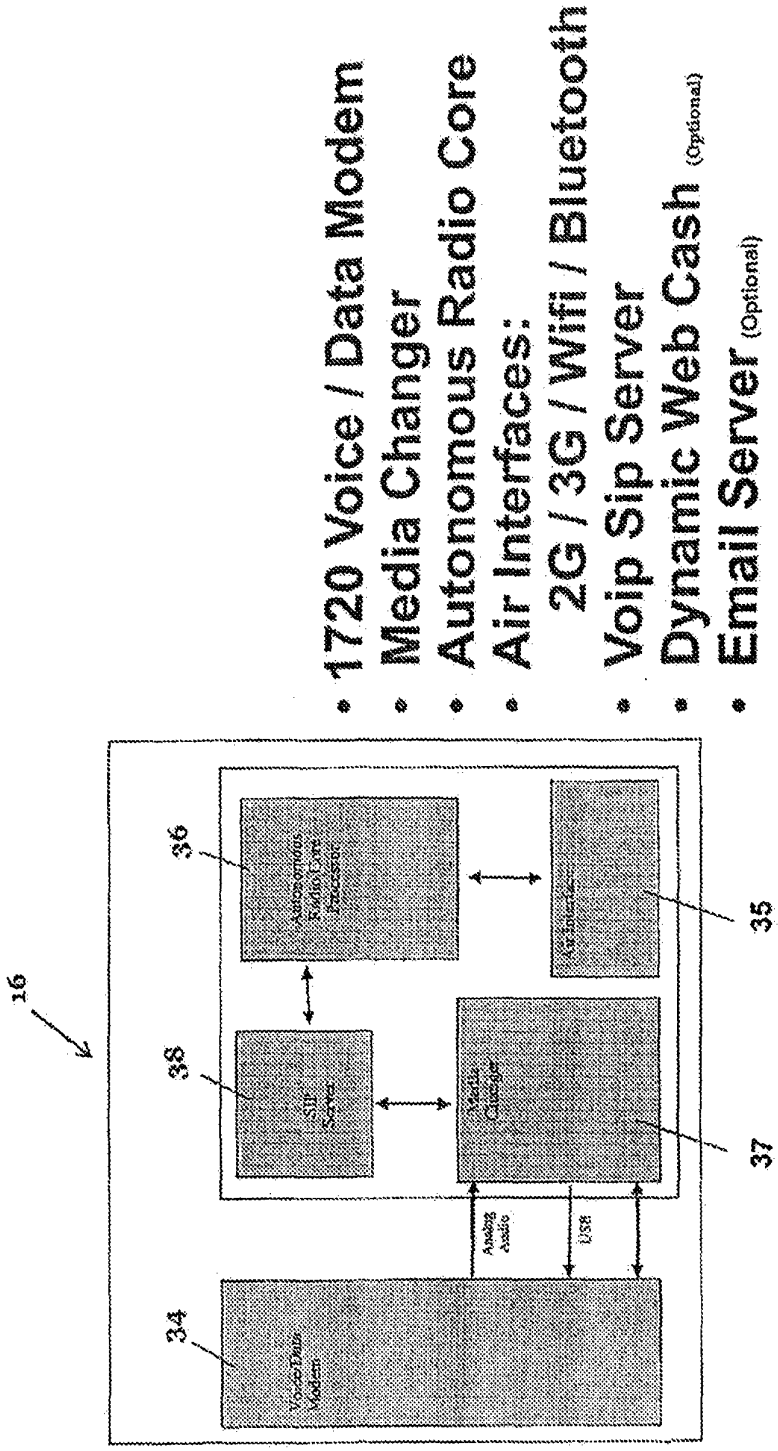

• 1720 Voice / Data Modem
• Media Changer
• Autonomous Radio Core
• Air Interfaces:
2G / 3G / Wifi / Bluetooth
• Voip Sip Server
• Dynamic Web Cash (Optional)
• Email Server (Optional)
16
34
36
38
35
37
Analog Audio
USB

Fig. E

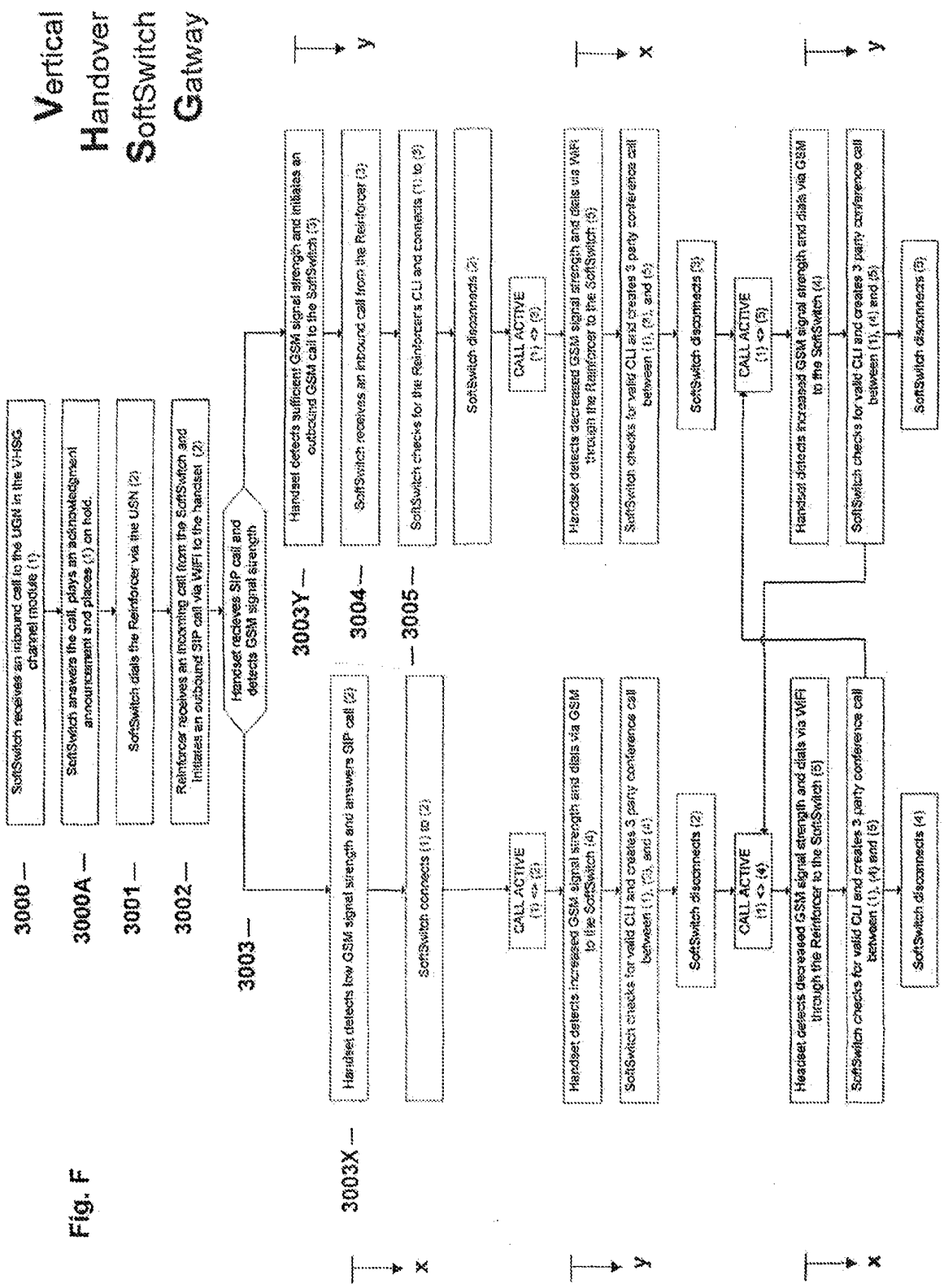

Vertical Handover SoftSwitch Gatway
3000
3000A
3001
3002
3003
3003X
3003Y
3004
3005
SoftSwitch receives an inbound call to the USM in the VHSG channel module (1)
SoftSwitch answers the call, plays an acknowledgment announcement and places (1) on hold.
SoftSwitch dials the Reinforcer via the USN (2)
Reinforcer receives an incoming call from the SoftSwitch and initiates an outbound SIP call via WiFi to the handset (2)
Handset receives SIP call and detects GSM signal strength
Handset detects low GSM signal strength and answers SIP call (2)
SoftSwitch connects (1) to (2)
CALL ACTIVE (1) <> (2)
Handset detects sufficient GSM signal strength and initiates an outbound GSM call to the SoftSwitch (3)
SoftSwitch receives an inbound call from the Reinforcer (3)
SoftSwitch checks for the Reinforcer's CLI and connects (1) to (3)
SoftSwitch disconnects (2)
CALL ACTIVE (1) <> (3)
Handset detects increased GSM signal strength and dials via GSM to the SoftSwitch (4)
SoftSwitch checks for valid CLI and creates 3 party conference call between (1), (3), and (4)
SoftSwitch disconnects (2)
CALL ACTIVE (1) <> (4)
Handset detects decreased GSM signal strength and dials via WiFi through the Reinforcer to the SoftSwitch (5)
SoftSwitch checks for valid CLI and creates 3 party conference call between (1), (4) and (5)
SoftSwitch disconnects (4)
Handset detects decreased GSM signal strength and dials via WiFi through the Reinforcer to the SoftSwitch (5)
SoftSwitch checks for valid CLI and creates 3 party conference call between (1), (3), and (5)
SoftSwitch disconnects (3)
CALL ACTIVE (1) <> (5)
Handset detects increased GSM signal strength and dials via GSM to the SoftSwitch (4)
SoftSwitch checks for valid CLI and creates 3 party conference call between (1), (4) and (5)
SoftSwitch disconnects (5)
x
y
x
y
y

Fig. F

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 13/31746

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - H04W 4/00 (2013.01)
USPC - 455/432.1
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
USPC: 455/432.1

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
USPC: 455/3.01, 12.1, 428, 432.1, 436 (keyword limited - see terms below)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
PatBase; GOOGLE; GoogleScholar; GooglePatents
Search Terms: communication, network, satellite, switch, hand-off, soft, mobile, wireless, cellular, cell phone, smart phone, transfer, virtual, transmit, send, receive, transceiver, radio, RF, notify, message, alert, notice, integrate

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2006/0171359 A1 (Schwarz) 03 August 2006 (03.08.2006), entire document, especially; abstract, para. [0004], [0006]-[0008], [0010]-[0013], [0018]-[0020], [0027], [0036]-[0039], [0042]-[0044], Claim 8	1 - 18
Y	US 2010/0265957 A1 (Foxworthy et al.) 21 October 2010 (21.10.2010), entire document, especially; abstract, para. [0026]-[0030], [0039], [0052], [0063]	1 - 18
X, P	US 2012/0149364 A1 (Leedom et al.) 14 June 2012 (14.06.2012), entire document	1 - 18
A	US 2010/0029273 A1 (Bennett et al.) 04 February 2010 (04.02.2010), entire document	1 - 18

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search
23 April 2013 (23.04.2013)

Date of mailing of the international search report
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Form PCT/ISA/210 (second sheet) (July 2009)

Claims

1. A method of roaming in a system comprising a mobile cellular enabled device that has an associated home base comprising a home registry, said mobile cellular device further comprising a short range non-cellular radio transceiver;

a satellite communications emulator that comprises an antenna, a transceiver for two way communications over a satellite communications network, said emulator further comprising a short range non-cellular radio transceiver for communication with a mobile cellular device, said emulator associated with a home gateway comprising a gateway registry;

a Backoffice comprising a processor and database, said Backoffice capable of communication with a satellite communications network and a public switched telephone network or a packet network;

the method comprising the steps of:

the Backoffice processor receiving a communication from said mobile cellular device requesting communication service through said satellite emulator;

said Backoffice associating said satellite emulator with said mobile cellular device in said Backoffice database;

said Backoffice sending notification to said cellular enabled mobile device home registry of the status of said mobile cellular device as a roaming device on said Backoffice.

2. The method of claim 2 further comprising the steps of said Backoffice requesting identification of a servicing satellite gateway of said emulator from said emulator home gateway registry.

3. The method of claim 2 wherein said Backoffice receives an identification of a servicing gateway from said home registry.

4. The method of claim 1 further comprising the steps of establishing an incoming call to said mobile cellular device.

5. The method of claim 4 wherein said steps of establishing an incoming call comprises the steps of said Backoffice receiving a first request for routing a communications to said mobile cellular device from said home base; and

said Backoffice sending a temporary routing number to said home base of said cellular enabled device.

6. The method of claim 4 further comprising the steps of said Backoffice assigning an IP address to said mobile device.

7. A method of forwarding calls to a cellular enabled device in a system comprising a cellular enabled device having a home base comprising a home registry, said cellular enabled device further comprising a short range non-cellular radio transceiver;

a satellite communications emulator that comprises an antenna, a transceiver for two way communications over a satellite communications network, said emulator further comprising a short range non-cellular radio transceiver for communication with a mobile cellular device;

a Backoffice comprising a processor and associated databases, said Backoffice in communications with a satellite communications network and a public switched telephone network or a packet network;

the method comprising the steps of:

the Backoffice processor receiving a communication from said cellular enabled device to communicate through said emulator;

said Backoffice determining a routing number for communications with said emulator over said satellite communications network;

said Backoffice sending a call forward request to said home network of said cellular enabled device, said call forwarding request including said routing number.

8. The method of claim 7 wherein said routing number is a satellite address associated with said emulator.

9. The method of claim 8 wherein said satellite address is an MSISDN or ISDN of said emulator.

10. The method of claim 8 wherein said satellite address is provided by said enulator to said Backoffice.

11. A method of establishing a cellular device terminating call over a satellite network using the cellular device phone number or ISDN in a system comprising a cellular enabled device that has an associated home base comprising a home registry, said cellular enabled device further having an associated telephone number or ISDN, said cellular enabled device further comprising a short range non-cellular radio transceiver;

a satellite communications emulator that comprises an antenna, a transceiver for two way communications to a satellite in a satellite communications network, said satellite communications emulator further comprising a short range non-cellular radio transceiver

for communication with said cellular enabled device, said emulator associated with a home satellite gateway comprising a gateway registry;

a Backoffice comprising a processor and database, said Backoffice in communication with a satellite communications network and a public switched telephone network or a packet network;

the method comprising the steps of receiving a request for a cellular device terminating call to said cellular enabled device, said request including either the cellular enabled device's MSISDN or the ISDN or an IP address of said cellular enabled device, but said request lacking satellite communications emulator address or identification information;

identifying said emulator associated with said cellular enabled device or identifying an address of said emulator associated with a satellite gateway serving said satellite communications emulator;

routing said cellular device terminating call through said servicing satellite gateway to said satellite to said satellite communications emulator;

said satellite communications emulator routing said cellular device terminating call to said cellular device over said non-cellular short range transceiver in said satellite communications emulator.

12. The method of claim 11 wherein said Backoffice performs the step of determining an address of said satellite communications emulator associated with a serving satellite gateway.

13. The method of claim 11 wherein said home registry of said cellular device performs the step of identifying a satellite communications emulator servicing said mobile cellular device.

14. The method of claim 13 wherein said home registry performs the step of identifying a satellite communications emulator by recovering a call forward address, said call forward address associated with said satellite communications emulator.

15. A system comprising mobile cellular enabled device that has an associated home base comprising a home registry, said mobile cellular device further comprising a short range non-cellular radio transceiver;

a satellite communications emulator that comprises an antenna, a transceiver for two way communications over a satellite communications network , said emulator further comprising a short range non-cellular radio transceiver for communication with a mobile

cellular device, said emulator associated with a home gateway comprising a gateway registry;

a Backoffice comprising a processor and database, said Backoffice capable of communication with a satellite communications network and a public switched telephone network or a packet network;

said Backoffice processor configured to: (1) associate said satellite emulator with said mobile cellular device in said Backoffice database and (2) to send notification to said cellular enabled mobile device home registry of the status of said mobile cellular device as a roaming device on said Backoffice when said Backoffice processor receives a communication from said mobile cellular device requesting communication service through said satellite emulator.