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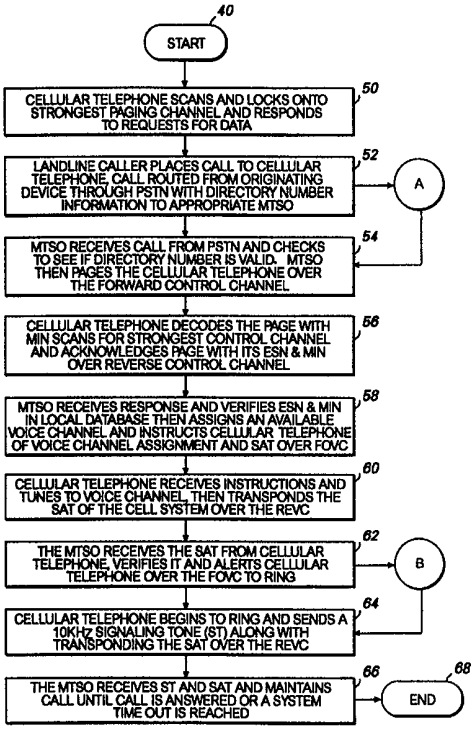
(54) Title: METHOD AND SYSTEM FOR TRANSMITTING INFORMATION TO A CELLULAR TELEPHONE

(57) Abstract

A method and system for transmitting information to a cellular telephone in a cellular telecommunications network. The information is transmitted to the cellular telephone in an analog data stream during the ringing phase of a cellular telephone call. The analog data stream transmits information such as calling line identification information or other short messages from the mobile telephone switching office to the cellular telephone before the user answers the call or after the ring signal that is transmitted to the cellular telephone to cause the cellular telephone to ring.



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METHOD AND SYSTEM FOR TRANSMITTING INFORMATION TO A CELLULAR TELEPHONE

Technical Field

The present invention relates generally to a cellular telecommunications network, and more specifically, relates to a method and system for transmitting information in an analog format to a cellular telephone before the user answers the associated incoming call.

Background of the Invention

In recent years, the use of wireless communication devices has greatly increased. Specifically, the use of cellular telephones has become commonplace such that many users, or subscribers, to cellular services use cellular telephones with regularity. One particular advantage of cellular telephones is that when installed in an automobile or otherwise away from the home or office, cellular telephones provide users with the freedom of travel without losing the ability to be constantly linked to a communications network.

In certain cellular telephone billing schemes, the called party pays for the call. Charges for the cellular call generally commence when the call is answered. Therefore, for billing purposes, it is advantageous for

the called party in a cellular telecommunications network to know the identity of the calling party prior to answering a call. It is advantageous for the called party to know who is calling to avoid unwanted charges for answering calls that the called party deems to be unimportant or unnecessary. Prior knowledge of the identity of the calling party before the call is answered allows the called party greater control over the expenses incurred in using a cellular telephone. Such control also increases the convenience and efficiency of using cellular telephones by allowing the user to differentiate between calls that the user deems to be important from other calls that are unimportant or are placed at an undesirable time.

The process by which the identity of the calling party is determined is known as calling line identification (CLI) or automatic number identification (ANI), as is well known to those skilled in the art. Automatic number identification capabilities currently exist for wireline telephones and are provided to the user as a "caller ID" service. Such "caller ID" service provides the called party with the telephone number of the telephone from which the call is placed, i.e., the originating device. Typically, the telephone number of the originating device is visually displayed to the called party on a separate unit that is connected to the called party's telephone.

The coverage area of a cellular telecommunications network including cellular telephones is divided into smaller coverage areas called "cells" using low power transmitters and coverage-restricted receivers. As is well known in the art, the limited coverage area enables the radio channels used in one cell to be reused in another cell. As a cellular telephone within one cell moves across the boundary of the cell into an adjacent cell, control circuitry associated with the cell detects that the signal

strength of the telephone in the adjacent cell is stronger and communications with the cellular telephone are "handed off" to the adjacent cell.

A cellular telecommunications network typically utilizes a pair of radio frequencies for each radio channel in each cell. Each cell typically includes at least one paging channel (also referred to as a control channel or signaling channel) and several voice channels. The paging channel receives requests for service from cellular telephones, pages the appropriate cellular telephones, and instructs the cellular telephones to tune to a predetermined voice channel to establish voice communications. The paging channel is responsible for receiving and transmitting data to control the actions of the cellular telephones within the coverage area of the cellular telecommunications network.

A cellular telephone communicates with other telephones and compatible electronic equipment through one or more mobile telephone switching offices (MTSOs) and a plurality of cell sites. The MTSO, also known as the "switch", establishes voice communications between a cellular telephone within the coverage area of the cellular telecommunications network and compatible equipment, whether within the cellular telecommunications network or connected to the wireline telephone network. As is familiar to those skilled in the art, the MTSO controls the cellular telephone as it passes through various cell sites under the control of the MTSO. Each cell site contains a transmitter and a receiver for communicating voice and data signals directly to and from the MTSO and the cellular telephone while the cellular telephone is within the transmission range of the cell site.

As is well known to those skilled in the art, a control channel is responsible for receiving and transmitting data to control the communication actions of the cellular telephone. A cellular telecommunications network control channel comprises two channels that are commonly described as a forward control channel (FOCC) and a reverse control channel (RECC). The forward control channel is generally used for digital communications initiated by the MTSO to the cellular telephone. The reverse control channel is generally used for digital communications initiated by the cellular telephone to the MTSO.

Certain digital data messages may be transmitted to the cellular telephone on the forward control channel as a FOCC command. For example, the telephone number of an originating device may be transmitted as a digital data message on the forward control channel and displayed to the user on a display associated with the cellular telephone. However, the forward control channel does not transmit, in either digital or analog format, any other calling line identification information such as the name of the calling party or other short alphanumeric messages to the cellular telephones.

Additional data messages could be transmitted in a digital format on the forward voice channel. However, approval by the Telecommunications Industry Association (TIA) and an appropriate standard would be required for implementation of additional digital data messages on the forward voice channel. Therefore, a need exists to transmit information regarding a communication to a cellular telephone before the user answers the call, and to transmit the information in a form other than a digital format on the FOCC or FOVC.

Summary of the Invention

The present invention provides a method and system for transmitting information to cellular telephones in a cellular telecommunications network. The information is transmitted to the cellular telephone in an analog data stream during the ringing phase of a cellular telephone call. The analog data stream transmits information such as calling line identification information or other short messages from the mobile telephone switching office to the cellular telephone before the user answers the call or after the ring signal that is transmitted to the cellular telephone to cause the cellular telephone to ring.

The present invention is implemented by receiving a call from an originating device to the cellular telephone, obtaining information from the originating device comprising the directory number and/or the name associated with the originating device, and establishing a connection for the call on an analog voice channel between the mobile telephone switching office and the cellular telephone. The connection being completed by the call being answered responsive to a ring signal transmitted to the cellular telephone operative to cause the cellular telephone to ring.

Information is then encoded by an encoder at the mobile telephone switching office and transmitted on the forward voice channel (FOVC) from the mobile telephone switching office to the cellular telephone in an analog data stream after the ring signal is sent by the mobile telephone switching office. The analog data stream includes a first data stream and a second data stream that each include the information. The analog data stream is received by the cellular telephone where the information contained in the first data stream and second (redundant) data

stream is decoded. The information is then displayed on a display associated with the cellular telephone.

Brief Description of the Drawings

Fig. 1 is a block diagram of an exemplary cellular telecommunications network in which the preferred embodiment of the present invention may be implemented.

Fig. 2 is a block diagram of the basic components of a cellular telephone in accordance with the preferred embodiment of the present invention.

Fig. 3 is a flow chart illustrating the preferred method of processing a call to a cellular telephone.

Fig. 4 is a flow chart illustrating the preferred method of determining calling line identification information and other data in connection with processing a call to a cellular telephone.

Fig. 5 is a flow chart illustrating the preferred method of transmitting calling line identification information and other data in connection with processing a call to a cellular telephone.

Fig. 6 illustrates representational analog data signals such as may be transmitted from the mobile telephone switching office to the cellular telephone in accordance with the preferred embodiment.

Detailed Description

Turning next to the drawing figures in which like numerals represent like parts, the preferred embodiment will now be described in detail.

Generally, the preferred embodiment provides an analog data stream during the ringing phase of a cellular telephone call. The analog data stream transmits information such as calling line identification information or other short messages from the MTSO to the cellular telephone before the user answers the call or before the cellular telephone begins to ring. Although the preferred embodiment is described herein with reference to a "cellular telephone", it should be understood that the preferred embodiment may be implemented by transmitting an analog data stream to a device other than a cellular telephone such as a computer, fax machine, pager, or any other compatible device that receives and processes signals transmitted from the MTSO. Furthermore, although the preferred embodiment is described herein with reference to a "called party" and a "calling party", it should be understood that the terms "called party" and "calling party" need not refer only to human operators of telecommunications devices or equipment. It will be appreciated by those skilled in the art that the called party and the calling party may be devices or equipment, capable of operating without a human operator, that are connected to a cellular telecommunications network and that transmit and receive signals in accordance with the preferred embodiment described herein.

Fig. 1 is a block diagram of a typical cellular telecommunications network in which the preferred embodiment of the present invention may be implemented. The network is preferably an Advanced Mobile Telephone Service (AMPS) cellular telecommunications network, generally shown at 10. The present invention also is compatible with alternative cellular telecommunications systems.

The illustrated cellular telephone network 10 includes a mobile telephone switching office (MTSO) 11 that makes voice connections between a cellular telephone 20 in the network 10 and an originating device 16, typically a telephone, connected to a public switched telephone network (PSTN) 12, or other cellular telephone (not shown) within the network 10 or other network (not illustrated) through the PSTN 12. Reference herein is made to a singular mobile telephone switching office in the description of the preferred method and system. It will be appreciated that the method and system described may be carried out and implemented at other mobile telephone switching offices in the same cellular telecommunications network, and in other networks.

The MTSO 11, which may also be referred to as the "cellular switching office" or, more succinctly, the "switch", is connected via wired land lines to the public switched telephone network 12. The MTSO 11 includes equipment for controlling the processing of cellular calls made to and from the various cellular telephones operating within the coverage area of the MTSO 11.

A cellular telephone communicates with other telephones and compatible electronic equipment through one or more MTSOs and a plurality of cell sites, shown in Fig. 1 as reference numerals 14a-14n. As is familiar to those skilled in the art, the MTSO controls the cellular telephone as it passes through various cell sites under the control of the MTSO. Each cell site contains a transmitter and a receiver for communicating voice and data signals directly to and from the MTSO and the mobile unit 20 while the cellular telephone is within the cell site's transmission range. The connection between each cell site and the MTSO may be hard-wired, but is more typically a wireless connection.

The MTSO controls a number of cell sites and therefore has a geographic range for tracking and monitoring cellular telephones. As long as the cellular telephone 20 remains within range of the MTSO 11, the MTSO handles all calls to the cellular telephone. When the cellular telephone is located outside the range of the MTSO 11, another MTSO (not shown), having control over another number of cell sites, controls communications with the cellular telephone. For the sake of simplicity, the cellular telecommunications network shown in Fig. 1 includes only a single MTSO. It should be understood that although the preferred embodiment is described with reference to the operating environment shown in Fig. 1, the present invention is operative in a cellular telephone network that includes multiple MTSOs.

Fig. 2 illustrates a block diagram identifying the basic components of an AMPS cellular telephone for use in accordance with the preferred embodiment of the present invention. The cellular telephone, generally shown at 20, includes a microphone 22, into which the user speaks. A modulator 24 receives audio signals from the microphone 22, modulates the audio signals, and provides the modulated audio signals to a cellular transmitter 26. The cellular transmitter 26 then provides the modulated audio signals to the antenna 28 for transmission to the cell site.

The cellular telephone 20 also may receive signals transmitted from the cell site via antenna 28. The received signals are detected by a cellular receiver 30 and then demodulated by a demodulator 32. The demodulated signals are passed to an amplifier 34 and then to an ear piece 36 that includes a speaker to translate the amplified, demodulated signals into audible sound.

The cellular telephone 20 includes a keypad 38 that allows the user to dial any desired telephone directory number. The cellular telephone 20 includes a display 40 that visually displays the dialed number to the user for verification. The display 40 is typically a liquid crystal display (LCD), as is well known in the art.

The cellular telephone 20 also includes a controller 42 for controlling the respective operations of the transmitter, receiver, keypad, and display. The controller 42 is preferably a microprocessor-based control system that can be programmed to conduct control operations in a manner well known in the art.

In accordance with the preferred embodiment of the present invention, the cellular telephone 20 includes a decoder 44 which is electrically connected to the demodulator 32 and which is controlled by the controller 42. The decoder 44 receives demodulated signals from the demodulator after the demodulator processes signals transmitted to the cellular telephone from the cell site. The decoder 44 is operative to decode data messages, which are described further below, that are included in the signals received from the cell site. The decoder then delivers the decoded data messages to the controller 42, which, in turn, provides the data messages to the display 40 to be visually displayed to the user. As will be described more fully below, the data messages may include calling line identification information such as the telephone number and name of the calling party. The data messages may also include other short alphanumeric messages.

The decoder 44 of the preferred embodiment of the present invention preferably may be included in an integrated circuit computer chip in existing AMPS cellular telephones. For cellular telephones that

include the decoder chip, software should be included in the controller to activate and control the decoder to decode the data messages. Thus, the present invention can be inexpensively and easily implemented and used in connection with existing cellular systems.

Fig. 3 is a flow chart illustrating the preferred method of processing a call to a cellular telephone. The flow chart describes the preferred operations that occur in the MTSO and cellular telephone when a call is placed from a telephone connected by wired land lines to the PSTN to a cellular telephone in the cellular telecommunications network. It should be understood that the method is not limited to a call placed to a cellular telephone only from a wireline telephone, and the present invention may be implemented when a call is made to or from a cellular telephone within the cellular telecommunications network.

With reference to Fig. 3, it should be understood that the additional operations designated by steps A (Fig. 4) and B (Fig. 5) occur only during implementation of the preferred embodiment. Therefore, steps 50 through 66 (Fig. 3) should be understood to generally occur during a call to a cellular telephone in which the present invention is not implemented. The steps of the present invention are further described in Figs. 4 and 5.

With reference to the following description, it should also be understood that signals are transmitted from the MTSO for ultimate reception by the cellular telephone. Similarly, the cellular telephone transmits signals with the MTSO as the ultimate destination. It should be understood that these transmissions occur through a cell site, and that the MTSO and cellular telephone do not transmit signals directly to each other. The protocol that governs the signals transmitted during the setup of a

cellular telephone call is the BELLCORE standard, well known to those skilled in the art. For example, the LSSGR: Voiceband Data Transmission Interface Section 6.6, GR-30-Core, FR-NWT-000064, Issue 1, December 1994; LSSGR LATA Switching Systems Generic Requirements, CLASS^{SM} Feature: Calling Number Delivery, FSD 01-02-1051, Issue 4, December 1992; and the LSSGR LATA Switching Systems Generic Requirements CLASS^{SM} Feature: Calling Name Delivery Generic Requirements, FSD 01-02-1070, Issue 1, December 1991 are several of the design specifications that are relevant to the present invention.

When a call is placed to a cellular telephone, the call is routed from the device from which the place is placed, i.e., the originating device or the network that services the originating the device, through the public switched telephone network 12 until the call reaches the appropriate mobile telephone switching office 11 to handle the call. The call then is routed to the called cellular telephone as described generally in accordance with the preferred embodiment illustrated in Fig. 5.

Referring to Fig. 3, the processing of a call pursuant to the preferred method begins at start step 48. Initially, in providing for a call to a cellular telephone, each cell site continuously sends out data on its forward control channel (paging channel) to be received by a cellular telephone. As the cellular telephone scans and receives the signals sent from the cell sites, it locks onto the strongest signal in a manner well known to those skilled in the art, as seen at step 50. After locking onto the paging channel having the strongest signal, the cellular telephone will remain locked onto that frequency until the cellular telephone receives instructions to switch to another paging channel. Once the cellular

telephone has locked on, the cellular telephone responds back to the cell site requesting for data and waits.

When a landline caller places a call to a cellular telephone, the call is routed from the originating device through the public switched telephone network (PSTN) to the appropriate MTSO, as shown at step 52. The caller hears a ringing signal while the call is being processed. At step 54, the call is received at the MTSO and initial call processing is begun wherein the directory number of the cellular telephone is matched to a separate identification number that corresponds to the cellular telephone and that is stored in a local database at the MTSO. Once the directory number is matched (and the cellular telephone is not on a call), the identification number is then transmitted on the forward control channel (FOCC) from the MTSO to all of the cell sites together with instructions to transmit the identification number on all of the paging channels of the cell sites.

The cellular telephone, if it is located within the geographic range of a cell site served by the MTSO, recognizes its identification number on the paging channel. Consequently, at step 56, the cellular telephone decodes the page with its mobile identification number (MIN) and scans for the strongest control channel. The cellular telephone then acknowledges the page over the reverse control channel RECC with its electronic serial number (ESN) and MIN.

Still referring to Fig. 3, at step 58, the MTSO receives aresponse from the cellular telephone and verifies the ESN and MIN numbers with its local database. If the ESN and MIN numbers are valid, then the MTSO assigns an available voice channel and an associated supervisory audio tone (SAT) corresponding to a cell system and instructs

the cellular telephone of the voice channel and SAT assignments. Voice channels are used for circuit switched analog connections, including both voice and data analog signals. There are over 300 available voice channels. The cell site then formats the voice channel designation and transmits such designation and SAT to the cellular telephone on the assigned voice channel. In continuing, at step 60, the cellular receiver in the cellular telephone receives the instructions and tunes to the voice channel that was assigned by the MTSO. The cellular transmitter in the cellular telephone, as an acknowledgment signal, then transponds the SAT of the cell system (the system being made up of cells 1 - n) over the reverse voice channel (REVC).

Next, at step 62, if the MTSO receives the correct SAT from the cellular telephone, the MTSO then alerts the cellular telephone over the forward voice channel (FOVC) to ring. The MTSO provides this alert by transmitting a ring signal to the cellular telephone. This ring signal provides notice to the cellular telephone that it is being called. In providing the ring signal to the cellular telephone, the MTSO generates a data stream including a digital FOVC command, i.e., a ring signal, to be transmitted on the forward voice channel to the cellular telephone. Other digital FOVC commands may be transmitted that include commands to change voice channels, to hang-up, to return to scanning the paging channels, and to change power levels.

Upon receiving the digital FOVC ring signal command, the cellular telephone, at step 64, generates an audible ringing to alert the user that the cellular telephone is being called. In addition, the cellular telephone begins to send a 10KHz signaling tone (ST) in conjunction with continuing to transpond with the SAT over the reverse voice channel

(REVC). At step 66, the MTSO through the cell nearest the cellular telephone receives the ST and SAT and maintains the call: (1) until the call is answered by the user such as by pushing the send button on the cellular telephone; or (2) until a system time out is reached such as on an unanswered call. If the user answers the call, the cell site acknowledges this fact to the MTSO, which then connects the call to the cellular telephone. At this point, the billing of the call generally commences for the user who is then responsible for all charges associated with the call, and the method ends at step 68.

Referring now to Fig. 4, the preferred method of the present invention causes the operations of steps 70 and 72 to occur between steps 52 and 54 described in Fig. 3. As described above with reference to steps 50 and 52 of Fig. 3, the cellular telephone scans and locks onto the strongest paging channel. The cellular telephone remains locked onto the frequency of the paging channel until the cellular telephone receives instructions to switch to another paging channel. When a call is placed to a cellular telephone, the call is routed from the originating device through the public switched telephone network until the call is routed to the appropriate MTSO. At the MTSO, the directory number of the called unit is matched to a separate identification number corresponding to the called unit.

In Fig. 4, at step 70, the MTSO determines the directory number of the originating device. In this manner, the MTSO obtains identification information relating to the device from which the call originated. In a manner well known to those skilled in the art, identifying information such as an "equipment number" associated with the originating device is provided to the MTSO from the PSTN when a call is placed from

an originating device. For example, the directory number, i.e., the calling line identification number, of the originating device is one type of information that may be determined from such identifying information provided to the MTSO from PSTN calls through a CLASS^{SM} feature of delivery that is well known to one skilled in the art and is described in detail in BELLCORE Generic Requirement TR-NWT-000031 entitled "LSSGR LATA Switching Systems Generic Requirements, CLASS^{SM} Feature: Calling Number Delivery," FSD 01-02-1051, Issue 4, December 1992.

For the purposes of this description, another type of information that may be determined from such identification information is the name of the user of the originating device, i.e., the calling name. The calling name information is also provided to the MTSO from the PSTN when a call is placed from an originating device through a CLASS^{SM} feature of delivery that is well known to one skilled in the art. The delivery of the calling name information is described in detail in BELLCORE Generic Requirement TR-NWT-001188 entitled "LSSGR LATA Switching Systems Generic Requirements CLASS^{SM} Feature: Calling Name Delivery Generic Requirements," FSD 01-02-1070, Issue 1, December 1991. The calling party should be understood to be the person in whose name the telephone service to the originating device is being provided for.

At step 72, the MTSO may receive other data transmitted from the originating device. Such other information is optional, and may include paging, short messages, or any other data that the calling party may wish to transmit to the called party.

Therefore, to summarize, when the calling party dials the directory number of the cellular telephone, the MTSO determines identifying information regarding the calling party including, at a minimum, the calling line identification number.

With reference to Fig. 5, the preferred method of the present invention causes the operations of steps 80, 82, and 84 to occur between steps 62 and 64 described in Fig. 3. As discussed above with reference to Fig. 3, the cellular receiver in the cellular telephone tunes to the assigned voice channel and the cellular transmitter in the cellular telephone transponds a SAT signal to the cell system over the reverse voice channel to acknowledge receipt of the assignment instructions, at step 60.

At step 62, the MTSO generates a data stream including a digital FOVC command signal to be transmitted on the analog voice channel to the cellular telephone to cause the cellular telephone to ring. Although digital FOVC command signals are transmitted on the analog voice channel for performing functions such as ringing the cellular telephone, the analog voice channel can be used to transmit calling line identification information or other data using an analog signaling scheme. The present invention preferably operates to transmit an analog data stream including calling line identification information after a digital FOVC command signal on the analog voice channel before the user answers the incoming call. In an embodiment of the present invention, an analog data stream is transmitted on the analog voice channel after the digital FOVC ring signal command.

Synchronization of the analog information signal to the cellular system is not explicitly required. It is preferable, however, that synchronization be triggered after the MTSO through the nearest cellalerts

the cellular telephone to ring over the forward voice channel (FOVC). To ensure that an uninterrupted analog signal is transmitted by the MTSO through the nearest cell and that the cellular telephone is ready to receive the message stream, it is preferable that the analog data stream commence after the MTSO, through the nearest cell, receives and detects the signaling tone (ST) sent from the cellular telephone as is described in connection with steps 64 and 66 of Fig. 3.

Referring again to the method of the preferred embodiment of the present invention in Fig. 5, after the MTSO transmits a digital ring signal (a digital FOVC command) to the cellular telephone, the MTSO then transmits an analog data stream including the calling line identification number as well as any other information, at step 80. A further description of the construction of the transmission of this analog data stream is described with reference to Fig. 6.

At step 82, upon receiving the transmission of the calling line identification number, the called cellular telephone decodes the transmission to identify the calling line identification number. The decoder, identified at 44 in Fig. 2, receives and decodes the analog data stream to obtain the information contained therein in a manner well known to those skilled in the art. In addition to calling line identification information, other information such as short messaging or paging information may be transmitted in the analog data stream and detected at step 82. At step 84, the cellular telephone displays the calling line identification number and any other information on the display of the cellular telephone.

Therefore, it should be understood that in the preferred embodiment, the calling line identification number is transmitted as an

analog data stream after a digital ring signal is transmitted as a digital FOVC command signal by the MTSO on the voice channel. After the analog data stream is decoded, the calling line identification number may be displayed on the display of the cellular telephone between rings, thus allowing the user of the called cellular telephone to determine whether the call is one which the user wishes to answer. One of the obvious benefits of the display of data prior to the user answering the call is that no billing charges will commence until the call is answered. The present invention allows the calling line identification number to be transmitted and allows the user to make a decision regarding the importance of the call prior to incurring charges for the call. Such a scheme allows cost-sensitive users to reduce the charges incurred from unwanted or unimportant calls. In addition, the present invention allows for the determination of the number of calls and the time that the calls were received when the cellular telephone is unattended or when the calls are unanswered. From this collected calling line identification information, the unanswered calls could be readily returned by the user by displaying the calling line identification information and pressing the send button on the cellular telephone. Further, the number and name of the calling party could be readily saved in a customized dialing directory in memory that is associted with the cellular telephone, for example, a speed dial directory.

Fig. 6 illustrates a representational analog data stream such as may be transmitted from the mobile telephone switching office to the cellular telephone in accordance with the preferred embodiment. As seen generally at 100, ring signal 101 is transmitted on the forward voice channel (FOVC) at a predetermined time. After the ring signal 101 is

transmitted from the MTSO, the analog data stream 110 is transmitted on the forward voice channel (FOVC).

An analog data stream such as may be transmitted after the ring signal 101 in accordance with the preferred embodiment of the present invention is seen generally at 110. It should be understood that the analog data stream 110 shown in Fig. 6 is not drawn to scale and therefore, the duration of each portion of the analog data stream should not be assumed to be defined solely by reference to Fig. 6.

The analog data stream 110 includes a short preamble 112 followed by a sync word 114. The preamble 112 is used by the decoder in the cellular telephone to lock on to the incoming data stream, as is well known in the art. Also well known in the art, the sync word 114 allows the decoder to synchronize with the incoming analog data stream. The sync word 114 is followed by first data stream 116 that includes the calling line identification information and/or other data such as short messaging or paging information. The first data stream 116 is delivered to the decoder in the cellular telephone for decoding. Preferably, the preamble 112, sync word 114, and first data stream 116 total approximately 450 milliseconds (ms) in duration. The analog data stream 110 of the present invention is preferably transmitted at a rate of 1.2 kilobits per second (kb/s).

In continuing with the analog data stream 110 description, immediately following the first data stream 116 are checksum and error correction bits 118. The checksum and error correction bits 118 allow the cellular telephone to determine whether an error has occurred in the transmission of the first data stream 116. After the checksum and error correction bits 118, a second sync word 119 follows so to allow the decoder to once again synchronize with another incoming analog data

stream that is to follow. A second data stream 120, which preferably includes the identical information as the first data stream 116, is then transmitted after the second sync word 119. Both the first and second data streams 116 and 120, respectively, are preferably approximately 200 ms in duration.

The redundant transmission of the first and second data streams 116 and 120 is provided to increase the probability that a completed and uninterrupted data transmission is accurately received and successfully decoded by the cellular telephone. Checksum and error correction bits 122 follow the transmission of the second data stream 120. The decoder in the cellular telephone ignores incomplete or duplicate data from the redundant first and second data stream transmissions. The end of the analog data stream 110 is shown at 124.

It should be understood that the first and second data stream 116 and 120 preferably include identical information. However, in another embodiment of the present invention, each data stream may include different or unique information.

The present invention operates with existing cellular signal protocols. Therefore, only minimal changes are required for implementation of the present invention, both at the MTSO and in cellular telephones. The only additional functions required in the cellular telephones are those functions that are performed by the decoder. Similarly, the only additional functionality required at the MTSO is that of an encoder (not shown), to properly encode the data to be transmitted. The encoding of data is performed at the appropriate time to allow the MTSO to properly generate and transmit the analog data stream to the cellular telephone after a ring signal. For the encoder and decoders used in the

present invention, standard encoders and decoders commonly known and used in the industry are suitable for use in the present invention. However, for example, in one embodiment of the present invention, manufactured by EXAR Integrated Systems, Inc., Sunnyvale, CA, an EXAR XR-2211 FSK Demodulator is used to provide the decoder functionality and an EXAR XR-2206 Monolithic Function Generator, implemented for sinusoidal Frequency shift keying (FSK) signal operation, is utilized to provide the encoder functionality.

As referenced above, the preferred embodiment of the present invention utilizes the Bellcore standard that is required to be used for the governing of wired, land line calling line identification signals. The preferred embodiment of the present invention also utilizes the Bell type 202 modem format for the transmission of analog signals. The 202 modem format is well suited for analog cellular telephone operations because of its short synchronization period, fast data transmission, and low cost circuitry.

The 202 modem format uses frequency shift keying (FSK) which provides for a synchronization period in milliseconds. Synchronization is the ability of the receiver of analog transmissions to synchronize its signaling and data reception with the transmitter. Fast synchronization and high data rates are preferred for use with the present invention primarily because the analog data stream 110 must be transmitted entirely within a short interval, such as after the digital FOVC ring command 101.

It is advantageous to transmit calling line identification information after the digital ring signal as an analog data stream rather than a digital data stream. If such information is transmitted as a digital data stream between digital FOVC commands, another decoder would be

required in the cellular telephone to decode the calling line identification information. Additionally, transmission of calling line identification information as a digital data stream would require the approval of the Telecommunications Industry Association (TIA) and would require that an industry standard be written to define such a digital data stream. By using an analog data stream, no such standard is required, although it is desired that a standard be adopted as well by the industry for such an analog scheme.

From the foregoing it will be appreciated that the disclosed embodiments of the present invention overcome the drawbacks of the prior art described hereinabove and accomplish the previously stated objects of the present invention. From the description of the alternate preferred embodiments, equivalents of the elements shown therein will suggest themselves to those skilled in the art. Equivalent ways of constructing and implementing other embodiments of the present invention will suggest themselves to practitioners of the art. Therefore, the scope of the present invention is to be limited only by the claims below.

Claims

What is claimed is:

1. In a cellular telecommunications network including a mobile telephone switching office, an originating device and a cellular telephone, a method for transmitting information between the originating device and the cellular telephone, comprising the steps of:

receiving a call from the originating device to the cellular telephone;

obtaining information from the originating device;

establishing a connection for the call on an analog voice channel between the mobile telephone switching office and the cellular telephone; and

transmitting the information from the mobile telephone switching office to the cellular telephone in an analog data stream on the analog voice channel.

2. The method of Claim 1, wherein the information comprises the directory number associated with the originating device, and wherein the obtaining step further comprises obtaining the directory number relating to the originating device.

3. The method of Claim 1, wherein the informationfurther comprises the time the call was received, and further comprising the step of displaying the time the call was received on a display associated with the cellular telephone.

4. The method of Claim 1, wherein the information comprises a name of a party initiating the call, and wherein the obtaining step further comprises obtaining the name from the originating device.

5. The method of Claim 1, wherein the information includes an alphanumeric message, and wherein the obtaining step further comprises obtaining the alphanumeric message from the originating device.

6. The method of Claim 1, wherein the analog data stream includes a first data stream with the information, and wherein the transmitting step further comprises transmitting the information from the mobile telephone switching office to the cellular telephone in the analog data stream that includes the first data stream with the information.

7. The method of Claim 6, wherein the analog data stream includes a second data stream with the information, and wherein the transmitting step further comprises transmitting the information from the mobile telephone switching office to the cellular telephone in the analog data stream that includes the first data stream with the information.

8. The method of Claim 1, wherein the establishing step further comprises sending a ring signal to the cellular telephone; and

wherein the transmitting step further comprises transmitting the analog data stream on the analog voice channel to the cellular telephone after the ring signal.

9. The method of Claim 8, further comprising the step of displaying the information on a display associated with the cellular telephone.

10. The method of Claim 1, wherein the establishing step further comprises sending a ring signal to the cellular telephone, and wherein the transmitting step further comprises transmitting the analog data stream to the cellular telephone after the ring signal.

11. The method of Claim 10, further comprising the step of displaying the information on a display associated with the cellular telephone.

12. The method of Claim 11, wherein the step of displaying the information occurs after transmission of the ring signal to the cellular telephone.

13. The method of Claim 1, wherein the transmitting step further comprises encoding the information in the analog data stream.

14. The method of Claim 1, wherein the transmitting step transmits the analog data stream in less than one second.

15. The method of Claim 10, further comprising the step of displaying the information on a display associated with the cellular telephone.

16. The method of Claim 10 further comprising the step of storing the information in a dialing directory in memory associated with the cellular telephone.

17. The method of Claim 15, further comprising the step of dialing a directory number using the cellular telephone and the information displayed on the display associated with the cellular telephone.

18. The method of Claim 16, wherein the information includes an alphanumeric message, and wherein the obtaining step further comprises obtaining the alphanumeric message from the originating device, and further comprising the steps of selecting the information of the call, displaying the information on a display associated with the cellular telephone and storing the alphanumeric information associated with the call into the dialing directory in memory.

19. In a cellular telecommunications network including a mobile telephone switching office, an originating device and a cellular telephone, a method for transmitting information between the originating device and the cellular telephone, comprising the steps of:

receiving a call from the originating device to the cellular telephone;

obtaining information from the originating device comprising the directory number associated with the originating device;

establishing a connection for the call on an analog voice channel between the mobile telephone switching office and the cellular telephone, the connection being completed by the call being answered responsive to a ring signal transmitted to the cellular telephone operative to cause the cellular telephone to ring; and

transmitting the information on the analog voice channel from the mobile telephone switching office to the cellular telephone in an analog data stream after the ring signal, wherein the analog data stream includes a first data stream and a second data stream that each include the information; and

displaying the information on a display associated with the cellular telephone before the cellular telephone rings.

20. A system for transmitting information from an originating device to a cellular telephone, comprising:

the cellular telephone; and

a mobile telephone switching office, the mobile telephone switching office being operative to:

receive a call from the originating device for the cellular telephone,

obtain information relating to the originating device,

establish a connection for the call on an analog voice channel between the mobile telephone switching office and the cellular telephone, and

transmit the information to the cellular telephone in an analog data stream on the analog voice channel.

21. The system of Claim 20, wherein the mobile telephone switching office is further operative to:

establish the connection by sending a ring signal to the cellular telephone to cause the cellular telephone to ring, and

transmit the analog data stream after the ring signal on the analog voice channel.

22. The system of Claim 20, wherein the mobile telephone switching office is further operative to:

establish the connection by sending a ring signal to the cellular telephone on the analog voice channel, and transmit the analog data stream on the analog voice channel after the ring signal.

23. The system of Claim 20, wherein the mobile telephone switching office further comprises an encoder, the encoder being operative to generate the analog data stream.

24. The system of Claim 20, wherein the information comprises a directory number associated with the originating device.

25. The system of Claim 20, wherein the information includes a name of a party initiating the call.

26. The system of Claim 20, wherein the information includes a time for when the call was recieved.

27. The system of Claim 20, wherein the information includes an alphanumeric message.

28. The system of Claim 20, wherein the analog data stream includes a first data stream having the information.

29. The system of Claim 28, wherein the analog data stream includes a second data stream having said information.

30. The system of Claim 24, wherein the cellular telephone further comprises a display operative to display theinformation.

31. The system of Claim 30, wherein the display is further operative to display the information after the transmission of a ring signal to the cellular telephone.

32. The system of Claim 22, wherein the cellular telephone further comprises a display operative to display theinformation.

33. The system of Claim 32, wherein the display is further operative to display the information after the cellular telephone rings.

34. The system of Claim 20, wherein the analog data stream is less than one second in duration.

35. The system of Claim 29, wherein each of the first and second data streams is approximately 200 milliseconds in duration.

36. The system of Claim 30, wherein the cellular telephone, the mobile telephone switching office and the display are further operative to:

display the information associated with the call, select the directory number in the information displayed in associated with the call, and dialing the directory number.

37. The system of Claim 36, wherein the cellular telephone, the mobile telephone switching office and the display are further operative to:

provide for the storing of the call information in a dialing directory in memory.

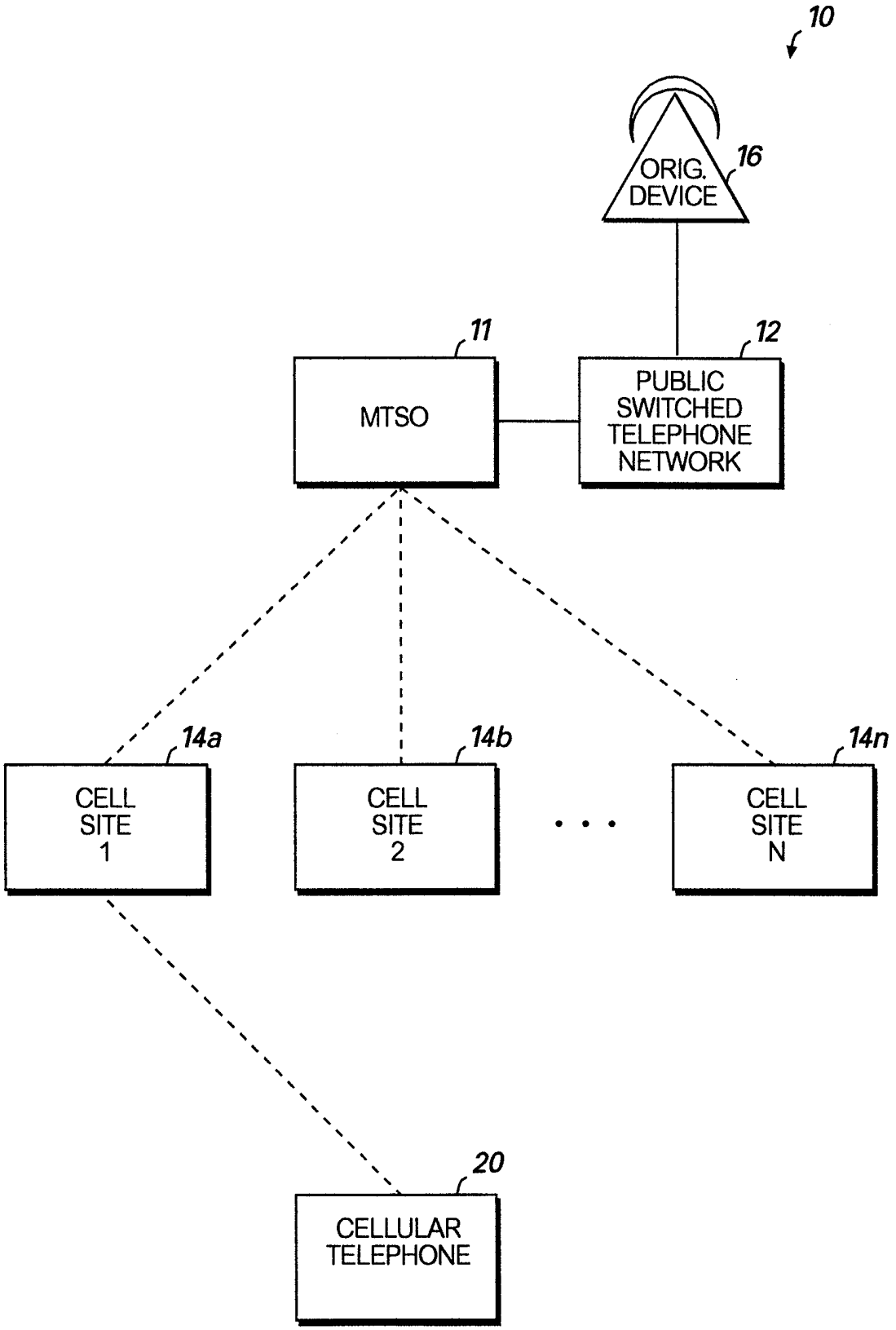
10
ORIG. DEVICE
16
11
MTSO
12
PUBLIC SWITCHED TELEPHONE NETWORK
14a
CELL SITE 1
14b
CELL SITE 2
14n
CELL SITE N
20
CELLULAR TELEPHONE

FIG.1

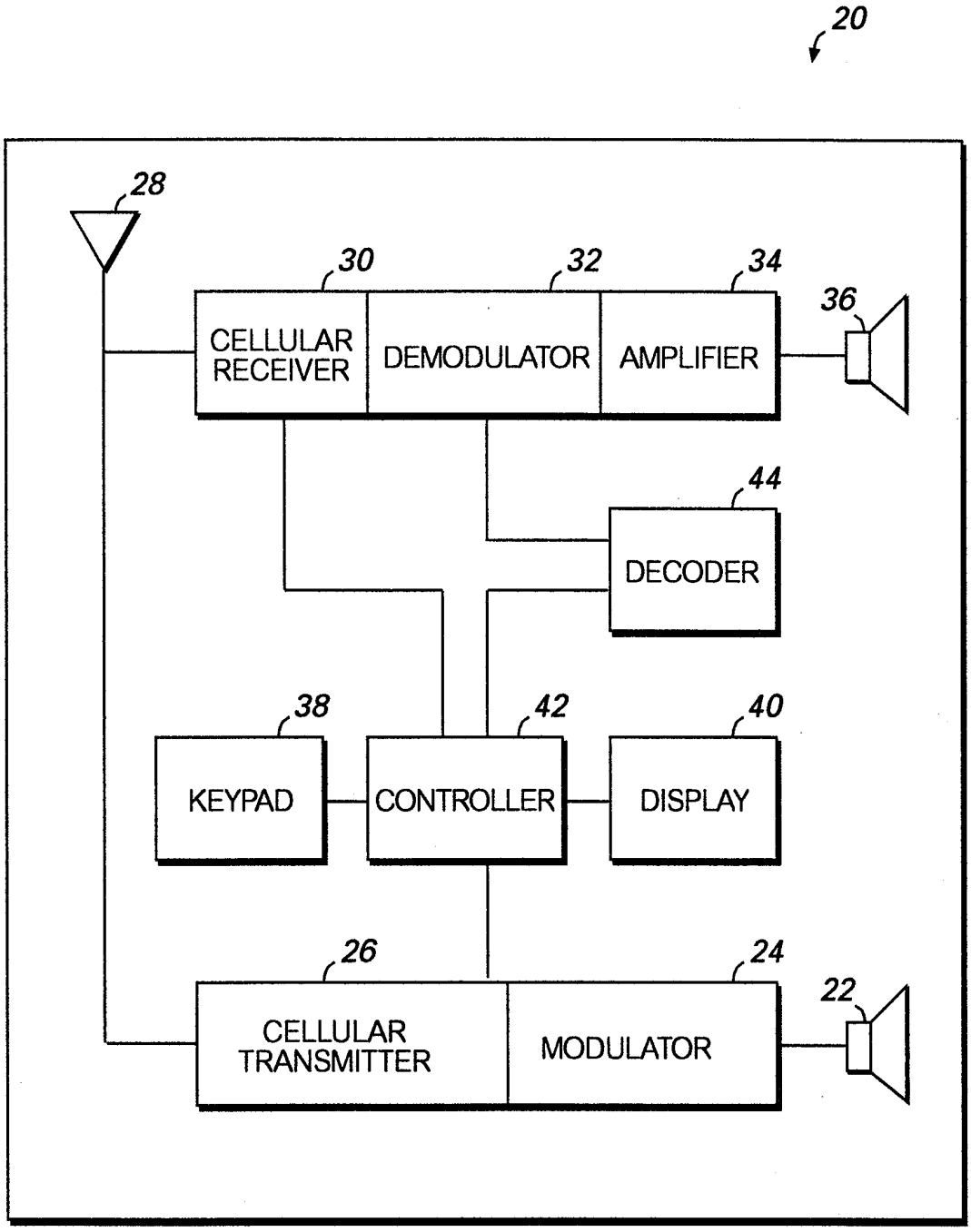
20
28
30
32
34
36
CELLULAR RECEIVER
DEMODULATOR
AMPLIFIER
44
DECODER
38
42
40
KEYPAD
CONTROLLER
DISPLAY
26
24
22
CELLULAR TRANSMITTER
MODULATOR

FIG.2

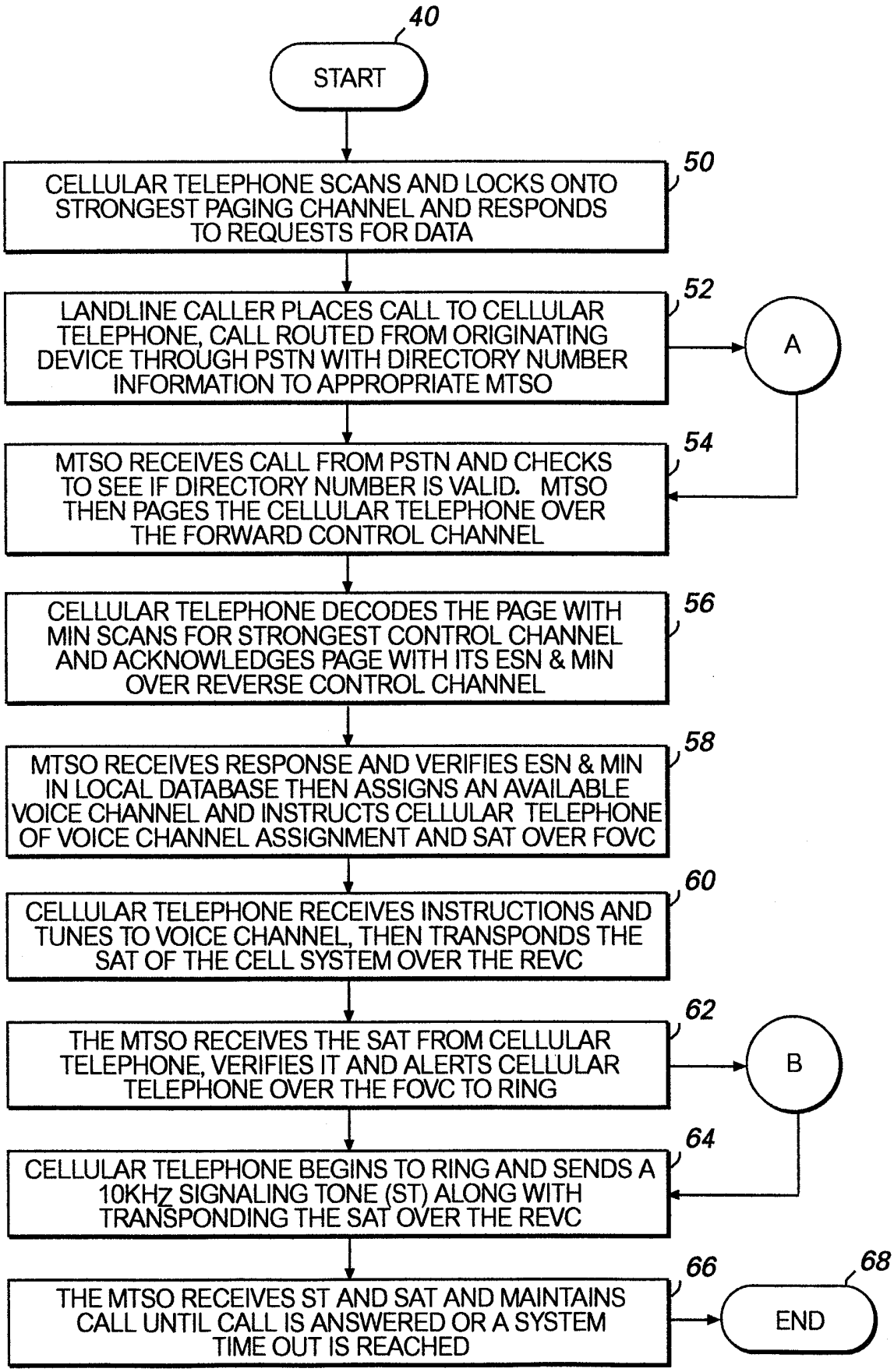
40
START
CELLULAR TELEPHONE SCANS AND LOCKS ONTO STRONGEST PAGING CHANNEL AND RESPONDS TO REQUESTS FOR DATA
50
LANDLINE CALLER PLACES CALL TO CELLULAR TELEPHONE, CALL ROUTED FROM ORIGINATING DEVICE THROUGH PSTN WITH DIRECTORY NUMBER INFORMATION TO APPROPRIATE MTSO
52
A
MTSO RECEIVES CALL FROM PSTN AND CHECKS TO SEE IF DIRECTORY NUMBER IS VALID. MTSO THEN PAGES THE CELLULAR TELEPHONE OVER THE FORWARD CONTROL CHANNEL
54
CELLULAR TELEPHONE DECODES THE PAGE WITH MIN SCANS FOR STRONGEST CONTROL CHANNEL AND ACKNOWLEDGES PAGE WITH ITS ESN & MIN OVER REVERSE CONTROL CHANNEL
56
MTSO RECEIVES RESPONSE AND VERIFIES ESN & MIN IN LOCAL DATABASE THEN ASSIGNS AN AVAILABLE VOICE CHANNEL AND INSTRUCTS CELLULAR TELEPHONE OF VOICE CHANNEL ASSIGNMENT AND SAT OVER FOVC
58
CELLULAR TELEPHONE RECEIVES INSTRUCTIONS AND TUNES TO VOICE CHANNEL, THEN TRANSPONDS THE SAT OF THE CELL SYSTEM OVER THE REVC
60
THE MTSO RECEIVES THE SAT FROM CELLULAR TELEPHONE, VERIFIES IT AND ALERTS CELLULAR TELEPHONE OVER THE FOVC TO RING
62
B
CELLULAR TELEPHONE BEGINS TO RING AND SENDS A 10KHZ SIGNALING TONE (ST) ALONG WITH TRANSPONDING THE SAT OVER THE REVC
64
THE MTSO RECEIVES ST AND SAT AND MAINTAINS CALL UNTIL CALL IS ANSWERED OR A SYSTEM TIME OUT IS REACHED
66
END
68

FIG.3

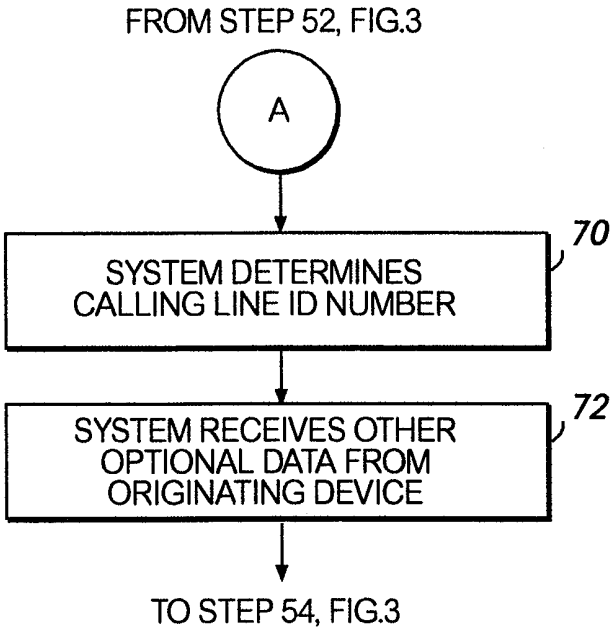
FROM STEP 52, FIG.3
A
SYSTEM DETERMINES CALLING LINE ID NUMBER
70
SYSTEM RECEIVES OTHER OPTIONAL DATA FROM ORIGINATING DEVICE
72
TO STEP 54, FIG.3

FIG.4

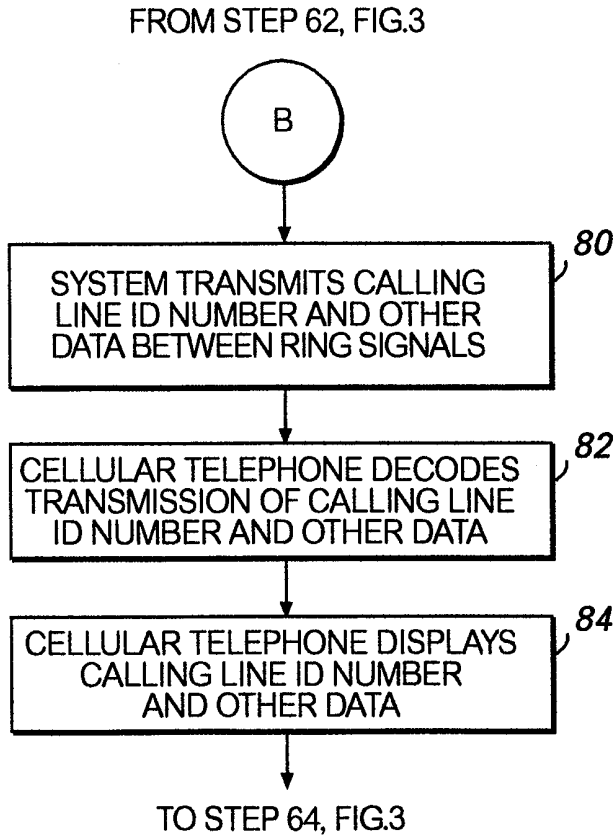
FROM STEP 62, FIG.3
B
SYSTEM TRANSMITS CALLING LINE ID NUMBER AND OTHER DATA BETWEEN RING SIGNALS
80
CELLULAR TELEPHONE DECODES TRANSMISSION OF CALLING LINE ID NUMBER AND OTHER DATA
82
CELLULAR TELEPHONE DISPLAYS CALLING LINE ID NUMBER AND OTHER DATA
84
TO STEP 64, FIG.3

FIG.5

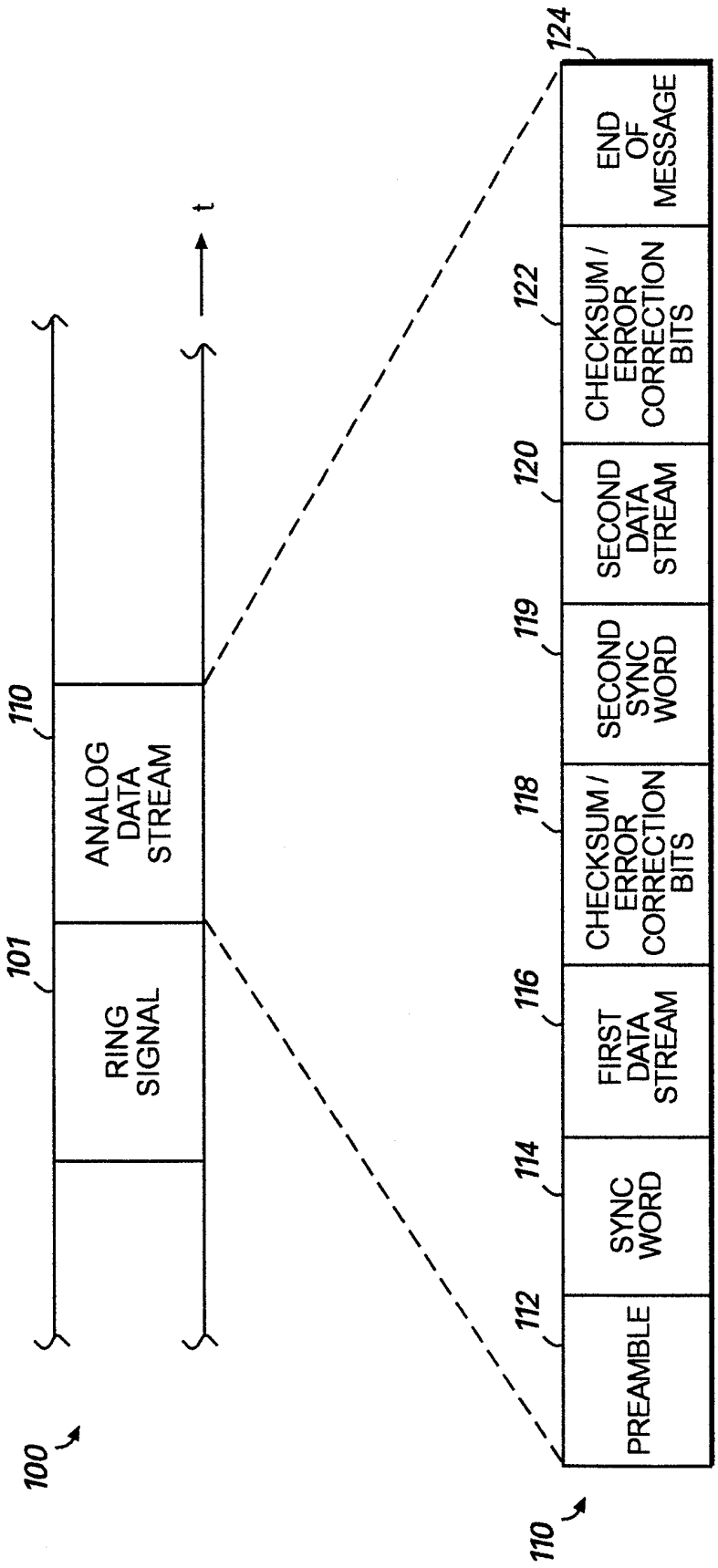
100
101
RING SIGNAL
110
ANALOG DATA STREAM
t
110
112
PREAMBLE
114
SYNC WORD
116
FIRST DATA STREAM
118
CHECKSUM / ERROR CORRECTION BITS
119
SECOND SYNC WORD
120
SECOND DATA STREAM
122
CHECKSUM / ERROR CORRECTION BITS
124
END OF MESSAGE

FIG.6