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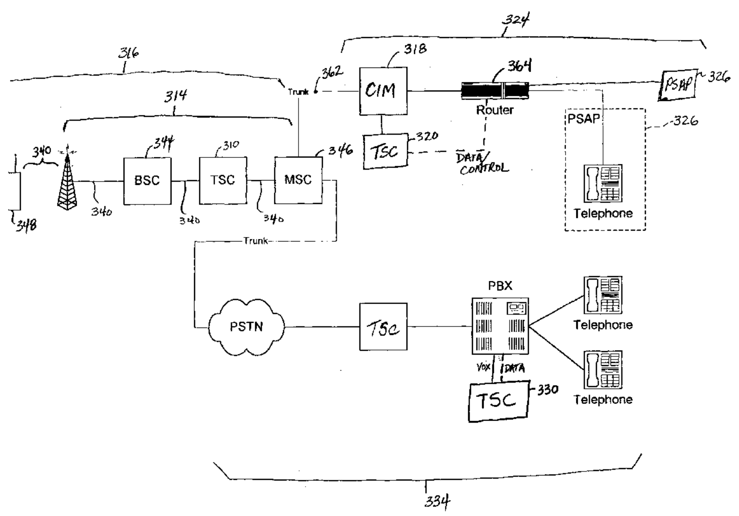
(54) **Title:** CONTROLLER FOR RECEIVING DATA AND PROVIDING SERVICES OVER A COMUNICATION NETWORK



(57) **Abstract:** Methods and apparatuses for receiving and decoding data received from a mobile unit over an audio traffic channel and for providing services in response to the data involve a transport services controller (TSC) that is connected to an audio call path of a communication network for intercepting and receiving audio signals of an audio call, extracting data from the audio signals, and distributing information and dispatching service requests in response to the data. The TSC may be connected to signaling subsystems or other network control resources of the communication network so that the TSC can control or assist the operation of communication network equipment such as routers, interactive voice response (IVR) systems, private branch exchange (PBX) switches, and public safety answering point (PSAP) equipment. The TSC can also forward the received data to a data recipient, for example, over a dedicated data communication network or the Internet.

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CONTROLLER FOR RECEIVING DATA AND PROVIDING SERVICES OVER A COMMUNICATION NETWORK

Technical Field

The present invention relates to methods and devices for receiving data transmitted from a cellular telephone or other wireless communication device over an audio traffic channel of a communication network and for providing services based on the data and, in particular, to a system for extracting the data from the audio traffic channel that uses the data to initiate call routing, redirect the data and/or the call, and provide responsive data and other services.

Background of the Invention

Cellular telephones and wireless devices such as, for example, pagers, wireless-enabled personal data assistants, etc. (collectively "mobile units"), transmit data and/or audio by radio-frequency signals to a cellular base station of a wireless communication network. Cellular base stations are then connected to a land-based portion of the wireless communication network, which may in turn be connected to a wireline network such as a Public Switched Telephone Network (PSTN). The wireless communication network may also be connected to a second wireless network. Radio-frequency transmission over the wireless communication network is accomplished using one of many analog and digital wireless communications protocols. Digital cellular communications protocols, such as CDMA, TDMA, GSM, iDEN, PDC, and others, are designed to efficiently transmit voice signals over wireless and PSTN segments of an audio traffic channel. For example, a vocoder device of a mobile unit uses predictive encoding techniques to filter out noise (non-voice signals) while compressing the voice signals for efficient transmission over the wireless segment of the audio traffic channel. These predictive encoding techniques make conventional methods of data signaling ineffective for transmitting data over the audio traffic channels of digital wireless communication networks.

Two operable methods of transmitting data over the air interface of a digital wireless communication network are known. The first involves transmission of data signals over a control channel of the wireless communication network that is separate from the audio traffic channel. Control channel protocols are typically peculiar to the type of cellular communication protocol in use (e.g., CDMA, TDMA, etc.) and require special receiving equipment within the wireless communication network for converting the control channel signals to data. After the control channel signals have been converted, the data is then retransmitted, using an appropriate protocol, over the wireline network. The second data transmission method uses a modem to transmit data over the air interface. In analog wireless networks, modems convert data to analog audio signals that can be transmitted over the audio traffic channel. However, such modems are not effective to transmit data over a digital wireless network due to the predictive coding and compression techniques used in digital networks. So-called "digital cellular modems" utilize protocols such as Cellular Digital Packet Data (CDPD) that require an initialization sequence and dedication of the audio traffic channel. CDPD precludes concurrent or alternating use of the audio traffic channel for voice transmission during data transmission.

Other known methods of data transmission over the air interface use digital packet data transfer protocols on a dedicated data transmission channel that is independent of the audio traffic channel. This method allows unobstructed use of the audio traffic channel during data transmission. However, such dedicated data transmission channels are similar to control channels of conventional digital wireless networks in that they require special equipment to be installed in the wireless network and are peculiar to the communication protocol in use, e.g., CDMA, TDMA, and GSM.

U.S. Patent Application Nos. 09/431,367, filed March 21, 2000, and 09/602,593, filed June 22, 2000, which are incorporated herein by reference, describe methods and devices for sending data over an audio traffic channel of a digital cellular network concurrently with a voice call and for extracting and decoding the data sent using such transmission methods. There exists a need for methods and devices for using the data in a communication network to initiate call routing, to redirect the data and/or the call, and to provide responsive electronic data and other services.

Summary of the Invention

In accordance with the present invention, methods and apparatuses are provided for receiving and decoding data received from a mobile unit over an audio traffic channel and for providing services in response to the data. In a preferred embodiment, a transport services controller (TSC) is connected to an audio call path of a communication network for intercepting and receiving audio signals of an audio call, extracting data from the audio signals, and distributing information and dispatching service requests in response to the data. The TSC may be connected to signaling subsystems or other network control resources of the communication network so that the TSC can control or assist the operation of communication network equipment such as routers, interactive voice response (IVR) systems, private branch exchange (PBX) switches, and public safety answering point (PSAP) equipment. The TSC can also forward the received data to a data recipient, for example, over a dedicated data communication network or the Internet.

Additional aspects and advantages of this invention will be apparent from the following detailed description of preferred embodiments thereof, which proceeds with reference to the accompanying drawings.

Brief Description of the Drawings

Fig. 1 shows a schematic diagram of a call-taker transport services controller (CT-TSC) in use at a call-taker station in accordance with a first preferred embodiment of the present invention;

Fig. 2 shows a schematic diagram of a network transport services controller (TSC) for use in a communication network environment in accordance with a second preferred embodiment of the present invention;

Fig. 3A shows a schematic diagram of a preferred embodiment trunk interface unit (TIU) of the TSC of Fig. 2;

Fig. 3B shows a schematic diagram of an alternative embodiment TIU of the TSC of Fig. 2;

Fig. 4 is a communication network diagram showing three of the TSCs of Fig. 2 in use in three locations in a communication network: (1) a land-based portion of a wireless network, (2) a 911 network in connection with a PSAP, and (3) a wireline/PSTN network;

Fig. 5 is a communication network diagram of the TSC of Fig. 2 in use in a 911 network for display of location data at a PSAP call-taker workstation;

Fig. 6 is a communication network diagram of the TSC of Fig. 2 in use in a wireline network (PSTN) for data extraction, distribution, and services initiation; and

Fig. 7 is a flow diagram illustrating a preferred sequence of operation of the TSC of Fig. 5.

Detailed Description of Preferred Embodiments

As used herein, the term "audio call path" means the path that is traveled by signals carrying the audio call transmission and is also known as the audio traffic channel, voice call path, and voice traffic channel. The audio call path may include both wireless segments in which audio is transmitted over an air interface using radio-frequency signals and PSTN segments in which data is transmitted over copper wire, fiber optic cable, or other means. The wireless segment of the audio call path may be operated using analog cellular telephone protocols, digital wireless communication protocols, or both. Preferably, a transport services controller ("TSC") in accordance with the present invention receives and transmits data that passes over digital and analog wireless communications networks to accommodate mobile units that are roaming between service areas in which various types of analog and digital wireless communication protocols are used.

As used herein, the term "mobile unit" means any communication device that is capable of transmitting audio on a radio frequency carrier signal over an audio call path of a wireless communication network including, without limitation, cellular telephones, satellite telephones, pagers, wireless-enabled personal data assistants, and motor vehicle telematics transceivers, regardless of whether the device is actually mobile. The term "mobile unit" also includes such devices installed at a fixed location, for example where access to a PSTN or other wireline network is unavailable. Mobile units are capable of transmitting data, which can be generated internal to the mobile unit or received from an external, auxiliary device.

The data received and detected by the TSC may comprise any data generated by the mobile unit or input into the mobile unit. Examples of data include:

- location condition data, such as global positioning system ("GPS") signals, GPS timing data, and geographic position information, which may be received and/or calculated by the mobile unit;
- environmental condition data, such as temperature, moisture, proximity, velocity, altitude, oxygen concentration, and the presence, absence, and/or concentration of other substances;
- medical condition data that identifies a medical condition of the user or a predisposition of the user to, for example, diabetic seizure, heart condition, and/or mental illness;
- text messages;
- personal identification information;
- user account information;
- vehicle condition data, such as crash indication, rollover indication, air bag deployment indication, vehicle speed, engine rpm, fuel level, and engine failure;
- auxiliary device condition data generated by auxiliary devices such as computers, motor vehicles, containers, appliances, heart monitors, pacemakers, blood-glucose level sensors, and other medical sensors,

and other safety-related devices, one or more of which may be external to the mobile unit or integrated with the mobile unit; and

- other data representative of a condition associated with the mobile unit, for example funds remaining, communications signal strength, and status or error conditions of an auxiliary system in communication with the mobile unit.

As used herein, the term "condition data" includes environmental, medical, vehicle, auxiliary device, and location condition data, and any other data representative of a condition that is or may be associated with the mobile unit.

The TSC includes various modules for performing steps of the methods described herein. These modules include a call interception module for intercepting an audio call session and a data receiving module in communication with the call interception module for extracting data from the audio call session. A call-forwarding decision module of the TSC determines where the call or the data should be routed. A forwarding signaling module is in communication with the call-forwarding decision module and the data receiving module for forwarding the call and/or the data to a call taker and/or data receiver, respectively. A service request dispatch module is in communication with at least the data receiving module for selecting and dispatching a service request that initiates the provision of services. The service request may be dispatched to an external system, for example via the Internet, which provides services and/or data in response to data received from the mobile unit by the data receiving module. Alternatively, the service request may be dispatched internally of the TSC, which itself provides the responsive services and/or data, for example via the communications network, the Internet, or otherwise.

The call interception module (CIM) of the TSC intercepts an audio call session involving a mobile unit. The audio call session can be intercepted either by establishing an initial connection directly between the mobile unit and the CIM, or by "listening" to an audio call session between the mobile unit and the call taker. To this end, the CIM may be spliced into the audio call path, for example by interposing the CIM between components of a wireline network so that the audio call path is necessarily routed through the call interception module. Alternatively, equipment of the wireline network, such as a router or PBX, may create an audio bridge as a branch of the audio call path in a manner known in the art. The CIM can be connected to the audio bridge to allow the CIM to receive the audio signals without being spliced into or forming an integral part of the audio call path.

In a packet-switched network environment, the CIM may include multiple trunk interface units (TIUs), each connected to one or more audio trunk lines of the wireline network or audio bridge. Each trunk line may be capable of carrying up to 24 call sessions. The TIUs may be connected to each other, e.g., by daisy-chaining or connection to an H.110 bus, for redundancy so that failure of one of the TIUs will not cause a failure in the CIM.

In a preferred embodiment, the data receiving module of the CIM is integrated with the TIU. As briefly described above, the data receiving module extracts data from the audio call signal as transmitted by the mobile unit over the audio call path, for example using the in-band wireless data transmission protocol described in U.S. Patent Application No. 09/531,367 and 09/602,593. In one embodiment, the data receiving module is in communication with a bus controller of the TIU, such as a PCI bus controller. The bus controller is connected to a bus that is shared with a services control module of the TSC that includes the call-forwarding decision module and the forwarding signaling module. In this embodiment, the forwarding signaling module communicates with a router or PBX of the communication network via a signaling system of the communication network or a dedicated forwarding signaling connection between the services control module and the router or PBX. In this manner, the forwarding signaling module can direct the router or PBX to route or forward the audio call based upon the extracted data. The services control module may comprise a personal computer, for example, of the type including a Pentium-class microprocessor. Alternatively, the TIU, data receiving module, and all or part of the services control module may all be integrated in a single specialized processor unit.

The services control module may also be coupled to a computer workstation used by the call taker and/or a data network such as the Internet for display and/or retransmission of the extracted data. Retransmission of the data to a variety of external systems via the Internet allows responsive services to be provided by the external systems.

The services control module of the TSC may include service application software for providing responsive information or services using the data received from the mobile unit. Examples of services application software include the following:

- mapping module that uses location data sent by the mobile unit to generate a graphical display of the caller's location on a map. The map can then be transmitted to the mobile unit, the call taker workstation, or the external system for display and/or further processing;
- stolen car notification module that notifies the police and/or a car recovery service in the event that the vehicle is stolen;
- 911 location data module that calculates and/or retransmits the location of the mobile unit to a database or workstation accessible by an operator at a public safety answering point (PSAP);
- fleet vehicle tracking module that uses location data to provide tracking information and fleet optimization information for fleet vehicles such as semi trucks, dump trucks, cement trucks, taxis, trains, and buses;
- concierge services module for providing voice-directed navigation and directions, "find the nearest" services, purchasing agent services (e.g., for tickets, reservations, goods, and services) and other concierge-type services;
- location-aware Web content module for providing automated voice-enabled driving directions, location specific weather reports, location-sensitive traffic reports, and other location-aware Web content;
- advertising module for providing location-based advertisements and discount offers displayable on the mobile unit for purchasing location-

based opinion polls, performing demographic surveys and analysis, and for other advertising and marketing-related services;

- gaming module for providing entertainment services such as gambling interactive role-playing games, trading "cards," and other electronically transmitted gaming services;
- inventory and asset tracking module for tracking high-value movable assets such as computers, test equipment, and automated teller machines ("ATMs"), in which a mobile unit can be installed;
- roadside assistance module for dispatching tow trucks and other roadside assistance personnel;
- telematics services module for remote diagnostics and tune-ups, remote vehicle disablement (low-jack), vehicle maintenance reminders, recall notices, warranty compliance reporting, traffic congestion management, and automatic driving; and
- VXML module for encoding, decoding, and transmitting extensible voice markup language codes and/or digital audio data to the mobile unit and/or external systems, text to speech conversion, verbal directions and navigation feedback, and integration with IVR systems, concierge systems, and any other system using a speech interface.

In one embodiment of the TSC, the services control module includes a multitasking processor that enables multiple copies of service application software to execute concurrently. Multitasking of multiple software programs allows multiple services to be provided to one or more users. The services provided can be selected from any of the above services and can include multiple instances of the same service.

To facilitate the provision of services to the user of the mobile unit, the mobile unit informs the TSC about the capabilities of the mobile unit by transmitting configuration data. The configuration data preferably includes information about the make and model of the mobile unit, which implies certain standard features and capabilities of the mobile unit. Nonstandard capabilities can also be defined by the configuration data. For example, if the mobile unit has a video display associated with it, it can inform the TSC of the existence, size, and type of display. Other types of capabilities include text display capability, location determination capability (e.g., GPS, triangulation, precision, error correction capability, etc.), audio playback capability, and data storage capacity. The user of the mobile unit can also select preference settings that alter or modify configuration data to the user's liking. For example, the preference settings may include the user's language preference and city of residence. The configuration data may be transferred by the mobile unit automatically upon call initiation or, alternatively, upon receipt at the mobile unit of a configuration polling request sent by the TSC. The software of the TSC can use the configuration data to provide the services more efficiently.

In another embodiment of the invention, the TSC extracts data from the audio call session after intercepting the audio call session at an interception location in the audio call path between the mobile unit and the call taker. The call interception and extraction may occur either before or after the call is completed to the call taker. The extracted data is then forwarded to a data receiver via a computer data network. A data-forwarding decision unit of the TSC may choose the data receiver from a plurality of possible data receivers. The selected data receiver may include a data display device (that is accessible by the call taker for viewing the data during the audio call session), a local database, a log file, a billing system, a service provider, and/or a Web server. The data receiver may be a stand-alone system or may be integrated with other components of the TSC. To facilitate data forwarding, the TSC can receive call routing information associated with the audio call session from an automated number identification (ANI) server that provides the caller identification, a DNIS server that provides the number being called, or a signaling network such as a common channel interface signaling system (CCIS) or SS7 signaling system. The selection of the data receiver by the data-forwarding decision unit can be based on: the caller or recipient (as identified by the call routing information), the data itself, or a combination of the data and the call routing information.

To facilitate the user-developed TSC-based applications and service modules, various application program interfaces (APIs) may be included in the services control module. One type of API is a message routing system that allows external and internal applications to be connected to the services control module and to send messages back and forth to other applications. Each message is preceded by a header that contains a message type field, message size field, and a destination field naming the application that a message can be sent to. The services control module will only recognize a reserved range of message types for system commands, any message types outside this range are assumed to be understood by the applications sending and receiving the messages. The services control module supports two types of methods for sending messages. First by sending a message directly from one application through the services control module to another application (point-to-point), and the second method is to send by broadcasting (broadcast) a message through the services control module to whatever applications that are interested in receiving this message. In the point-to-point case, all that is needed to be known by the sending application with respect to the message's destination is the name of the application that is to receive this message. The services control module will know of all applications that are connected to it at any time and will route the message to the requested destination. In the case of the broadcast method, all applications interested in receiving any non-system message types will so inform the services control module. Whenever the services control module receives any of these types of messages from an application that called the send broadcast method, it will then route that message to the appropriate applications that have previously requested to receive a message of this type.

Fig. 1 shows a schematic diagram of a call-taker TSC (CT-TSC) 10 in accordance with a first preferred embodiment of the present invention. With reference to Fig. 1, CT-TSC 10 can be implemented on a personal computer platform and includes a telephone line circuit 22 connected to an analog voice line 26 of a telephone network (PSTN) 30. PSTN 30 is coupled to a wireless network 32 that includes a mobile switching center (MSC) 34, which communicates with a mobile unit 36 via a mobile station 38 (base station) of wireless network 32. Mobile unit 36 is preferably a GPS-enabled digital cellular telephone that includes hardware and/or software for transmitting data over an audio traffic channel of wireless network 32 in accordance with the in-band data transfer protocol described in U.S. Patent Application Nos. 09/431,367 and 09/602,593, which are incorporated herein by reference.

CT-TSC 10 includes a data controller unit 44 that loads and executes a modem protocol selected from a modem stack 46. Modem stack 46 is stored in a memory of TSC (not shown) and includes one or more modem images 48 suitable for extracting data from the audio signal received by telephone line circuit 22. To optimize data transfer, modem stack 46 includes multiple modem images 48 for use with audio signals sent over a variety of air-interface protocols, such as iDEN, AMPS, CDMA, TDMA, GSM, and PDC. One of the modem images 48 may be selected by data controller unit 44 as a step in an initialization sequence whereby the air-interface protocol of wireless network 32 and mobile unit 36 is determined, for example, by a low data rate signaling sequence operable over any air interface.

Data controller unit 44 also controls a headset control unit 50 that receives the audio signal from telephone line circuit 22, which passes the audio signal from analog voice line 26. Headset control unit 50 is then coupled to a call taker headset circuit 52 that is used by a call taker (not shown) to listen to the audio signal and to speak with the user of mobile unit 36. A call taker application 60 operates externally to CT-TSC 10, but can also be integrated with data controller unit 44 in an alternative embodiment (not shown). Call taker application 60 receives data from data controller unit 44 and uses the data to provide a service to the call taker or the mobile unit user. For example, call taker application 60 may be a mapping routine that displays to the call taker the location of mobile unit 36 on a graphical map display (not shown).

CT-TSC 10 may also include a GPS support unit 70 for servicing GPS support requests 72 made by data controller unit 44. A GPS reference receiver 74 and a GPS antenna 76 are used by GPS support unit 70 to collect GPS signals and GPS timing information from GPS satellites in earth orbit and to thereby provide error correction services, differential GPS services, time synchronization, and other GPS support services in response to GPS support requests 72. In addition to the information collected from GPS reference receiver 74 and GPS antenna 76, GPS support unit 70 is capable of retrieving GPS timing information and GPS signals from a GPS network 80 located externally of CT-TSC 10. GPS network 80 allows CT-TSC to obtain GPS data for locations 100 km or greater distance from GPS antenna 76, which is necessary for providing GPS support services to mobile unit 36 if located more than 100 km from the GPS antenna 76. CT-TSC also includes a data connection to a network server 84, for providing network-based data transfer from CT-TSC 10 and network-based access to CT-TSC 10. Data controller unit 44 communicates with a storage device 86 for storage and retrieval of data collected from mobile unit 36, operational software, and internally generated information such as activity logs and administrative data. A dial-up maintenance port 88 of the CT-TSC 10 is provided for providing remote maintenance and software updates to CT-TSC 10.

Fig. 2 shows a schematic diagram of a network TSC 100 for use in a communication network environment in accordance with a second preferred embodiment of the present invention. With reference to Fig. 2, TSC 100 includes a location services controller server (LSC server) 110 coupled to at least one TIU controller 120. TIU controller 120 includes one or more TIUs 124, each capable of being connected to and handling the call volume of a DS1 trunk 126 that may carry up to 24 audio calls simultaneously.

Fig. 3A shows a schematic diagram of a preferred embodiment TIU 124. With reference to Fig. 3, TIU 124 includes a DS1/T1 port 130 to which one of the DS1 trunks 126 (Fig. 2) is connected. A T1 transceiver framer 132 receives multiplexed audio signals from DS1 trunk 126 and prepares the digital audio data signals for apportionment and distribution by a TIU controller 136 to two TIU digital signal processor units (TIU-DSPs) 140a, 140b. TIU-DSPs 140a, 140b extract data from the audio signals, append channel-identifying information to the data, and return data to TIU controller 136 for distribution via a PCI controller 146 connected to a PCI bus 150 of TIU controller 120 (Fig. 2). In the event that greater physical separation is required between TIU 124 and other parts of TIU controller 120, an ethernet or cable network transceiver (not shown) may be substituted for PCI controller 146. A TIU serial port 154 and a TIU UART 156 are provided on TIU 124 for performing maintenance and diagnostics on TIU 124. An alternative embodiment TIU 124′, shown in Fig. 3B, includes twelve TIU-DSPs 140′ (only four of which are shown) so that the audio signals may be apportioned two channels per TIU-DSP. In the event of a failure of one of the TIU-DSPs 140, TIU controllers 136 of TIUs 124, 124′ include failure recovery software for redistributing the signals to remaining live TIU-DSPs. An H.110 bus 158 connects all TIUs for additional failure recovery. In the event of a total TIU failure, a backup TIU can receive all audio signals of the failed TIU and process them without interruption.

Returning to Fig. 2, TIU controller 120 is a microprocessor-based system and includes a TIU controller processor 170, operating a communications kernel 182 and controller software 184, including a CPE interface application 186 and a maintenance, diagnostics, and analysis (MD&A) utility 188. A TIU controller disk drive 194 and TIU SDRAM 196 are provided for storage of software and data, and for use by TIU controller processor 170. An MD&A port 198 is provided so that TIU controller 120 can be accessed by a local TIU MD&A terminal 202 for maintenance and software updates. PCI bus 150 is connected to a network card 206 that allows TIU controller 120 to send and receive data and commands to and from LSC server 110 over a local area network (LAN) 210. The configuration of TIU controller 120 and LSC server 110 provides modularity and expansion capability.

Similarly to TIU controller 120, LSC server 110 can be implemented in a microprocessor-based system, such as a personal computer, and includes an LSC processor 220, LSC PCI bus 222, LSC network card 224, LSC MD&A port 226, LSC hard disk drive 228, and LSC SDRAM 232. An LSC kernel 240 provides a software platform on which various LSC service applications 250 may be executed. The data received by TSC 100 from a mobile unit (not shown) includes location condition data in the form of geographic position information and timing information, and text data, which may be manually entered into the mobile unit by the user. The location condition data is used by location service modules 256 of the LSC service applications 250 including tracking service module 258, DGPS module 262, and reverse geocoding module 264. Text data is handled by messaging modules 272 of LSC service applications 250, which may include a wireless applications protocol (WAP) module 274, Web-based messaging 276, and ICQ modules 278. LSC core applications 282 include an MD&A module 284, GPS assist module 286, and session logging module 288.

A DGPS receiver 292 of LSC server 110 provides reference GPS signals for use by DGPS module 262 in providing DGPS service to the mobile unit user. A long haul modem 294 provides for notification of off-site maintenance personnel of errors and provides status updates. Long haul modem 294 and a computer network connection 296 may also be used to retransmit data to external service modules. A CPE network connection 298 allows LSC server 110 to control and communicate with communications network equipment 300, such as routers, switches, ACDs, and PBXs, via a CTI server 302, as described above.

Fig. 4 is a diagram of a communication network showing three independent TSCs 100 in use. With reference to Fig. 4, a first TSC 310 is installed in a fixed portion 314 of a wireless communication network 316. A second TSC 320 is installed in an emergency services network (911 network) 324 for providing location information for use in 911 network 324 including one or more PSAPs 326. A third TSC 330 is shown installed in a wireline network 334. First, second, and third TSCs 310, 320, and 330 are all shown in Fig. 4 to illustrate some of the places in which TSC 100 may be installed. TSCs 310, 320, and 330 operate independently of one another to provide different services, and any one of them may be used without the presence of the others.

First TSC 310 is installed in an audio call path 340 of wireless communication network 316 between a base station controller (BSC) 344 and a mobile switching center (MSC) 346. First TSC 310 intercepts audio calls that originate from a mobile unit 348 before they are switched by MSC 346. By intercepting calls before they reach MSC 346, first TSC 310 has an opportunity to extract condition data from the audio call and perform call routing or forwarding services based on the condition data, as described above. One method for call routing involves grabbing the audio signal, stuffing routing information into the signal to create an augmented audio signal, and forwarding the augmented audio signal on to MSC 346. MSC 346 then uses the routing information in the augmented audio signal to route the call. Alternatively, a data line (not shown) is provided between first TSC 310 and MSC 346 and is used by first TSC to pass instructions to MSC 346 for routing the audio call.

In a similar manner, a call interception module (CIM) 318 connected to second TSC 320 may intercept audio signals on a 911 trunk 362 before they reach a 911 router 364. Second TSC 320 then extracts location condition data from the audio call, and initiates routing and/or forwarding to the appropriate PSAP 326. Alternatively, second TSC 320 may merely distribute the location condition data to the appropriate PSAP 326. Fig. 5 shows a detailed view of a preferred implementation of second TSC 320 in 911 network 324. With reference to Fig. 5, 911 router 364 includes an audio bridge 368 used by second TSC 320 to intercept audio calls from which location condition data is extracted. A 911 router data link 372 between second TSC 320 and 911 router 364 allows second TSC 320 to pass control signals and forwarding information to 911 router 364. The 911 router 364 routes calls to a 911 PSAP trunk 376, to which an ALI controller 382 and PSAP 326 are connected. For non-wireless PSTN calls, ALI controller 382 extracts location information from an ALI database 383 based on the phone number of the calling phone. The location information is then directed to an ALI display 384 visible to a 911 operator (not shown) who receives the call at PSAP 326 on a telephone 386. Multiple telephones and 911 operators are typically situated at a PSAP. For clarity, only one 911 operator station is illustrated in Fig. 5. Because ALI controller 382 must route the location information to ALI display 384 where the 911 call is routed, ALI controller 382 receives routing feedback from a PSAP PBX 388 that identifies the telephone 386 to which the call is directed. A backup TSC 390 provides location information to the 911 operator in the event of a failure of the primary system. An audio connection 394 is provided to backup TSC 390, from which backup TSC 390 can extract location information and transmit it for display on ALI display 384 via a backup data connection 396.

Fig. 6 shows a detailed view of third TSC 330 operating in a wireline network (PSTN) 334 for data extraction, distribution, and services initiation. With reference to Fig. 6, third TSC 330 is operating in parallel with other servers 402, 404, which may also be TSC units. Third TSC 330 receives analog audio signals from a commercial PBX 410 and extracts data from the audio signals. The extracted data, which may comprise any type of data or condition data, is distributed to a mediator 412, which then translates the data into a format suitable for distribution, use, and display by other service components, including a computer telephone (CT) server 414, an IVR 416, and an agent terminal 418. Agent terminal 418 is viewable at a seat 420 of a commercial call taker facility 422 where an agent (not shown) can receive calls on a telephone 424. CT server 414 and IVR 416 have access to various databases, including customer accounts databases 434, map databases 436, and directory databases 438. Third TSC 330 may also transmit service requests based on the extracted data for further handling by external means such as CT server 414, .TVR 416, and/or call taker agent (at seat 420).

Fig. 7 is a flow diagram illustrating a preferred sequence of operation of the TSC of Fig. 5. In the operating sequence of Fig. 7 the mobile unit initiates the audio call (step 710) and establishes an audio call path (step 712). Alternative methods of initiating the audio call may involve initiation of the audio call by a caller that calls the mobile unit, or by a TSC or other automated calling device. Once the audio call path has been established (step 712), the TSC intercepts the audio call signal (step 714).

Optionally, the caller may be calling an IVR system, which plays a voice prompt to the mobile user (step 716) describing available services. In an alternative embodiment (not shown), the TSC may send a signal notifying the IVR of the presence of the mobile unit and causing the IVR to generate the voice prompt, which may be inserted into the audio call session by either the IVR or the TSC. In response to the voice prompt, the user make a selection or inputs data via a keypad or other input mechanism associated with the mobile unit (step 718). The selection or data generated by use is preferably transmitted to IVR as multi frequency "touch-tones," but may be transmitted by other methods such as, for example, in-band data transfer protocol. Upon receipt of the selection and/or data from the mobile unit, the sends a control signal to the TSC (step 720), which causes the TSC to transmit a polling request to the mobile unit for requesting condition data associated with the mobile unit (step 722).

In the absence of an IVR system, the TSC may transmit a polling request (step 722) immediately after it intercepts the audio call (step 714). In response to the polling request, the mobile unit transmits condition data to the TSC (step 724), for example, by using the in-band data signaling method. In response to receipt of the condition data (step 726), the TSC initiates one or more of the following services:

- TSC dispatches a service request either internally of the TSC or to an external device (step 728);
- TSC responds with data services that may take the condition data into account (step 730);
- TSC forwards the audio call or data received from the mobile unit (step 732); and
- TSC logs administrative data, service request data, and transaction information, then records or transmits billing information (step 734).

Upon termination of the call the TSC resets the communication channel and waits for a new audio call path to be established by another mobile device.

It will be obvious to those having skill in the art that many changes may be made to the details of the above-described embodiment of this invention without departing from the underlying principles thereof. The scope of the present invention should, therefore, be determined only by the following claims.

Claims

1. A method of providing services to a user of a mobile unit, comprising:

establishing an audio call path between the mobile unit and a transport services controller (TSC), the TSC coupled to an interactive voice response (IVR) system;

transmitting a voice prompt from the IVR system to the mobile unit over the audio call path, the voice prompt describing one or more services;

transmitting from the mobile unit to the IVR system a signal indicative of a selected one of the services;

transmitting condition data from the mobile unit to the TSC over the audio call path; and

in response to the receipt of the signal and the condition data, providing the selected service to the user based upon the condition of the mobile unit.

2. The method of claim 1 in which:

the audio call path includes a wireless call path segment including an audio traffic channel of a digital wireless communication network; and

in which the transmitting of the condition data includes transmission over the audio traffic channel.

3. The method of claim 1, further comprising:

sending a polling request from the TSC to the mobile unit; and

in which the mobile unit transmits the condition data to the IVR system automatically in response to the polling request.

4. The method of claim 3 in which the polling request is indicative of a specific type of condition data, selected from the group consisting of:

(a) location condition data;

(c) environmental condition data;

(d) vehicle condition data;

(e) medical condition data; and

(f) auxiliary device condition data.

5. The method of claim 1 in which the mobile unit is a GPS-enabled mobile unit and the condition data includes location data.

6. The method of claim 1 in which the signal transmitted from the mobile unit and received at the IVR system includes a DTMF signal.

7. A device for use in routing an audio call from a mobile unit over a PSTN network to a call taker, the mobile unit including a data transmission module, comprising:

a call interception module adapted for coupling to an audio call path of the PSTN network between the mobile unit and the call taker for intercepting the audio call;

a data receiving module in communication with the call interception module for receiving condition data sent from the data transmission module of the mobile unit, the condition data representing a condition of the mobile unit;

a call-forwarding decision module in communication with the data receiving module for generating a routing command based on the condition data; and

a forwarding signaling module in communication with the call-forwarding decision module for transmitting the routing command to the switch of the PSTN network to thereby cause the switch of the PSTN network to route the audio call to the call taker.

8. The device of claim 7 in which the forwarding signaling module is coupled to the call interception module for transmitting the routing command over the audio call path.

9. The device of claim 7, further comprising a data line coupling the forwarding signaling module to the switch for carrying the routing command.

10. The device of claim 7, in which the data receiving module, the call-forwarding decision module and the forwarding signaling module include fast call routing circuitry and software adapted to route the audio call during initialization of the audio call to the call taker.

11. A device for extracting data sent from a mobile unit in an audio call session established at least partly over a digital wireless communication network and for forwarding the data to a data recipient, comprising:

a call interception module adapted for coupling to an audio call path at a interception position between the mobile unit and a call taker for intercepting the audio call session;

a data receiving module in communication with the call interception module for extracting the data from the audio call session;

a data-forwarding decision unit for selecting a data receiving unit accessible by the data recipient; and

a data routing module in communication with the data receiving unit for transmitting the data to the data receiving unit.

12. A method for delivering data from a mobile unit to a data recipient, comprising:

establishing an audio call session between the mobile unit and a transport services controller (TSC), the audio call session including audio signals transmitted over an audio traffic channel of a digital wireless communication network;

transmitting the data from the mobile unit in the audio call session;

intercepting the audio call session and the data at the TSC; and

forwarding the data to the data recipient.

13. The method of claim 12, in which the forwarding of the data includes forwarding the data via a computer data network.

14. The method of claim 13, further comprising:

identifying a call recipient of the audio call session and a data receiving unit accessible by the call recipient; and

forwarding the data to the data receiving unit.

15. The method of claim 14, in which the data received by the TSC from the mobile unit identifies the call recipient.

16. Device for providing services in response to condition data received from a mobile unit via a digital wireless communication network, comprising:

a call interception module in communication with an audio call path, the audio call path including a digital wireless audio call segment;

a data receiving module in communication with the call interception module for receiving condition data sent from the mobile unit in the audio call path, the condition data representing a condition of the mobile unit;

a services control module in communication with the data receiving module for receiving the condition data from the data receiving module and initiating the provision of a selected service based on the condition data.

17. The device of claim 16 in which the services control module includes a service application software for providing responsive services using the data received from the mobile unit, the service application software including one or more service modules selected from the group consisting of:

(a) a mapping module;

(b) a stolen car notification module;

(c) a 911 location data module;

(d) a fleet vehicle tracking module;

(e) a concierge services module;

(f) a location-aware Web content module;

(g) an advertising module;

(h) a gaming module;

(i) an asset tracking module;

(j) a roadside assistance module;

(k) a telematics services module; and

(l) a VXML module.

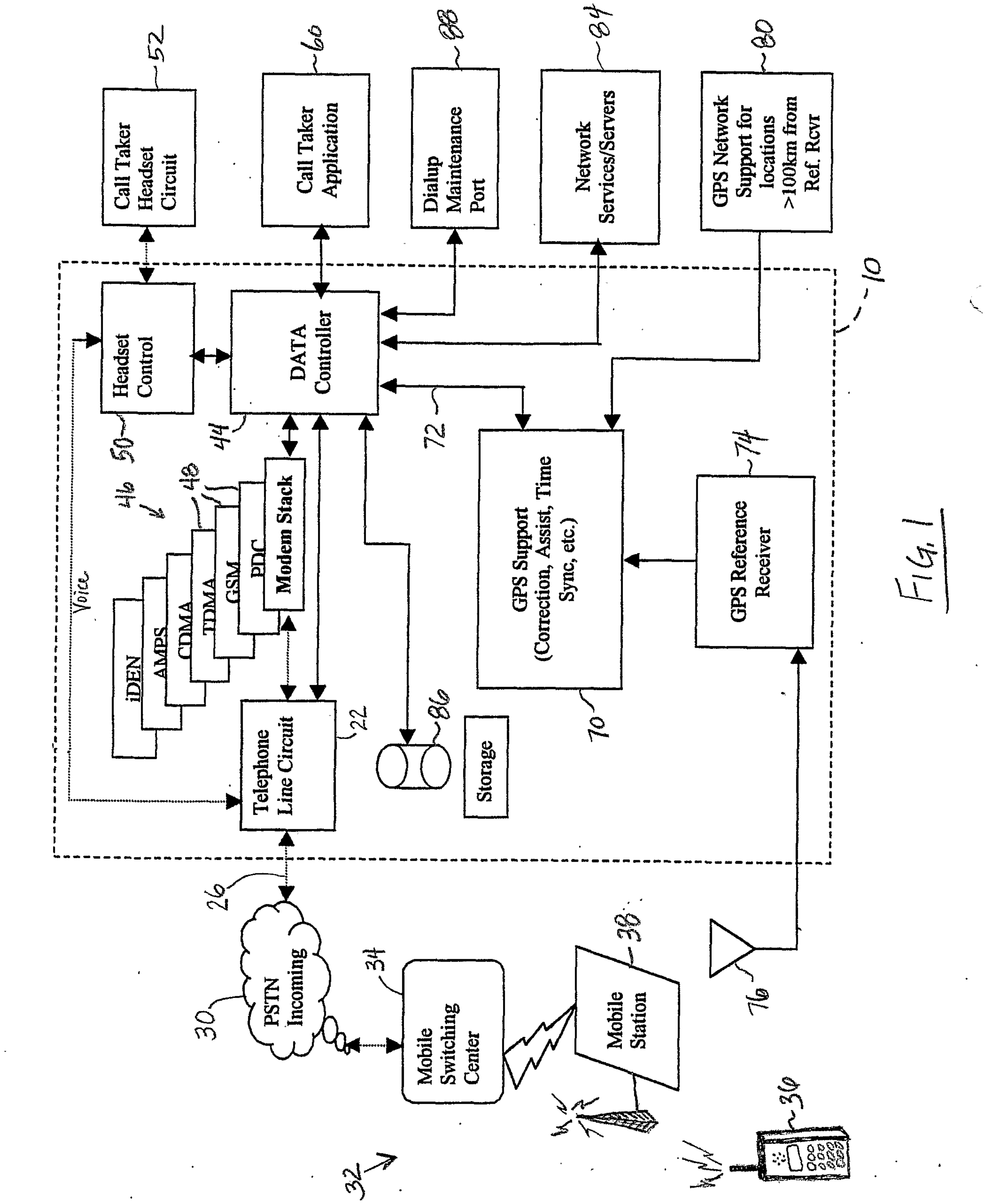
Call Taker Headset Circuit
52
Call Taker Application
60
Dialup Maintenance Port
88
Network Services/Servers
84
GPS Network Support for locations >100km from Ref. Rcvr
80
10
Headset Control
50
DATA Controller
44
72
GPS Support (Correction, Assist, Time Sync, etc.)
70
GPS Reference Receiver
74
Voice
46
48
iDEN
AMPS
CDMA
TDMA
GSM
PDC
Modem Stack
Telephone Line Circuit
22
86
Storage
26
PSTN Incoming
30
Mobile Switching Center
34
Mobile Station
38
76
36
32

FIG. 1

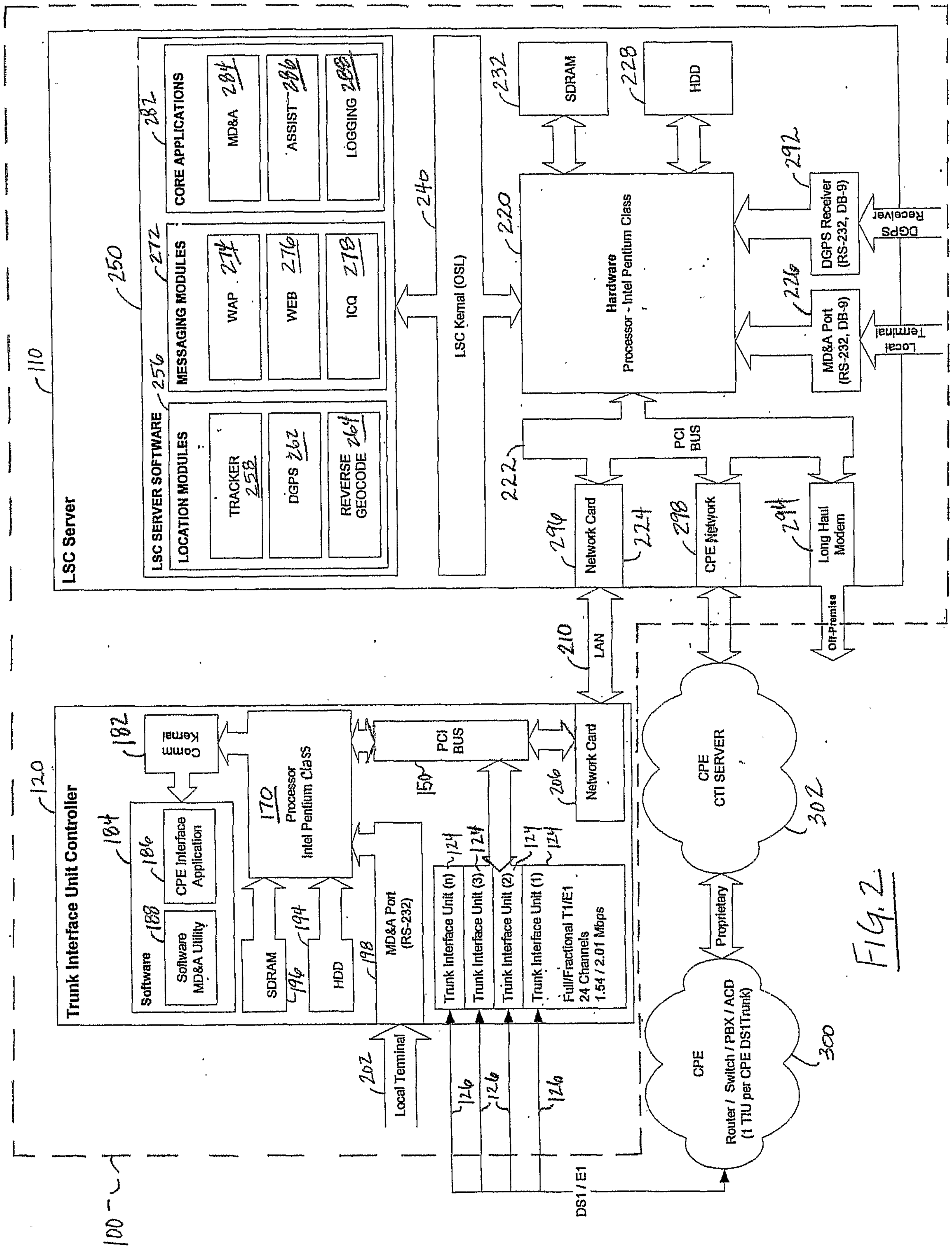
LSC Server
110
LSC SERVER SOFTWARE
256
250
LOCATION MODULES
TRACKER 258
DGPS 262
REVERSE GEOCODE 264
MESSAGING MODULES
272
WAP 274
WEB 276
ICQ 278
CORE APPLICATIONS
282
MD&A 284
ASSIST 286
LOGGING 288
LSC Kernal (OSL)
240
Hardware
Processor - Intel Pentium Class
220
SDRAM
232
HDD
228
DGPS Receiver (RS-232, DB-9)
292
DGPS Receiver
MD&A Port (RS-232, DB-9)
226
Local Terminal
PCI BUS
222
Network Card
296
224
CPE Network
298
Long Haul Modem
294
Off-Premise
LAN
210
Trunk Interface Unit Controller
120
Comm Kernal
182
Software
184
CPE Interface Application
186
Software MD&A Utility
188
170
Processor Intel Pentium Class
SDRAM
196
HDD
194
MD&A Port (RS-232)
198
PCI BUS
150
Network Card
206
Trunk Interface Unit (n)
Trunk Interface Unit (3)
Trunk Interface Unit (2)
Trunk Interface Unit (1)
124
Full/Fractional T1/E1
24 Channels
1.54 / 2.01 Mbps
Local Terminal
202
126
DS1 / E1
CPE
CTI SERVER
302
Proprietary
CPE
Router / Switch / PBX / ACD
(1 TIU per CPE DS1Trunk)
300
100

FIG. 2

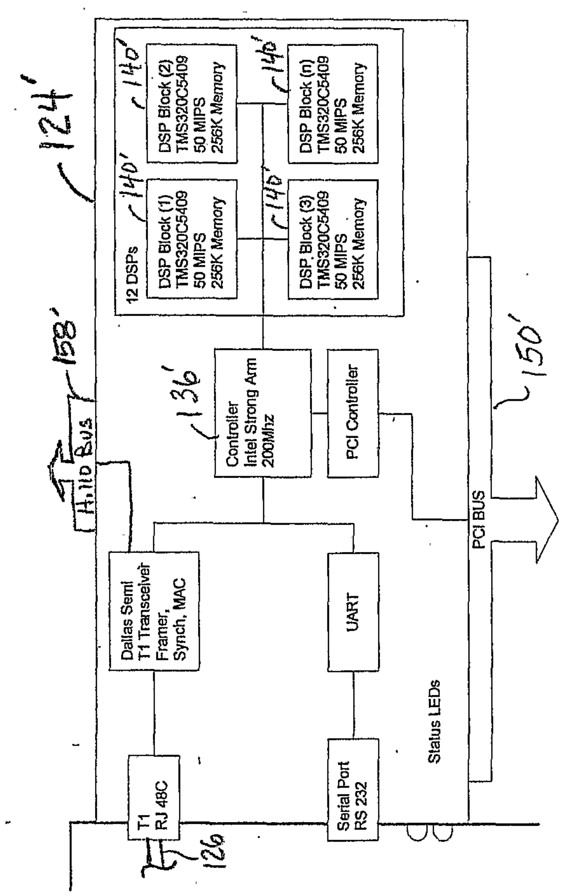
124'
158'
H.110 Bus
12 DSPs
DSP Block (1)
TMS320C5409
50 MIPS
256K Memory
140'
DSP Block (2)
TMS320C5409
50 MIPS
256K Memory
140'
DSP Block (3)
TMS320C5409
50 MIPS
256K Memory
140'
DSP Block (n)
TMS320C5409
50 MIPS
256K Memory
140'
Controller
Intel Strong Arm
200Mhz
136'
PCI Controller
150'
Dallas Semi
T1 Transceiver
Framer,
Synch, MAC
UART
PCI BUS
T1
RJ 48C
126
Serial Port
RS 232
Status LEDs

FIG. 3B

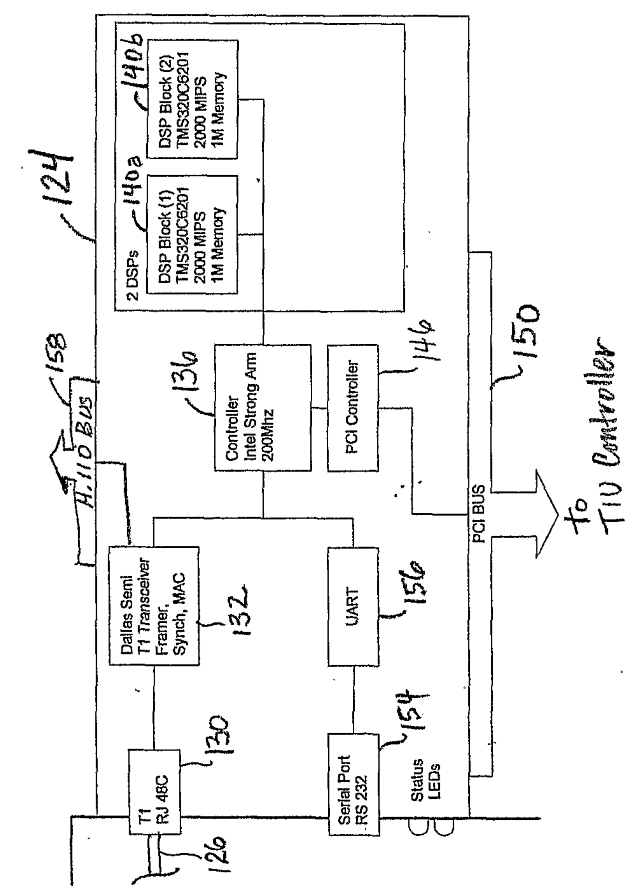
124
158
H.110 Bus
2 DSPs
DSP Block (1)
TMS320C6201
2000 MIPS
1M Memory
140a
DSP Block (2)
TMS320C6201
2000 MIPS
1M Memory
140b
Controller
Intel Strong Arm
200Mhz
136
PCI Controller
146
150
Dallas Semi
T1 Transceiver
Framer,
Synch, MAC
132
UART
156
PCI BUS
to
T1U Controller
T1
RJ 48C
130
126
Serial Port
RS 232
154
Status
LEDs

FIG. 3A

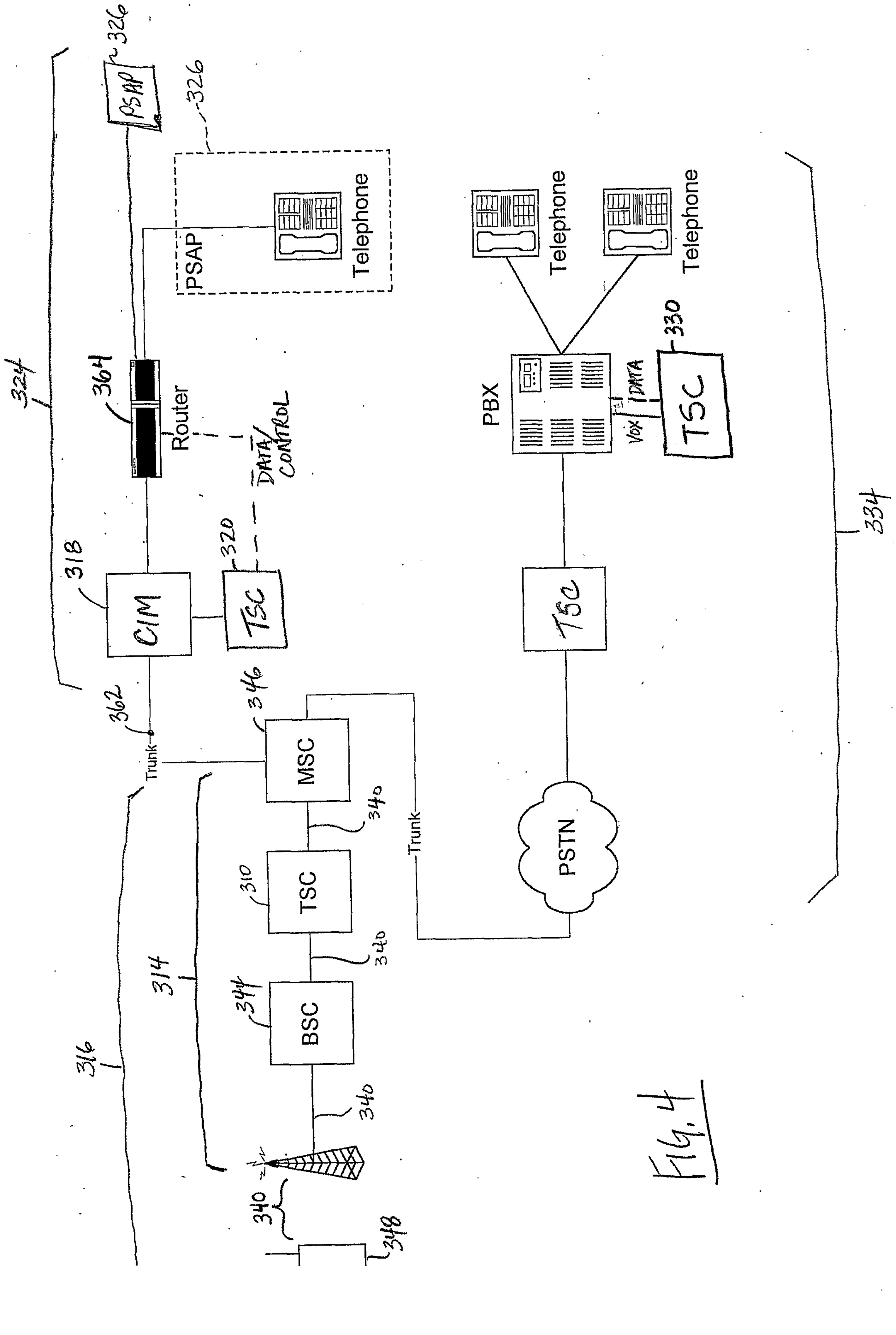
PSAP
326
326
PSAP
Telephone
Telephone
Telephone
324
364
Router
DATA/CONTROL
PBX
330
VOX
DATA
TSC
318
CIM
320
TSC
TSC
334
362
346
Trunk
MSC
340
Trunk
TSC
310
PSTN
340
314
BSC
344
316
340
340
348

FIG. 4

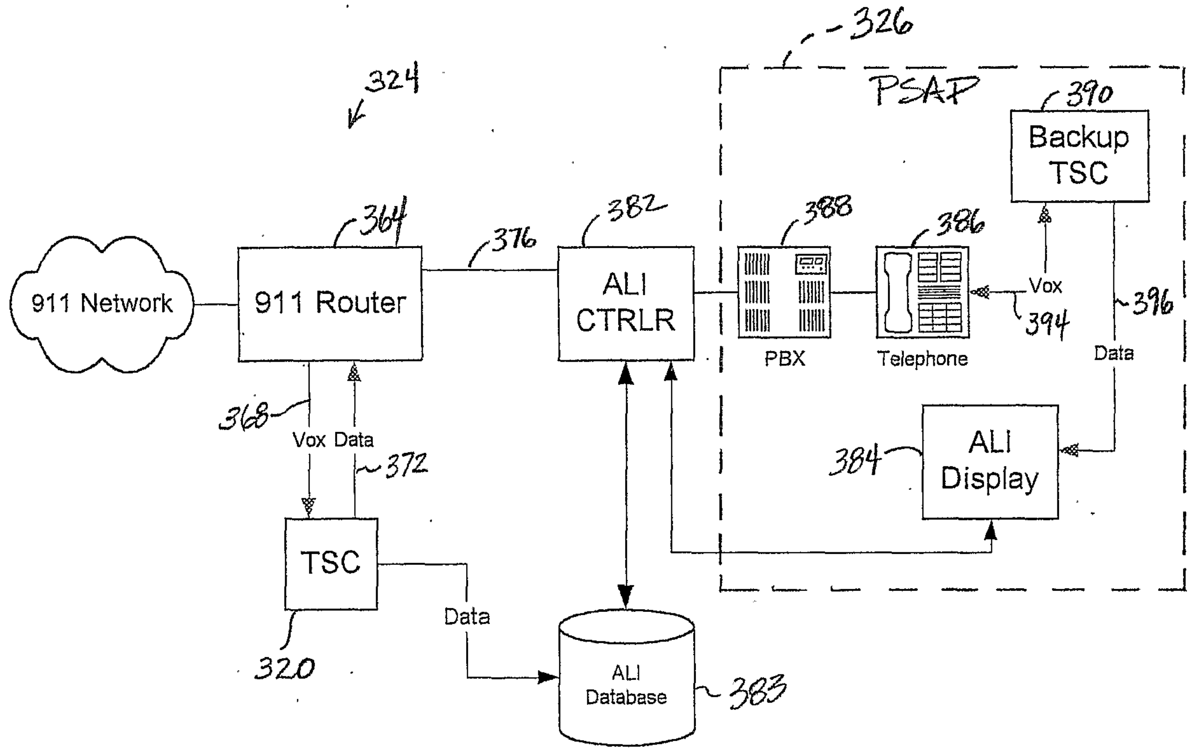
324
326
PSAP
390
Backup TSC
364
376
382
388
386
911 Network
911 Router
ALI CTRLR
PBX
Telephone
Vox
394
396
Data
368
Vox
Data
372
384
ALI Display
TSC
Data
320
ALI Database
383

FIG. 5

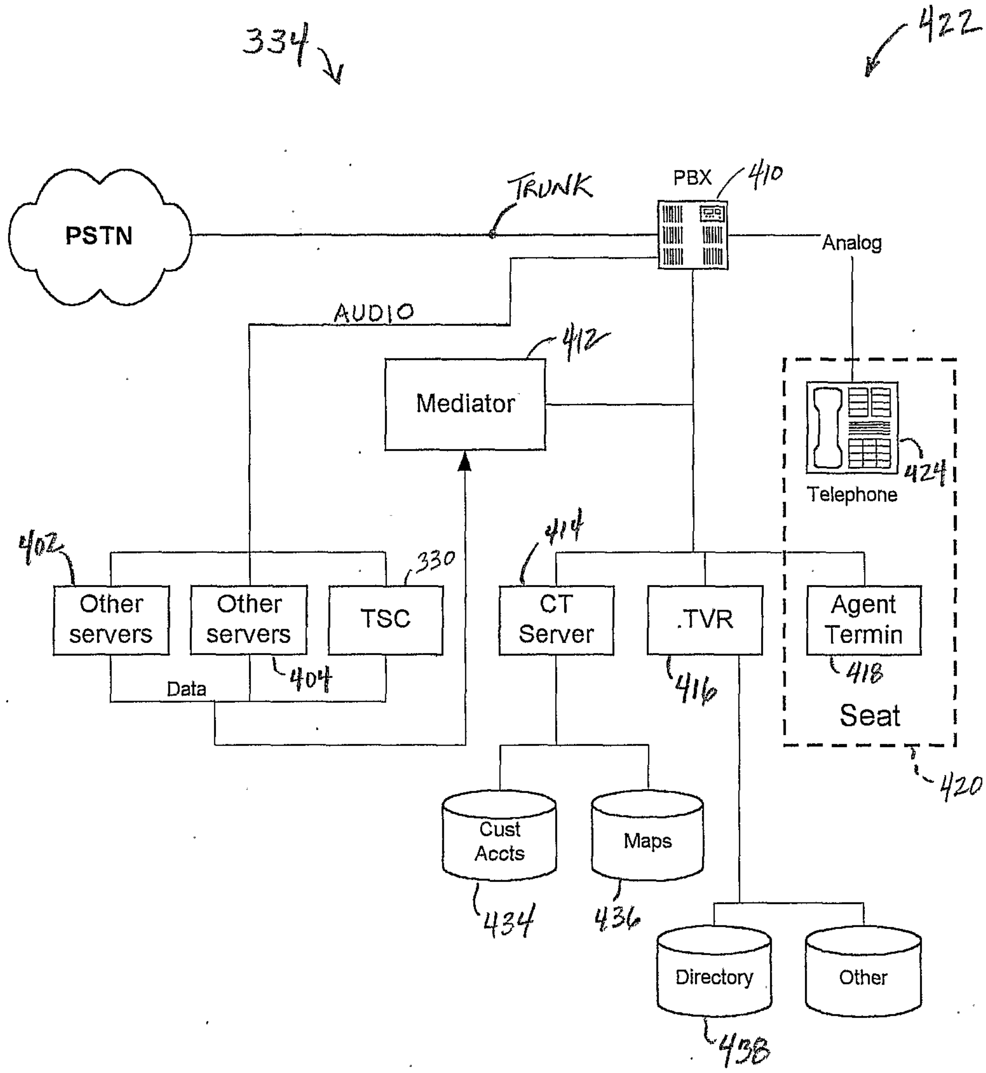
334
422
PSTN
TRUNK
PBX
410
Analog
AUDIO
412
Mediator
424
Telephone
402
330
414
Other servers
Other servers
TSC
CT Server
.TVR
Agent Termin
404
416
418
Data
Seat
420
Cust Accts
Maps
434
436
Directory
Other
438

FIG. 6

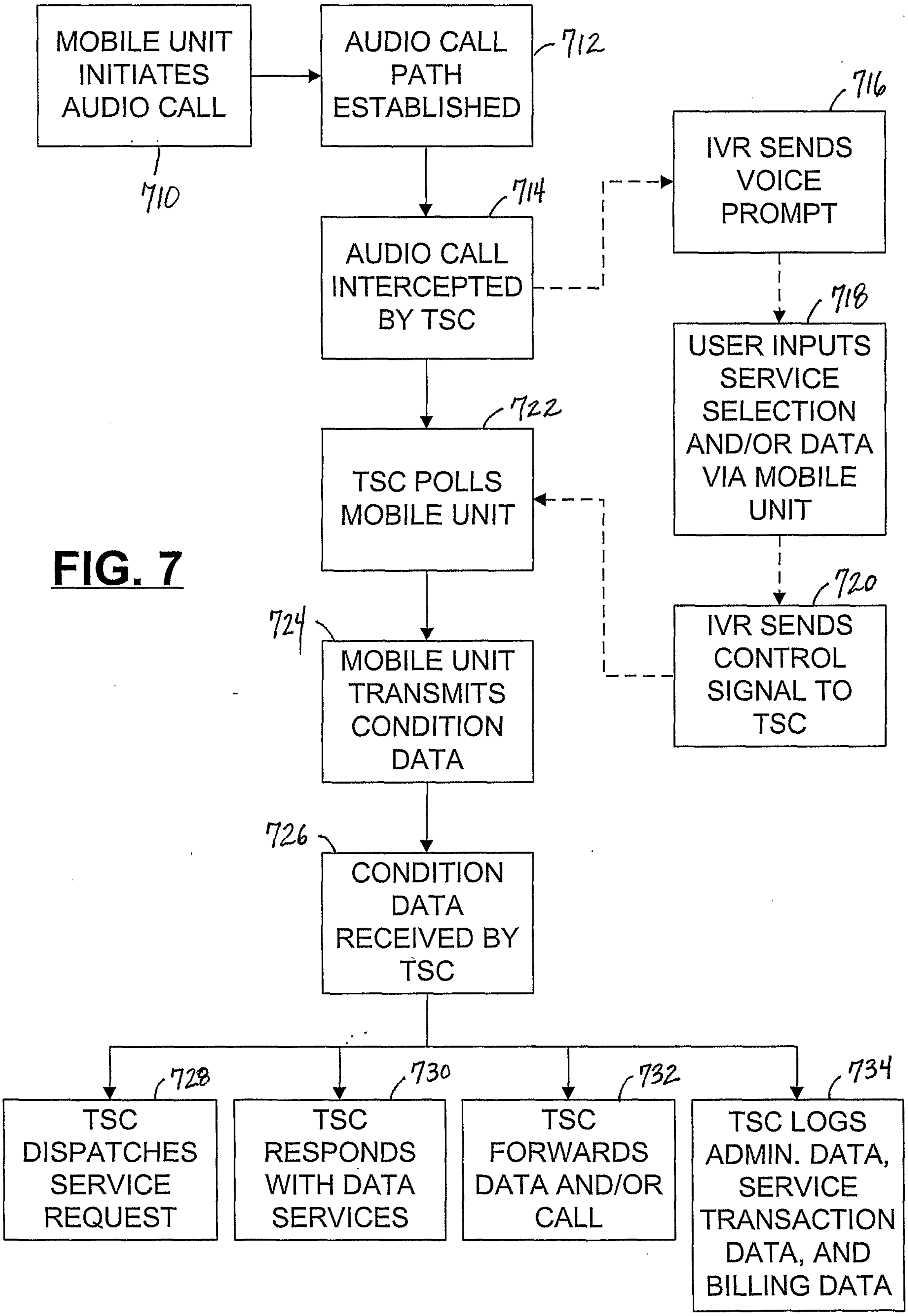
MOBILE UNIT INITIATES AUDIO CALL
710
AUDIO CALL PATH ESTABLISHED
712
AUDIO CALL INTERCEPTED BY TSC
714
IVR SENDS VOICE PROMPT
716
USER INPUTS SERVICE SELECTION AND/OR DATA VIA MOBILE UNIT
718
IVR SENDS CONTROL SIGNAL TO TSC
720
TSC POLLS MOBILE UNIT
722
MOBILE UNIT TRANSMITS CONDITION DATA
724
CONDITION DATA RECEIVED BY TSC
726
TSC DISPATCHES SERVICE REQUEST
728
TSC RESPONDS WITH DATA SERVICES
730
TSC FORWARDS DATA AND/OR CALL
732
TSC LOGS ADMIN. DATA, SERVICE TRANSACTION DATA, AND BILLING DATA
734

FIG. 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US01/27238

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : H04M 11/00; H04Q 7/00
US CL : 455/414,403,412 ; 379/58,88,59
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)
U.S. : 455/414,403,412,517 ; 379/58,88,59,100,91,355

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)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US 5,752,186 A (MALACKOWSKI ET AL) 12 May 1998, col. 3 through col. 13	1-5,9,10,12-15 ----------- 6,7,8,11,16,17
Y	US 6,041,124 A (SUGITA) 21 March 2000 col. 2, lines 55 throughcol.7	6-8,11,16,17

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* 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 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 31 October 2001 (31.10.2001)	Date of mailing of the international search report 13 FEB 2002
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703)305-3230	Authorized officer Daniel Hunter Telephone No. 703-305-4700