(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
18 September 2014 (18.09.2014)

WIPO | PCT

(10) International Publication Number
WO 2014/144263 A1

(51) International Patent Classification:
H04M 3/42 (2006.01) *H04W 88/06* (2009.01)

(21) International Application Number:
PCT/US2014/028596

(22) International Filing Date:
14 March 2014 (14.03.2014)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
13/831,803 15 March 2013 (15.03.2013) US

(71) Applicant: **QUALCOMM INCORPORATED** [US/US]; Attn: International IP Administration, 5775 Morehouse Drive, San Diego, California 92121-1714 (US).

(72) Inventors: **VARGHESE, Vinay**; Building No. 10, 1st and 8th Floor, Mindspace, Hitec City Road, Hyderabad, Andhra Pradesh 500 001 (IN). **PODDAR, Manish**; Building No. 10, 1st and 8th Floor, Mindspace, Hitec City Road, Hyderabad, Andhra Pradesh 500 001 (IN).

(74) Agents: **HANSEN, Robert** et al.; 11800 Sunrise Valley Drive, 15th Floor, Reston, Virginia 20191 (US).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

[Continued on next page]

(54) Title: HANDLING MULTIPLE VOICE CALLS IN MULTIPLE SIM MOBILE PHONE

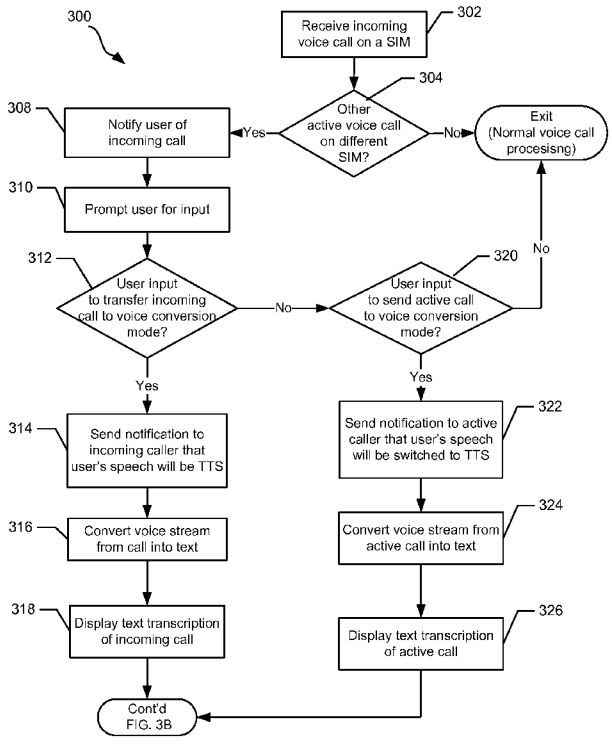


FIG. 3A

(57) Abstract: Enable a user of a dual-SIM dual active DSDA wireless device to handle multiple simultaneous independent real time calls SIMs to prevent calls from being dropped on a multi-SIM wireless device. A DSDA device user busy on an active call receives a second voice call and select to process the incoming voice call using a voice/ text conversation mode. The parties on the multiple simultaneous calls may not be aware of the wireless device's simultaneous communications with one another that the wireless device user is communicating with another party simultaneously with the wireless device.

WO 2014/144263 A1

(84) **Designated States** *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

Published:

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

TITLE

Handling Multiple Voice Calls in Multiple SIM Mobile Phone

FIELD

[0001] The present invention relates generally to multi-SIM wireless communication devices, and more particularly to methods of using multi-SIM capabilities to participate in simultaneous discreet communications.

BACKGROUND

[0002] Multi-SIM wireless devices have become increasing popular in recent years because of the versatility that they provide, particularly in countries where there are many service providers. For example, dual-SIM smart phones allow a user to implement two different plans or service providers on the same cellular telephone, each with separate telephone numbers and bills (e.g., a business account/number and a personal account/number). Also, during travel, users can obtain local SIM cards and pay local call rates in the destination country. By using multiple SIMs, a user can take advantage of different pricing plans, and save on mobile data usage. Thus, dual-SIM wireless devices effectively provide users with two phones, without the need to carry two separate devices.

[0003] Dual-SIM mobile phones have developed in recent years because of the flexibility they provide to users. Using dual-SIM devices, users avoid the need to carry two phones at the same time, such as one for business and one for personal use. Further, by using multiple SIMs, a user can taken advantage of different pricing plans, and save on mobile data usage.

[0004] Instead of requiring a user to switch between SIMs, some newer dual-SIM devices are configured for dual-SIM dual active (DSDA) operation. DSDA devices, which typically have two radio transmitter/receiver circuits (referred to herein as RF resources), allow both SIMs to be active (i.e., supporting

telecommunications via a network) at the same time. In this manner, simultaneous independent communications are enabled. However, while a DSDA device allows a user to engage in simultaneous active calls, a user cannot generally participate in two separate telephone calls at the same time. Therefore, at least some capabilities of a DSDA device may not be fully realized by users.

SUMMARY

[0005] The various embodiments provide a method for a user to engage in simultaneous calls on a DSDA device using speech-to-text and text-to-speech conversions on a second call. By converting speech from a second incoming voice call to text that is displayed on the DSDA device, and converting text entered by the user to speech that is played to the second caller, the user can maintain real-time communications discreetly with two different parties at the same time.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] The accompanying drawings, which are incorporated herein and constitute part of this specification, illustrate exemplary embodiments of the invention, and together with the general description given above and the detailed description given below, serve to explain the features of the invention.

[0007] FIG. 1 is a communication system block diagram of a wireless communication system suitable for use with the various embodiments.

[0008] FIG. 2 is a block diagram illustrating a dual-SIM dual active wireless communications device according to an embodiment.

[0009] FIGs. 3A and 3B are process flow diagrams illustrating an embodiment method for determining appropriate handing of simultaneously active voice calls.

[0010] FIGs. 4A and 4B are block diagrams illustrating the interaction between components of a wireless device using voice/text conversation mode according to an embodiment.

[0011] FIG. 5 is a block diagram illustrating components of a server that provides voice and text conversions to a wireless device using voice/text conversation mode according to an embodiment.

[0012] FIG. 6 is a process flow diagram illustrating an embodiment method for handling simultaneous active and incoming voice calls on a wireless device.

[0013] FIG. 7 is a process flow diagram illustrating an embodiment method for providing voice and text conversion services on a server.

[0014] FIG. 8 is a component diagram of another example mobile device suitable for use with the various embodiments.

[0015] FIG. 9 is a component diagram of another example mobile device suitable for use with the various embodiments.

[0016] FIG. 10 is a component diagram of an example server suitable for use with the various embodiments

DETAILED DESCRIPTION

[0017] The various embodiments will be described in detail with reference to the accompanying drawings. Wherever possible, the same reference numbers will be used throughout the drawings to refer to the same or like parts. References made to particular examples and implementations are for illustrative purposes, and are not intended to limit the scope of the invention or the claims.

[0018] The word "exemplary" is used herein to mean "serving as an example, instance, or illustration." Any implementation described herein as "exemplary" is not necessarily to be construed as preferred or advantageous over other implementations.

[0019] The terms "wireless device" and "wireless communication device" are used interchangeably herein to refer to any one or all of cellular telephones, smart

phones, personal or mobile multi-media players, personal data assistants (PDAs), laptop computers, tablet computers, smart books, palm-top computers, wireless electronic mail receivers, multimedia Internet enabled cellular telephones, wireless gaming controllers, and similar personal electronic devices that include a programmable processor and memory and circuitry for establishing wireless communication pathways and transmitting/receiving data via wireless communication pathways.

[0020] As used herein, the terms "SIM", "SIM card" and "subscriber identification module" are used interchangeably to mean an integrated circuit, embedded into a removable card, that stores an International Mobile Subscriber Identity (IMSI), related keys, and/or other information used to identify and/or authenticate a wireless device to a wireless telecommunication network. The term SIM may also be used as shorthand reference to a particular communication network or subscriber account with which the SIM is associated, since the information stored in a SIM enables the wireless device to establish a communication link with a particular network, thus the SIM and the communication network correlate to one another.

[0021] As used herein, the terms "multi-SIM wireless device" "dual-SIM device" "dual-SIM dual active device" and "DSDA device" are used interchangeably to describe a wireless device that is configured with more than one SIM and is capable of independently handling communications with networks of both subscriptions.

[0022] The various embodiments improve user experience on a DSDA device by utilizing the dual active capability and enabling the user to maintain multiple calls with multiple parties simultaneously, without requiring a conference call. A DSDA device user may be engaged in an active call with a first party when an incoming voice call is received from a second party. In the various embodiments, the first call may proceed as normal over the speaker/headphone on the device,

while the second call may be handled using a "voice/text conversation mode" while still maintaining the active first call.

[0023] In the various embodiments, each SIM of a multi-SIM wireless device may enable communications over different communications networks using the same or different wireless communication protocols. In another embodiment, two or more SIMs may enable communications over the same network using the same wireless communications protocol. In the various embodiments, each SIM may enable communications over its network using the different RF resources of the multi-SIM wireless device. In the various embodiments, a multi-SIM wireless device may be a dual-SIM dual active (DSDA) device in which each SIM is associated with an independent RF resource (e.g., independent RF transceivers).

[0024] The methods of the various embodiments may be utilized for calls on the networks associated with either SIM. While the terms "first" and "second" may be used herein to describe the SIMs and associated networks, such identifiers are merely for convenience and are not meant to limit the various embodiments to a particular order, sequence, type of network, or carrier. Further, the embodiments may be employed in multi-SIM wireless devices with more than two RF resources and more than two SIM cards to enable simultaneous communications with three or more parties in a similar manner.

[0025] In the various embodiments, audio capture may include receiving audio inputs via a microphone of the multi-SIM wireless device and preparing the audio inputs for transmission, as well as converting received data to audio outputs via a speaker of the wireless device. In the various embodiments, calls may include continuous streams of audio data exchanged between wireless devices and/or servers. While example embodiments are discussed in terms of operations performed to transmit and receive streams of data during audio calls (i.e., voice calls), the various embodiment methods may also be implemented to transmit and receive video calls (i.e., audio and video calls or video only calls). While example

embodiments are discussed in terms of operations to switch a call between networks associated with two SIMs, additional SIMs and network connections may be enabled in a multi-SIM wireless device.

[0026] FIG. 1 illustrates a wireless network system 100 suitable for use with the various embodiments. Wireless devices 102, 104 may be configured to establish wireless connections with cell towers or base stations of one or more radio access networks. For example, wireless devices 102, 104 may transmit/receive data using base stations 106, 108, which may be part of a network 110, as is known in the art. Wireless device 102 may further be configured to transmit/receive data through base station 112, which may be part of a different network 114.

[0027] The wireless networks 110, 114 may be cellular data networks, and may use channel access methods including, but not limited to, Frequency Division Multiple Access (FDMA), Time Division Multiple Access (TDMA), Code Division Multiple Access (CDMA), Universal Mobile Telecommunications Systems (UMTS) (particularly, Long Term Evolution (LTE)), Global System for Mobile Communications (GSM), Wi-Fi, PCS, G-3, G-4, or other protocols that may be used in a wireless communications network or a data communications network. Networks 110, 114 may use the same or different wireless interfaces and/or physical layers. In an embodiment, base stations 106, 108, 112 may be controlled by one or more base station controllers (BSC) 116, 118. For example, base stations 106, 108, BSC 116, and other components may form network 110, as is known in the art. Alternate network configurations may also be used and the embodiments are not limited to the configuration illustrated. For example, in another embodiment the functionality of the BSC 116 and at least one of base stations 106, 108 may be collapsed into a single "hybrid" module having the functionality of these components.

[0028] In the various embodiments, a wireless device 102 may simultaneously access two (or more) core networks 120, 122 after camping on cells managed by

two (or more) base stations 106, 112. Wireless device 102 may also establish connections with Wi-Fi access points, which may connect to the Internet. While the various embodiments are particularly useful with wireless networks, the embodiments are not limited to wireless networks and may also be implemented over wired networks with no changes to the methods.

[0029] In wireless network system 100, wireless device 102 may be a multi-SIM wireless device that is capable of operating on a plurality of networks or subscriptions supported by a plurality of SIMs. For example, the wireless device 102 may be a dual-SIM device. Using dual-SIM functionality, the wireless device 102 may simultaneously access two core networks 120, 122 by camping on cells managed by two base stations 106, 112. Core networks 120, 122 may be interconnected by public switched telephone network (PSTN) 124, across which the core networks 120, 122 may route various incoming and outgoing communications to the wireless device 102.

[0030] The wireless device 102 may make a voice or data call to a third party device, such as wireless device 104, using one of the SIMs. The wireless device 102 may also receive a voice call or other data transmission from a third party. The third party device (e.g., wireless device 104) may be any of a variety of devices, including, but not limited to, a mobile phone, laptop computer, PDA, server, etc.).

[0031] A SIM in the various embodiments may be a Universal Integrated Circuit Card (UICC) that is configured with SIM and/or USIM applications, enabling access to GSM and/or UMTS networks. The UICC may also provide storage for a phone book and other applications. Alternatively, in a CDMA network, a SIM may be a UICC removable user identity module (R-UIM) or a CDMA subscriber identity module (CSIM).

[0032] Each SIM card may have a CPU, ROM, RAM, EEPROM and I/O circuits. The SIM cards used in the various embodiments may contain user account

information, an international mobile subscriber identity (IMSI), a set of SIM application toolkit (SAT) commands and storage space for phone book contacts. A micro-processing unit (MCU) of a baseband chip may interact with MCUs of SIM cards to retrieve data or SAT commands from the SIM cards installed in a wireless device. A wireless device may be immediately programmed after plugging in the SIM card. SIM cards may be also programmed to display custom menus for personalized services. A SIM card may further store a Home Public-Land-Mobile-Network (HPLMN) code to indicate the SIM card network operator provider. An Integrated Circuit Card Identity (ICCID) SIM serial number is printed on the SIM card for identification.

[0033] FIG. 2 is a functional block diagram of a multi-SIM wireless device 200 that is suitable for implementing the various embodiments. The multi-SIM wireless device 200 may include a first SIM interface 202a, which may receive a first identity module SIM-1 204a that is associated with the first subscription. The multi-SIM wireless device 200 may also include a second SIM interface 202b, which may receive a second identity module SIM-2 204b that is associated with the second subscription.

[0034] The multi-SIM wireless device 200 may include at least one controller, such as a general processor 206, which may be coupled to an audio codec (vocoder) 208. The vocoder 208 may in turn be coupled to a speaker 210 and a microphone 212. The general processor 206 may also be coupled to at least one memory 214. The memory 214 may be a non-transitory tangible computer readable storage medium that stores processor-executable instructions. For example, the instructions may include routing communication data relating to the first or second subscription though a corresponding baseband -RF resource chain.

[0035] The memory 214 may store operating system (OS), as well as user application software and executable instructions. The memory 214 may also store application data, such as pre-determined user preference settings and/or rules for

automatically determining when to commence voice/text conversation mode. Such settings or rules may configure the multi-SIM wireless device processor to automatically enter the voice/text conversation mode when a set of pre-determined rules stored in the memory 214 are satisfied.

[0036] The general processor 206 and memory 214 may each be coupled to at least one baseband modem processor 216. Each SIM in the multi-SIM wireless device 200 (e.g., SIM-1 202a and SIM-2 202b) may be associated with a baseband-RF resource chain. Each baseband-RF resource chain may include baseband modem processor 216 to perform baseband/modem functions for communications on a SIM, and one or more amplifiers and radios, referred to generally herein as RF resources 218. In an embodiment, the baseband-RF resource chains may share a common baseband modem processor 206 (i.e., a single device that performs baseband/modem functions for all SIMs on the wireless device). Alternatively, each baseband-RF resource chain may include physically or logically separate baseband modem processors (e.g., Modem1, Modem2). Baseband/modem functions may also be physically or logically integrated with the vocoder 208. For example, the vocoder and modem functions may be implemented in a digital signal processor.

[0037] The RF resources 218a, 218b may each be transceivers that perform transmit/receive functions for the associated SIM of the wireless device. The RF resources 218a, 218b may include separate transmit and receive circuitry, or may include a transceiver that combines transmitter and receiver functions. The RF resources 218a, 218b may be coupled to a wireless antenna (e.g., a first wireless antenna 220a and a second wireless antenna 220b). The memory 214 of the wireless device 200 may store an operating system (OS) and user application software.

[0038] In an embodiment, the general processor 206 may be coupled to a speech-to-text (STT) conversion engine 224, and to a text-to-speech (TTS) conversion

engine 226. The STT conversion engine 224 may convert speech (i.e., voice stream) into text, and the TTS conversion engine 226 may convert text into speech. A voice synthesizer 229 to produce speech signals simulating a human voice may be coupled to the TTS conversion engine 226. In the various embodiments, the voice synthesizer 229 may be integrated with the vocoder 208 and/or the TTS conversion engine 226. In addition, the STT conversion engine 224, TTS conversion engine 226, and/or the vocoder 208 may be integrated into a single module, unit, component, or software. The STT conversion engine 226, TTS conversion engine 228, and voice synthesizer 229 may be implemented on a multi-SIM wireless device 200 as software modules in an application executed on an application processor and/or digital signal processor (DSP), as hardware modules (e.g., hardware components hard wired to perform such functions), or as combinations of hardware components and software modules executing on one or more device processors.

[0039] While STT conversion engine 226, TTS conversion engine 228, and voice synthesizer 229 are illustrated in FIG. 2 as being components or modules of the multi-SIM wireless device 200, in alternative embodiments, one or more of these components may be located on a server accessible through a wireless network, discussed in further detail below with respect to FIGs. 5-7.

[0040] In a particular embodiment, the general purpose processor 206, STT conversion engine 224, TTS conversion engine 226, memory 214, baseband processor(s) 216, and RF resources 218a, 218b may be included in a system-on-chip device 222. The first and second SIMs 202a, 202b and their corresponding interfaces 204a, 204b may be external to the system-on-chip device 222. Further, various input and output devices may be coupled to components of the system-on-chip device 216, such as interfaces or controllers. Example user input components suitable for use in the wireless device 200 may include, but are not limited to, a keypad 228 and a touchscreen display 230.

[0041] In an embodiment, the keypad 228, touchscreen display 230, microphone 212, or a combination thereof, may perform the function of receiving the request to initiate an outgoing call. For example, the touchscreen display 230 may receive a selection of a contact from a contact list or receive a telephone number. In another example, either or both of the touchscreen display 230 and microphone 212 may perform the function of receiving a request to initiate an outgoing call. For example, the touchscreen display 230 may receive selection of a contact from a contact list or to receive a telephone number. As another example, the request to initiate the outgoing call may be in the form of a voice command received via the microphone 212. Interfaces may be provided between the various software modules and functions in wireless device 200 to enable communication between them, as is known in the art.

[0042] In a particular embodiment, the general processor 202 memory 204, and baseband processor 206 may be included in a system-on-chip device 216. The first and second SIMs 208a, 208b and their corresponding interfaces 210a, 210b may be external to the system-on-chip device 216. Further, various input and output devices may be coupled to components of the system-on-chip device 216, such as interfaces or controllers.

[0043] In the various embodiments, a multi-SIM wireless device 200 may determine how to handle an incoming voice call on one SIM while participating in an active call on the other SIM. In the various embodiments, a user on an active call with a first party may select to handle the incoming voice call in a "voice/text conversation mode." In the voice/text conversation mode, the user may "talk" to the incoming voice caller by receiving and sending text, thereby allowing the user to engage in a second simultaneous call. Advantageously, voice/text conversation mode does not require any corresponding mode change (for example, to text) by the caller, and causes no disruption to the active voice call on the other SIM.

[0044] FIGs. 3A and 3B illustrate an embodiment method 300 for using the voice/text conversation mode on a wireless device configured to perform text to speech and speech to text conversions. The operations of method 300 may be implemented by one or more processors of a dual-SIM device, such as a general processor 206, DSP (not shown separately) and/or baseband processor 216 in the wireless device 200 described above with reference to FIG. 2.

[0045] Referring to FIG. 3A, the voice/text conversation mode may be initiated in method 300. In block 302, the wireless device may receive an incoming voice call on an RF resource associated with SIM-1. The wireless device may determine, in determination block 304, whether a voice call is already active on the device on an RF-resource associated with a different SIM (i.e., SIM-2). If there is no active call on the wireless device (i.e., determination block 304 = "No"), the incoming voice call may be handled according to normal call processing in block 306. If there is another active voice call on a different SIM (i.e., determination block 304 = "Yes"), the wireless device may notify the user of the incoming voice call, such as by playing an audio clip, blinking lights, displaying a notification message, etc., in block 308. In block 310, the wireless device user may be prompted for input to select whether to activate the voice/text conversation mode for call processing. In determination block 312, the wireless device may determine whether user input to use voice/text conversation mode was received for processing the incoming voice call.

[0046] If input was received to use voice/text conversation mode for processing the incoming voice call (i.e., determination block 312 = "Yes"), in block 314 the wireless device may send a notification to the incoming voice caller indicating that the user intends to answer and converse using the speech-to-text and text-to-speech process. This notification alerts the incoming voice caller that responses to spoken words or questions will be delayed while the called party reads the caller's words as text and then replies with machine-generated speech. That way, the calling party understands how the conversation will take place and is not surprised by any

delay or hearing a computer-generated voice. Additionally, the calling party may choose to hang up if conversing in such a manner is not desirable. In block 316, the wireless device may convert the voice stream received from the incoming voice call into text, thus generating a transcription of the incoming voice call voice stream. In block 318, the wireless device may display the text transcript on a display of the multi-SIM wireless device.

[0047] If a user input was not received or the user declines to use the voice/text conversation mode for processing the incoming voice call (i.e., determination block 312 = "No"), the wireless device may determine whether the user input indicated a desire to use voice/text conversation mode for processing the active call (i.e., the first call), in determination block 320. If a user input was not received indicating a desire to use voice/text conversation mode for processing the active (i.e., first) call (i.e., determination block 320 = "No"), the wireless device may handle the incoming and active calls according to normal call processing methods (e.g., activating call-waiting, transferring the incoming voice call to voice mail, sending a pre-selected response, placing one of the calls on hold, etc.).

[0048] If a user input was received indicating a desire to the use voice/text conversation mode for processing the active (i.e., first) call (i.e., determination block 320 = "Yes"), the wireless device may send a notification to the active caller informing that party that user is about to switch to voice/text conversation mode in block 322. Again, this notification informs the first calling party that the user will be reading a transcript of the caller's speech and replying via text entry that will be played via a speech synthesizer. That way, the first calling party is not surprised by a sudden delay in responses or by hearing a computer-generated voice. Also as part of block 322, the incoming (i.e. second) called may be activated in the normal voice mode. In block 324, the wireless device may convert the voice stream from the previously active (i.e., first) call to text, generating a transcription of the active call voice stream. In block 326, the wireless device may display the text transcript

on the wireless device. The operations implemented in blocks 322 - 326 may be the same as those in blocks 314 - 318, but applied to the first call voice stream.

[0049] In an alternative embodiment, the wireless device may automatically perform the functions of determination blocks 312 and 320, without requiring user input. That is, the wireless device may automatically apply voice/text conversation mode to calls according to one or more pre-determined rules. For example, a user may designate a particular contact or group of contacts as "high priority." If an incoming voice call is received from such contact, upon determining that another active call exists through a different SIM on the DSDA device, the DSDA device may automatically convert the active call to the voice/text conversation mode to allow the user to answer the high priority call according to normal voice call processes without having to hang up on the first call. Other rules may include various selection criteria such as time of day, relative priority of calls, location of DSDA device when call is received, etc.

[0050] Referring now to FIG. 3B, which continues method 300, in block 328, the wireless device may receive text input from the user that the user intends to be sent in a voice stream to the caller (i.e., incoming voice caller or active caller). In block 330, the wireless device may convert the text input to speech data using text-to-speech conversion software, discussed in further detail below with respect to FIGs. 4A and 4B. In block 332, the wireless device may transmit the converted speech to the caller, such as via Modem1 or Modem2, depending on the applicable SIM. In determination block 334, the wireless device may determine whether the call that is operating in normal voice call processing mode on another SIM (i.e., not the call in voice/text conversation mode) has terminated. If the normal mode call has not terminated (i.e., determination block 334 = "No"), the wireless device repeats this determination as it continues to monitor the status of the normal mode call until that call is terminated.

[0051] When the wireless device processor determines that the normal mode call on the other SIM has terminated (i.e., determination block 334 = "Yes"), the wireless device may determine whether the voice/text conversation mode call should continue in voice/text conversation mode. This determination may involve informing the user that the second call may be converted to the normal mode, prompting the user for a further input, and handling that call according to a received user input. In an alternative embodiment, this determination may be based on pre-determined rules sets and/or default actions if a user does not respond to a prompt for input (e.g., automatically converting a speech/text conversion mode call to normal mode).

[0052] If the voice/text conversation mode call should not be kept in voice/text conversation mode (i.e., determination block 336 = "No"), the wireless device may switch that call to normal mode in determination block 336. If the voice/text conversation mode call should be kept in the voice/text conversation mode (i.e., determination block 336 = "Yes"), the wireless device may continue the voice/text conversation mode using cycles of speech to text and text to speech conversions.

[0053] The conversions of the caller's voice to text and the user's text input to voice may be accomplished using any of the various speech-to-text and text-to-speech conversion applications that are known in the art. FIGs. 4A and 4B illustrate in further detail the use of a TTS conversion engine and a STT conversion engine (for example, STT conversion engine 224 and TTS conversion engine 226 as shown in FIG. 2) implemented in the multi-SIM wireless device for voice/text conversation mode according to an embodiment.

[0054] Referring to FIG. 4A, an embodiment multi-SIM wireless device may receive a voice stream in a call from a third party device. The call may be, for example, an incoming voice call or active call as discussed above with respect to FIG. 3A. The voice stream may be encoded speech data modulated onto a carrier

RF signal, which the wireless device may receive, demodulate, and provide to a vocoder (e.g., vocoder 208).

[0055] The vocoder 208 may include an encoder to encode speech signals into speech data packets and a decoder to decode speech data packets into speech signals. The vocoder 102 may be any type of vocoder, such as an enhanced variable rate coder (EVRC), Adaptive Multi-Rate (AMR), Fourth Generation vocoder (4GV), etc.

[0056] Speech data packets may be decoded by the vocoder 208, and the decoded speech signal may be input to a STT conversion engine 224 to convert the speech data to text. In the various embodiments, the STT conversion engine 224 may include a speech recognition system 402, and a text generator 404. The components of the STT conversion engine 224 may be implemented as separate devices, or may be logically separate modules within the same device. The STT conversion engine 224 may output text data, which may be displayed to the wireless device user, for example, on touchscreen 230.

[0057] Referring to FIG. 4B, in order to "speak" to the caller in the voice/text conversation mode (i.e., during incoming voice call or active call), the wireless device may receive text inputs from the user via a user interface, such as a touch screen or keypad. Notably, this text input to respond in the voice/text conversation mode may be occurring while the user is also participating in a normal voice call on the network of the other SIM in the multi-SIM wireless device. The multi-SIM wireless device may receive text inputs from the keypad 228 in voice/text conversation mode, and the text may be input to a TTS conversion engine 228.

[0058] In the various embodiments, the TTS conversion engine 226 may include a text recognition system 406 and a pre-recorded message storage 408. For example, in initiating voice/text conversation mode, the wireless device may send a pre-recorded notification to the caller alerting that the user's speech will be machine-generated speech from a TTS conversion process, such as in blocks 314

and 322 as shown in FIG. 3A above. Such notifications may one of several pre-recorded options that may be selected by a user's input to the keypad 228. The components of the TTS conversion engine 226 may be implemented as separate devices, or may be logically separate modules within the same device.

[0059] The TTS conversion engine 226 may output data to the voice synthesizer 229, which may output a speech signal to the vocoder 208. The vocoder 208 may encode the speech signal into an encoded speech data packet, which may be modulated onto a carrier signal (not shown) and transmitted to the caller.

[0060] In an alternative embodiment, the conversion of user-inputted text into machine-generated speech and the conversion of the caller's speech into text while in voice/text conversation mode may be performed at a server to which the multi-SIM wireless device 200 may be connected. In an embodiment, the voice/text server may be integrated within a base station, and accessed through the access network of the SIM. In another embodiment, the voice/text server may be an independent server that is accessible to the wireless device over a wireless data network. For example, the wireless device 200 may be connected over WiFi to a voice/text server on a wireless data network.

[0061] Embodiments in which the conversions are performed on a network component (i.e., a voice/text server) may have a number of advantages, particularly for multi-SIM wireless devices that are not already configured with a TTS and/or STT conversion engine. Further, such embodiments allow sharing of processing resources such that multiple wireless devices may utilize the same conversion modules when operating in voice/text conversation mode. Further, server-based TTS and STT conversion engines may implement more sophisticated processing, leveraging the increased computing power available in servers compared to mobile communication devices.

[0062] FIG. 5 illustrates components of an embodiment voice/text server 500 and example data paths for conversion of text to voice and voice to text. Similar to

wireless device 200, the various conversion components implemented in the voice/text server 500 may be physically and/or logically separate, integrated, or a combination thereof. A processor 502 may be connected to a memory 504. The processor 502 may include one or more microprocessors, microcontrollers, and/or digital signal processors that provide processing functions, as well as other calculation and control functionality. The processor 502 may access memory 504 for reading/writing data and/or software instructions for executing programmed functionality. The memory 504 may be onboard the processor 502 (e.g., within the same IC package), and/or the memory may be external memory to the processor and functionally coupled over a data bus.

[0063] The voice/text server 500 may include a conversion unit 506 that has various conversion components and a network interface 508. The network interface 508, which may include a modem and/or RF resources, may be wired and/or wireless for communicating over wireless data networks. The processor 502 may be connected to the conversion unit 506. An example conversion unit 506 may be configured with conversion components including, but not limited to, a vocoder 510, a STT conversion engine 512, a TTS conversion engine 514, and a voice synthesizer 516. Also, similar to the conversion components shown in FIGs. 2 and 4, the STT conversion engine 512 implemented within a server may include a speech recognition system and text generator, and the TTS conversion engine 514 implemented within a server may include a text recognition system and storage of pre-recorded messages.

[0064] Example conversion processing pathways for both speech and text are illustrated in FIG. 5. The text/voice server 500 may receive encoded speech data packets from the multi-SIM wireless device 200 via the network interface 508. The encoded speech data may be decoded by the vocoder 510, and the decoded speech signals may be passed to the STT conversion engine 512. Text data output from the STT conversion engine may be transmitted back to the wireless device 200 through the network interface 508.

[0065] In another pathway, the server may receive text data from the multi-SIM wireless device 200 via the network interface 508, which may be passed to the TTS conversion engine 514. The TTS conversion engine 514 may use a voice synthesizer to generate speech signals emulating the words in the original text data. The vocoder 510 may encode those speech signals into speech data packets, which may be transmitted back to the wireless device 200 via the network interface.

[0066] Thus, the wireless data network may enable connections to a voice/text server 500 that may perform some or all of the conversion processes for the wireless device. This embodiment may be well suited implementations in which a wireless device lacks computational resources, battery power, etc. necessary to execute the speech/text conversion mode processes alone. This embodiment may also be useful for devices that are not configured with TTS and/or STT conversion engines.

[0067] FIG. 6 illustrates an embodiment method 600 for utilizing conversion capabilities on a server to perform speech to text and text to speech functions for a wireless device communication in voice/text conversation mode. The operations of method 600 may be implemented by one or more processors of a dual-SIM device, such as a baseband processor 206 in the wireless device 200 described above with reference to FIG. 2.

[0068] Method 600 may have similar steps to those of method 300 described above with reference to FIG. 3A. Specifically, method 600 may implement the same or similar processes as method 300 through determination blocks 314 and 322. In block 602, the wireless device may transmit to a server (e.g., voice/text server 500 as shown in FIG. 5) packets of speech data from the incoming voice call or active call, depending on the user's selection in determination blocks 312 and 320. In block 604, the wireless device may receive a text transcription of the speech data from the server. In block 606, the wireless device may display the text

transcription of the speech data. In block 608, the wireless device may receive user inputs in the form of text through an interface with a keypad, for example. In block 610, the wireless device may transmit packets of text data to the server for conversion into speech. In block 612, the wireless device may receive from the server encoded speech data packets including machine-generated speech data corresponding to the text data. Method 600 may proceed to determination block 334 of method 300, as shown in FIG. 3B, and may complete the remaining operations in method 300.

[0069] FIG. 7 illustrates an embodiment server method 700 for providing the conversion functions needed by the wireless device corresponding to method 600 illustrated in FIG. 6. In block 702, a server (e.g., the voice/text server 500 as shown in FIG. 5) may receive encoded speech data packets from a wireless device. In block 704, the server may convert the encoded speech data to a text representation (i.e., transcription) of the spoken words, using the components and/or operations discussed above with respect to FIG. 5. In block 706, the wireless device may transmit the text data to the wireless device via a data communication link. In block 708, the server may receive a text data packet from the wireless device via the data communication like. In block 710, the server may convert the received text data to encoded speech data using the components and/or operations discussed above with respect to FIG. 5. In block 712, the server may transmit encoded speech data packets to the wireless device.

[0070] The various embodiments may be implemented in any of a variety of wireless devices, an example of which is illustrated in FIG. 8. For example, the wireless device 800 may include a processor 802 coupled to internal memories 804 and 810. Internal memories 804 and 810 may be volatile or non-volatile memories, and may also be secure and/or encrypted memories, or unsecure and/or unencrypted memories, or any combination thereof. The processor 802 may also be coupled to a touch screen display 806, such as a resistive-sensing touch screen, capacitive-sensing touch screen infrared sensing touch screen, or the like.

Additionally, the display of the wireless device 800 need not have touch screen capability. Additionally, the wireless device 800 may have one or more antenna 808 for sending and receiving electromagnetic radiation that may be connected to one or more a wireless data link and/or cellular telephone transceiver 816 coupled to the processor 802. The wireless device 800 may also include physical buttons 812a and 812b for receiving user inputs. The wireless device 800 may also include a power button 818 for turning the wireless device 800 on and off. The wireless device 800 may also include a battery 820 coupled to the processor 802. The wireless device 800 may also include a position sensor 822, such as a GPS receiver, coupled to the processor 802.

[0071] The various embodiments described above may also be implemented within a variety of personal computing devices, such as a laptop computer 910 as illustrated in FIG. 9. Many laptop computers include a touch pad touch surface 917 that serves as the computer's pointing device, and thus may receive drag, scroll, and flick gestures similar to those implemented on mobile computing devices equipped with a touch screen display and described above. A laptop computer 910 will typically include a processor 911 coupled to volatile memory 912 and a large capacity nonvolatile memory, such as a disk drive 913 of Flash memory. The laptop computer 910 may also include a floppy disc drive 914 and a compact disc (CD) drive 915 coupled to the processor 911. The laptop computer 910 may also include a number of connector ports coupled to the processor 911 for establishing data connections or receiving external memory devices, such as a USB or FireWire® connector sockets, or other network connection circuits for coupling the processor 911 to a network.

[0072] In a notebook configuration, the computer housing includes the touchpad 917, the keyboard 918, and the display 919 all coupled to the processor 911. The laptop computer 910 may also include a battery 920 coupled to the processor 911. The laptop computer 910 may also include a position sensor 922, such as a GPS receiver, coupled to the processor 911. Additionally, the laptop computer 910 may

have one or more antenna 908 for sending and receiving electromagnetic radiation that may be connected to one or more a wireless data link and/or cellular telephone transceiver 916 coupled to the processor 911. Other configurations of the computing device may include a computer mouse or trackball coupled to the processor (e.g., via a USB input) as are well known, which may also be used in conjunction with the various embodiments.

[0073] The various embodiments may also be implemented on any of a variety of commercially available server devices, such as the server 1000 illustrated in FIG. 10. Such a server 1000 typically includes a processor 1001 coupled to volatile memory 1002 and a large capacity nonvolatile memory, such as a disk drive 1003. The server 1000 may also include a floppy disc drive, compact disc (CD) or DVD disc drive 1004 coupled to the processor 1001. The server 1000 may also include network access ports 1006 coupled to the processor 1001 for establishing network interface connections with a network 1007, such as a local area network coupled to other broadcast system computers and servers, the Internet, the public switched telephone network, and/or a cellular data network (e.g., CDMA, TDMA, GSM, PCS, 3G, 4G, LTE, or any other type of cellular data network).

[0074] The processors 602, 911, and 1001 may be any programmable microprocessor, microcomputer or multiple processor chip or chips that can be configured by software instructions (applications) to perform a variety of functions, including the functions of the various embodiments described above. In some devices, multiple processors may be provided, such as one processor dedicated to wireless communication functions and one processor dedicated to running other applications. Typically, software applications may be stored in the internal memory 804, 810, 912, 913, 1002, and 1003 before they are accessed and loaded into the processors 802, 911, and 1001. The processors 802, 911, and 1001 may include internal memory sufficient to store the application software instructions. In many devices the internal memory may be a volatile or nonvolatile memory, such as flash memory, or a mixture of both. For the purposes of this

description, a general reference to memory refers to memory accessible by the processors 802, 911, and 1001 including internal memory or removable memory plugged into the device and memory within the processor 802, 911, and 1001 themselves.

[0075] The foregoing method descriptions and the process flow diagrams are provided merely as illustrative examples and are not intended to require or imply that the steps of the various embodiments must be performed in the order presented. As will be appreciated by one of skill in the art the order of steps in the foregoing embodiments may be performed in any order. Words such as "thereafter," "then," "next," etc. are not intended to limit the order of the steps; these words are simply used to guide the reader through the description of the methods. Further, any reference to claim elements in the singular, for example, using the articles "a," "an" or "the" is not to be construed as limiting the element to the singular.

[0076] The various illustrative logical blocks, modules, circuits, and algorithm steps described in connection with the embodiments disclosed herein may be implemented as electronic hardware, computer software, or combinations of both. To clearly illustrate this interchangeability of hardware and software, various illustrative components, blocks, modules, circuits, and steps have been described above generally in terms of their functionality. Whether such functionality is implemented as hardware or software depends upon the particular application and design constraints imposed on the overall system. Skilled artisans may implement the described functionality in varying ways for each particular application, but such implementation decisions should not be interpreted as causing a departure from the scope of the present invention.

[0077] The hardware used to implement the various illustrative logics, logical blocks, modules, and circuits described in connection with the aspects disclosed herein may be implemented or performed with a general purpose processor, a

digital signal processor (DSP), an application specific integrated circuit (ASIC), a field programmable gate array (FPGA) or other programmable logic device, discrete gate or transistor logic, discrete hardware components, or any combination thereof designed to perform the functions described herein. A general-purpose processor may be a microprocessor, but, in the alternative, the processor may be any conventional processor, controller, microcontroller, or state machine. A processor may also be implemented as a combination of computing devices, e.g., a combination of a DSP and a microprocessor, a plurality of microprocessors, one or more microprocessors in conjunction with a DSP core, or any other such configuration. Alternatively, some steps or methods may be performed by circuitry that is specific to a given function.

[0078] In one or more exemplary aspects, the functions described may be implemented in hardware, software, firmware, or any combination thereof. If implemented in software, the functions may be stored as one or more instructions or code on a non-transitory processor-readable storage medium. The steps of a method or algorithm disclosed herein may be embodied in a processor-executable software module which may reside on a non-transitory computer-readable storage medium. Tangible, non-transitory processor-readable storage media may be any available media that may be accessed by a processor of a computer, mobile computing device or a wireless communication device. By way of example, and not limitation, such non-transitory processor-readable media may comprise RAM, ROM, EEPROM, CD-ROM or other optical disk storage, magnetic disk storage or other magnetic storage devices, or any other medium that may be used to store desired program code in the form of instructions or data structures and that may be accessed by a processor of a computing device. Disk and disc, as used herein, includes compact disc (CD), laser disc, optical disc, digital versatile disc (DVD), floppy disk, and blu-ray disc where disks usually reproduce data magnetically, while discs reproduce data optically with lasers. Combinations of the above should also be included within the scope of non-transitory processor-readable media. Additionally, the operations of a method or algorithm may reside as one or any

combination or set of codes and/or instructions on a tangible, non-transitory machine readable medium and/or non-transitory processor-readable medium, which may be incorporated into a computer program product.

[0079] The preceding description of the disclosed embodiments is provided to enable any person skilled in the art to make or use the present invention. Various modifications to these embodiments will be readily apparent to those skilled in the art, and the generic principles defined herein may be applied to other embodiments without departing from the spirit or scope of the invention. Thus, the present invention is not intended to be limited to the embodiments shown herein but is to be accorded the widest scope consistent with the following claims and the principles and novel features disclosed herein.

CLAIMS

What is claimed is:

1. A method of maintaining simultaneous active calls on a multi-SIM wireless device, comprising:

receiving an incoming voice call on a first radio frequency (RF) resource associated with a first SIM;

determining whether the wireless device has an active voice call on a second RF resource associated with a second SIM; and

entering a voice/text conversation mode in response to determining that the wireless device has an active voice call on the second RF resource associated with the second SIM,

wherein the voice/text conversation mode comprises:

converting a caller's speech into text data;

displaying the text data on the wireless device;

receiving text inputs from a user;

converting the text inputs into machine-generated speech; and

transmitting the machine-generated speech to the caller.

2. The method of claim 1, wherein entering a voice/text conversation mode in response to determining that the wireless device has an active voice call on the second RF resource associated with the second SIM comprises:

notifying the user of the incoming voice call;

selecting whether to enter the voice/text conversation mode; and

determining which call will enter the voice/text conversation mode in response to selecting to enter the voice/text conversation mode.

3. The method of claim 2, wherein selecting whether to enter the voice/text conversation mode comprises outputting a prompt for user input and making a selection according to a user input received in response to the prompt.

4. The method of claim 2, wherein determining which call will enter the voice/text conversation mode is based on a user input.

5. The method of claim 2, further comprising sending a notification to the incoming voice caller that the call will be conducted in voice/text conversation mode in response to receiving a user input selecting the incoming voice call for voice/text conversation mode.

6. The method of claim 2, further comprising sending a notification to the active caller that the call will be switched to voice/text conversation mode in response to receiving a user input selecting the active call for voice/text conversation mode.

7. The method of claim 1, wherein entering a voice/text conversation mode in response to determining that the wireless device has an active voice call on the second RF resource associated with the second SIM comprises:

notifying the user of the incoming voice call; and

automatically entering the voice/text conversation mode when a set of pre-determined rules are satisfied.

8. The method of claim 5, further comprising:

determining whether the active call has terminated; and

requesting user input for selecting whether to end the voice/text conversation mode on the incoming voice call in response to determining that the active call has terminated.

9. The method of claim 1, wherein sending a notification to a caller of the incoming voice call that the call is being conducted in the voice/text conversation mode comprises sending a pre-recorded audio message to the caller, wherein the pre-recorded audio message informs the caller that the caller's voice will be

converted to text for display to the user and user responses will be heard via machine-generated speech.

10. The method of claim 1, wherein:

converting a caller's speech into text data comprises:

sending a caller's speech to a server capable of speech-to-text conversion; and

receiving from the server a text transcription of the caller's speech; and

converting the text inputs into machine-generated speech comprises:

sending the text inputs to a server configured to convert text into machine-generated speech data; and

receiving from the server speech data packets including the machine-generated speech data.

11. A multi-SIM wireless device, comprising:

a first SIM;

a second SIM;

a display

a memory;

a first radio frequency (RF) resource associated with the first SIM;

a second RF resource associated with the second SIM; and

a processor coupled to the first and second SIMs, the display, the memory, the first and second RF resources, wherein the processor is configured with processor-executable instructions to perform operations comprising:

receiving an incoming voice call on the first RF resource associated with the first SIM;

determining whether the wireless device has an active voice call on the second RF resource associated with the second SIM; and

entering a voice/text conversation mode in response to determining that the wireless device has an active voice call on the second RF resource associated with the second SIM,

wherein the voice/text conversation mode comprises:

converting a caller's speech into text data using a speech-to-text (STT) conversion engine;

displaying the text data on the wireless device;

receiving text inputs from a user;

converting the text inputs into machine-generated speech using a text-to-speech (TTS) conversion engine; and

transmitting the machine-generated speech to the caller.

12. The multi-SIM wireless device of claim 11, wherein the processor is configured with processor-executable instructions to perform operations such that entering a voice/text conversation mode in response to determining that the wireless device has an active voice call on the second RF resource associated with the second SIM comprises:

notifying the user of the incoming voice call;

selecting whether to enter the voice/text conversation mode; and

determining which call will enter the voice/text conversation mode in response to selecting to enter the voice/text conversation mode.

13. The multi-SIM wireless device of claim 12, wherein the processor is configured with processor-executable instructions to perform operations such that selecting whether to enter the voice/text conversation mode comprises outputting a prompt for user input and making a selection according to a user input received in response to the prompt.

14. The multi-SIM wireless device of claim 12, wherein the processor is configured with processor-executable instructions to perform operations such that

determining which call will enter the voice/text conversation mode is based on a user input.

15. The multi-SIM wireless device of claim 12, wherein the processor is configured with processor-executable instructions to perform operations further comprising:

sending a notification to the incoming voice caller that the call will be conducted in voice/text conversation mode in response to receiving a user input selecting the incoming voice call for voice/text conversation mode.

16. The multi-SIM wireless device of claim 12, wherein the processor is configured with processor-executable instructions to perform operations further comprising:

sending a notification to the active caller that the call will be switched to voice/text conversation mode in response to receiving a user input selecting the active call for voice/text conversation mode.

17. The multi-SIM wireless device of claim 11, wherein the processor is configured with processor-executable instructions to perform operations such that entering a voice/text conversation mode in response to determining that the wireless device has an active voice call on the second RF resource associated with the second SIM comprises:

notifying the user of the incoming voice call; and

automatically entering the voice/text conversation mode when a set of pre-determined rules are satisfied.

18. The multi-SIM wireless device of claim 15, wherein the processor is configured with processor-executable instructions to perform operations further comprising:

determining whether the active call has terminated; and

requesting user input for selecting whether to end the voice/text conversation mode on the incoming voice call in response to determining that the active call has terminated.

19. The multi-SIM wireless device of claim 11, wherein the processor is configured with processor-executable instructions to perform operations such that sending a notification to a caller of the incoming voice call that the call is being conducted in the voice/text conversation mode comprises:

sending a pre-recorded audio message to the caller, wherein the pre-recorded audio message informs the caller that the caller's voice will be converted to text for display to the user and user responses will be heard via machine-generated speech.

20. The multi-SIM wireless device of claim 11, wherein the processor is configured with processor-executable instructions to perform operations such that:

converting a caller's speech into text data using a speech-to-text (STT) conversion engine comprises:

sending a caller's speech to a server configured with an STT conversion engine; and

receiving from the server a text transcription of the caller's speech; and

converting the text inputs into machine-generated speech using a text-to-speech (TTS) conversion engine comprises:

sending the text inputs to a server configured with a TTS conversion engine; and

receiving from the server speech data packets including the machine-generated speech data.

21. A multi-SIM wireless device, comprising:

means for receiving an incoming voice call on a first radio frequency (RF) resource associated with a first SIM;

means for determining whether the wireless device has an active voice call on a second RF resource associated with a second SIM;

means for entering a voice/text conversation mode in response to determining that the wireless device has an active voice call on the second RF resource associated with the second SIM,

means for converting a caller's speech into text data;

means for displaying the text data on the wireless device;

means for receiving text inputs from a user;

means for converting the text inputs into machine-generated speech; and

means for transmitting the machine-generated speech to the caller.

22. The multi-SIM wireless device of claim 21, wherein means for entering a voice/text conversation mode in response to determining that the wireless device has an active voice call on the second RF resource associated with the second SIM comprises:

means for notifying the user of the incoming voice call;

means for selecting whether to enter the voice/text conversation mode; and

means for determining which call will enter the voice/text conversation mode in response to selecting to enter the voice/text conversation mode.

23. The multi-SIM wireless device of claim 22, wherein means for selecting whether to enter the voice/text conversation mode comprises:

means for outputting a prompt for user input; and

means for making a selection according to a user input received in response to the prompt.

24. The multi-SIM wireless device of claim 22, wherein means for determining which call will enter the voice/text conversation mode is based on a user input.

25. The multi-SIM of claim 22, further comprising sending a notification to the incoming voice caller that the call will be conducted in voice/text conversation mode in response to receiving a user input selecting the incoming voice call for voice/text conversation mode.

26. The multi-SIM wireless device of claim 22, further comprising:

means for sending a notification to the active caller that the call will be switched to voice/text conversation mode in response to receiving a user input selecting the active call for voice/text conversation mode.

27. The multi-SIM wireless device of claim 21, wherein means for entering a voice/text conversation mode in response to determining that the wireless device has an active voice call on the second RF resource associated with the second SIM comprises:

means for notifying the user of the incoming voice call; and

means for automatically entering the voice/text conversation mode when a set of pre-determined rules are satisfied.

28. The multi-SIM wireless device of claim 5, further comprising:

means for determining whether the active call has terminated; and

means for requesting user input for selecting whether to end the voice/text conversation mode on the incoming voice call in response to determining that the active call has terminated.

29. The multi-SIM wireless device of claim 21, wherein means for sending a notification to a caller of the incoming voice call that the call is being conducted in the voice/text conversation mode comprises:

means for sending a pre-recorded audio message to the caller, wherein the pre-recorded audio message informs the caller that the caller's voice will be converted to text for display to the user and user responses will be heard via machine-generated speech.

30. The multi-SIM wireless device of claim 21, wherein:

means for converting a caller's speech into text data comprises:

means for sending a caller's speech to a server capable of speech-to-text conversion; and

means for receiving from the server a text transcription of the caller's speech; and

means for converting the text inputs into machine-generated speech comprises:

means for sending the text inputs to a server configured to convert text into machine-generated speech data; and

means for receiving from the server speech data packets including the machine-generated speech data.

31. A non-transitory processor-readable storage medium having stored thereon processor-executable instructions configured to cause a multi-SIM wireless device processor to perform operations comprising:

receiving an incoming voice call on a first radio frequency (RF) resource associated with a first SIM;

determining whether the wireless device has an active voice call on a second RF resource associated with a second SIM; and

entering a voice/text conversation mode in response to determining that the wireless device has an active voice call on the second RF resource associated with the second SIM,

wherein the voice/text conversation mode comprises:

converting a caller's speech into text data;

displaying the text data on the wireless device;

receiving text inputs from a user;

converting the text inputs into machine-generated speech; and

transmitting the machine-generated speech to the caller.

32. The non-transitory processor-readable storage medium of claim 31, wherein the stored processor-executable instructions are configured to cause the multi-SIM wireless device processor to perform operations such that entering a voice/text conversation mode in response to determining that the wireless device has an active voice call on the second RF resource associated with the second SIM comprises:

notifying the user of the incoming voice call;

selecting whether to enter the voice/text conversation mode; and

determining which call will enter the voice/text conversation mode in response to selecting to enter the voice/text conversation mode.

33. The non-transitory processor-readable storage medium of claim 32, wherein the stored processor-executable instructions are configured to cause the multi-SIM wireless device processor to perform operations such that selecting whether to enter the voice/text conversation mode comprises:

outputting a prompt for user input; and

making a selection according to a user input received in response to the prompt.

34. The non-transitory processor-readable storage medium of claim 32, wherein the stored processor-executable instructions are configured to cause the multi-SIM wireless device processor to perform operations such determining which call will enter the voice/text conversation mode is based on a user input.

35. The non-transitory processor-readable storage medium of claim 32, wherein the stored processor-executable instructions are configured to cause the multi-SIM wireless device processor to perform operations further comprising:

sending a notification to the incoming voice caller that the call will be conducted in voice/text conversation mode in response to receiving a user input selecting the incoming voice call for voice/text conversation mode.

36. The non-transitory processor-readable storage medium of claim 32, wherein the stored processor-executable instructions are configured to cause the multi-SIM wireless device processor to perform operations further comprising:

sending a notification to the active caller that the call will be switched to voice/text conversation mode in response to receiving a user input selecting the active call for voice/text conversation mode.

37. The non-transitory processor-readable storage medium of claim 31, wherein the stored processor-executable instructions are configured to cause the multi-SIM wireless device processor to perform operations such that entering a voice/text conversation mode in response to determining that the wireless device has an active voice call on the second RF resource associated with the second SIM comprises:

notifying the user of the incoming voice call; and

automatically entering the voice/text conversation mode when a set of pre-determined rules are satisfied.

38. The non-transitory processor-readable storage medium of claim 35, wherein the stored processor-executable instructions are configured to cause the multi-SIM wireless device processor to perform operations further comprising:

determining whether the active call has terminated; and

requesting user input for selecting whether to end the voice/text conversation mode on the incoming voice call in response to determining that the active call has terminated.

39. The non-transitory processor-readable storage medium of claim 31, wherein the stored processor-executable instructions are configured to cause the multi-SIM wireless device processor to perform operations such that sending a notification to a caller of the incoming voice call that the call is being conducted in the voice/text conversation mode comprises:

sending a pre-recorded audio message to the caller, wherein the pre-recorded audio message informs the caller that the caller's voice will be converted to text for display to the user and user responses will be heard via machine-generated speech.

40. The non-transitory processor-readable storage medium of claim 31, wherein the stored processor-executable instructions are configured to cause the multi-SIM wireless device processor to perform operations such that:

converting a caller's speech into text data comprises:

sending a caller's speech to a server capable of speech-to-text conversion; and

receiving from the server a text transcription of the caller's speech; and

converting the text inputs into machine-generated speech comprises:

sending the text inputs to a server configured to convert text into machine-generated speech data; and

receiving from the server speech data packets including the machine-generated speech data.

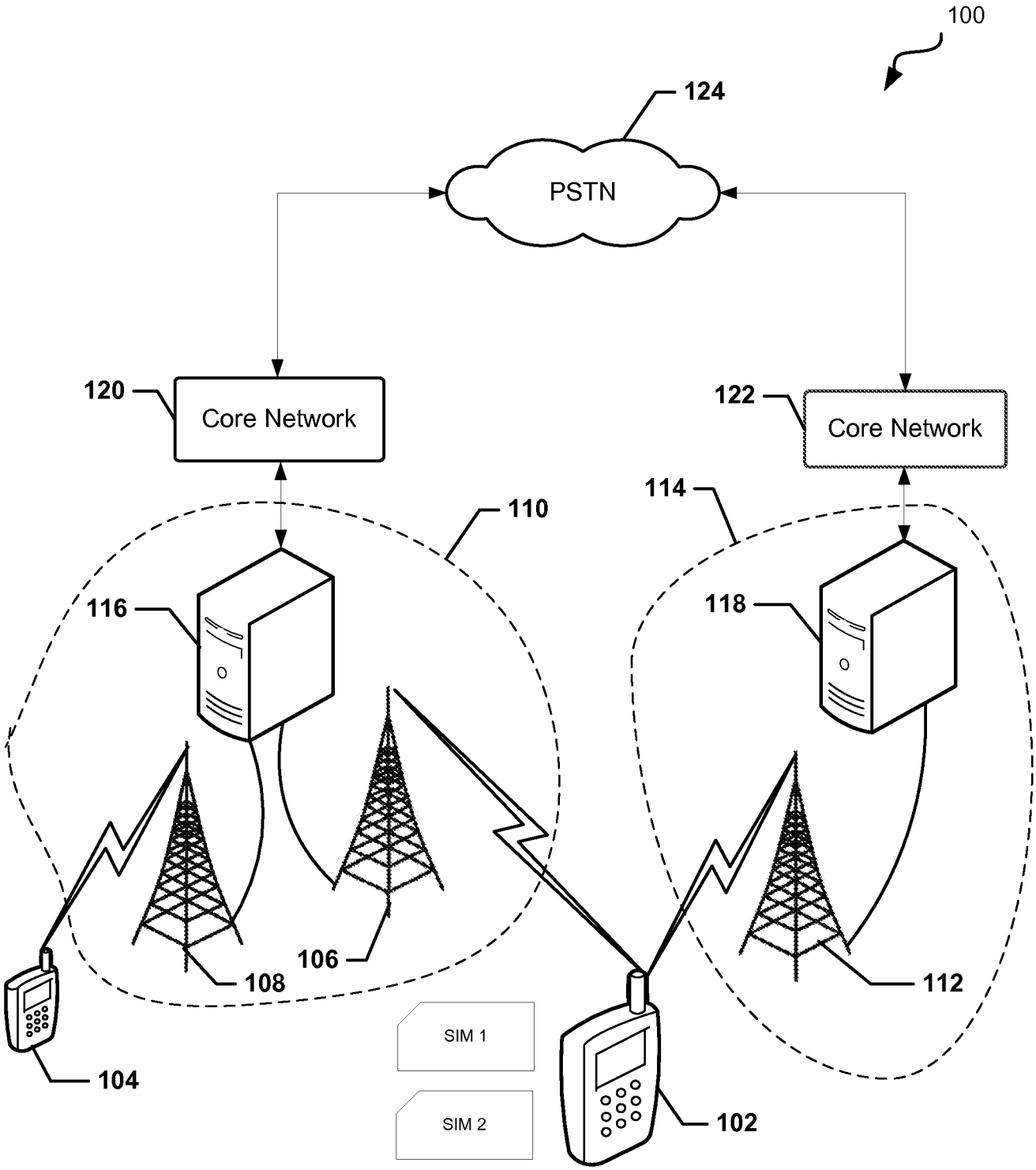

100
124
PSTN
120
Core Network
122
Core Network
110
114
116
118
106
108
112
SIM 1
SIM 2
104
102

FIG. 1

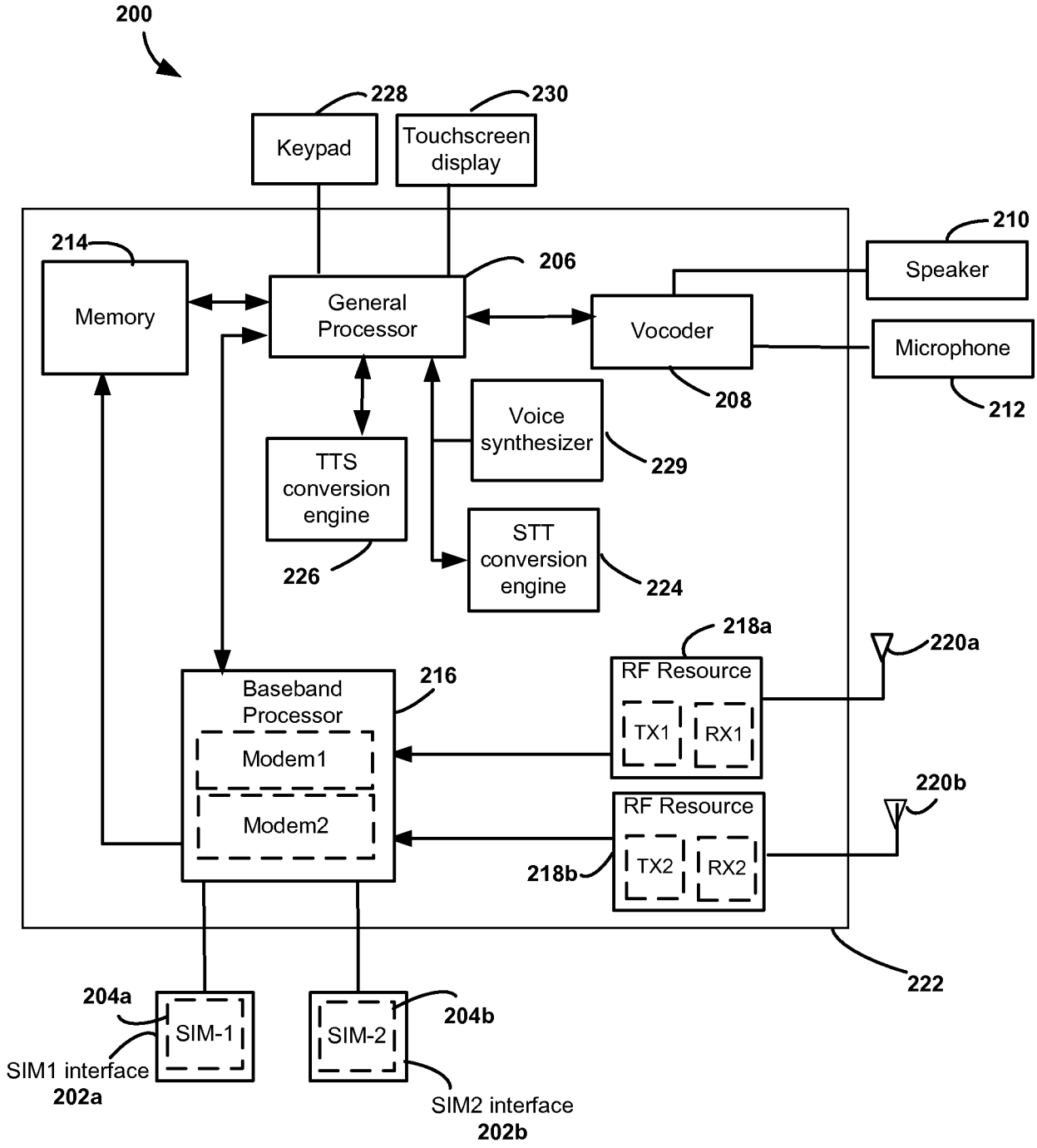

200
228
230
Keypad
Touchscreen display
214
Memory
206
General Processor
210
Speaker
Vocoder
Microphone
208
212
Voice synthesizer
229
TTS conversion engine
226
STT conversion engine
224
218a
220a
RF Resource
TX1
RX1
216
Baseband Processor
Modem1
Modem2
220b
RF Resource
TX2
RX2
218b
222
204a
SIM-1
SIM1 interface
202a
SIM-2
204b
SIM2 interface
202b

FIG. 2

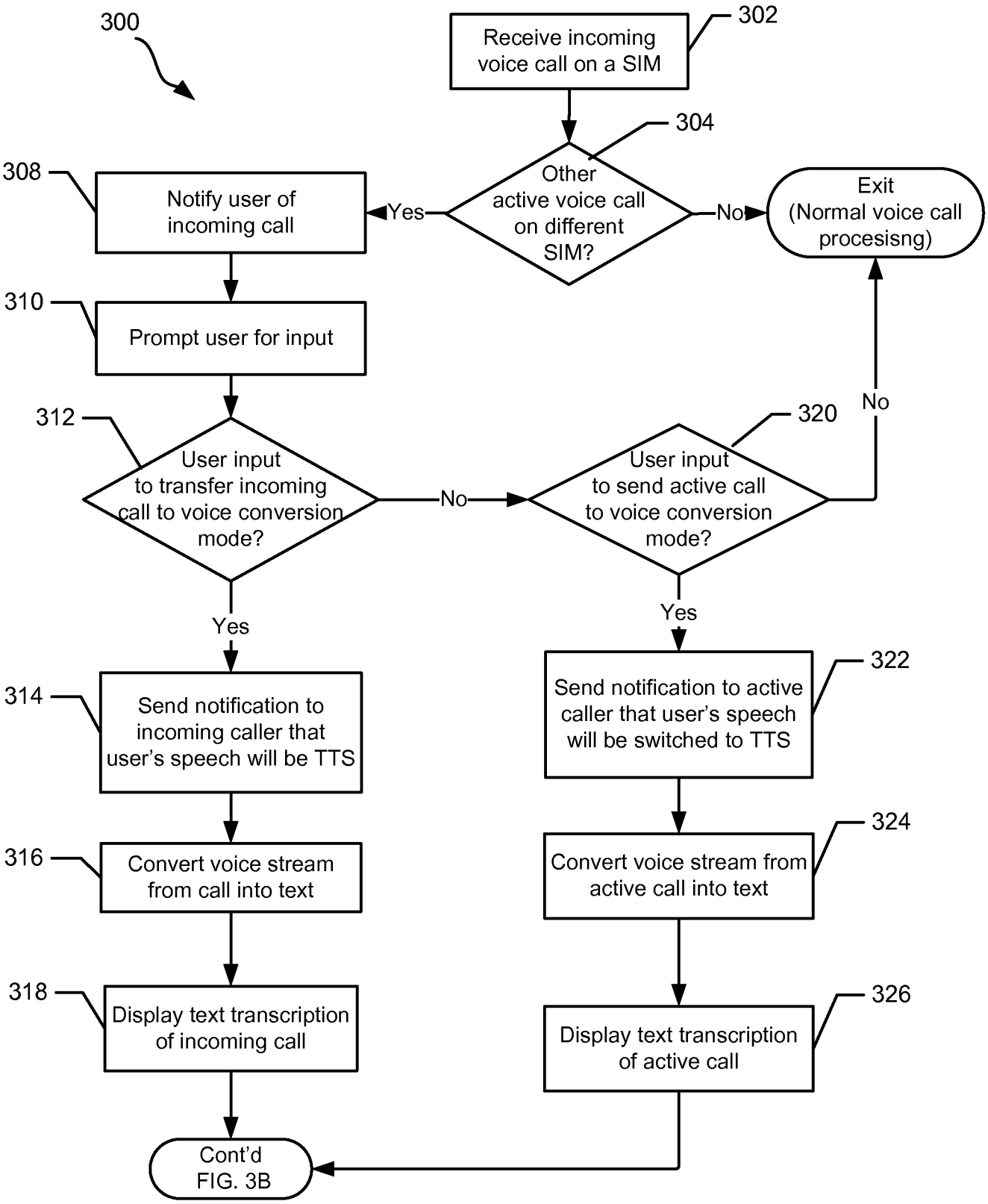

300
Receive incoming voice call on a SIM
302
304
Other active voice call on different SIM?
Yes
No
Exit (Normal voice call procesisng)
308
Notify user of incoming call
310
Prompt user for input
312
User input to transfer incoming call to voice conversion mode?
No
320
User input to send active call to voice conversion mode?
No
Yes
Yes
314
Send notification to incoming caller that user's speech will be TTS
316
Convert voice stream from call into text
318
Display text transcription of incoming call
322
Send notification to active caller that user's speech will be switched to TTS
324
Convert voice stream from active call into text
326
Display text transcription of active call
Cont'd FIG. 3B

FIG. 3A

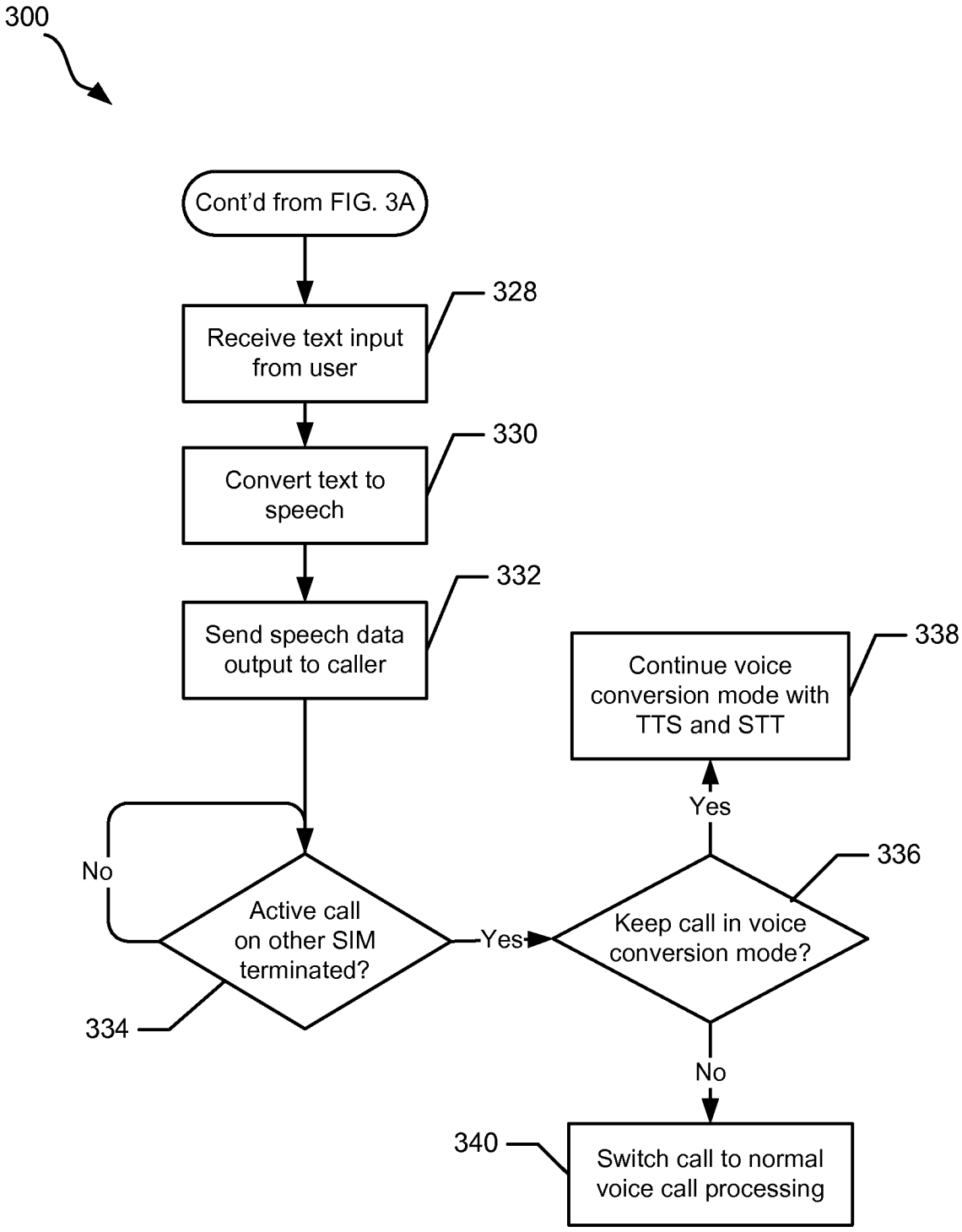

300
Cont'd from FIG. 3A
Receive text input from user
328
Convert text to speech
330
Send speech data output to caller
332
Active call on other SIM terminated?
334
No
Yes
Keep call in voice conversion mode?
336
Yes
Continue voice conversion mode with TTS and STT
338
No
Switch call to normal voice call processing
340

FIG. 3B

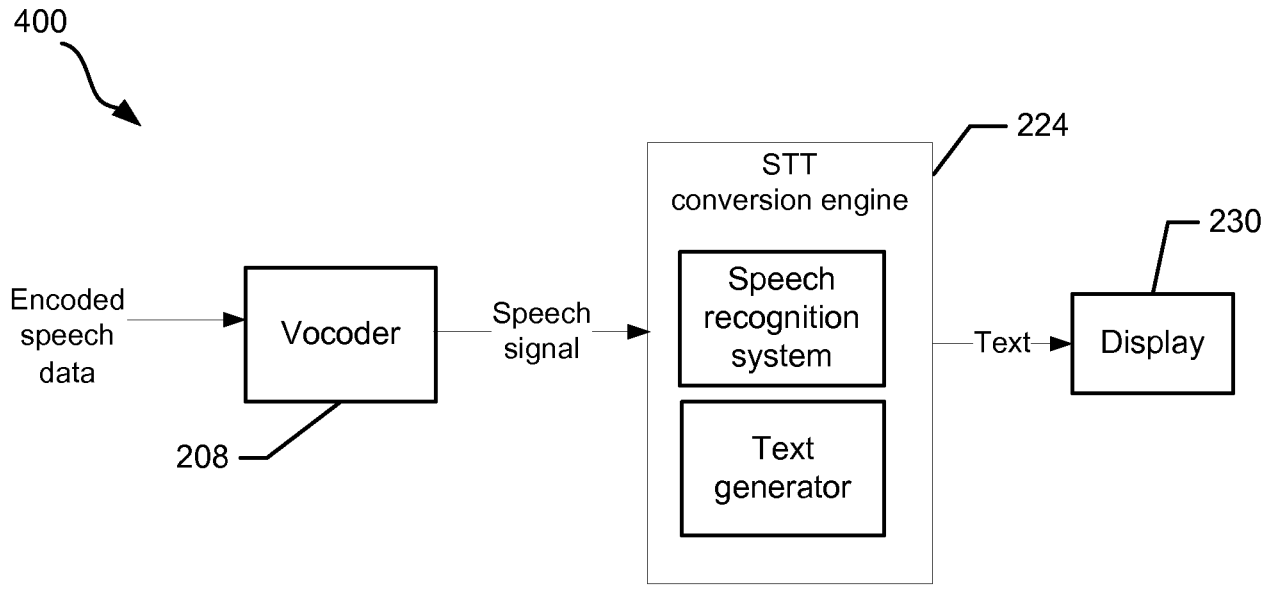

400
224
STT
conversion engine
230
Encoded
speech
data
Vocoder
Speech
signal
Speech
recognition
system
Text
Display
Text
generator
208

FIG. 4A

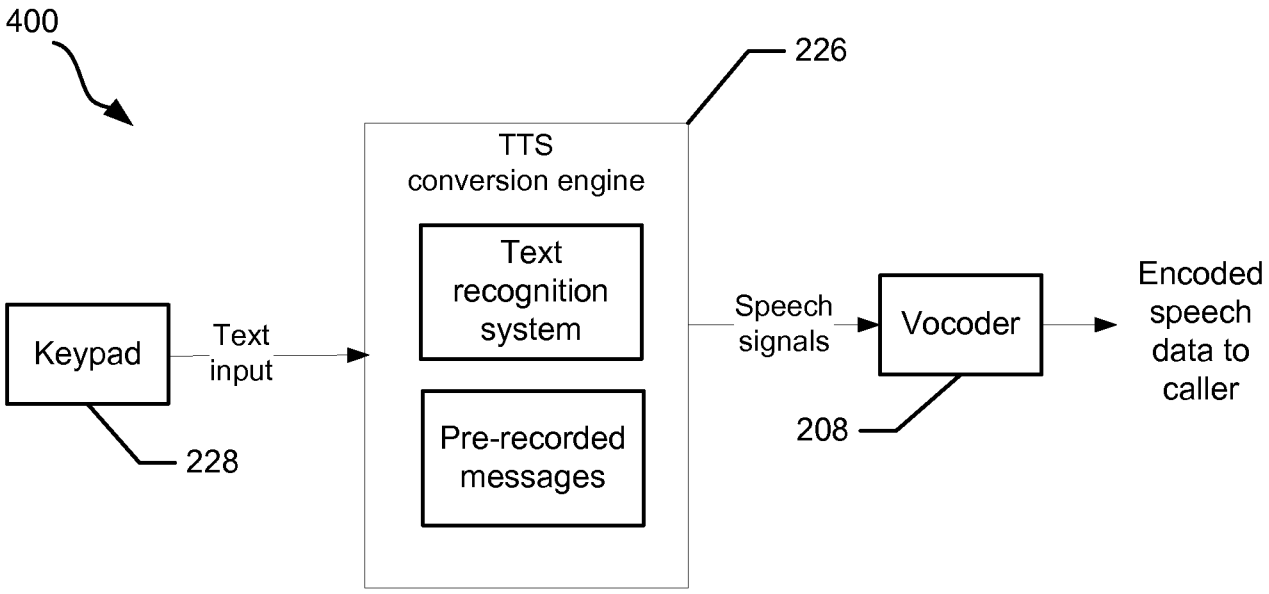

400
226
TTS
conversion engine
Text
recognition
system
Keypad
Text
input
Speech
signals
Vocoder
Encoded
speech
data to
caller
Pre-recorded
messages
208
228

FIG. 4B

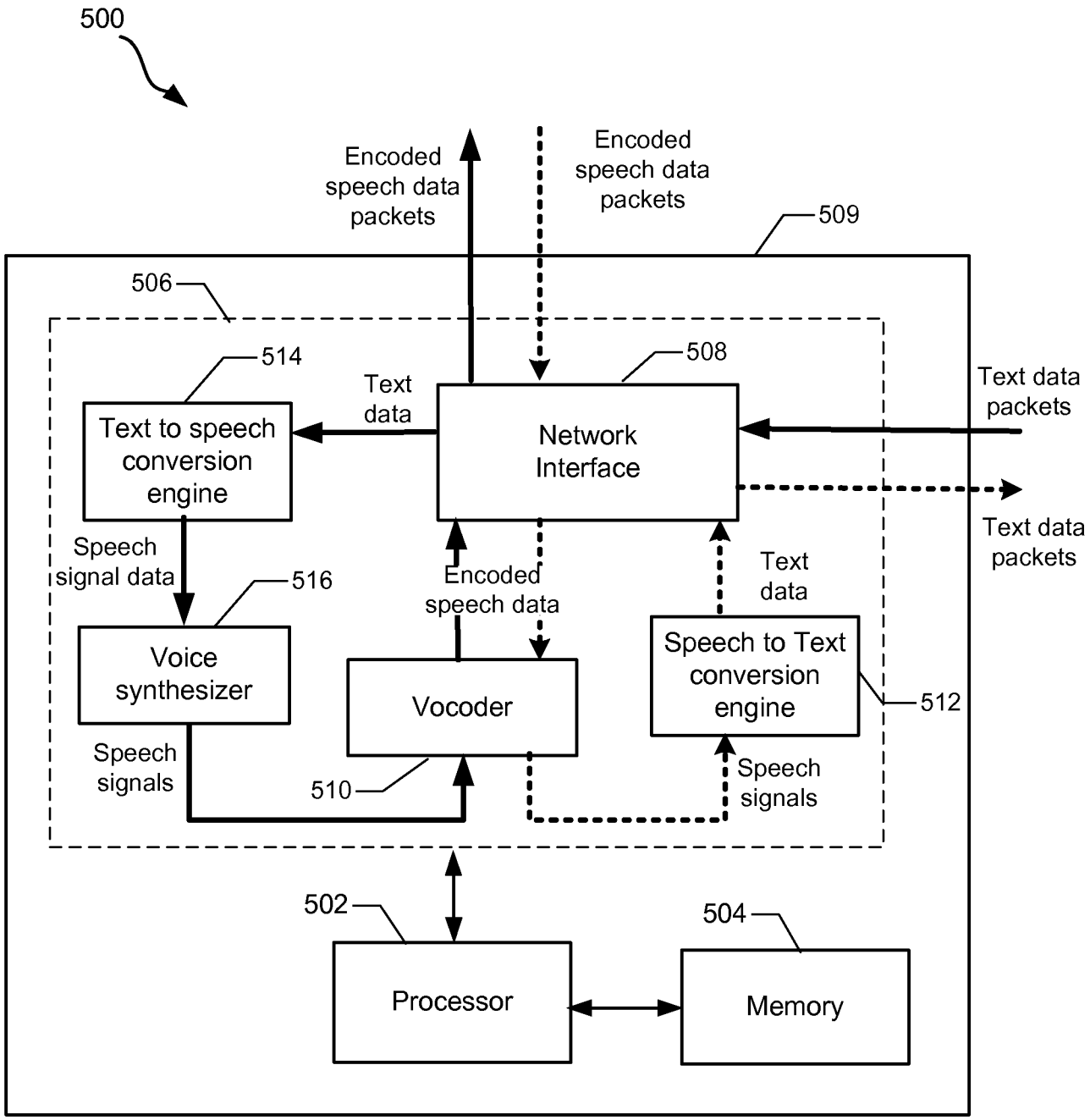

500
Encoded speech data packets
Encoded speech data packets
509
506
514
508
Text data
Text data packets
Text to speech conversion engine
Network Interface
Speech signal data
516
Encoded speech data
Text data
Text data packets
Voice synthesizer
Vocoder
Speech to Text conversion engine
512
Speech signals
510
Speech signals
502
504
Processor
Memory

FIG. 5

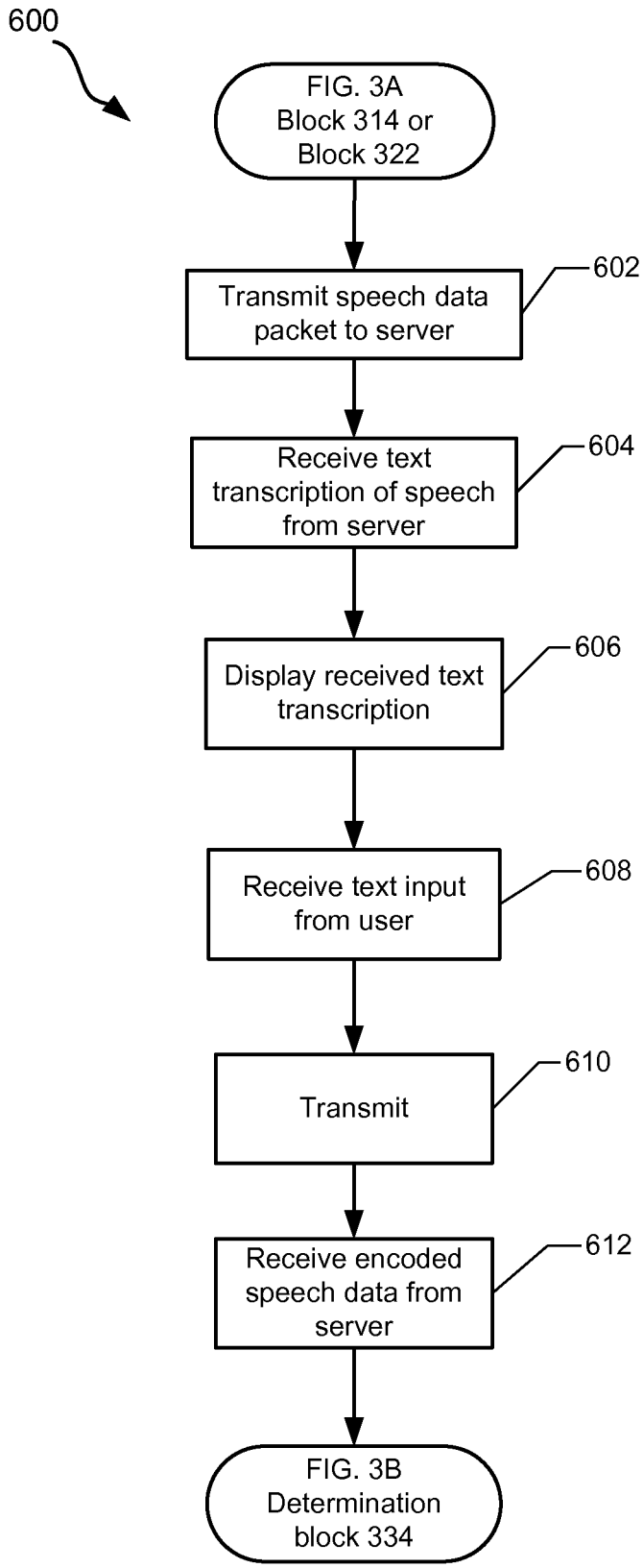

600
FIG. 3A
Block 314 or
Block 322
Transmit speech data packet to server
602
Receive text transcription of speech from server
604
Display received text transcription
606
Receive text input from user
608
Transmit
610
Receive encoded speech data from server
612
FIG. 3B
Determination
block 334

FIG. 6

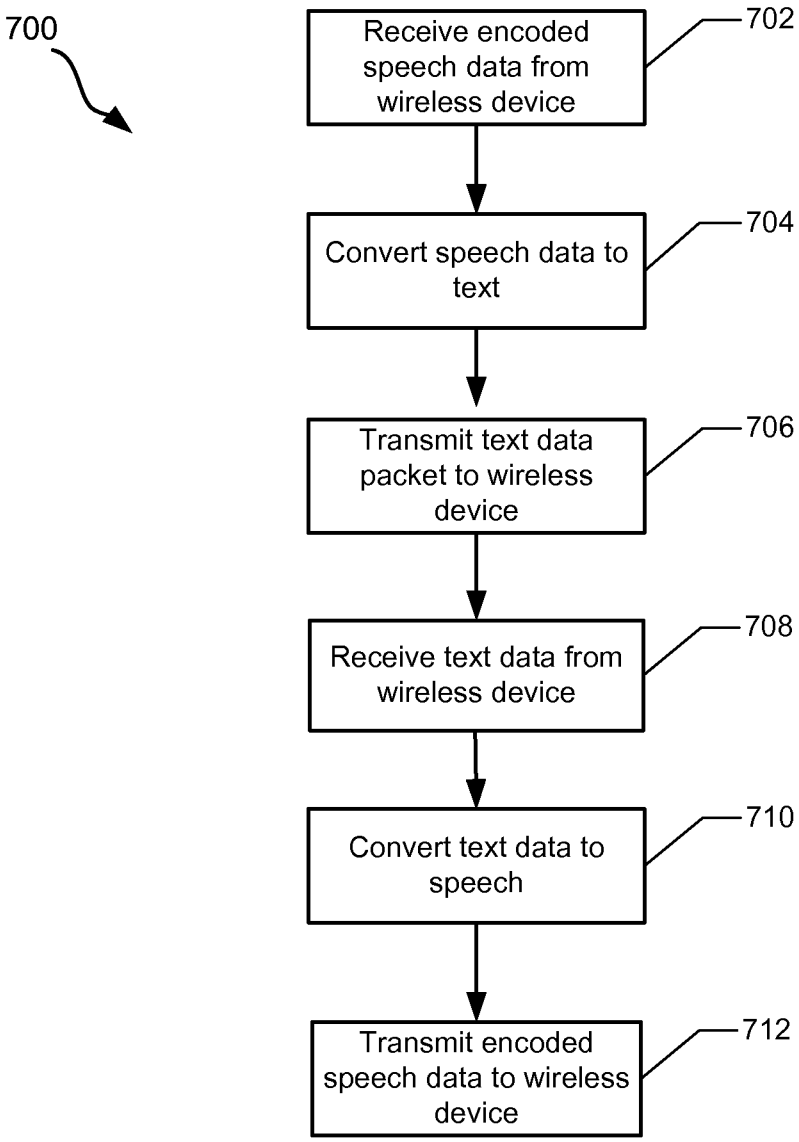

700
Receive encoded speech data from wireless device
702
Convert speech data to text
704
Transmit text data packet to wireless device
706
Receive text data from wireless device
708
Convert text data to speech
710
Transmit encoded speech data to wireless device
712

FIG. 7

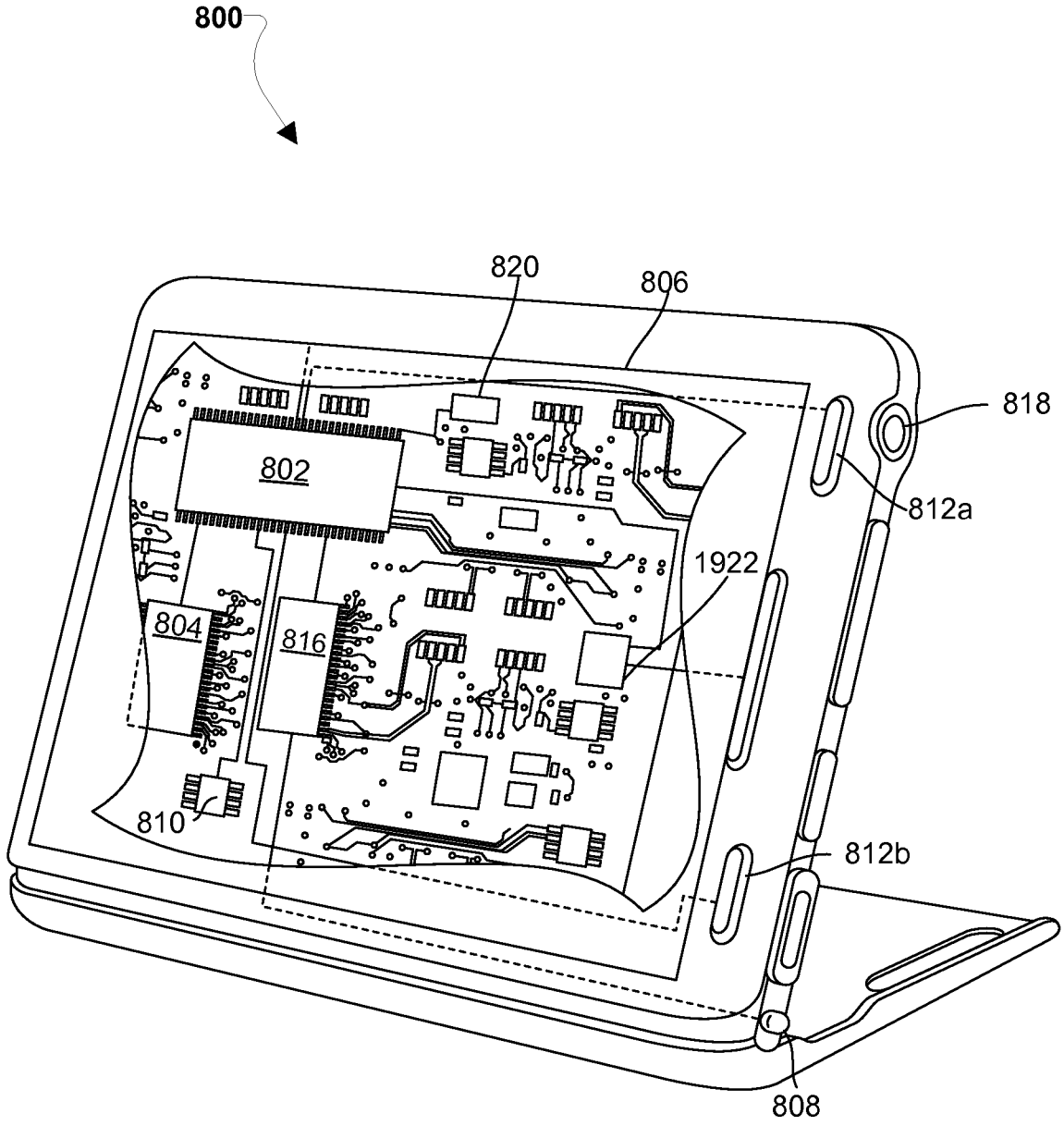


FIG. 8

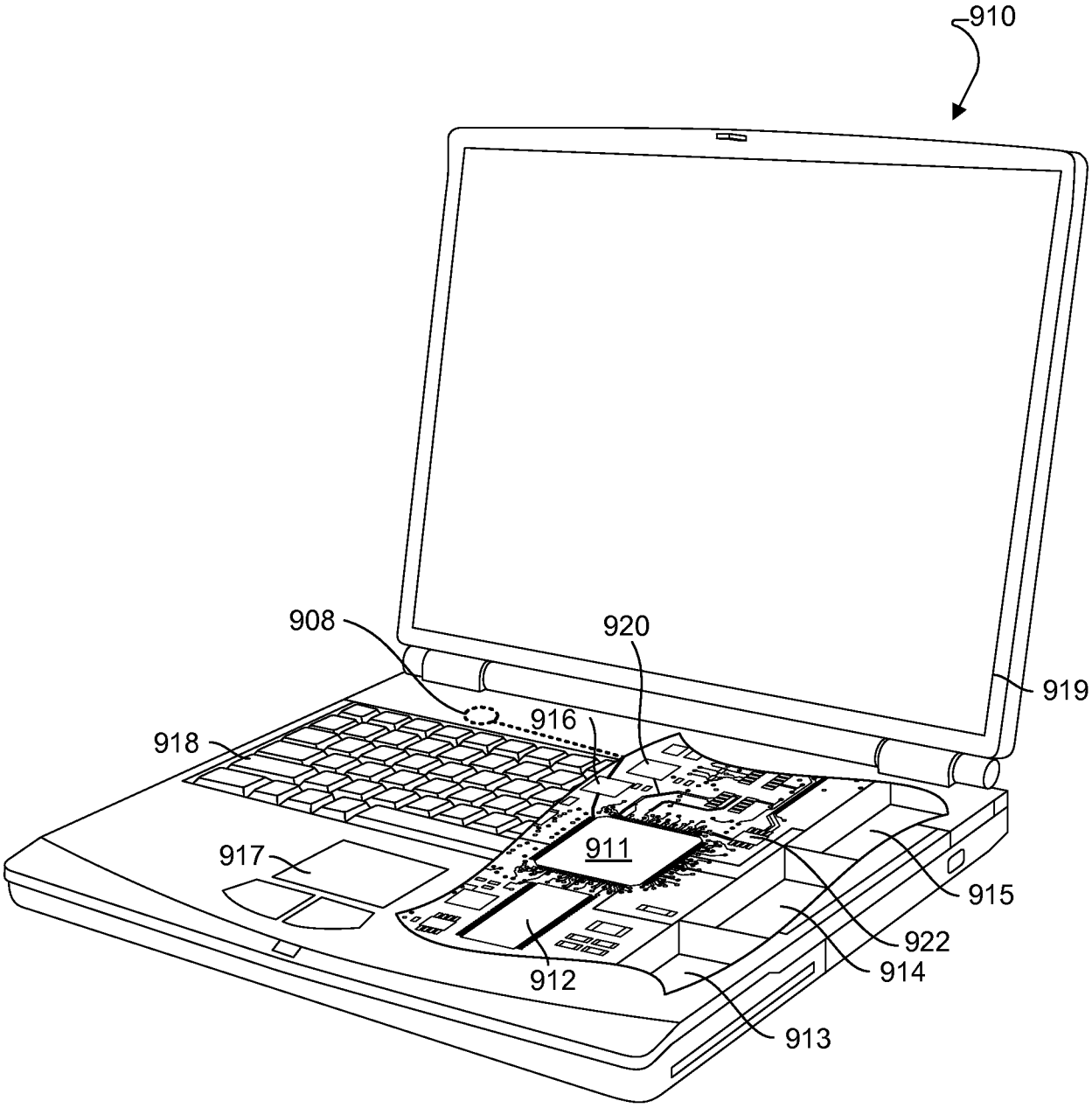


FIG. 9

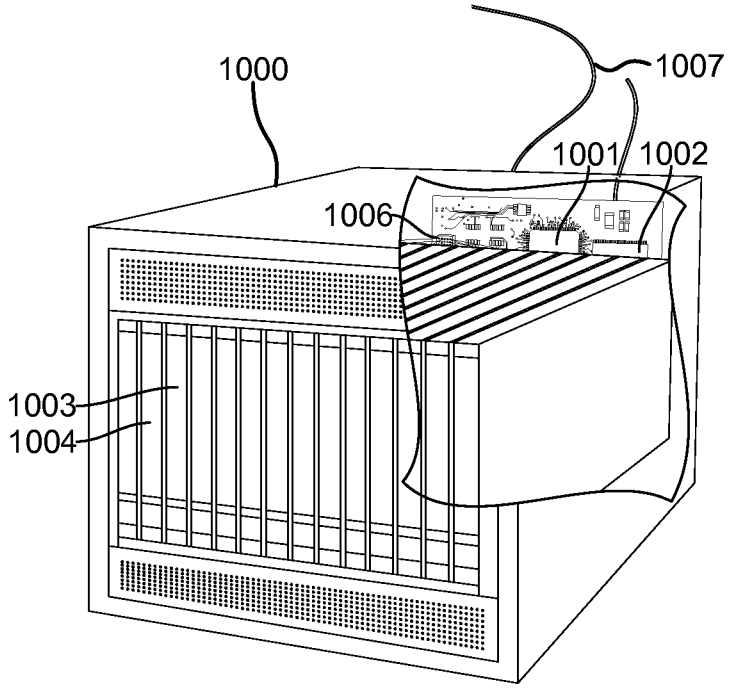


FIG. 10

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2014/028596

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04M3/42 H04W88/06
ADD.

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)
H04M H04W

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)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2011/212737 A1 (ISIDORE EUSTACE P [US]) 1 September 2011 (2011-09-01) abstract figures 3,4 paragraph [0011] - paragraph [0002] paragraph [0045] - paragraph [0053] -----	1-40
A	US 2012/021755 A1 (CHIN TOM [US] ET AL) 26 January 2012 (2012-01-26) figures 5,6 paragraph [0042] - paragraph [0049] -----	1-40

☐ 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 but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
4 June 2014	18/06/2014

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Molinari, Fausto

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2014/028596

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2011212737 A1	01-09-2011	US 2006234693 A1	19-10-2006
		US 2011212737 A1	01-09-2011
		US 2013244626 A1	19-09-2013
		US 2014018050 A1	16-01-2014
		WO 2007108811 A2	27-09-2007
US 2012021755 A1	26-01-2012	AR 082344 A1	28-11-2012
		CN 103026776 A	03-04-2013
		TW 201210384 A	01-03-2012
		US 2012021755 A1	26-01-2012
		WO 2012012787 A1	26-01-2012

(19)中华人民共和国国家知识产权局

(12)发明专利申请

(10)申请公布号 CN 105191268 A
(43)申请公布日 2015.12.23

(21)申请号 201480014275.9
(22)申请日 2014.03.14
(30)优先权数据
13/831,803 2013.03.15 US
(85)PCT国际申请进入国家阶段日
2015.09.11
(86)PCT国际申请的申请数据
PCT/US2014/028596 2014.03.14
(87)PCT国际申请的公布数据
WO2014/144263 EN 2014.09.18
(71)申请人 高通股份有限公司
地址 美国加利福尼亚州
(72)发明人 维纳·瓦盖斯 马尼什·波达尔
(74)专利代理机构 北京律盟知识产权代理有限责任公司 11287
代理人 宋献涛
(51)Int.Cl.
H04M 3/42(2006.01)
H04W 88/06(2006.01)

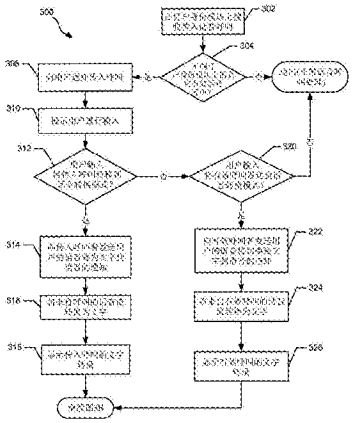
权利要求书6页 说明书11页 附图11页

(54)发明名称

在多SIM移动电话中处置多个话音呼叫

(57)摘要

使双SIM双有效DSDA无线装置的用户能够处置多个同时独立的实时呼叫SIM以防止呼叫在多SIM无线装置上丢失。忙于有效呼叫的DSDA装置用户接收第二话音呼叫且选择使用话音/文字对话模式处理传入话音呼叫。多个同时呼叫上的各方可能彼此不知道所述无线装置的同时通信,即无线装置用户正以所述无线装置同时与另一方通信。



CN 105191268 A

1. 一种维持多 SIM 无线装置上的同时有效呼叫的方法，其包括：

接收与第一 SIM 相关联的第一射频 RF 资源上的传入话音呼叫；

确定所述无线装置是否具有与第二 SIM 相关联的第二 RF 资源上的有效话音呼叫；以及

响应于确定所述无线装置具有与所述第二 SIM 相关联的所述第二 RF 资源上的有效话音呼叫而进入话音 / 文字对话模式，

其中所述话音 / 文字对话模式包括：

将呼叫者的语音转换为文字数据；

在所述无线装置上显示所述文字数据；

从用户接收文字输入；

将所述文字输入转换为机器产生的语音；以及

将所述机器产生的语音发射到所述呼叫者。

2. 根据权利要求 1 所述的方法，其中响应于确定所述无线装置具有与所述第二 SIM 相关联的所述第二 RF 资源上的有效话音呼叫而进入话音 / 文字对话模式包括：

向所述用户通知所述传入话音呼叫；

选择是否进入所述话音 / 文字对话模式；以及

响应于选择进入所述话音 / 文字对话模式而确定哪一呼叫将进入所述话音 / 文字对话模式。

3. 根据权利要求 2 所述的方法，其中选择是否进入所述话音 / 文字对话模式包括输出针对用户输入的提示且根据响应于所述提示接收的用户输入而做出选择。

4. 根据权利要求 2 所述的方法，其中确定哪一呼叫将进入所述话音 / 文字对话模式是基于用户输入。

5. 根据权利要求 2 所述的方法，其进一步包括向所述传入话音呼叫者发送通知：响应于接收到选择所述传入话音呼叫用于话音 / 文字对话模式的用户输入而将在话音 / 文字对话模式中进行所述呼叫。

6. 根据权利要求 2 所述的方法，其进一步包括向所述有效呼叫者发送通知：响应于接收到选择所述有效呼叫用于话音 / 文字对话模式的用户输入而将把所述呼叫切换到话音 / 文字对话模式。

7. 根据权利要求 1 所述的方法，其中响应于确定所述无线装置具有与所述第二 SIM 相关联的所述第二 RF 资源上的有效话音呼叫而进入话音 / 文字对话模式包括：

向所述用户通知所述传入话音呼叫；以及

当满足预定规则的集合时自动进入所述话音 / 文字对话模式。

8. 根据权利要求 5 所述的方法，其进一步包括：

确定所述有效呼叫是否已终止；以及

响应于确定所述有效呼叫已终止而请求用于选择是否对所述传入话音呼叫结束所述话音 / 文字对话模式的用户输入。

9. 根据权利要求 1 所述的方法，其中向所述传入话音呼叫的呼叫者发送正在所述话音 / 文字对话模式中进行所述呼叫的通知包括将预记录音频消息发送到所述呼叫者，其中所述预记录音频消息向所述呼叫者告知所述呼叫者的话音将转换成文字以用于显示给所述用户且将经由机器产生的语音听见用户响应。

10. 根据权利要求 1 所述的方法，其中：

将呼叫者的语音转换为文字数据包括：

将呼叫者的语音发送到能够进行语音到文字转换的服务器；以及

从所述服务器接收所述呼叫者的语音的文字转录；且

将所述文字输入转换为机器产生的语音包括：

将所述文字输入发送到经配置以将文字转换为机器产生的语音数据的服务器；以及

从所述服务器接收包含所述机器产生的语音数据的语音数据包。

11. 一种多 SIM 无线装置，其包括：

第一 SIM；

第二 SIM；

显示器

存储器；

与所述第一 SIM 相关联的第一射频 RF 资源；

与所述第二 SIM 相关联的第二 RF 资源；以及

处理器，其耦合到所述第一和第二 SIM、所述显示器、所述存储器、所述第一和第二 RF 资源，其中所述处理器配置有处理器可执行指令以执行包括以下各项的操作：

接收与所述第一 SIM 相关联的所述第一 RF 资源上的传入话音呼叫；

确定所述无线装置是否具有与所述第二 SIM 相关联的所述第二 RF 资源上的有效话音呼叫；以及

响应于确定所述无线装置具有与所述第二 SIM 相关联的所述第二 RF 资源上的有效话音呼叫而进入话音 / 文字对话模式，

其中所述话音 / 文字对话模式包括：

使用语音到文字 STT 转换引擎将呼叫者的语音转换为文字数据；

在所述无线装置上显示所述文字数据；

从用户接收文字输入；

使用文字到语音 TTS 转换引擎将所述文字输入转换为机器产生的语音；以及

将所述机器产生的语音发射到所述呼叫者。

12. 根据权利要求 11 所述的多 SIM 无线装置，其中所述处理器配置有处理器可执行指令以执行操作以使得响应于确定所述无线装置具有与所述第二 SIM 相关联的所述第二 RF 资源上的有效话音呼叫而进入话音 / 文字对话模式包括：

向所述用户通知所述传入话音呼叫；

选择是否进入所述话音 / 文字对话模式；以及

响应于选择进入所述话音 / 文字对话模式而确定哪一呼叫将进入所述话音 / 文字对话模式。

13. 根据权利要求 12 所述的多 SIM 无线装置，其中所述处理器配置有处理器可执行指令以执行操作以使得选择是否进入所述话音 / 文字对话模式包括输出针对用户输入的提示且根据响应于所述提示接收的用户输入而做出选择。

14. 根据权利要求 12 所述的多 SIM 无线装置，其中所述处理器配置有处理器可执行指令以执行操作以使得确定哪一呼叫将进入所述话音 / 文字对话模式是基于用户输入。

15. 根据权利要求 12 所述的多 SIM 无线装置，其中所述处理器配置有处理器可执行指令以执行进一步包括以下各项的操作：

向所述传入话音呼叫者发送通知：响应于接收到选择所述传入话音呼叫用于话音 / 文字对话模式的用户输入而将在话音 / 文字对话模式中进行所述呼叫。

16. 根据权利要求 12 所述的多 SIM 无线装置，其中所述处理器配置有处理器可执行指令以执行进一步包括以下各项的操作：

向所述有效呼叫者发送通知：响应于接收到选择所述有效呼叫用于话音 / 文字对话模式的用户输入而将把所述呼叫切换到话音 / 文字对话模式。

17. 根据权利要求 11 所述的多 SIM 无线装置，其中所述处理器配置有处理器可执行指令以执行操作以使得响应于确定所述无线装置具有与所述第二 SIM 相关联的所述第二 RF 资源上的有效话音呼叫而进入话音 / 文字对话模式包括：

向所述用户通知所述传入话音呼叫；以及

当满足预定规则的集合时自动进入所述话音 / 文字对话模式。

18. 根据权利要求 15 所述的多 SIM 无线装置，其中所述处理器配置有处理器可执行指令以执行进一步包括以下各项的操作：

确定所述有效呼叫是否已终止；以及

响应于确定所述有效呼叫已终止而请求用于选择是否对所述传入话音呼叫结束所述话音 / 文字对话模式的用户输入。

19. 根据权利要求 11 所述的多 SIM 无线装置，其中所述处理器配置有处理器可执行指令以执行操作以使得向所述传入话音呼叫的呼叫者发送正在所述话音 / 文字对话模式中进行所述呼叫的通知包括：

将预记录音频消息发送到所述呼叫者，其中所述预记录音频消息向所述呼叫者告知所述呼叫者的话音将转换成文字以用于显示给所述用户且将经由机器产生的语音听见用户响应。

20. 根据权利要求 11 所述的多 SIM 无线装置，其中所述处理器配置有处理器可执行指令以执行操作以使得：

使用语音到文字 STT 转换引擎将呼叫者的语音转换为文字数据包括：

将呼叫者的语音发送到经配置有 STT 转换引擎的服务器；以及

从所述服务器接收所述呼叫者的语音的文字转录；且

使用文字到语音 TTS 转换引擎将所述文字输入转换为机器产生的语音包括：

将所述文字输入发送到经配置有 TTS 转换引擎的服务器；以及

从所述服务器接收包含所述机器产生的语音数据的语音数据包。

21. 一种多 SIM 无线装置，其包括：

用于接收与第一 SIM 相关联的第一射频 RF 资源上的传入话音呼叫的装置；

用于确定所述无线装置是否具有与第二 SIM 相关联的第二 RF 资源上的有效话音呼叫的装置；

用于响应于确定所述无线装置具有与所述第二 SIM 相关联的所述第二 RF 资源上的有效话音呼叫而进入话音 / 文字对话模式的装置，

用于将呼叫者的语音转换为文字数据的装置；

用于在所述无线装置上显示所述文字数据的装置；

用于从用户接收文字输入的装置；

用于将所述文字输入转换为机器产生的语音的装置；以及

用于将所述机器产生的语音发射到所述呼叫者的装置。

22. 根据权利要求 21 所述的多 SIM 无线装置，其中用于响应于确定所述无线装置具有与所述第二 SIM 相关联的所述第二 RF 资源上的有效话音呼叫而进入话音 / 文字对话模式的装置包括：

用于向所述用户通知所述传入话音呼叫的装置；

用于选择是否进入所述话音 / 文字对话模式的装置；以及

用于响应于选择进入所述话音 / 文字对话模式而确定哪一呼叫将进入所述话音 / 文字对话模式的装置。

23. 根据权利要求 22 所述的多 SIM 无线装置，其中用于选择是否进入所述话音 / 文字对话模式的装置包括：

用于输出针对用户输入的提示的装置；以及

用于根据响应于所述提示接收的用户输入而做出选择的装置。

24. 根据权利要求 22 所述的多 SIM 无线装置，其中用于确定哪一呼叫将进入所述话音 / 文字对话模式的装置是基于用户输入。

25. 根据权利要求 22 所述的多 SIM，其进一步包括向所述传入话音呼叫者发送通知：响应于接收到选择所述传入话音呼叫用于话音 / 文字模式的用户输入而将在话音 / 文字对话模式中进行所述呼叫。

26. 根据权利要求 22 所述的多 SIM 无线装置，其进一步包括：

用于向所述有效呼叫者发送响应于接收到选择所述有效呼叫用于话音 / 文字对话模式的用户输入而将把所述呼叫切换到话音 / 文字对话模式的通知的装置。

27. 根据权利要求 21 所述的多 SIM 无线装置，其中用于响应于确定所述无线装置具有与所述第二 SIM 相关联的所述第二 RF 资源上的有效话音呼叫而进入话音 / 文字对话模式的装置包括：

用于向所述用户通知所述传入话音呼叫的装置；以及

用于当满足预定规则的集合时自动进入所述话音 / 文字对话模式的装置。

28. 根据权利要求 5 所述的多 SIM 无线装置，其进一步包括：

用于确定所述有效呼叫是否已终止的装置；以及

用于响应于确定所述有效呼叫已终止而请求用于选择是否对所述传入话音呼叫结束所述话音 / 文字对话模式的用户输入的装置。

29. 根据权利要求 21 所述的多 SIM 无线装置，其中用于向所述传入话音呼叫的呼叫者发送正在所述话音 / 文字对话模式中进行所述呼叫的通知的装置包括：

用于将预记录音频消息发送到所述呼叫者的装置，其中所述预记录音频消息向所述呼叫者告知所述呼叫者的话音将转换成文字以用于显示给所述用户且将经由机器产生的语音听见用户响应。

30. 根据权利要求 21 所述的多 SIM 无线装置，其中：

用于将呼叫者的语音转换为文字数据的装置包括：

用于将呼叫者的语音发送到能够进行语音到文字转换的服务器的装置；以及

用于从所述服务器接收所述呼叫者的语音的文字转录的装置；且

用于将所述文字输入转换为机器产生的语音的装置包括：

用于将所述文字输入发送到经配置以将文字转换为机器产生的语音数据的服务器的装置；以及

用于从所述服务器接收包含所述机器产生的语音数据的语音数据包的装置。

31. 一种具有存储于其上的处理器可执行指令的非暂时性处理器可读存储媒体，所述处理器可执行指令经配置以致使多 SIM 无线装置处理器执行包括以下各项的操作：

接收与第一 SIM 相关联的第一射频 RF 资源上的传入话音呼叫；

确定所述无线装置是否具有与第二 SIM 相关联的第二 RF 资源上的有效话音呼叫；以及

响应于确定所述无线装置具有与所述第二 SIM 相关联的所述第二 RF 资源上的有效话音呼叫而进入话音 / 文字对话模式，

其中所述话音 / 文字对话模式包括：

将呼叫者的语音转换为文字数据；

在所述无线装置上显示所述文字数据；

从用户接收文字输入；

将所述文字输入转换为机器产生的语音；以及

将所述机器产生的语音发射到所述呼叫者。

32. 根据权利要求 31 所述的非暂时性处理器可读存储媒体，其中所述所存储的处理器可执行指令经配置以致使所述多 SIM 无线装置处理器执行操作以使得响应于确定所述无线装置具有与所述第二 SIM 相关联的所述第二 RF 资源上的有效话音呼叫而进入话音 / 文字对话模式包括：

向所述用户通知所述传入话音呼叫；

选择是否进入所述话音 / 文字对话模式；以及

响应于选择进入所述话音 / 文字对话模式而确定哪一呼叫将进入所述话音 / 文字对话模式。

33. 根据权利要求 32 所述的非暂时性处理器可读存储媒体，其中所述所存储的处理器可执行指令经配置以致使所述多 SIM 无线装置处理器执行操作以使得选择是否进入所述话音 / 文字对话模式包括：

输出针对用户输入的提示；以及

根据响应于所述提示接收的用户输入而做出选择。

34. 根据权利要求 32 所述的非暂时性处理器可读存储媒体，其中所述所存储的处理器可执行指令经配置以致使所述多 SIM 无线装置处理器执行操作，此确定哪一呼叫将进入所述话音 / 文字对话模式是基于用户输入。

35. 根据权利要求 32 所述的非暂时性处理器可读存储媒体，其中所述所存储的处理器可执行指令经配置以致使所述多 SIM 无线装置处理器执行进一步包括以下各项的操作：

向所述传入话音呼叫者发送通知：响应于接收到选择所述传入话音呼叫用于话音 / 文字对话模式的用户输入而将在话音 / 文字对话模式中进行所述呼叫。

36. 根据权利要求 32 所述的非暂时性处理器可读存储媒体，其中所述所存储的处理器

可执行指令经配置以致使所述多 SIM 无线装置处理器执行进一步包括以下各项的操作 :

向所述有效呼叫者发送通知 :响应于接收到选择所述有效呼叫用于话音 / 文字对话模式的用户输入而将把所述呼叫切换到话音 / 文字对话模式。

37. 根据权利要求 31 所述的非暂时性处理器可读存储媒体,其中所述所存储的处理器可执行指令经配置以致使所述多 SIM 无线装置处理器执行操作以使得响应于确定所述无线装置具有与所述第二 SIM 相关联的所述第二 RF 资源上的有效话音呼叫而进入话音 / 文字对话模式包括 :

向所述用户通知所述传入话音呼叫 ;以及

当满足预定规则的集合时自动进入所述话音 / 文字对话模式。

38. 根据权利要求 35 所述的非暂时性处理器可读存储媒体,其中所述所存储的处理器可执行指令经配置以致使所述多 SIM 无线装置处理器执行进一步包括以下各项的操作 :

确定所述有效呼叫是否已终止 ;以及

响应于确定所述有效呼叫已终止而请求用于选择是否对所述传入话音呼叫结束所述话音 / 文字对话模式的用户输入。

39. 根据权利要求 31 所述的非暂时性处理器可读存储媒体,其中所述所存储的处理器可执行指令经配置以致使所述多 SIM 无线装置处理器执行操作以使得向所述传入话音呼叫的呼叫者发送正在所述话音 / 文字对话模式中进行所述呼叫的通知包括 :

将预记录音频消息发送到所述呼叫者,其中所述预记录音频消息向所述呼叫者告知所述呼叫者的话音将转换成文字以用于显示给所述用户且将经由机器产生的语音听见用户响应。

40. 根据权利要求 31 所述的非暂时性处理器可读存储媒体,其中所述所存储的处理器可执行指令经配置以致使所述多 SIM 无线装置处理器执行操作以使得 :

将呼叫者的语音转换为文字数据包括 :

将呼叫者的语音发送到能够进行语音到文字转换的服务器 ;以及

从所述服务器接收所述呼叫者的语音的文字转录 ;且

将所述文字输入转换为机器产生的语音包括 :

将所述文字输入发送到经配置以将文字转换为机器产生的语音数据的服务器 ;以及

从所述服务器接收包含所述机器产生的语音数据的语音数据包。

在多 SIM 移动电话中处置多个话音呼叫

技术领域

[0001] 本发明大体上涉及多 SIM 无线通信装置，且更具体地说涉及使用多 SIM 能力来参与同时精密通信的方法。

背景技术

[0002] 多 SIM 无线装置因为其具体来说在存在许多服务提供商的国家中提供的多功能性而在近年来变得日益流行。举例来说，双 SIM 智能电话允许用户在同一蜂窝式电话上实施两个不同计划或服务提供商，所述计划或服务提供商各自具有分离电话号码及帐单（例如，企业帐户 / 号码及个人帐户 / 号码）。并且，在旅行期间，用户可获得本地 SIM 卡，且在目的地国家支付市话费率。通过使用多个 SIM，用户可利用不同定价计划，且节省移动数据使用。因此，双 SIM 无线装置实际上向用户提供两个电话而无需携带两个独立装置。

[0003] 近年来由于对用户提供的灵活性而已经开发双 SIM 移动电话。使用双 SIM 装置，用户避免了同时携带两个电话的需要，例如一个用于企业且一个用于个人使用。此外，通过使用多个 SIM，用户可利用不同定价计划，且节省移动数据使用。

[0004] 一些较新的双 SIM 装置经配置以用于双 SIM 双有效 (DSDA) 操作，而不是要求用户在 SIM 之间切换。通常具有两个无线电发射器 / 接收器电路（在本文中被称作 RF 资源）的 DSDA 装置允许两个 SIM 同时有效（即，支持经由网络的电信）。以此方式，实现同时的独立通信。然而，虽然 DSDA 装置允许用户参与同时的有效呼叫，但用户无法大体上同时参与两个单独的电话呼叫。因此，DSDA 装置的至少一些能力可能未由用户完全实现。

发明内容

[0005] 各种实施例提供用于用户使用第二呼叫上的语音到文字和文字到语音转换在 DSDA 装置上参与同时呼叫的方法。通过将来自第二传入话音呼叫的语音转换为在 DSDA 装置上显示的文字，且将用户输入的文字转换为播放给第二呼叫者的语音，用户可同时与两个不同方谨慎地维持实时通信。

附图说明

[0006] 并入本文中并且构成本说明书一部分的随附图式展示本发明的示范性实施例，并且与上文给出的一般描述和下文给出的详细描述一起用来解释本发明的特征。

[0007] 图 1 为适合于与各种实施例一起使用的无线通信系统的通信系统框图。

[0008] 图 2 是说明根据实施例的双 SIM 双有效无线通信装置的框图。

[0009] 图 3A 和 3B 是说明用于确定同时有效话音呼叫的适当操纵的实施例方法的过程流程图。

[0010] 图 4A 和 4B 是说明根据实施例的使用话音 / 文字对话模式在无线装置的组件之间的交互的框图。

[0011] 图 5 是说明根据实施例的使用话音 / 文字对话模式对无线装置提供话音和文字转

换的服务器的组件的框图。

[0012] 图 6 是说明用于在无线装置上处置同时有效和传入话音呼叫的实施例方法的过程流程图。

[0013] 图 7 是说明用于在服务器上提供话音和文字转换服务的实施例方法的过程流程图。

[0014] 图 8 是适合与各种实施例一起使用的另一实例移动装置的组件图。

[0015] 图 9 是适合与各种实施例一起使用的另一实例移动装置的组件图。

[0016] 图 10 是适合与各种实施例一起使用的实例服务器的组件图。

具体实施方式

[0017] 将参看附图详细描述各种实施例。在可能的情况下，将在整个附图中使用相同的参考数字来指代相同或类似的部分。对特定实例及实施方案作出的参考是用于说明性目的，且无意限制本发明或权利要求书的范围。

[0018] 词“示范性”在本文中用以意味着“充当实例、例子或说明”。本文中描述为“示范性”的任何实施方案未必应解释为比其它实施方案优选或有利。

[0019] 术语“无线装置”和“无线通信装置”在本文中可互换地使用以指代以下各项中的任何一者或全部：蜂窝式电话、智能电话、个人或移动多媒体播放器、个人数据助理 (PDA)、膝上型计算机、平板计算机、智能本、掌上型计算机、无线电子邮件接收器、具多媒体因特网功能的蜂窝式电话、无线游戏控制器，以及包含可编程处理器和存储器以及用于建立无线通信路径且经由无线通信路径发射 / 接收数据的电路的相似个人电子装置。

[0020] 如本文所使用，术语“SIM”、“SIM 卡”和“订户识别模块”可互换地使用以意味着嵌入到可装卸式卡中的集成电路，其存储国际移动订户身份 (IMSI)、相关密钥和 / 或用以向无线电信网络识别和 / 或验证无线装置的其它信息。术语 SIM 也可以用作对所述 SIM 相关联的特定通信网络或订户帐户的简写参考，因为存储在 SIM 中的信息使无线装置能够与特定网络建立通信链路，因此 SIM 和通信网络彼此相关。

[0021] 如本文所使用，术语“多 SIM 无线装置”、“双 SIM 装置”、“双 SIM 双有效装置”和“DSDA 装置”可互换地使用以描述经配置有一个以上 SIM 且能够独立地处置与两个预订的网络的通信的无线装置。

[0022] 各种实施例通过利用双有效能力且使用户能够同时维持与多方的多个呼叫而不需要电话会议来改善 DSDA 装置上的用户体验。DSDA 装置用户可当从第二方接收到传入话音呼叫时参与与第一方的有效呼叫。在各种实施例中，第一呼叫可经由装置上的扬声器 / 头戴受话器正常进行，同时可使用“话音 / 文字对话模式”处置第二呼叫，同时仍维持有效的第一呼叫。

[0023] 在各种实施例中，多 SIM 无线装置的每一 SIM 可使用相同或不同无线通信协议实现不同通信网络上的通信。在另一实施例中，两个或两个以上 SIM 可使用相同无线通信协议实现同一网络上的通信。在各种实施例中，每一 SIM 可使用多 SIM 无线装置的不同 RF 资源实现其网络上的通信。在各种实施例中，多 SIM 无线装置可为双 SIM 双有效 (DSDA) 装置，其中每一 SIM 与独立 RF 资源 (例如，独立 RF 收发器) 相关联。

[0024] 各种实施例的方法可用于与任一 SIM 相关联的网络上的呼叫。虽然术语“第一”和

“第二”在此可用来描述 SIM 和相关联网络，但此些识别符仅是为方便起见且不有意将各种实施例限于特定次序、序列、网络类型或载波。此外，实施例可用于具有两个以上 RF 资源和两个以上 SIM 卡的多 SIM 无线装置中以用类似方式实现与三方或三方以上的同时通信。

[0025] 在各种实施例中，音频俘获可包含经由多 SIM 无线装置的麦克风接收音频输入且准备音频输入用于发射，以及经由无线装置的扬声器将所接收数据转换为音频输出。在各种实施例中，呼叫可包含在无线装置和 / 或服务器之间交换的音频数据的连续流。虽然在经执行以在音频呼叫（即，话音呼叫）期间发射和接收数据流的操作方面论述实例实施例，但也可以实施各种实施例方法以发射和接收视频呼叫（即，音频和视频呼叫或仅视频呼叫）。虽然在在与两个 SIM 相关联的网络之间切换呼叫的操作方面论述实例实施例，但在多 SIM 无线装置中可实现额外 SIM 和网络连接。

[0026] 图 1 说明适合用于各种实施例的无线网络系统 100。无线装置 102、104 可经配置以与一或多个无线电接入网络的小区塔或基站建立无线连接。举例来说，无线装置 102、104 可使用可为网络 110 的部分的基站 106、108 发射 / 接收数据，如此项技术中已知。无线装置 102 可进一步经配置通过可为不同网络 114 的部分的基站 112 发射 / 接收数据。

[0027] 无线网络 110、114 可为蜂窝式数据网络，且可使用信道接入方法，包含但不限于频分多址 (FDMA)、时分多址 (TDMA)、码分多址 (CDMA)、通用移动电信系统 (UMTS)（具体来说，长期演进 (LTE)）、全球移动通信系统 (GSM)、Wi-Fi、PCS、G-3、G-4，或可在无线通信网络或数据通信网络中使用的其它协议。网络 110、114 可使用相同或不同的无线接口和 / 或物理层。在一个实施例中，基站 106、108、112 可由一或多个基站控制器 (BSC) 116、118 控制。举例来说，基站 106、108、BSC 116 和其它组件可形成网络 110，如此项技术中已知。也可以使用替代网络配置且实施例不限于所说明的配置。举例来说，在另一个实施例中，BSC 116 和基站 106、108 中的至少一者的功能性可收缩为具有这些组件的功能性的单个“混合”模块。

[0028] 在各种实施例中，无线装置 102 可在预占由两个（或两个以上）基站 106、112 管理的小区之后同时接入两个（或两个以上）核心网络 120、122。无线装置 102 还可与可连接因特网的 Wi-Fi 接入点建立连接。虽然各种实施例尤其有用于无线网络，但实施例不限于无线网络，且也可以经由有线网络实施而无对所述方法的改动。

[0029] 在无线网络系统 100 中，无线装置 102 可为能够在由多个 SIM 支持的多个网络或预订上操作的多 SIM 无线装置。举例来说，无线装置 102 可为双 SIM 装置。使用双 SIM 功能性，无线装置 102 可通过预占由两个基站 106、112 管理的小区而同时接入两个核心网络 120、122。核心网络 120、122 可通过公共交换电话网络 (PSTN) 124 互连，核心网络 120、122 可跨越所述 PSTN 而将各种传入和传出通信路由到无线装置 102。

[0030] 无线装置 102 可使用 SIM 中的一者做出对例如无线装置 104 等第三方装置的话音或数据呼叫。无线装置 102 还可从第三方接收话音呼叫或其它数据发射。第三方装置（例如，无线装置 104）可为多种装置中的任一者，包含但不限于移动电话、膝上型计算机、PDA、服务器等）。

[0031] 在各种实施例中，SIM 可为通用集成电路卡 (UICC)，其经配置有 SIM 及 / 或 USIM 应用程序从而使得能够接入 GSM 及 / 或 UMTS 网络。UICC 还可为电话簿和其它应用程序提供存储。或者，在 CDMA 网络中，SIM 可为 UICC 可装卸式用户身份模块 (R-UIM) 或 CDMA 订

户身份模块 (CSIM)。

[0032] 每一 SIM 卡可具有 CPU、ROM、RAM、EEPROM 和 I/O 电路。各种实施例中使用的 SIM 卡可含有用户帐户信息、国际移动订户身份 (IMSI)、SIM 应用工具包 (SAT) 命令的集合和用于电话簿联系人的存储空间。基带芯片的微处理单元 (MCU) 可与 SIM 卡的 MCU 交互以从安装在无线装置中的 SIM 卡检索数据或 SAT 命令。无线装置可在插入 SIM 卡中之后立即编程。SIM 卡也可经编程以显示用于个人化服务的定制菜单。SIM 卡可进一步存储归属公共陆地移动网络 (HPLMN) 代码以指示 SIM 卡网络运营商提供者。集成电路卡身份 (ICCID)SIM 序列号打印在 SIM 卡上以供识别。

[0033] 图 2 是适合于实施各种实施例的多 SIM 无线装置 200 的功能框图。所述多 SIM 无线装置 200 可包含第一 SIM 接口 202a，其可接收与第一预订相关联的第一身份模块 SIM-1204a。多 SIM 无线装置 200 还可包含第二 SIM 接口 202b，其可接收与第二预订相关联的第二身份模块 SIM-2204b。

[0034] 多 SIM 无线装置 200 可包含至少一个控制器，例如通用处理器 206，其可耦合到音频编解码器 (声码器)208。声码器 208 又可耦合到扬声器 210 和麦克风 212。通用处理器 206 也可以耦合到至少一个存储器 214。存储器 214 可为存储处理器可执行指令的非暂时性有形计算机可读存储媒体。举例来说，所述指令可包含经由对应的基带 -RF 资源链路由关于第一或第二预订的通信数据。

[0035] 存储器 214 可存储操作系统 (OS) 以及用户应用软件和可执行指令。存储器 214 还可存储应用程序数据，例如用于自动确定何时开始话音 / 文字对话模式的预定用户偏好设定和 / 或规则。此些设定或规则可配置多 SIM 无线装置处理器以当满足存储于存储器 214 中的预定规则的集合时自动进入话音 / 文字对话模式。

[0036] 通用处理器 206 和存储器 214 可各自耦合到至少一个基带调制解调器处理器 216。多 SIM 无线装置 200 中的每一 SIM(例如，SIM-1202a 和 SIM-2202b) 可与基带 RF 资源链相关联。每一基带 -RF 资源链可包含基带调制解调器处理器 216 以执行用于 SIM 上的通信的基带 / 调制解调器功能，以及一或多个放大器和无线电，在此大体上称为 RF 资源 218。在一个实施例中，所述基带 -RF 资源链可共享共同基带调制解调器处理器 206(即，执行用于无线装置上的所有 SIM 的基带 / 调制解调器功能的单个装置)。或者，每一基带 -RF 资源链可包含物理上或逻辑上单独的基带调制解调器处理器 (例如，调制解调器 1、调制解调器 2)。基带 / 调制解调器功能也可以物理上或逻辑上与声码器 208 集成。举例来说，声码器和调制解调器功能可在数字信号处理器中实施。

[0037] RF 资源 218a、218b 可各自为针对无线装置的相关联 SIM 执行发射 / 接收功能的收发器。RF 资源 218a、218b 可包含单独的发射和接收电路，或可包含组合发射器和接收器功能的收发器。RF 资源 218a、218b 可耦合到无线天线 (例如，第一无线天线 220a 和第二无线天线 220b)。无线装置 200 的存储器 214 可存储操作系统 (OS) 和用户应用程序软件。

[0038] 在一个实施例中，通用处理器 206 可耦合到语音到文字 (STT) 转换引擎 224，且耦合到文字到语音 (TTS) 转换引擎 226。STT 转换引擎 224 可将语音 (即，话音流) 转换为文字，且 TTS 转换引擎 226 可将文字转换为语音。用以产生模拟人类话音的语音信号的话音合成器 229 可耦合到 TTS 转换引擎 226。在各种实施例中，话音合成器 229 可与声码器 208 和 / 或 TTS 转换引擎 226 集成。另外，STT 转换引擎 224、TTS 转换引擎 226 和 / 或声码器

208 可集成到单个模块、单元、组件或软件中。STT 转换引擎 226、TTS 转换引擎 228 和话音合成器 229 可实施在多 SIM 无线装置 200 上作为在应用程序处理器和 / 或数字信号处理器 (DSP) 上执行的应用程序中的软件模块，作为硬件模块（例如，经硬连线以执行此些功能的硬件组件），或作为在一或多个装置处理器上执行的硬件组件和软件模块的组合。

[0039] 虽然 STT 转换引擎 226、TTS 转换引擎 228 和话音合成器 229 在图 2 中说明为多 SIM 无线装置 200 的组件或模块，但在替代实施例中，这些组件中的一或多者可位于通过无线网络可接入的服务器上，如下文关于图 5-7 进一步详细论述。

[0040] 在一特定实施例中，通用处理器 206、STT 转换引擎 224、TTS 转换引擎 226、存储器 214、基带处理器 216 和 RF 资源 218a、218b 可包含在芯片上系统装置 222 中。第一和第二 SIM 202a、202b 及其对应接口 204a、204b 可在芯片上系统装置 222 的外部。此外，各种输入和输出装置可耦合到芯片上系统装置 216 的组件，例如接口或控制器。适合用于无线装置 200 中的实例用户输入组件可包含（但不限于）小键盘 228 和触摸屏显示器 230。

[0041] 在一实施例中，小键盘 228、触摸屏显示器 230、麦克风 212 或其组合可执行接收起始传出呼叫的请求的功能。举例来说，触摸屏显示器 230 可接收来自联系人列表的联系人的选择或接收电话号码。在另一实例中，触摸屏显示器 230 和麦克风 212 中的任一者或两者可执行接收起始传出呼叫的请求的功能。举例来说，触摸屏显示器 230 可接收来自联系人列表的联系人的选择或接收电话号码。作为另一实例，所述起始传出呼叫的请求可呈经由麦克风 212 接收的语音命令的形式。接口可提供在无线装置 200 中的各种软件模块与功能之间以实现其间的通信，如此项技术中已知。

[0042] 在一特定实施例中，通用处理器 202、存储器 204 和基带处理器 206 可包含在芯片上系统装置 216 中。第一和第二 SIM 208a、208b 及其对应接口 210a、210b 可在芯片上系统装置 216 的外部。此外，各种输入和输出装置可耦合到芯片上系统装置 216 的组件，例如接口或控制器。

[0043] 在各种实施例中，多 SIM 无线装置 200 可确定如何处置一个 SIM 上的传入话音呼叫同时参与另一 SIM 上的有效呼叫。在各种实施例中，与第一方的有效呼叫上的用户可选择在“话音 / 文字对话模式”中处置传入话音呼叫。在话音 / 文字对话模式中，用户可通过接收和发送文字而对传入话音呼叫者“谈话”，进而允许所述用户参与第二同时呼叫。有利地，话音 / 文字对话模式并不需要呼叫者的任何对应模式改变（例如，改变为文字），且不会对另一 SIM 上的有效话音呼叫造成干扰。

[0044] 图 3A 和 3B 说明用于使用无线装置上经配置以执行文字到语音和语音到文字转换的话音 / 文字对话模式的实施例方法 300。方法 300 的操作可由双 SIM 装置的一或多个处理器实施，例如上文参看图 2 描述的无线装置 200 中的通用处理器 206、DSP（未单独地图示）和 / 或基带处理器 216。

[0045] 参考图 3A，在方法 300 中可起始话音 / 文字对话模式。在框 302 中，无线装置可在与 SIM-1 相关联的 RF 资源上接收传入话音呼叫。无线装置可在确定框 304 中确定话音呼叫是否已经在与不同 SIM（即，SIM-2）相关联的 RF 资源上在装置上有效。如果无线装置上不存在有效呼叫（即，确定框 304 =“否”），那么在框 306 中可根据正常呼叫处理处置传入话音呼叫。如果在不同 SIM 上存在另一有效话音呼叫（即，确定框 304 =“是”），那么无线装置可在框 308 中例如通过播放音频剪辑、闪烁灯、显示通知消息等而向用户通知传入话

音呼叫。在框 310 中，可提示无线装置用户进行输入以选择是否激活话音 / 文字对话模式用于呼叫处理。在确定框 312 中，无线装置可确定是否接收到使用话音 / 文字对话模式的用户输入用于处理传入话音呼叫。

[0046] 如果接收到使用话音 / 文字对话模式用于处理传入话音呼叫的输入（即，确定框 312 ＝“是”），那么在框 314 中无线装置可向传入话音呼叫者发送通知，指示用户希望使用语音到文字和文字到语音过程进行应答和交谈。此通知警示传入话音呼叫者，在被呼叫方将呼叫者的词语读取为文字且随后以机器产生的语音进行答复时，对口头的词语或问题的响应将被延迟。由此，呼叫方理解对话将如何进行且不会因任何延迟或听见计算机产生的话音而惊奇。另外，呼叫方可在以此方式的对话不是合意的情况下选择挂机。在框 316 中，无线装置可将从传入话音呼叫接收的话音流转换为文字，因此产生传入话音呼叫话音流的转录。在框 318 中，无线装置可在多 SIM 无线装置的显示器上显示所述文字转录。

[0047] 如果未接收到用户输入或用户拒绝使用话音 / 文字对话模式用于处理传入话音呼叫（即，确定框 312 ＝“否”），那么无线装置可在确定框 320 中确定用户输入是否指示需要使用话音 / 文字对话模式用于处理有效呼叫（即，第一呼叫）。如果未接收到指示需要使用话音 / 文字对话模式用于处理有效（即，第一）呼叫的用户输入（即，确定框 320 ＝“否”），那么无线装置可根据正常呼叫处理方法（例如，激活呼叫等待、传送传入话音呼叫到话音邮件、发送预先选择的响应、保持呼叫中的一者等）处置传入呼叫和有效呼叫。

[0048] 如果接收到指示需要使用话音 / 文字对话模式用于处理有效（即，第一）呼叫的用户输入（即，确定框 320 ＝“是”），那么无线装置可在框 322 中将通知发送到有效呼叫者，向所述方告知用户即将切换到话音 / 文字对话模式。再次，此通知向第一呼叫方告知用户将读数呼叫者的语音的转录且经由将经由语音合成器播放的文字输入进行答复。以此方式，第一呼叫方不会因突然的响应延迟或听见计算机产生的话音而惊奇。还作为框 322 的部分，可在正常话音模式中激活传入（即第二）呼叫。在框 324 中，无线装置可将来自先前有效（即，第一）呼叫的话音流转换为文字，从而产生有效呼叫话音流的转录。在框 326 中，无线装置可在无线装置上显示文字转录。在框 322-326 中实施的操作可与框 314-318 中的那些操作相同，但应用于第一呼叫话音流。

[0049] 在替代实施例中，无线装置可自动执行确定框 312 和 320 的功能而无需用户输入。即，无线装置可根据一或多个预定规则将话音 / 文字对话模式自动应用于呼叫。举例来说，用户可将特定联系人或联系人群组指定为“高优先级”。如果从此联系人接收到传入话音呼叫，那么在通过 DSDA 装置上的不同 SIM 确定另一有效呼叫存在之后，DSDA 装置可即刻将有效呼叫自动转换到话音 / 文字对话模式以允许用户根据正常话音呼叫过程接听所述高优先级呼叫而不必挂断第一呼叫。其它规则可包含各种选择标准，例如日时、呼叫的相对优先级、当接收到呼叫时 DSDA 装置的位置等。

[0050] 现参看图 3B，其继续方法 300，在框 328 中，无线装置可从用户接收用户意图将在话音流中发送到呼叫者（即，传入话音呼叫者或有效呼叫者）的文字输入。在框 330 中，无线装置可使用文字到语音转换软件将文字输入转换为语音数据，如下文关于图 4A 和 4B 进一步详细论述。在框 332 中，无线装置可取决于适用的 SIM 例如经由调制解调器 1 或调制解调器 2 将所转换语音发射到呼叫者。在确定框 334 中，无线装置可确定在另一 SIM 上在正常话音呼叫处理模式中操作的呼叫（即，不是话音 / 文字对话模式中的呼叫）是否已终

止。如果正常模式呼叫尚未终止（即，确定框 334 =“否”），那么无线装置在其继续监视正常模式呼叫的状态时重复此确定直到所述呼叫终止。

[0051] 当无线装置处理器确定另一 SIM 上的正常模式呼叫已终止（即，确定框 334 =“是”）时，无线装置可确定话音 / 文字对话模式呼叫是否应在话音 / 文字对话模式中继续。此确定可涉及向用户告知第二呼叫可转换成正常模式，提示用户进行另一输入，且根据所接收用户输入处置所述呼叫。在替代实施例中，此确定可在用户并不响应于输入的提示的情况下基于预定规则设定和 / 或默认动作（例如，自动将语音 / 文字转换模式呼叫转换到正常模式）。

[0052] 如果话音 / 文字对话模式呼叫不应保持在话音 / 文字对话模式中（即，确定框 336 =“否”），那么无线装置可在确定框 336 中将所述呼叫切换到正常模式。如果话音 / 文字对话模式呼叫应保持在话音 / 文字对话模式中（即，确定框 336 =“是”），那么无线装置可使用语音到文字和文字到语音转换的循环继续话音 / 文字对话模式。

[0053] 呼叫者的话音到文字以及使用者的文字输入到话音的转换可使用此项技术中已知的各种语音到文字和文字到语音转换应用程序中的任一者来实现。图 4A 和 4B 进一步详细说明根据实施例的在多 SIM 无线装置中实施的用于话音 / 文字对话模式的 TTS 转换引擎和 STT 转换引擎（例如，如图 2 中示出的 STT 转换引擎 224 和 TTS 转换引擎 226）的使用。

[0054] 参考图 4A，实施例多 SIM 无线装置可从第三方装置接收呼叫中的话音流。所述呼叫可（例如）为如上文关于图 3A 所论述的传入话音呼叫或有效呼叫。话音流可为经调制到载波 RF 信号上的经编码语音数据，无线装置可接收、解调所述信号且将其提供到声码器（例如，声码器 208）。

[0055] 声码器 208 可包含用以将语音信号编码为语音数据包的编码器和用以将语音数据包解码为语音信号的解码器。声码器 102 可为任何类型的声码器，例如增强可变速率译码器 (EVRC)、自适应多速率 (AMR)、第四代声码器 (4GV) 等。

[0056] 语音数据包可由声码器 208 解码，且经解码语音信号可输入到 STT 转换引擎 224 以将语音数据转换为文字。在各种实施例中，STT 转换引擎 224 可包含语音辨识系统 402 和文字产生器 404。STT 转换引擎 224 的组件可实施为单独的装置，或可为同一装置内的逻辑上单独的模块。STT 转换引擎 224 可输出文字数据，其可（例如）在触摸屏 230 上显示给无线装置用户。

[0057] 参考图 4B，为了在话音 / 文字对话模式中（即，在传入话音呼叫或有效呼叫期间）对呼叫者“说话”，无线装置可经由例如触摸屏或小键盘等用户接口从用户接收文字输入。特别地，在话音 / 文字对话模式中响应的此文字输入可发生，同时用户还参与在多 SIM 无线装置中的另一 SIM 的网络上的正常话音呼叫。多 SIM 无线装置可在话音 / 文字对话模式中从小键盘 228 接收文字输入，且所述文字可输入到 TTS 转换引擎 228。

[0058] 在各种实施例中，TTS 转换引擎 226 可包含文字辨识系统 406 和预记录消息存储装置 408。举例来说，在起始话音 / 文字对话模式时，无线装置可将预记录通知发送到呼叫者，警示用户的语音将为来自 TTS 转换过程的机器产生语音，例如在如上文图 3A 中示出的框 314 和 322 中。此些通知可为可通过对小键盘 228 的用户输入而选择的若干预记录选项中的一者。TTS 转换引擎 226 的组件可实施为单独的装置，或可为同一装置内的逻辑上单独的模块。

[0059] TTS转换引擎226可输出数据到话音合成器229，所述话音合成器可输出语音信号到声码器208。声码器208可将语音信号编码为经编码语音数据包，其可经调制到载波信号（未图示）上且发射到呼叫者。

[0060] 在替代实施例中，在话音/文字对话模式中时用户输入的文字到机器产生的语音的转换以及呼叫者的语音到文字的转换可在多SIM无线装置200可连接到的服务器处执行。在一个实施例中，话音/文字服务器可集成在基站内，且通过SIM的接入网络而接入。在另一实施例中，话音/文字服务器可为经由无线数据网络对无线装置可接入的独立服务器。举例来说，无线装置200可经由WiFi连接到无线数据网络上的话音/文字服务器。

[0061] 其中转换在网络组件（即，话音/文字服务器）上执行的实施例可具有许多优点，具体来说是针对尚未配置有TTS和/或STT转换引擎的多SIM无线装置。此外，此类实施例允许处理资源的共享以使得多个无线装置当在话音/文字对话模式中操作时可利用相同转换模块。此外，基于服务器的TTS和STT转换引擎可实施更复杂的处理，与移动通信装置相比利用服务器中可用的增加的计算能力。

[0062] 图5说明实施例话音/文字服务器500的组件以及用于文字到话音和话音到文字的转换的实例数据路径。类似于无线装置200，话音/文字服务器500中实施的各种转换组件可为物理上和/或逻辑上单独的、集成的或其组合。处理器502可连接到存储器504。处理器502可包含提供处理功能的一或多个微处理器、微控制器和/或数字信号处理器，以及其它计算和控制功能性。处理器502可存取存储器504以用于读数/写入用于执行经编程功能性的数据和/或软件指令。存储器504可装载于处理器502上（例如，在同一IC封装内），和/或所述存储器可为处理器外部的存储器且功能上经由数据总线耦合。

[0063] 话音/文字服务器500可包含具有各种转换组件的转换单元506和网络接口508。可包含调制解调器和/或RF资源的网络接口508可为有线和/或无线的以用于经由无线数据网络进行通信。处理器502可连接到转换单元506。实例转换单元506可经配置有转换组件，包含但不限于声码器510、STT转换引擎512、TTS转换引擎514和话音合成器516。并且，类似于图2和4中所示的转换组件，服务器内实施的STT转换引擎512可包含语音辨识系统和文字产生器，且服务器内实施的TTS转换引擎514可包含文字辨识系统和预记录消息的存储装置。

[0064] 图5中说明用于语音和文字两者的实例转换处理路径。文字/话音服务器500可经由网络接口508从多SIM无线装置200接收经编码语音数据包。经编码语音数据可由声码器510解码，且经解码语音信号可传递到STT转换引擎512。从STT转换引擎输出的文字数据可通过网络接口508发射回到无线装置200。

[0065] 在另一路径中，服务器可经由网络接口508从多SIM无线装置200接收文字数据，其可传递到TTS转换引擎514。TTS转换引擎514可使用话音合成器以产生模仿原始文字数据中的词语的语音信号。声码器510可将那些语音信号编码为语音数据包，其可经由网络接口发射回到无线装置200。

[0066] 因此，无线数据网络可实现到可执行用于无线装置的转换过程中的一些或全部的话音/文字服务器500的连接。此实施例可较好地适于其中无线装置缺乏单独执行语音/文字转换模式过程所必要的计算资源、电池电力等的实施方案。此实施例也可以适用于未经配置有TTS和/或STT转换引擎的装置。

[0067] 图6说明用于利用服务器上的转换能力来执行用于话音/文字对话模式中的无线装置通信的语音到文字和文字到语音功能的实施例方法600。方法600的操作可由双SIM装置的一或多个处理器实施，例如上文参看图2描述的无线装置200中的基带处理器206。

[0068] 方法600可具有与上文参看图3A描述的方法300的那些步骤相似的步骤。具体来说，方法600可通过确定框314和322实施与方法300相同或相似的过程。在框602中，无线装置可取决于确定框312和320中的用户选择而向服务器（例如，如图5中示出的话音/文字服务器500）发射来自传入话音呼叫或有效呼叫的语音数据包。在框604中，无线装置可从服务器接收语音数据的文字转录。在框606中，无线装置可显示语音数据的文字转录。在框608中，无线装置可通过与例如小键盘的接口而接收呈文字形式的用户输入。在框610中，无线装置可将文字数据包发射到服务器用于转换为语音。在框612中，无线装置可从服务器接收经编码语音数据包，包含对应于所述文字数据的机器产生的语音数据。方法600可继续到方法300的确定框334，如图3B中示出，且可完成方法300中的剩余操作。

[0069] 图7说明用于提供对应于图6中说明的方法600的由无线装置需要的转换功能的实施例服务器方法700。在框702中，服务器（例如，如图5中示出的话音/文字服务器500）可从无线装置接收经编码语音数据包。在框704中，服务器可使用上文关于图5所论述的组件和/或操作将经编码语音数据转换为口头词语的文字表示（即，转录）。在框706中，无线装置可经由数据通信链路将文字数据发射到无线装置。在框708中，服务器可经由例如数据通信从无线装置接收文字数据包。在框710中，可使用上文关于图5所论述的组件和/或操作将所接收文字数据转换为经编码语音数据。在框712中，服务器可将经编码语音数据包发射到无线装置。

[0070] 各种实施例可在多种无线装置中的任一者中实施，图8中说明所述无线装置的实例。举例来说，无线装置800可包含耦合到内部存储器804和810的处理器802。内部存储器804和810可为易失性或非易失性存储器，且也可以为安全和/或经加密存储器，或不安全和/或未加密的存储器，或其任何组合。处理器802还可耦合到触摸屏显示器806，例如电阻性感测触摸屏、电容性感测触摸屏、红外感测触摸屏或类似者。另外，无线装置800的显示器不必具有触摸屏能力。另外，无线装置800可具有用于发送和接收电磁辐射的一或多个天线808，其可连接到耦合到处理器802的一或多个无线数据链路和/或蜂窝式电话收发器816。无线装置800还可包含用于接收用户输入的物理按钮812a和812b。无线装置800还可包含用于接通和断开无线装置800的电力按钮818。无线装置800还可包含耦合到处理器802的电池820。无线装置800还可包含耦合到处理器802的位置传感器822，例如GPS接收器。

[0071] 上文所描述的各种实施例还可在多种个人计算装置（例如图9中图解说明的膝上型计算机910）内实施。许多膝上型计算机包含触摸垫触摸表面917（其充当计算机的指向装置），并且因而可以接收拖动、滚动和滑动手势，类似于配备有触摸屏显示器并且如上文所描述的移动计算装置上实施的那些手势。膝上型计算机910通常将包含耦合到易失性存储器912和大容量非易失性存储器（例如快闪存储器的磁盘驱动器913）的处理器911。膝上型计算机910还可包含耦合到处理器911的软盘驱动器914和压缩光盘（CD）驱动器915。膝上型计算机910还可包含多个耦合到处理器911的连接器端口，用于建立数据连接或接纳外部存储器装置，例如USB或FireWire®连接器插口，或其它用于将处理器911连接

到网络的网络连接电路。

[0072] 在笔记本配置中，计算机外壳包含全部耦合到处理器 911 的触摸垫 917、键盘 918 和显示器 919。膝上型计算机 910 还可包含耦合到处理器 911 的电池 920。膝上型计算机 910 还可包含耦合到处理器 911 的位置传感器 922，例如 GPS 接收器。另外，膝上型计算机 910 可具有用于发送和接收电磁辐射的一或多个天线 908，其可连接到耦合到处理器 911 的一或多个无线数据链路和 / 或蜂窝式电话收发器 916。计算装置的其它配置可包含众所周知的耦合到处理器（例如，经由 USB 输入）的计算机鼠标或轨迹球，其也可以结合各种实施例而使用。

[0073] 各种实施例还可实施在多种市售的服务器装置中的任一者上，例如图 10 中说明的服务器 1000。此服务器 1000 通常包含处理器 1001，其耦合到易失性存储器 1002 及大容量非易失性存储器，例如磁盘驱动器 1003。服务器 1000 还可包含耦合到处理器 1001 的软盘驱动器、压缩光盘 (CD) 或 DVD 光盘驱动器 1004。服务器 1000 还可包含网络接入端口 1006，其耦合到处理器 1001 以用于建立与网络 1007 的网络接口连接，所述网络例如为耦合到其它广播系统计算机及服务器的局域网、因特网、公共交换电话网络及 / 或蜂窝式数据网络（例如，CDMA、TDMA、GSM、PCS、3G、4G、LTE 或任何其它类型的蜂窝式数据网络）。

[0074] 处理器 602、911 和 1001 可为可通过软件指令（应用程序）配置以执行多种功能（包含上述各种实施例的功能）的任何可编程微处理器、微型计算机或多处理器芯片。在一些装置中，可以提供多个处理器，例如一个处理器专用于无线通信功能，并且一个处理器专用于运行其它应用。通常，软件应用程序在它们被存取且加载到处理器 802、911 和 1001 中之前可存储在内部存储器 804、810、912、913、1002 和 1003 中。处理器 802、911 和 1001 可包含足以存储应用程序软件指令的内部存储器。在许多装置中，内部存储器可以是易失性或非易失性存储器，例如快闪存储器，或这两种存储器的混合物。出于此描述的目的，对存储器的一般参考指代可由处理器 802、911 和 1001 存取的存储器，包含内部存储器或插入到装置中的可装卸式存储器和处理器 802、911 和 1001 本身内的存储器。

[0075] 前述方法描述和过程流程图仅仅作为说明性实例提供，并且其并不打算要求或暗示各种实施例的步骤必须以所呈现的顺序进行。如所属领域的技术人员将了解，可以任何次序执行前述实施例中的步骤的次序。例如“此后”、“接着”、“接下来”等词无意限制步骤的次序；这些词仅用以引导读者浏览对方法的描述。此外，举例来说，使用冠词“一”、或“所述”对单数形式的权利要求要素的任何参考不应解释为将所述要素限制为单数。

[0076] 结合本文揭示的实施例所描述的各种说明性逻辑块、模块、电路和算法步骤可实施为电子硬件、计算机软件，或两者的组合。为清楚说明硬件与软件的此互换性，上文已大致关于其功能性描述各种说明性组件、块、模块、电路和步骤。此类功能性是实施为硬件还是软件取决于特定应用及强加于整个系统的设计约束。所属领域的技术人员可针对每一特定应用以不同方式来实施所描述的功能性，但此类实施方案决策不应被解释为会导致脱离本发明的范围。

[0077] 用以实施结合本文中所揭示的方面而描述的各种说明性逻辑、逻辑块、模块和电路的硬件可用以下各项来实施或执行：通用处理器、数字信号处理器 (DSP)、专用集成电路 (ASIC)、现场可编程门阵列 (FPGA) 或经设计以执行本文中所描述的功能的其它可编程逻辑装置、离散门或晶体管逻辑、离散硬件组件，或其任何组合。通用处理器可以是微处理器，

但在替代方案中，处理器可以是任何常规处理器、控制器、微控制器或状态机。还可将处理器实施为计算装置的组合，例如 DSP 与微处理器的组合、多个微处理器的组合、一或多个微处理器与 DSP 核心的联合，或任何其它此类配置。或者，可通过特定地针对给定功能的电路来执行一些步骤或方法。

[0078] 在一或多个示范性方面中，所描述的功能可在硬件、软件、固体或其任何组合中实施。如果以软件实施，则功能可作为一或多个指令或代码存储于非暂时性处理器可读存储媒体上。本文揭示的方法或算法的步骤可以体现于可以驻留在非暂时性计算机可读存储媒体上的处理器可执行软件模块中。有形的非暂时性处理器可读存储媒体可为可由计算机、移动计算装置或无线通信装置存取的任何可用媒体。借助于实例而非限制，此类非暂时性处理器可读媒体可包括 RAM、ROM、EEPROM、CD-ROM 或其它光盘存储装置、磁盘存储装置或其它磁性存储装置，或可用于以指令或数据结构形式携载或存储所要程序代码且可由计算机存取的任何其它媒体。如本文所使用，磁盘及光盘包含压缩光盘 (CD)、激光光盘、光学光盘、数字多功能光盘 (DVD)、软性磁盘及蓝光光盘，其中磁盘通常以磁性方式再生数据，而光盘用激光以光学方式再生数据。以上各项的组合也应包含在非暂时性处理器可读媒体的范围内。另外，方法或算法的操作可作为代码和 / 或指令中的一者或任何组合或集合而驻留在可并入到计算机程序产品中的有形的非暂时性处理器可读媒体和 / 或计算机可读媒体上。

[0079] 提供对所揭示的实施例的前述描述以使得所属领域的技术人员能够制作或使用本发明。所属领域的技术人员将容易显而易见对这些实施例的各种修改，且可在不脱离本发明的精神或范围的情况下将本文定义的一般原理应用到其它实施例。因此，本发明并不希望限于本文中所示的实施例，而应被赋予与随附权利要求书和本文中所揭示的原理和新颖特征相一致的最广泛范围。

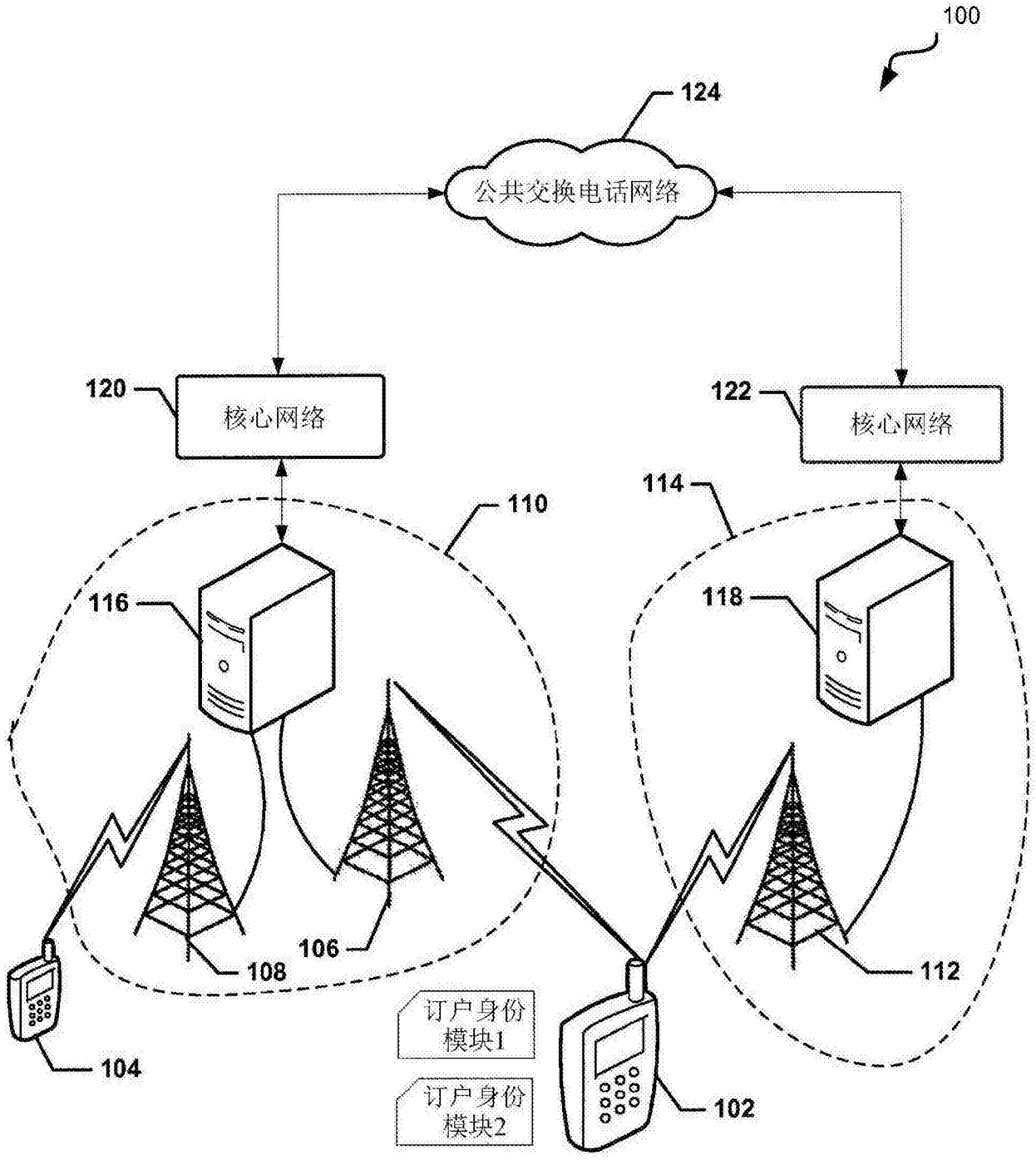

100
124
公共交换电话网络
120
核心网络
122
核心网络
110
114
116
118
106
108
112
104
102
订户身份模块1
订户身份模块2

图 1

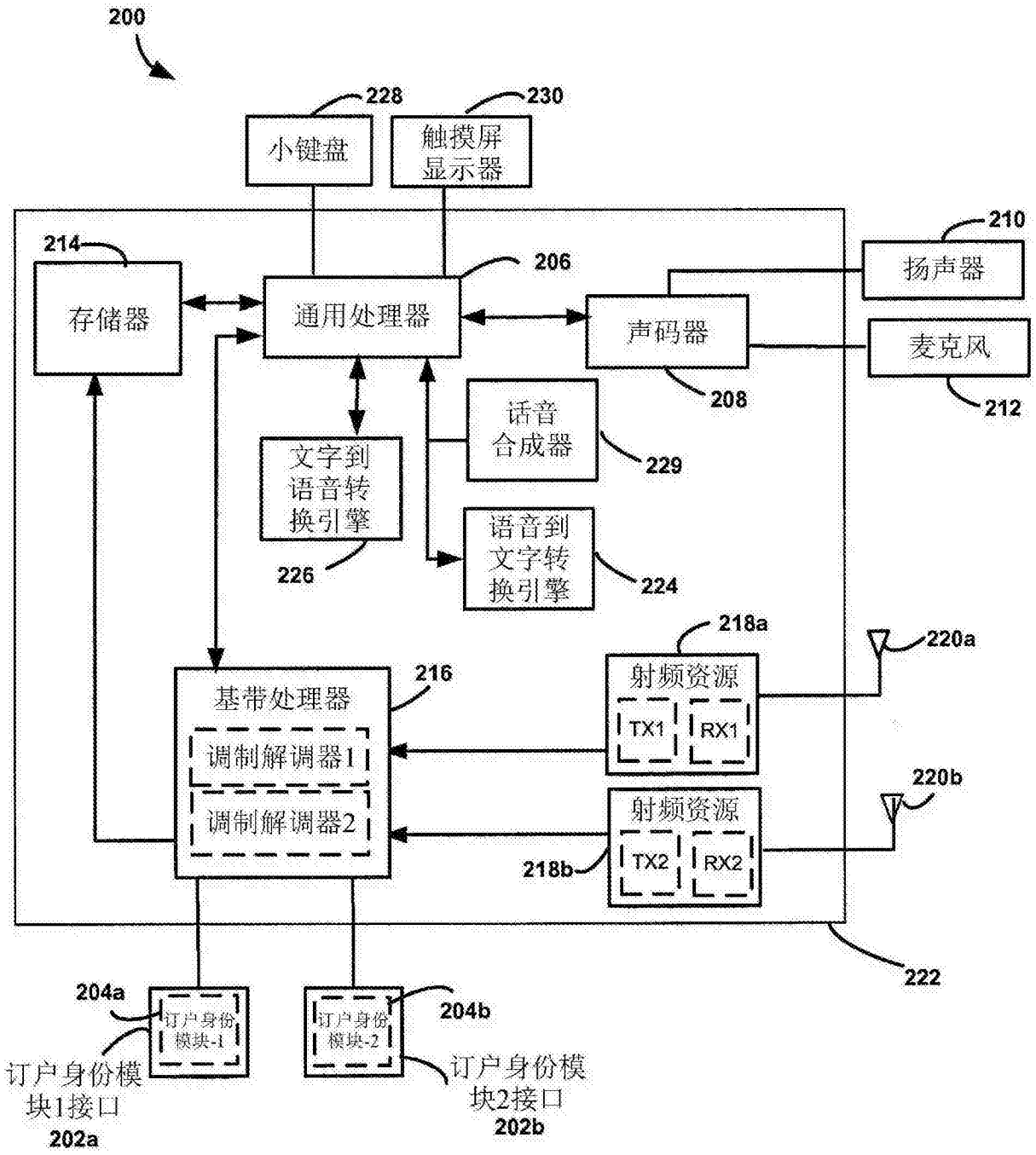

200
228
小键盘
230
触摸屏
显示器
214
存储器
206
通用处理器
210
扬声器
声码器
麦克风
208
212
话音
合成器
229
文字到
语音转
换引擎
226
语音到
文字转
换引擎
224
218a
220a
射频资源
TX1
RX1
基带处理器
216
调制解调器1
调制解调器2
220b
射频资源
218b
TX2
RX2
222
204a
订户身份
模块-1
204b
订户身份
模块-2
订户身份模
块1接口
202a
订户身份模
块2接口
202b

图 2

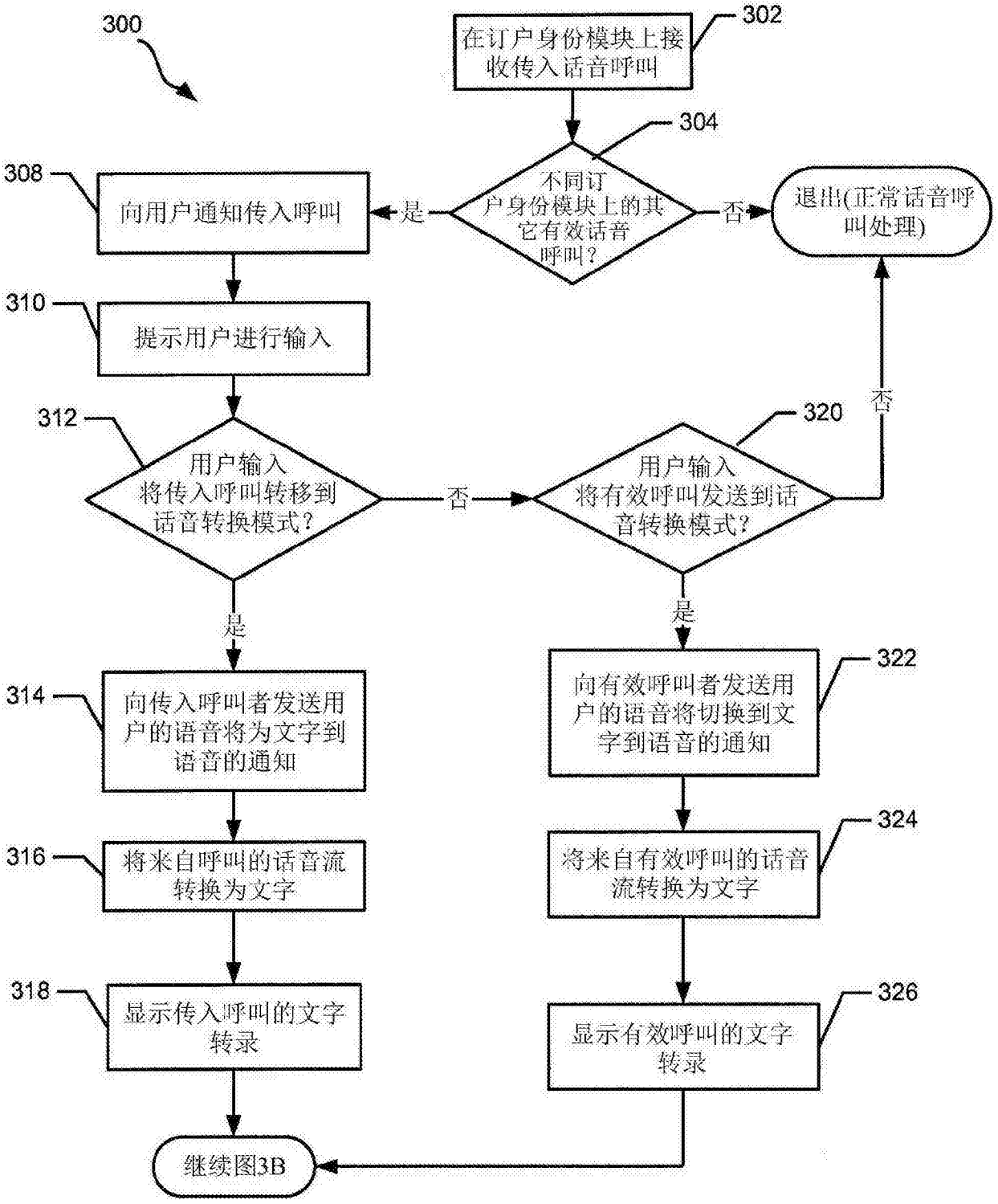

300
在订户身份模块上接收传入话音呼叫
302
304
不同订户身份模块上的其它有效话音呼叫？
是
否
308
向用户通知传入呼叫
退出(正常话音呼叫处理)
310
提示用户进行输入
312
用户输入将传入呼叫转移到话音转换模式？
否
320
用户输入将有效呼叫发送到话音转换模式？
否
是
是
314
向传入呼叫者发送用户的语音将为文字到语音的通知
322
向有效呼叫者发送用户的语音将切换到文字到语音的通知
316
将来自呼叫的话音流转换为文字
324
将来自有效呼叫的话音流转换为文字
318
显示传入呼叫的文字转录
326
显示有效呼叫的文字转录
继续图3B

图 3A

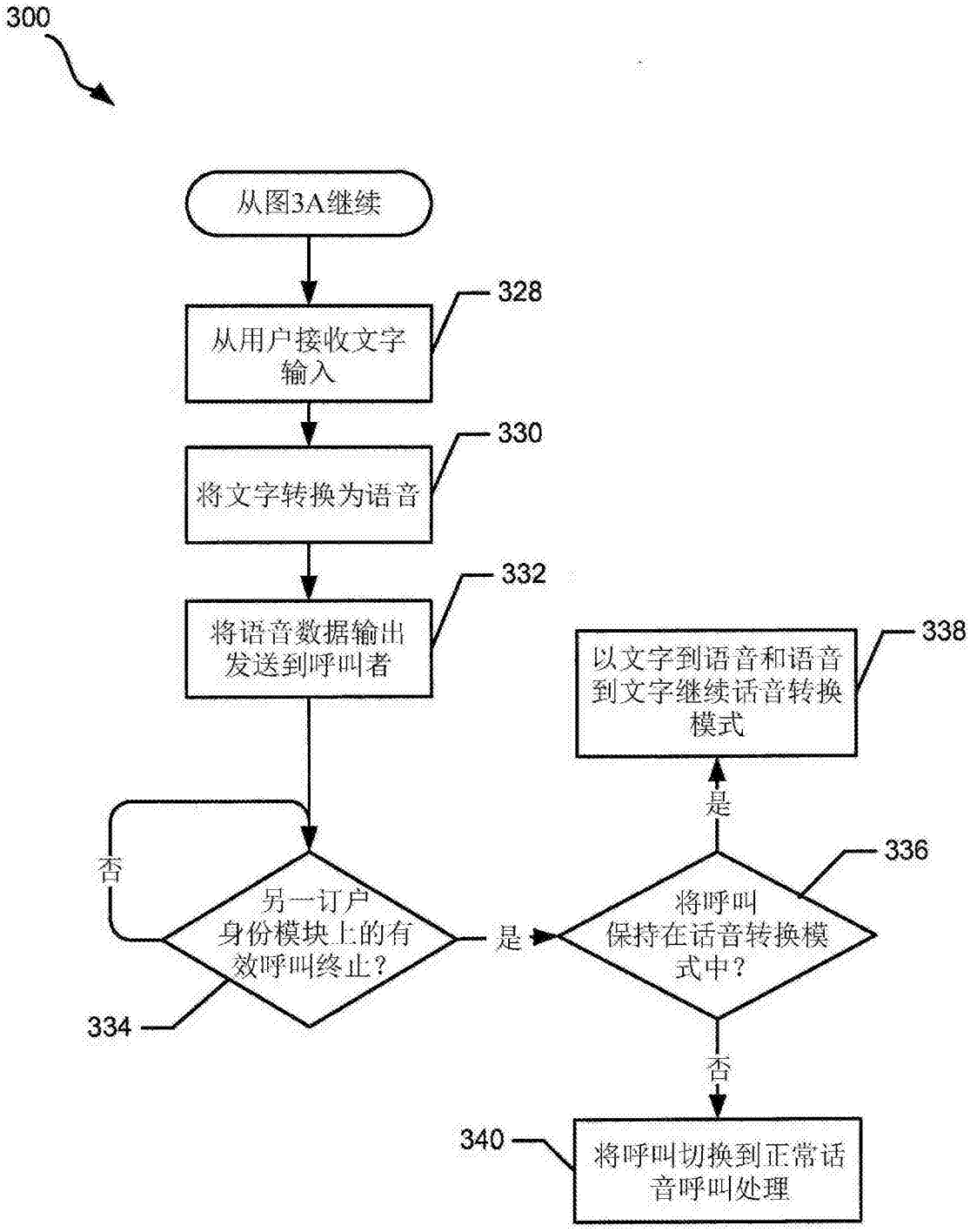

300
从图3A继续
328
从用户接收文字输入
330
将文字转换为语音
332
将语音数据输出发送到呼叫者
另一订户身份模块上的有效呼叫终止？
否
是
334
将呼叫保持在话音转换模式中？
336
是
以文字到语音和语音到文字继续话音转换模式
338
否
340
将呼叫切换到正常话音呼叫处理

图 3B

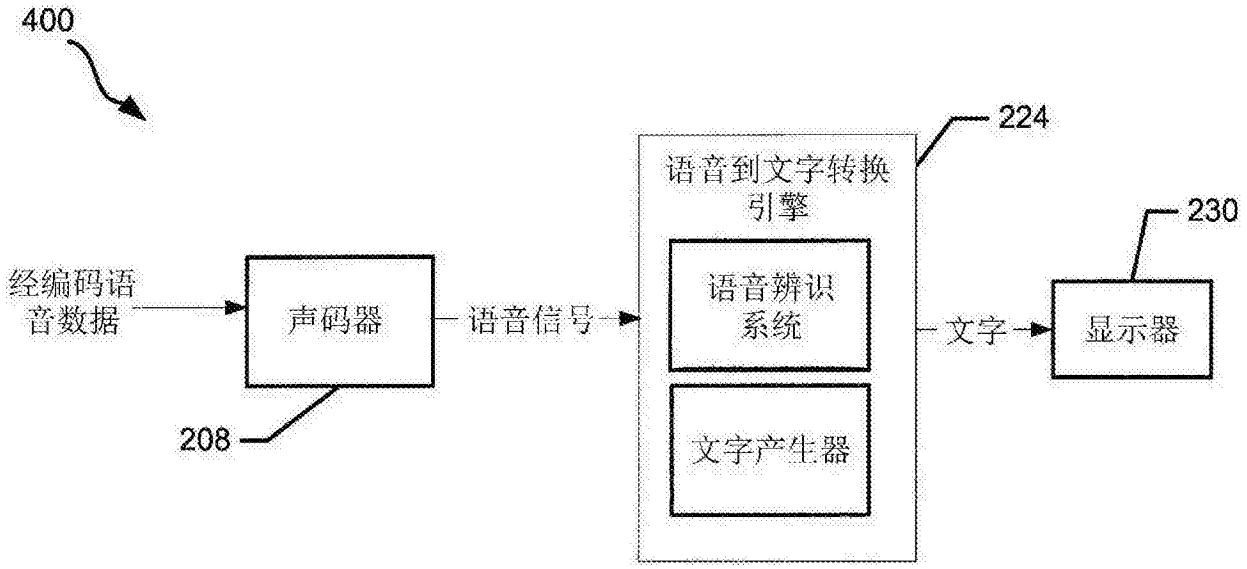

400
224
语音到文字转换引擎
230
经编码语音数据
声码器
语音信号
语音辨识系统
文字
显示器
208
文字产生器

图 4A

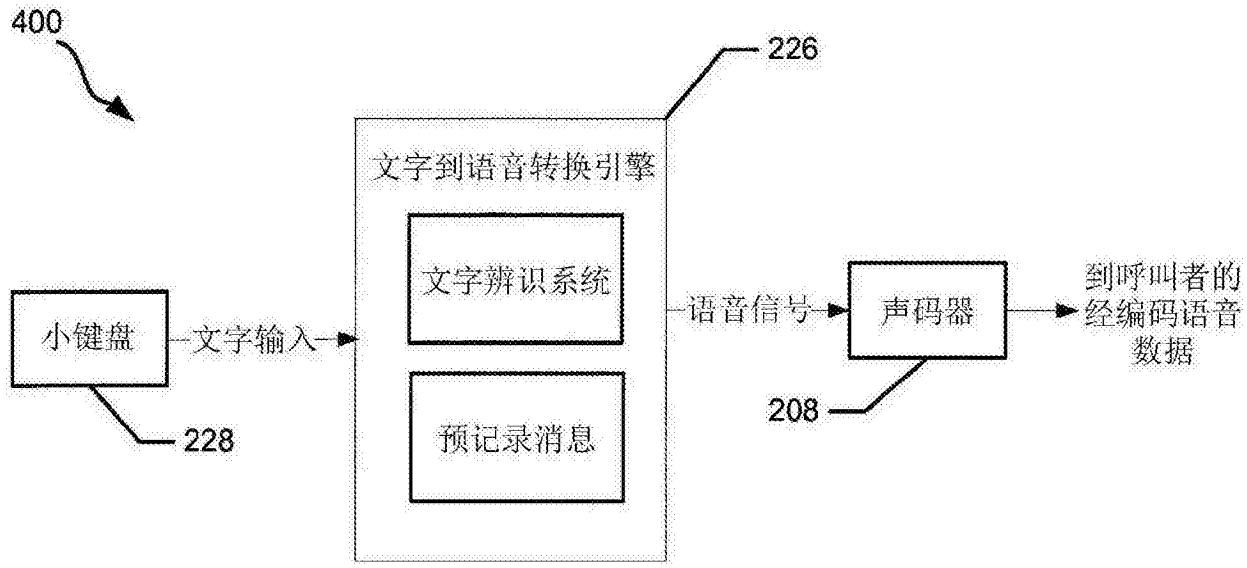

400
226
文字到语音转换引擎
小键盘
文字输入
文字辨识系统
语音信号
声码器
到呼叫者的经编码语音数据
预记录消息
208
228

图 4B

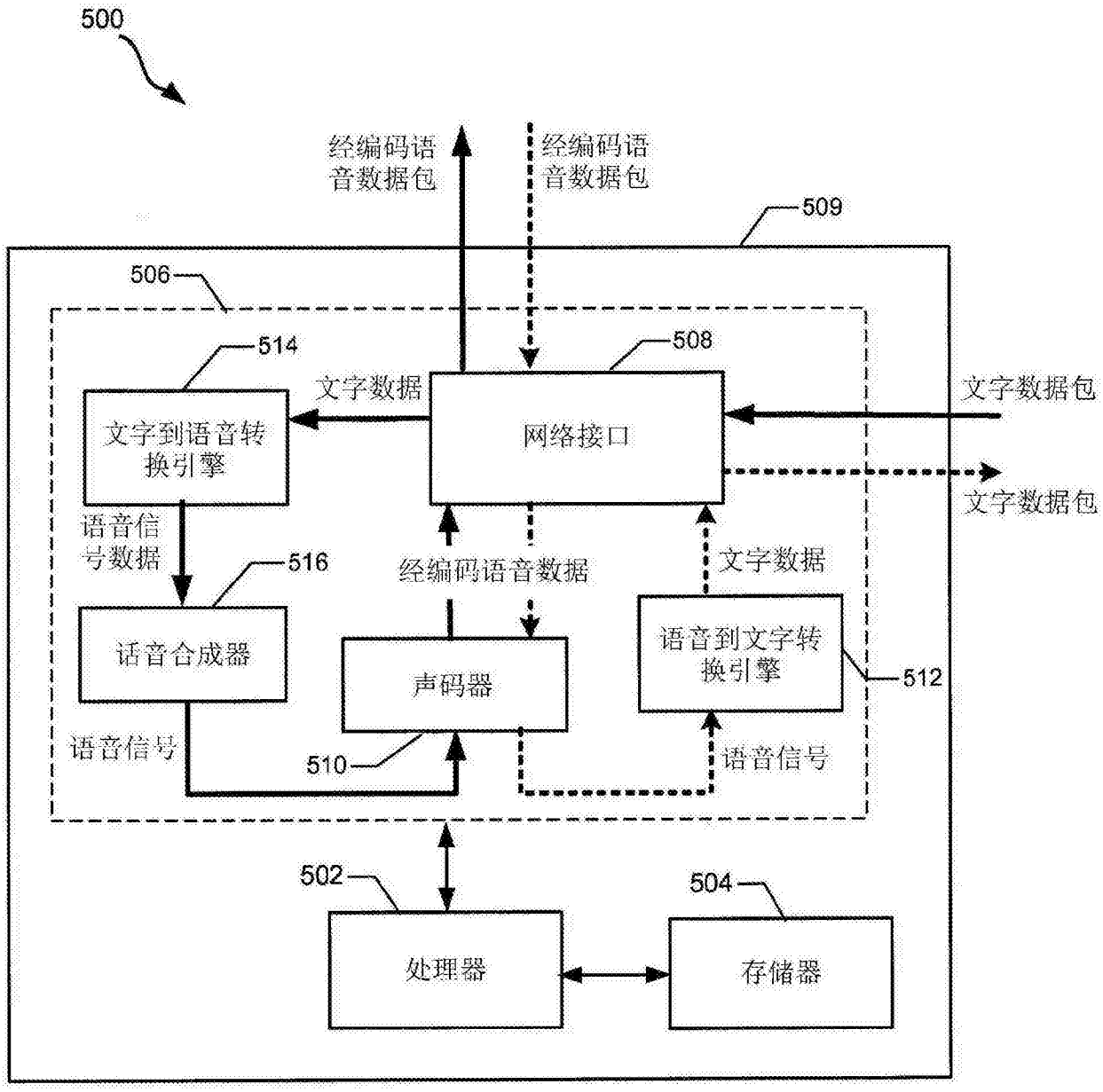

500
经编码语音数据包
经编码语音数据包
509
506
514
508
文字数据
文字到语音转换引擎
网络接口
文字数据包
文字数据包
语音信号数据
516
经编码语音数据
文字数据
话音合成器
声码器
语音到文字转换引擎
512
语音信号
510
语音信号
502
504
处理器
存储器

图 5

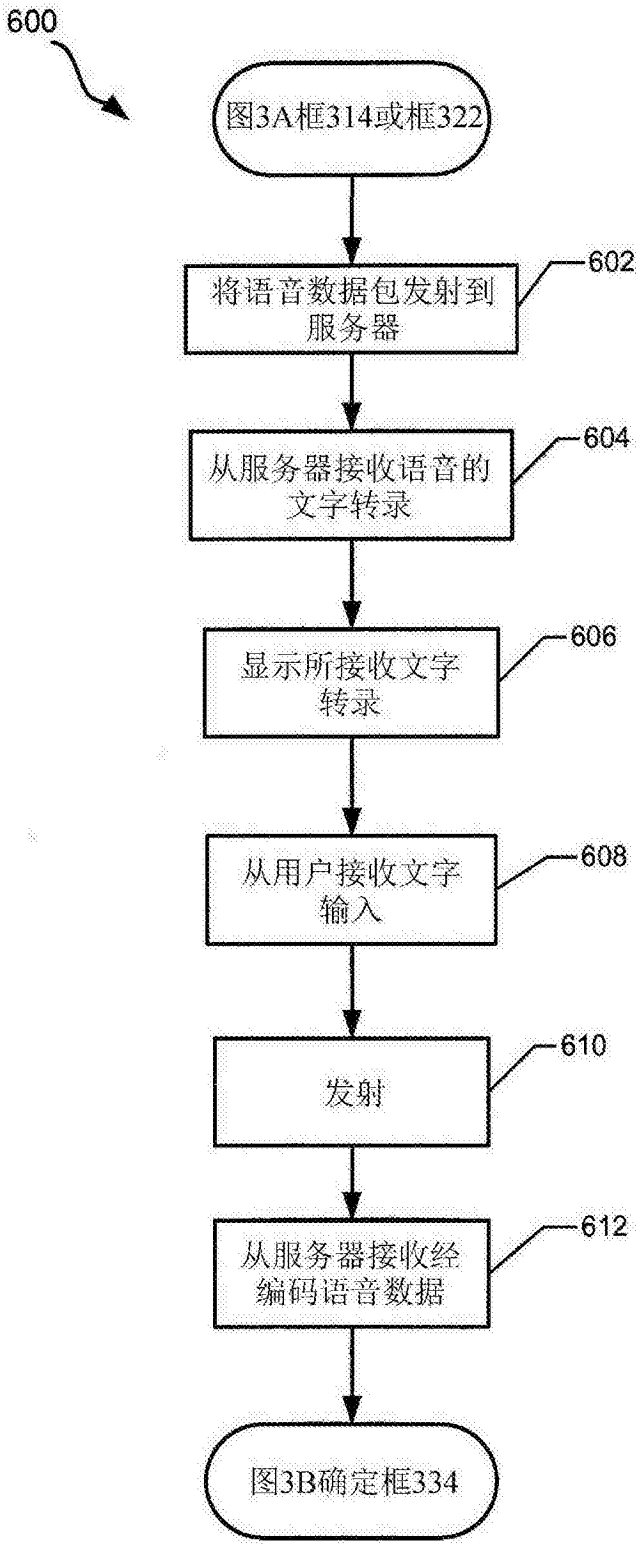

600
图3A框314或框322
将语音数据包发射到服务器
602
从服务器接收语音的文字转录
604
显示所接收文字转录
606
从用户接收文字输入
608
发射
610
从服务器接收经编码语音数据
612
图3B确定框334

图 6

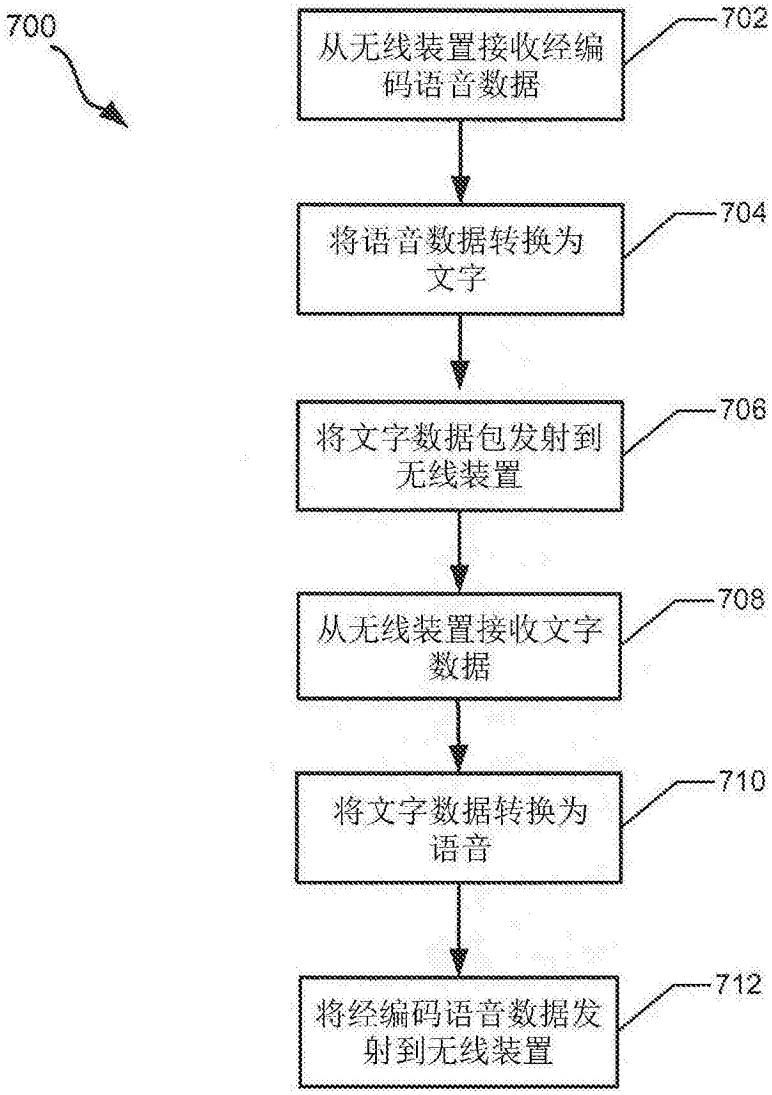

700
从无线装置接收经编码语音数据
702
将语音数据转换为文字
704
将文字数据包发射到无线装置
706
从无线装置接收文字数据
708
将文字数据转换为语音
710
将经编码语音数据发射到无线装置
712

图 7

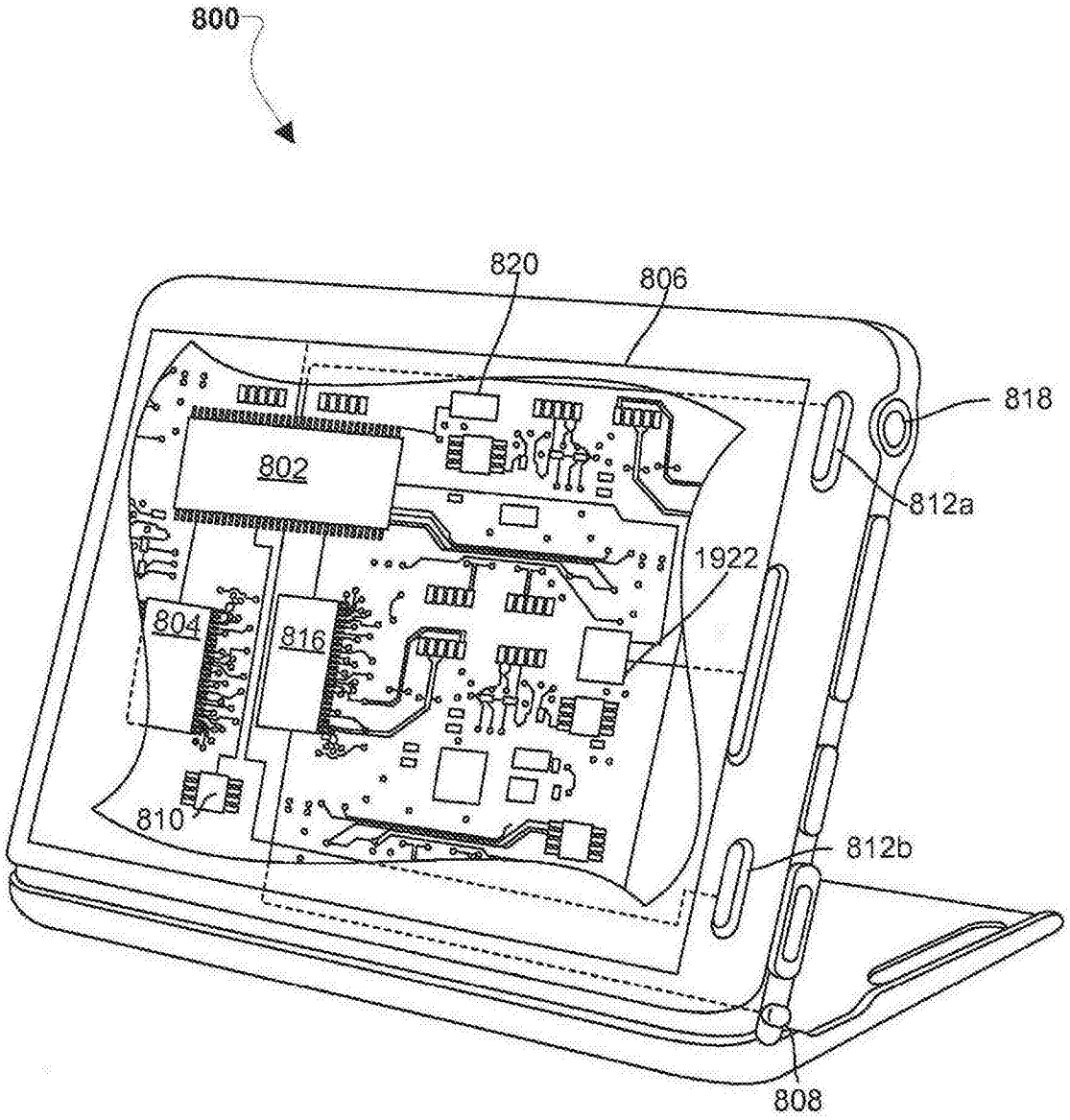


图 8

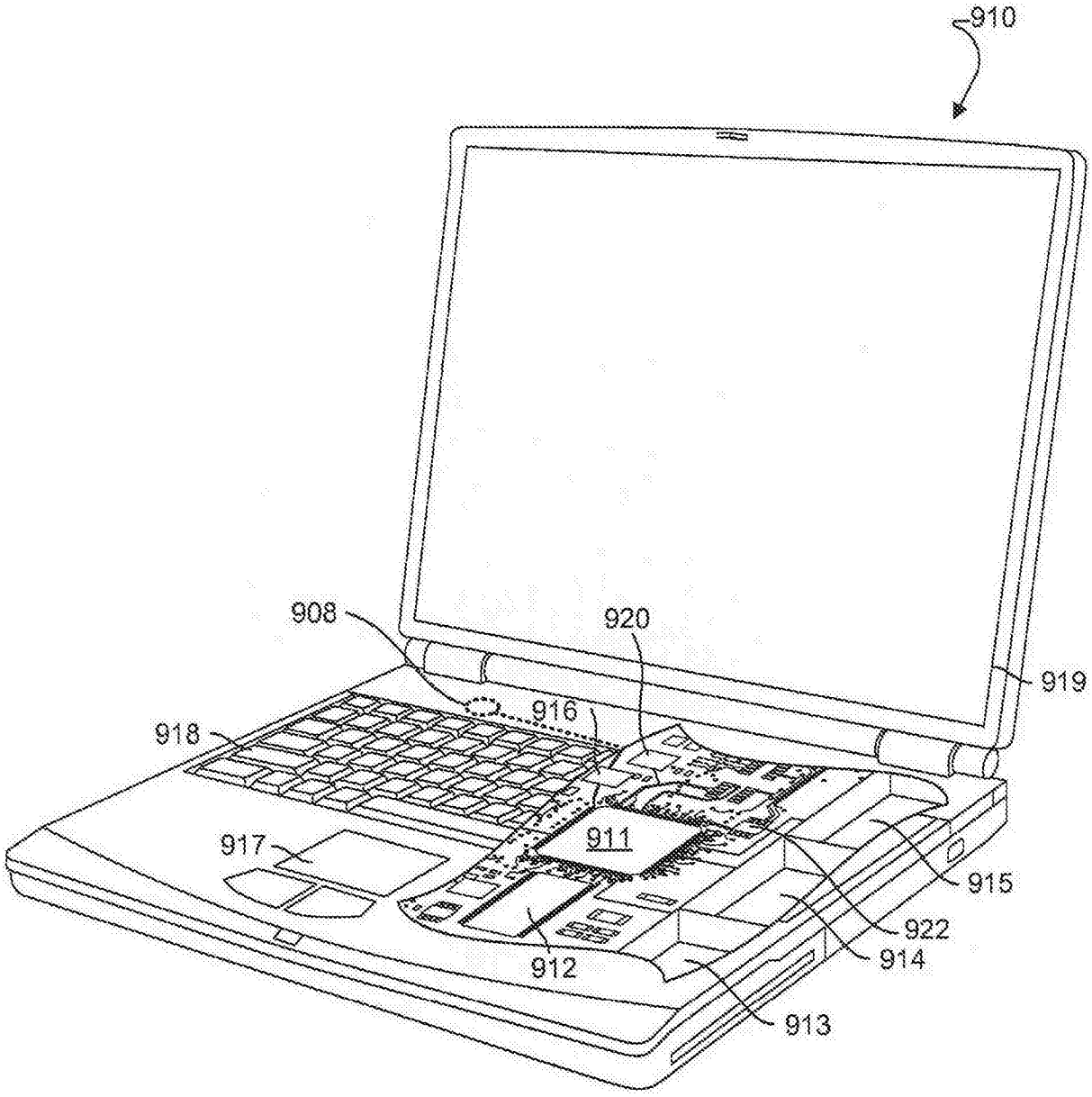


图 9

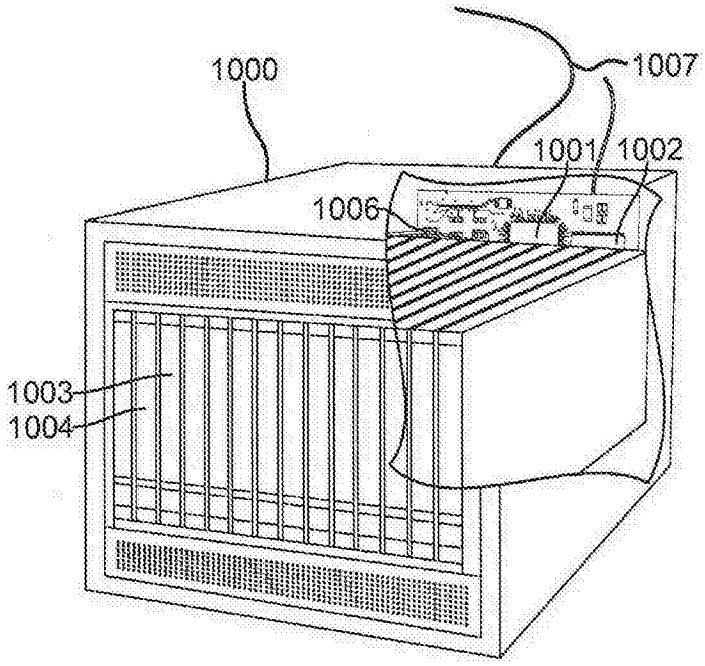


图 10