



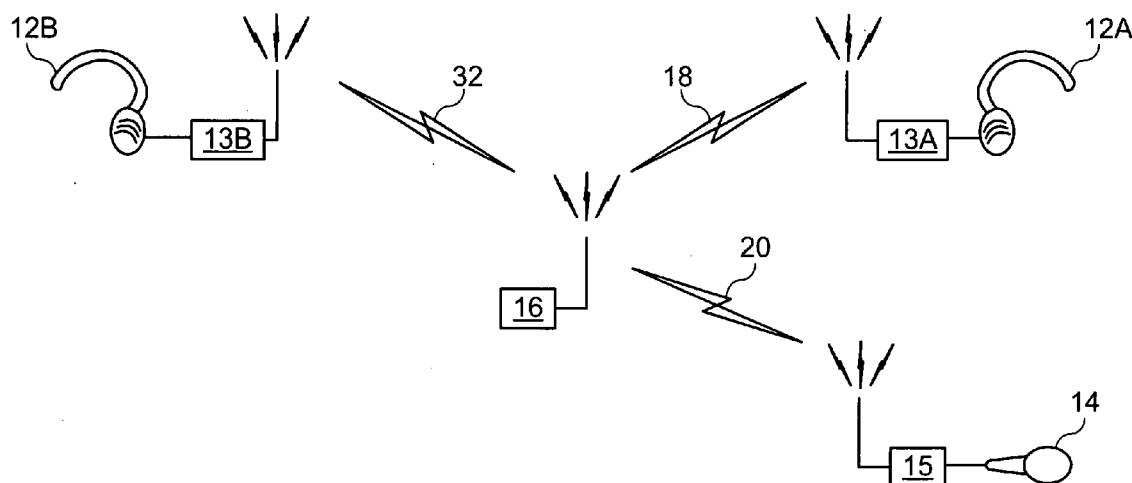
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(19) **United States**(12) **Patent Application Publication** (10) **Pub. No.: US 2005/0136839 A1**
Seshadri et al. (43) **Pub. Date: Jun. 23, 2005**(54) **MODULAR WIRELESS MULTIMEDIA
DEVICE****Publication Classification**(76) Inventors: **Nambirajan Seshadri**, Irvine, CA
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Clemente, CA (US); **Jeyhan Karaoguz**,
Irvine, CA (US)(51) **Int. Cl.⁷** **H04M 1/00**; H04B 1/38(52) **U.S. Cl.** **455/41.2**; 455/575.2

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AUSTIN, TX 78716-0727 (US)(57) **ABSTRACT**

A modular wireless headset includes wearable earpiece(s) and wearable microphone(s), where the earpiece and microphone may be physically separate devices. The wearable earpiece renders inbound radio frequencies received from a host device audible. The wearable earpiece may include a receiver module, data recovery module, and speaker module. The receiver module may convert inbound RF signals into low intermediate frequency (IF) signals. The data recovery module recovers audio signals from the low IF signals. The speaker module renders the audio signals audible. The wearable microphone converts received audio signals into outbound RF signals, where the outbound RF signals are transmitted to the host device. The wearable microphone includes an audio input module and a transmitter module. The audio input module is operably coupled to convert received analog audio signals into digital audio signals. The transmitter module is operably coupled to convert the digital audio signals into the outbound RF signals.

(21) Appl. No.: **10/976,300**(22) Filed: **Oct. 27, 2004****Related U.S. Application Data**(63) Continuation-in-part of application No. 10/856,124,
filed on May 28, 2004.Continuation-in-part of application No. 10/856,430,
filed on May 28, 2004.(60) Provisional application No. 60/473,675, filed on May
28, 2003. Provisional application No. 60/473,967,
filed on May 28, 2003.

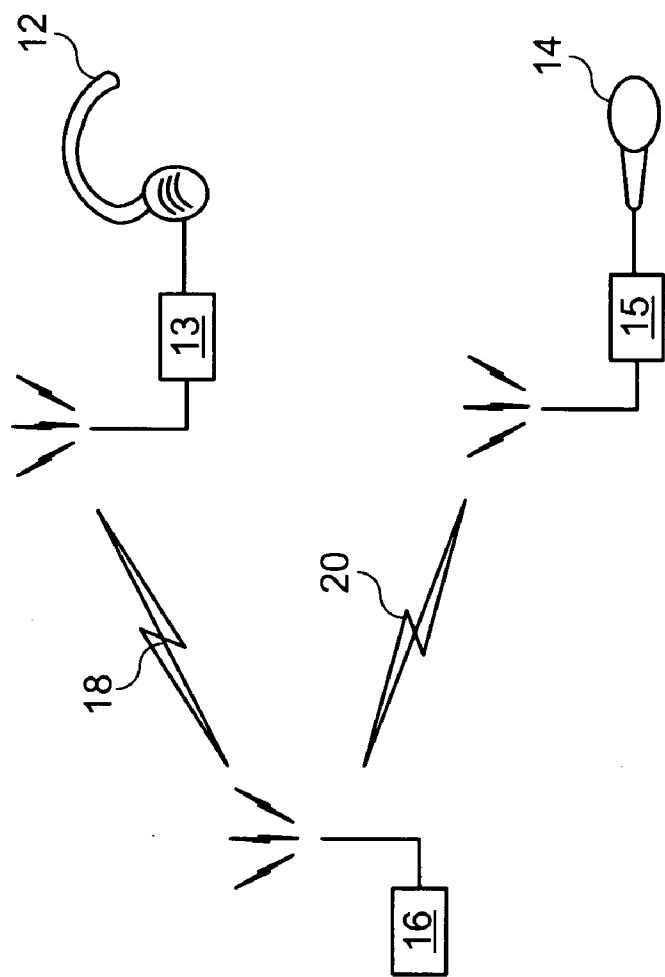


FIG. 1

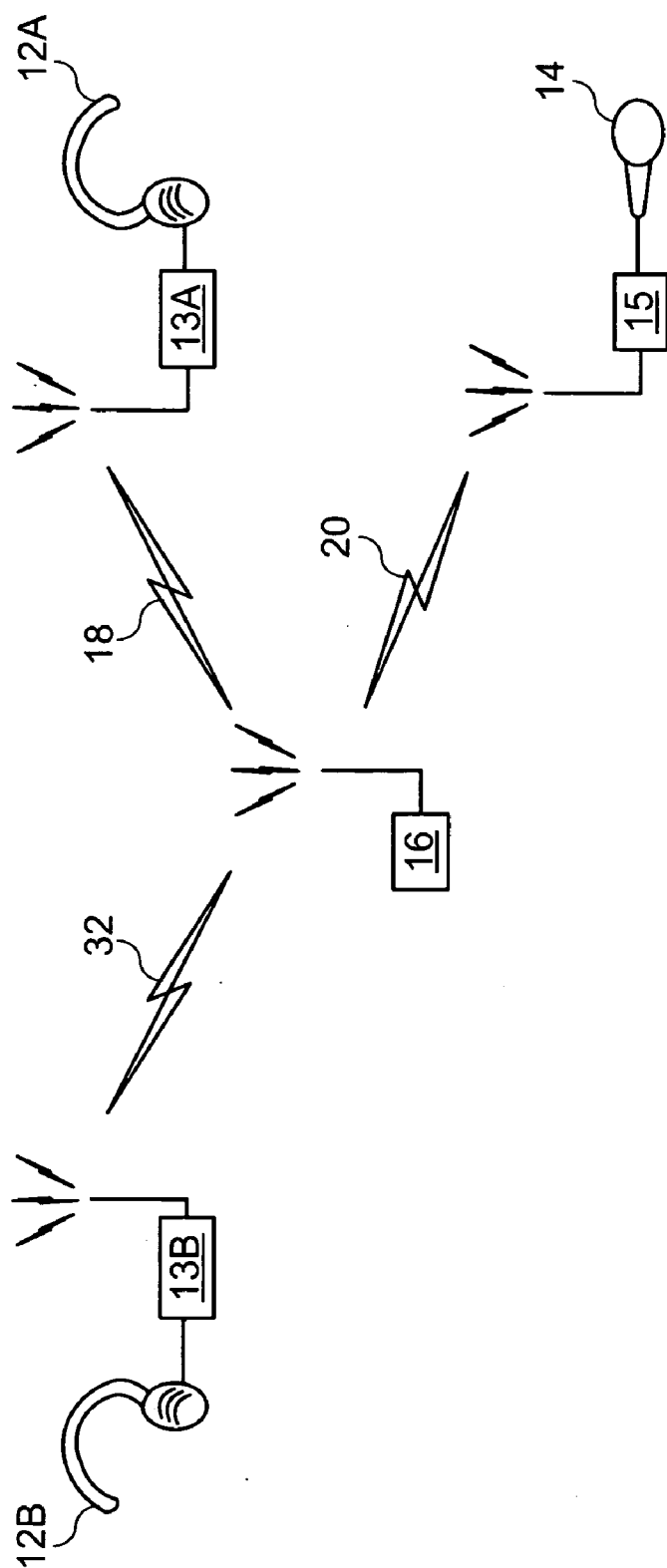


FIG. 2

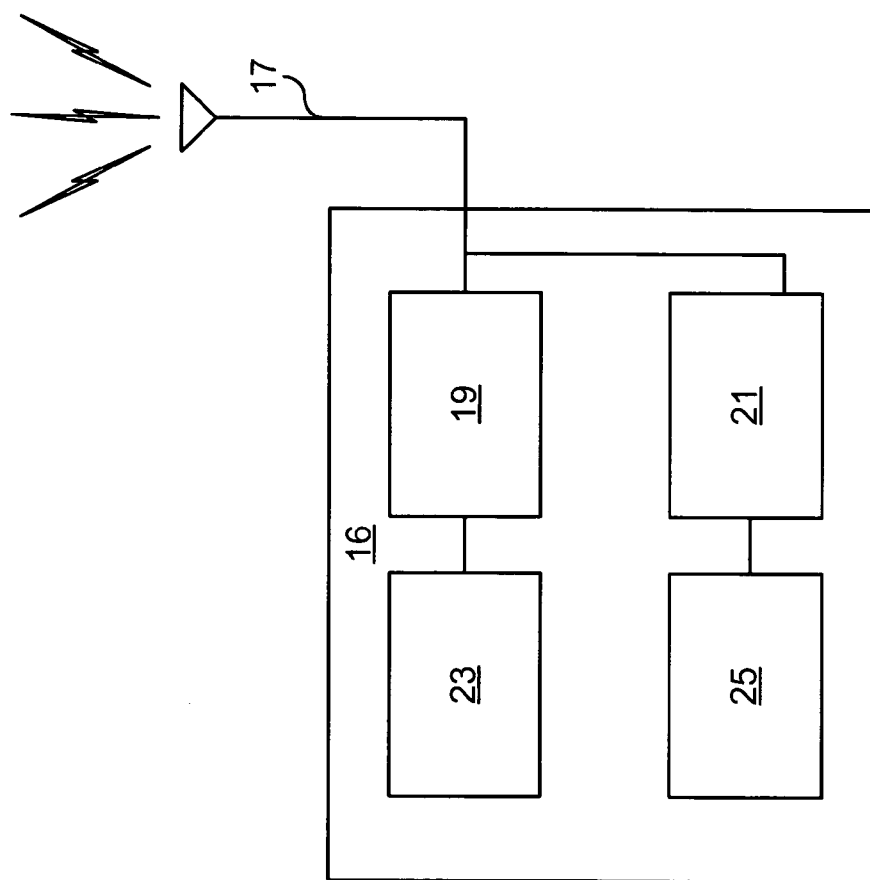


FIG. 3

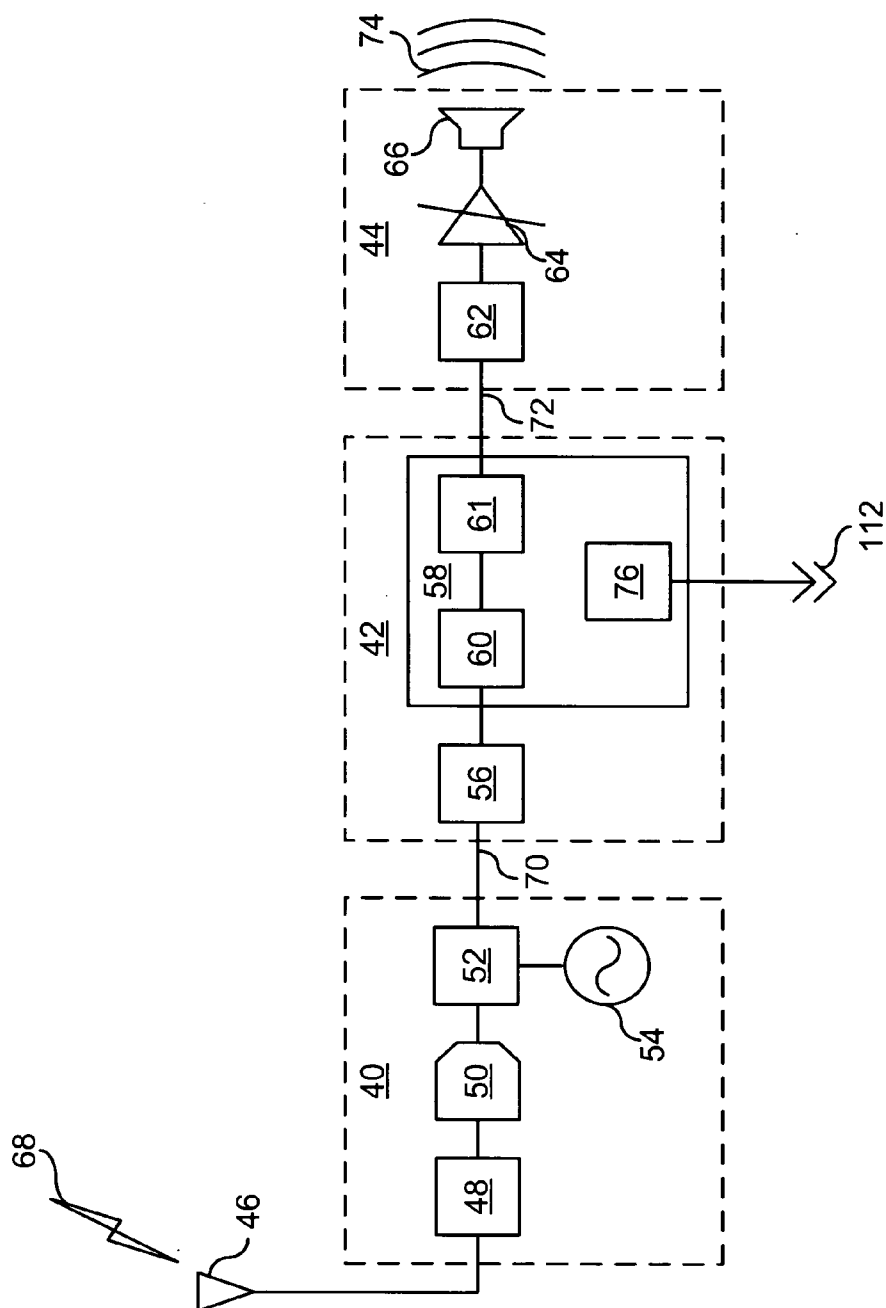


FIG. 4

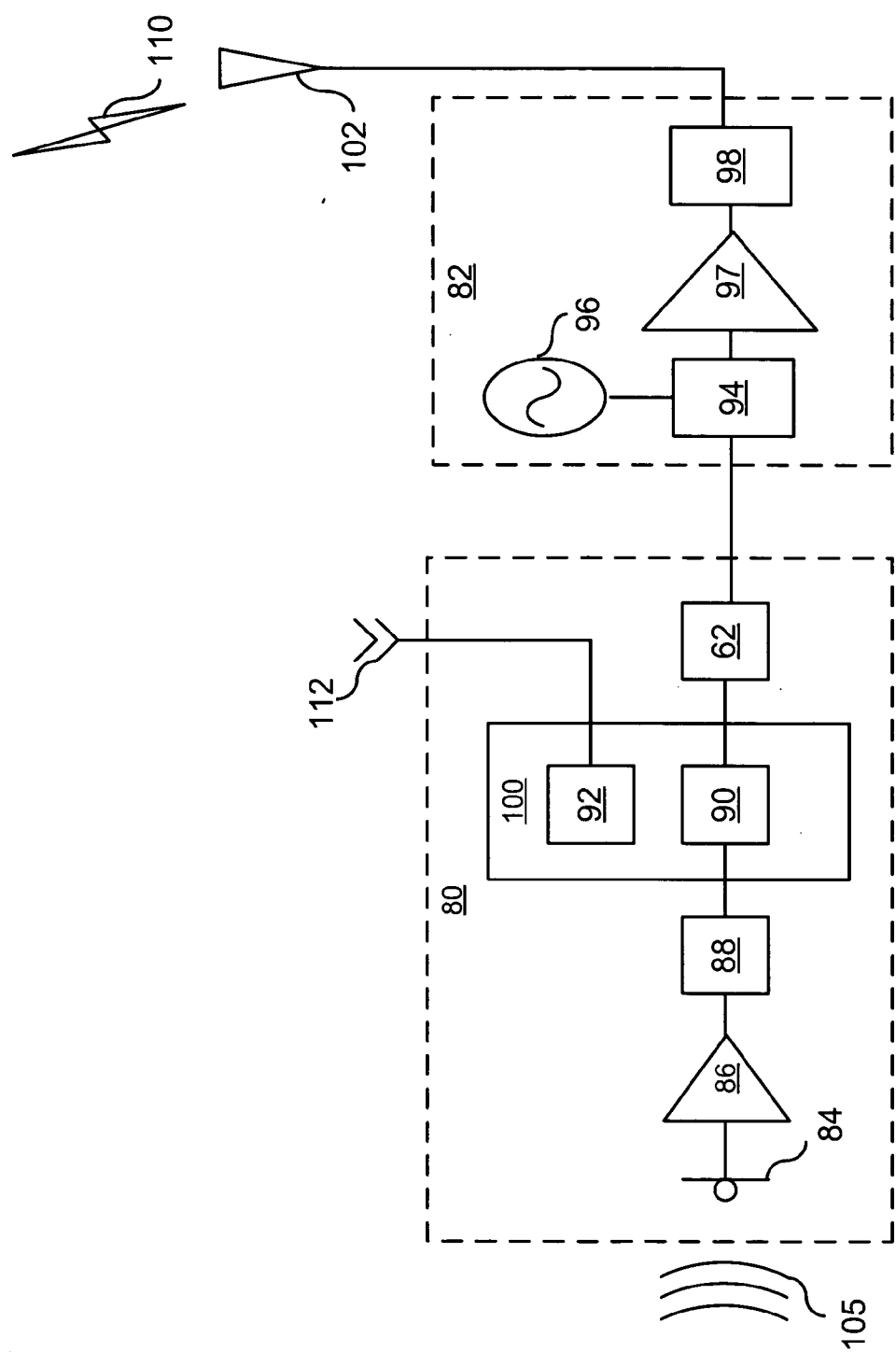


FIG. 5

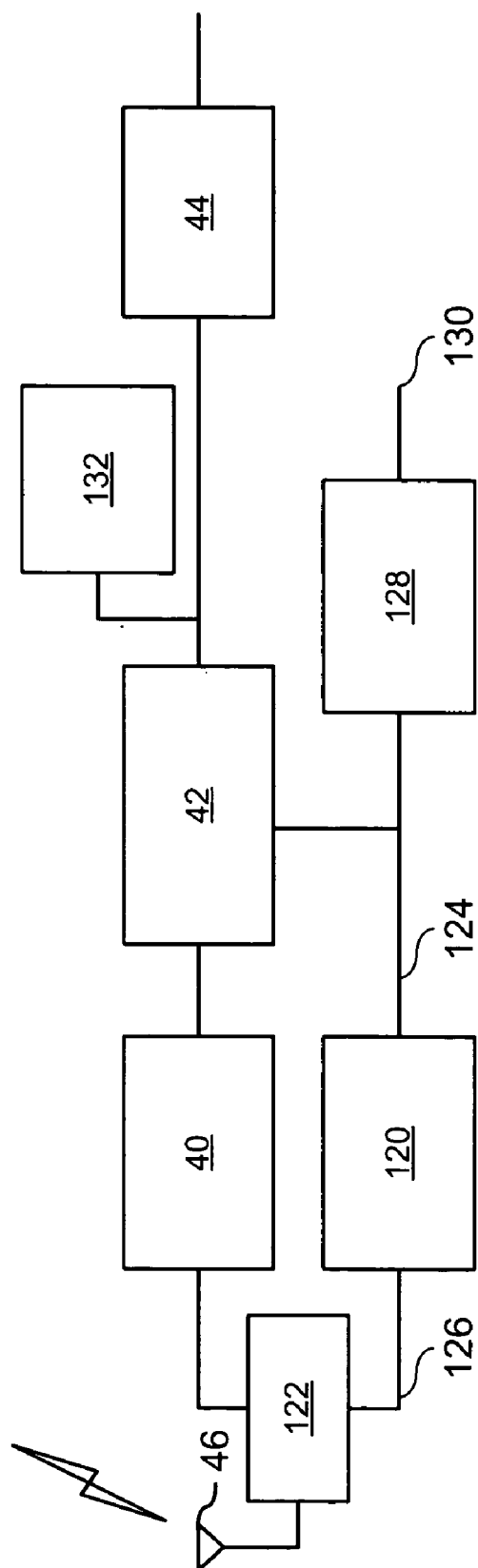


FIG. 6

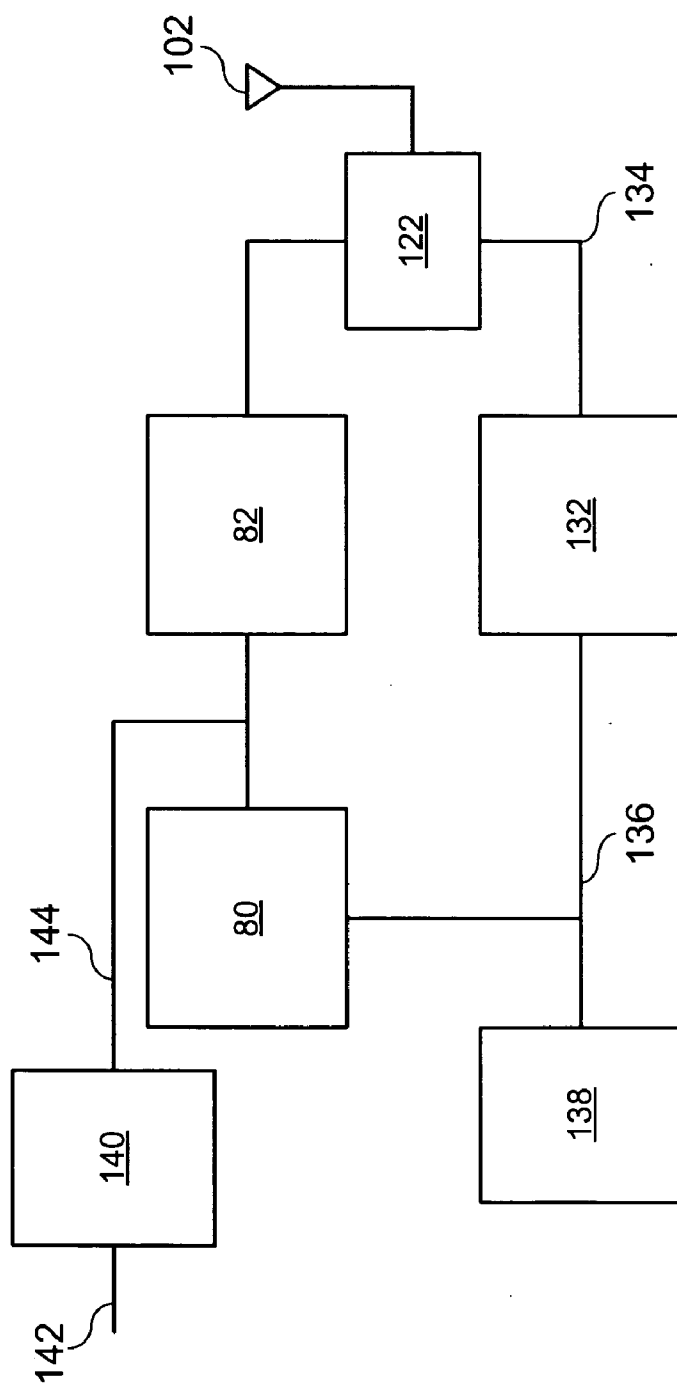


FIG. 7

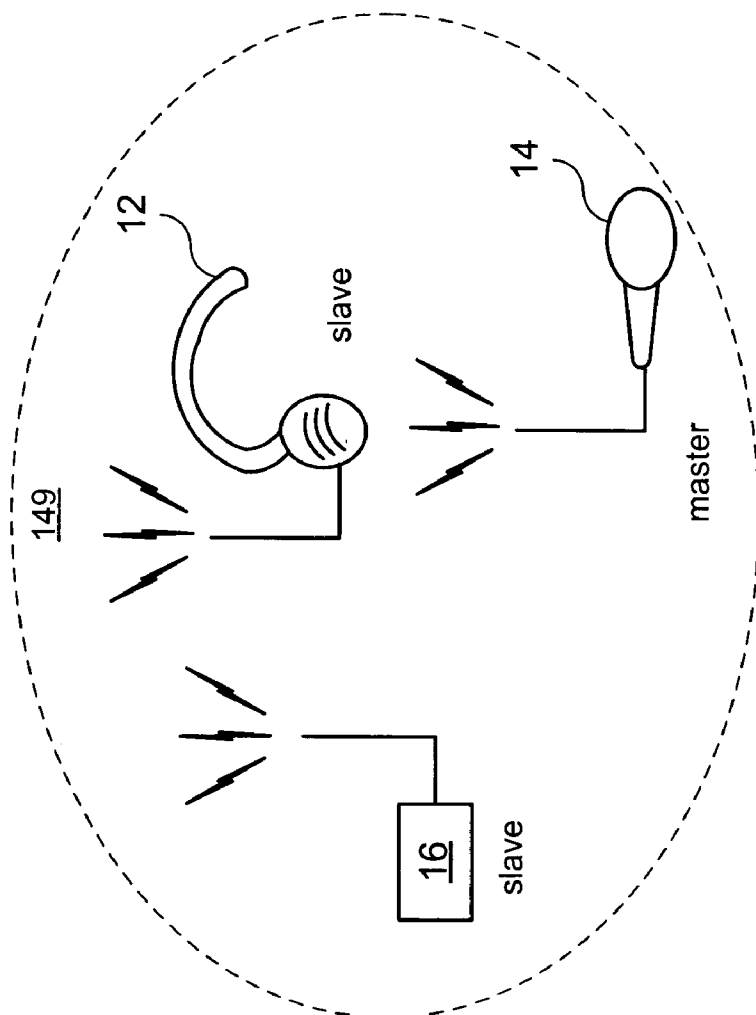


FIG. 8

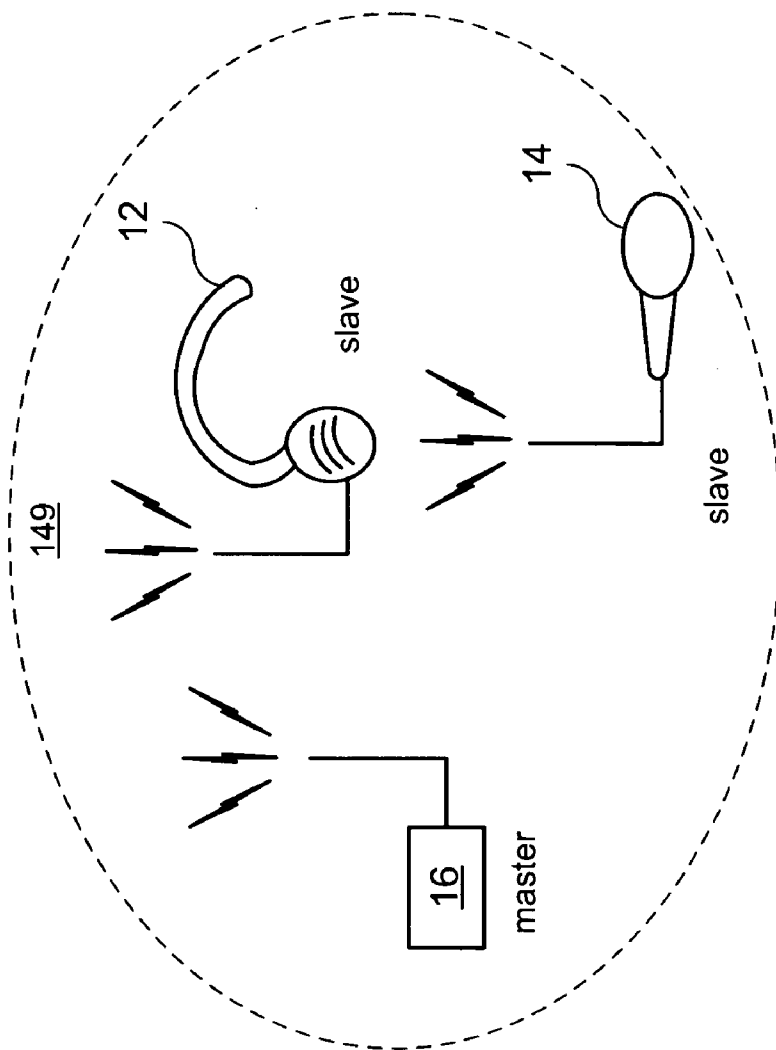


FIG. 9

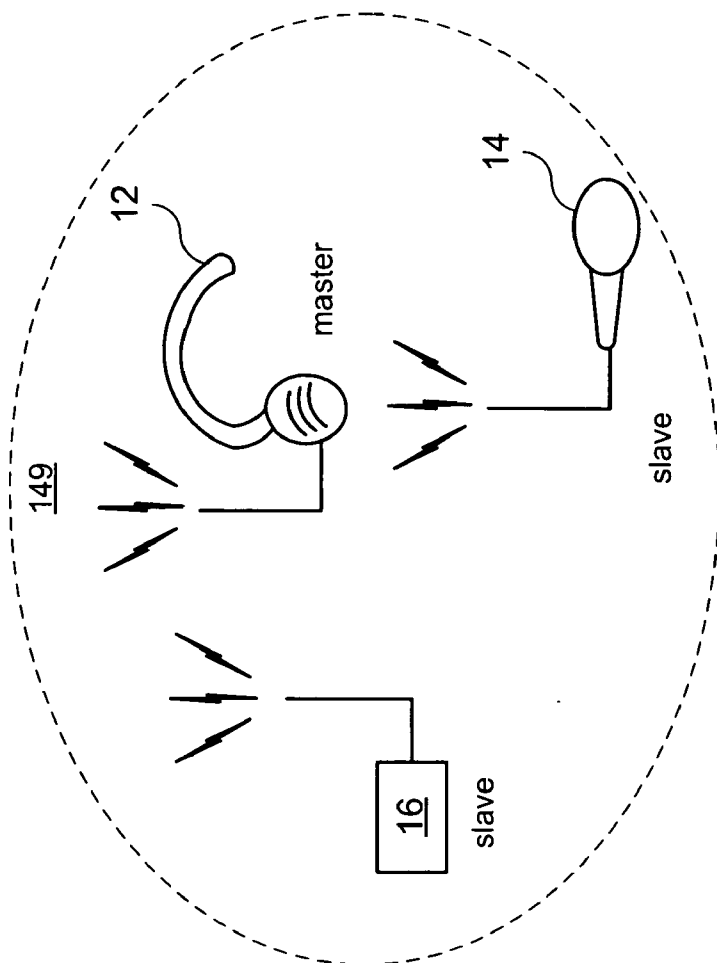


FIG. 10

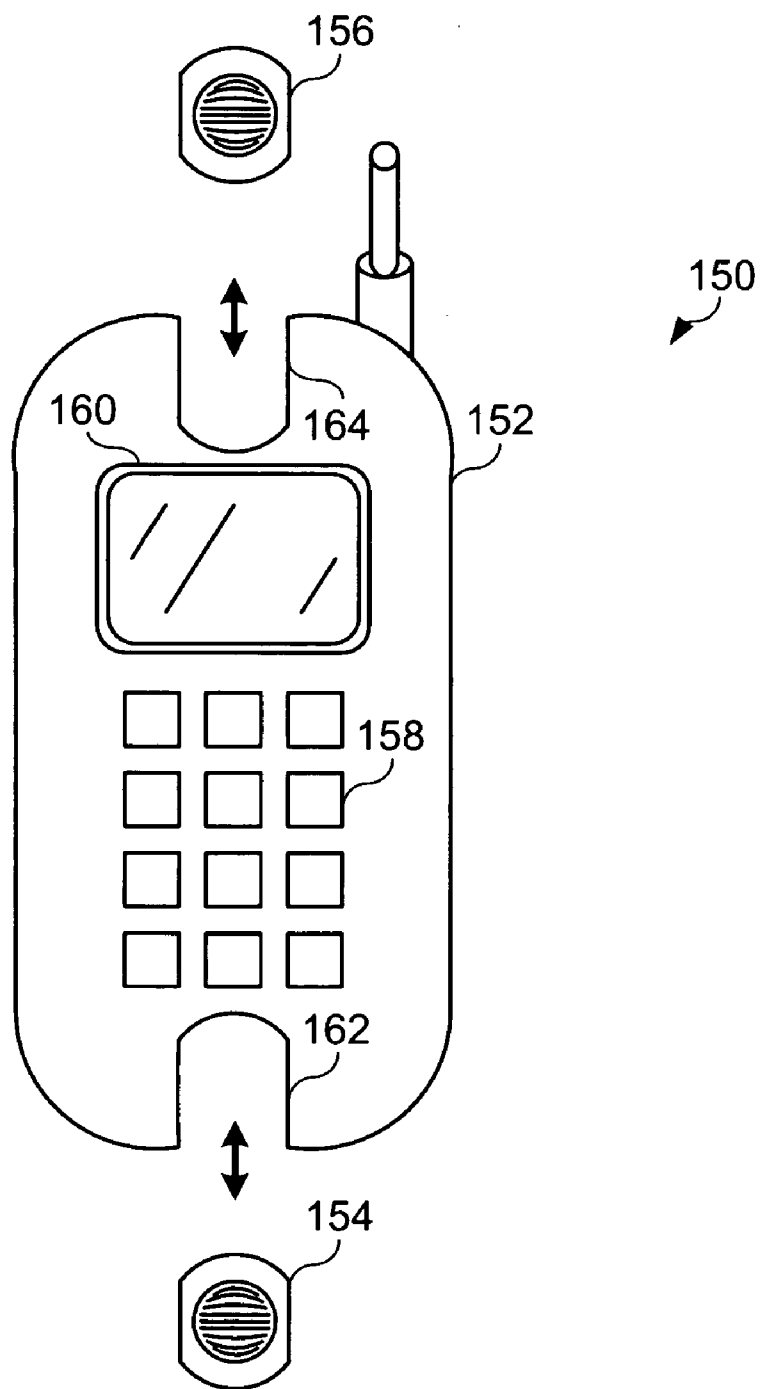


FIG. 11



FIG. 12

MODULAR WIRELESS MULTIMEDIA DEVICE**CROSS REFERENCES TO RELATED APPLICATIONS**

[0001] This Application is a continuation-in-part of application Ser. No. 10/856,124, filed May 28, 2004 which claims priority under 35 USC § 119(e) to Provisional Application No. 60/473,675, filed on May 28, 2003, both of which are incorporated herein by reference in their entirety. This Application is also a continuation-in-part of application Ser. No. 10/856,430, filed May 28, 2004 which claims priority under 35 USC § 119(e) to Provisional Application No. 60/473,967 filed on May 28, 2003, both of which are incorporated herein by reference in their entirety.

BACKGROUND OF THE INVENTION**[0002] 1. Field of the Invention**

[0003] This invention generally to wireless communications and more particularly to modular wireless headset and/or headphone and communications associated therewith.

[0004] 2. Background of the Invention

[0005] Wireless communications offer users the ability to be "wired" from almost anywhere in the world. Cellular telephones, satellite telephones, wireless local area networks, personal digital assistants (PDAs) with radio frequency (RF) interfaces, laptop computers with RF interfaces and other such devices enable these wireless communications. Such wireless communications have been extended to personal wireless networks, such as these defined by the Bluetooth specification. One popular use of personal wireless networks couples a wireless headset(s) with cellular telephone(s), personal computer(s), and laptop(s), etc. The Bluetooth specification provides specific guidelines for providing such wireless headset functionality.

[0006] In particular, Bluetooth provides a headset profile that defines protocols and procedures for implementing a wireless headset to a device private network. Once configured, the headset functions as the device's audio input and output. As further defined by the Bluetooth specification, the headset must be able to send AT (Attention) commands and receive resulting codes, such that the headset can initiate and terminate calls. The Bluetooth specification also defines certain headset profile restrictions. These restrictions include an assumption that the ultimate headset is assumed to be the only use case active between the two devices. The transmission of audio is based on continuously variable slope delta (CVSD) modulation. The result is a monophonic audio of a quality that normally will not have perceived audio degradation. Only one audio connection at a time is supported between the headset and audio gateway. The audio gateway controls the synchronous connection orientated (SCO) link establishment and release. The headset directly connects and disconnects the internal audio stream upon SCO link establishment and release. Once the link is established, valid speech exists on the SCO link in both directions. The headset profile offers only basic inoperability such that the handling of multiple calls at the audio gateway is not supported. It is assumed that the headset user interface can detect user initiated action, such as the pressing of a button.

[0007] While a wireless headset provides cord-free operation between the headset and the host device (i.e., the audio

gateway), there still must be a physical connectivity between the earpiece and microphone of the headset. This direct connectivity limits the physical structure that could be used for a wireless headset and, in many cases, results in headsets that are cumbersome to use and uncomfortable to wear.

[0008] Therefore, a need exists for a method and apparatus for a modular headset that is less cumbersome, more discrete, and more comfortable to wear.

BRIEF SUMMARY OF THE INVENTION

[0009] The modular wireless headset and/or headphones of the present invention substantially meet these above-identified needs and others. One embodiment includes at least one earpiece and at least one microphone, where the earpiece is physically separate from the microphone. The earpiece is operably to render inbound radio frequencies received from a host device audible. To do this, the wearable earpiece includes a receiver module, a data recovery module, and a speaker module. The receiver module converts inbound RF signals into low intermediate frequency (IF) signals. The data recovery module then recovers audio signals from the low IF signals. The speaker module renders these signals audible. The microphone converts received audio signals into outbound RF signals, where the outbound RF signals are transmitted to the host device (e.g., cellular telephone, personal computer, laptop computer, personal digital assistant, wire line telephone, et cetera). The wearable microphone includes, at least, an audio input module and a transmitter module. The audio input module converts received analog audio signals into digital audio signals. The transmitter module then converts the digital audio signals into the outbound RF signals.

[0010] In another embodiment, a method for wireless communications within a piconet that includes a modular wireless headset and a host device begins by establishing a piconet that includes the host device, the earpiece module, and the microphone module. The processing continues by transmitting outbound RF signals from the microphone module to the host device via a first wireless communication resource of the piconet. The processing further continues by transmitting inbound RF signals from the host device to the earpiece module via a second wireless communication resource of the piconet.

[0011] An embodiment of a modular communication device includes a host module and a detachable earpiece module. The modular communication device may further include a detachable microphone module. The host module is operable to generate inbound RF signals from playback baseband signals (e.g., digital audio signals produced by a CD player, DVD player, et cetera). The host module provides the playback baseband signals to the detachable earpiece via a physical connection when the detachable earpiece is physically coupled to the host module. The host module provides the inbound RF signals to the detachable earpiece via a wireless communication resource when the detachable earpiece module is not physically coupled to the host module. The host module may receive audio record baseband signals via a physical connection from the microphone module when the microphone module is physically coupled to the host module. When the microphone module is not physically coupled to the host module, the detachable microphone module converts the audio record baseband

signals into outbound RF signals and provides the outbound RF signals to the host module via a second wireless communication resource.

[0012] An embodiment of modular wireless headphones includes a first and second wearable earpiece. Each of the wearable earpieces is operably coupled to render inbound signals received from a host device into audible signals. In addition, each of the wearable earpieces includes a receiver module, data recovery module and speaker module. The receiver module is operably coupled to convert the inbound RF signals, which are received from the host device, into low intermediate frequency signals. The data recovery module is operably coupled to recover audio signals from the low intermediate frequency signals. The speaker module is operably coupled to render the audio signals audible. In such an embodiment, the first wearable earpiece may receive information corresponding to left channel stereo audio information, while the second wearable earpiece may receive right channel stereo audio information.

[0013] Each of these various embodiments provides separate wearable components of a headset and/or headphones. With separate earpieces and/or microphones, various physical embodiments of the earpieces and/or microphones may be generated. The components, when worn, are less conspicuous than previous integrated headsets and are more comfortable to wear. For instance, the earpieces may be form fitted to an individual's ear, contain an eyeglass clip-on piece, etc.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0014] FIG. 1 is a diagram of a modular wireless headset in accordance with the present invention;

[0015] FIG. 2 is a diagram of another modular wireless headset in accordance with the present invention;

[0016] FIG. 3 is a schematic block diagram of an access point in accordance with the present invention;

[0017] FIG. 4 is a schematic block diagram of a wearable earpiece in accordance with the present invention;

[0018] FIG. 5 is a schematic block diagram of a wearable microphone in accordance with the present invention;

[0019] FIG. 6 is a schematic block diagram of an alternate wearable earpiece in accordance with the present invention;

[0020] FIG. 7 is a schematic block diagram of another wearable microphone in accordance with the present invention;

[0021] FIGS. 8-10 are graphic representations of various piconets that include a modular wireless headset and host device in accordance with the present invention;

[0022] FIG. 11 is a diagram of a modular communication device in accordance with the present invention; and

[0023] FIG. 12 is a logic diagram of a method for wireless communications within a piconet that includes a modular wireless headset and host device in accordance with the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0024] FIG. 1 is a diagram of a modular wireless headset 10 that includes a wearable earpiece 12 and a wearable

microphone 14. Wearable earpiece 12 may be a separate physical device from wearable microphone 14. Accordingly, wearable earpiece 12 and wearable microphone 14 are separate communication devices that may individually communicate with host device 16 via separate communication pathways. As shown, wearable earpiece 12 may communicate with host device 16, which may be a cellular telephone, wire line telephone, laptop computer, personal computer, personal digital assistant, etc, using transceiver (or receiver) 13 via a first communication pathway 18. Host device 16 is operable to establish a wireless pathway to earpiece 12 or microphone 14. The wearable microphone 14 may communicate with the host device 16 using transceiver (or transmitter) 15 via a second communication pathway 20.

[0025] If the first and second communication pathways 18 and 20 are established in accordance with the Bluetooth specification, communication resources 18 and 20 may be different timeslot allocations on the same synchronous connection orientated (SCO) link, or may be separate SCO links. Configuration and construction details of wearable earpiece 12 and wearable microphone 14 will be described in greater detail with reference to FIGS. 4-12.

[0026] FIG. 2 is a diagram of another embodiment of modular wireless headset 30 that includes two wearable earpieces 12A and 12B, and wearable microphone 14. In this configuration, microphone 14 communicates with host device 16 via communication pathway 20, wearable earpiece 12A communicates with host device 16 using transceiver (or receiver) 13A via communication pathway 18 and wearable earpiece 12B communicates with host device 16 using transceiver (or receiver) 13B via communication pathway 32.

[0027] In operation, voice produced by the individual wearing microphone 14 is received via microphone 34 and converted into RF signals by circuitry within wearable microphone 14. These RF signals are provided to host device 16 via communication pathway 20. Host device 16 includes a corresponding receiver antenna 34 and receiver module 36 to recapture the audio signals received via communication pathways 18, 20 and 32. These items will be further discussed in FIG. 3. In addition, host device 16 includes at least one transmitter 38 to transmit audio information to the wearable earpiece(s) 12A and 12B. In one embodiment, host device 16 may transmit left channel stereo information to wearable earpiece 12 and right channel stereo information to wearable earpiece 12B.

[0028] A wireless headphone may be realized by omitting wearable microphone 14 and including either one or both of wearable earpieces 12A and 12B. In this embodiment, host device may be a playback device such as a CD player, DVD player, cassette player, etc. operable to stream audio information.

[0029] FIG. 3 is a diagram of host device that supports modular wireless headset 30. Host device 16 includes a combination of transmitter and receiver (or transceiver) modules that accept and modulate or demodulate streamed audio to and from earpiece(s) 12 and microphone 14 through antenna 17. The host device may be incorporated within or operably couple to another device such as a playback device, laptop, cellular telephone, land based telephone or other like device known to those skilled in the art. For example, one embodiment has transmitter module 19 and receiver module

21. Transmitter module **19** accepts unmodulated streamed audio from playback type device **23** (e.g., DVD player, MP3 player, CD player, cassette player, or other like devices known to those skilled in the art.). Transmitter module **19** then modulates the streamed audio into low intermediate frequency (IF) signal **70**. In the case where two earpieces are employed, multiple transmitter modules may be employed to modulate the streamed audio into low IF signals for the earpieces for each channel (i.e. left and right channels of stereo transmissions. Similarly, receiver module **21** accepts modulated streamed audio from wearable microphone **14**. Receiver module **21** recovers audio signals from the received low IF signals. The recovered audio signals are then relayed to receiving device **25**. Note that the generation of low IF signals and subsequent demodulation to recapture audio signal may be done in accordance with a particular wireless communication standard. For example, the Bluetooth specification may be used, IEEE802.11 (a), (b), and/or (g) may also be used, etc.

[0030] FIG. 4 is a schematic block diagram of wearable earpiece **12**. Wearable earpiece **12** includes receiver module **40**, data recovery module **42** and speaker module **44**. One embodiment of receiver module **40** includes antenna **46**, bandpass filter **48**, low noise amplifier **50**, down converter **52** and local oscillator **54**. Data recovery module **42** may include an analog-to-digital converter (ADC) **56** and processing module **58**. Processing module **58**, which may have associated memory, is configured to provide digital channel filter **60**, demodulator **61** and setup module **76**. Speaker module **44** includes a digital-to-analog converter (DAC) **62**, variable gain module **64**, and at least one speaker **66**.

[0031] Once the piconet is configured (which will be described subsequently), receiver module **40** receives inbound RF signal **68** from host device **16** via antenna **46**. Bandpass filter **48** filters the received RF signal **68** which are subsequently amplified by low noise amplifier **50**. Down converter **52** converts the filtered and gained RF signal **68** into low intermediate frequency (IF) signal **70** based on a local oscillator **54**. Low IF signals **70** may have a carrier frequency at DC ranging to a few megahertz.

[0032] Data recovery module **42** receives low IF signals **70** and converts the low IF signals **70** into digital signals via ADC **56**. Processing module **58** may be a single processing device or a plurality of processing devices. Such a processing device may be a microprocessor, micro-controller, digital signal processor, microcomputer, central processing unit, field programmable gate array, programmable logic device, state machine, logic circuitry, analog circuitry, digital circuitry, and/or any device that manipulates signals (analog and/or digital) based on operational instructions. The memory (not shown) may be a single memory device or a plurality of memory devices. Such a memory device may be a read-only memory, random access memory, volatile memory, non-volatile memory, static memory, dynamic memory, flash memory, and/or any device that stores digital information. Note that when processing module **58** implements one or more of its functions via a state machine, analog circuitry, digital circuitry, and/or logic circuitry, the memory storing the corresponding operational instructions is embedded with the circuitry comprising the state machine, analog circuitry, digital circuitry, and/or logic circuitry.

[0033] Digital channel filter **60** receives the digital low IF signals **72** and filters these signals. Demodulator **61** recovers

audio signals **74** from the filtered low IF signals. Note that the generation of RF signal **68** and subsequent demodulation to recapture audio signal **74** may be done in accordance with a particular wireless communication standard. For example, the Bluetooth specification may be used; IEEE802.11 (a), (b), and/or (g) may also be used, etc.

[0034] Speaker module **44** converts digital audio signal **74** into analog signals provided to the user through speakers **66**. Adjustable gain module **64** adjusts the gain (i.e., adjusts volume), and provides the gained signals to speaker **66**, which produces audible signals **74**. As long as the piconet remains in place between wearable earpiece **12** and host device **16**, wearable earpiece **12** will produce audible signals **74** from received inbound RF signal **68**.

[0035] FIG. 5 is a schematic block diagram of wearable microphone **14** that includes audio input module **80** and transmitter module **82**. Audio input module **80** includes microphone **84**, amplifier **86**, ADC **88**, processing module **100** that is configured to provide a setup module **92** and modulator **90**, and DAC **62**. Transmitter module **82** includes up-converter **94**, local oscillator **96**, power amplifier **97**, bandpass filter **98**, and antenna **102**.

[0036] Once wearable microphone **14** is configured within a piconet, microphone **84** is operably coupled to receive audio signals **105** and convert these signals to analog signals **106**. Amplifier **86** amplifies analog audio signals **106** to produce amplified signals. ADC **88** then converts the amplified signals into digital audio signals **108**. Modulator **90** modulates the digital signals based on a communication standard into modulated signals. As shown, modulator **90** and setup module **92** are implemented within processing module **100**. Processing module **100** may be a single processing device or a plurality of processing devices. Such a processing device may be a microprocessor, micro-controller, digital signal processor, microcomputer, central processing unit, field programmable gate array, programmable logic device, state machine, logic circuitry, analog circuitry, digital circuitry, and/or any device that manipulates signals (analog and/or digital) based on operational instructions. The memory may be a single memory device or a plurality of memory devices. Such a memory device may be a read-only memory, random access memory, volatile memory, non-volatile memory, static memory, dynamic memory, flash memory, and/or any device that stores digital information. Note that when processing module **100** implements one or more of its functions via a state machine, analog circuitry, digital circuitry, and/or logic circuitry, the memory storing the corresponding operational instructions is embedded with the circuitry comprising the state machine, analog circuitry, digital circuitry, and/or logic circuitry.

[0037] Up-converter **94** converts modulated signals **110** into RF signals based on local oscillator **96**. Power amplifier **97** amplifies these signals which may be subsequently bandpass filter **98**. The filtered RF signals are then transmitted via antenna **102** as outbound RF signals **110** to host device **16**. As long as the piconet is established to include wearable microphone **14** and host device **16**, wearable microphone **14** will transmit to host device **16** in the manner just described.

[0038] As shown in both FIGS. 4 and 5, separable connector **112** may couple setup modules **76** and **92**. Such a physical connection allows for wearable earpiece **12** and

wearable microphone 14 to communicate in both directions with the host device to establish the piconet. For example, if the devices are compliant with one or more versions of the Bluetooth specification, host device 16, functioning as the master, may issue a piconet request to wearable earpiece 12 coupled to wearable microphone 14. Upon receiving this request, wearable earpiece 12 and wearable microphone 14 respond to the request indicating that a receive RF channel (communication pathway 18) be setup for the wearable earpiece and a transmit RF channel (communication pathway 20) be setup for wearable microphone 14. Based on these responses, the master coordinates the establishment of the piconet and provides synchronization information through wearable earpiece 12 and wearable microphone 14 via receiver module 40 of earpiece 12. Setup modules 76 and 92 coordinate the synchronization of earpiece 12 and microphone 14 with the host device, as well as coordinating timeslot assignments and/or SCO link assignments. Once the piconet has been established in this manner, the connection between wearable earpiece 12 and wearable microphone may be secured to establish the wearable earpiece 12 and wearable microphone 14 as separate pieces.

[0039] As an alternative setup mode, wearable earpiece 12, wearable microphone 14 may be directly coupled to the host device. The direct coupling may be used to establish the piconet and exchange synchronization information, timeslot allocation information, etc. Once the information has been exchanged in this manner, the connections may be broken such that wearable earpiece 12, wearable microphone 14 and host device 16 are physically separate devices.

[0040] FIGS. 6 and 7 illustrate schematic block diagrams of wearable earpiece 12 and wearable microphone 14 that include transceiver modules (i.e., receiver modules and transmitter modules). The use of the transceiver modules allow wearable earpiece 12, wearable microphone 14 and host device 16 to be physically separate devices and be configured using the piconet's RF communications. As such, wearable earpiece 12 and wearable microphone 14 may be continuously worn on a person for receiving incoming calls and/or placing outgoing calls.

[0041] Wearable earpiece 12, as shown in FIG. 5, includes antenna 46, transmit/receive switch 122, receiver module 40, data recovery module 42, speaker module 44, transmitter module 120, input module 128 and display module 132. Receiver module 40, data recovery module 42 and speaker module 44 operate as discussed with reference to FIG. 4, with the exception of the data recovery module 42, to produce display information that is provided to display module 132. For instance, the received RF signal may include display information such as caller ID, command information, etc. which is separated by data recovery module 42 and provided to display module 132, which may be an LCD display, plasma display, etc.

[0042] Input module 128, which may be a keypad, touch screen, voice recognition circuit, or other like user interfaces, receives user commands and produces digital command messages 124 there from. Such digital command messages 124 includes, but are not limited to, packet size, synchronization information, frequency hopping initiation information, timeslot allocation information, link establishment information, piconet address information, fast-forward, play, pause, volume adjust, record, stop and rewind.

[0043] Data recovery module 42 receives digital command messages 124 and, when applicable, processes the command messages. For example, if the command message is with respect to a volume adjust; a graphical representation of adjusting the volume may be presented on display module 132 and the gain of amplifier 64 adjusted to adjust the volume associated with speaker 66.

[0044] Transmit module 120 receives digital command messages 124 and converts these messages into outbound RF command signals 126, which are subsequently transmitted to host device 16 and/or microphone module via antenna 46. Accordingly, by including transmitter module 120 along with receiver module 40, wearable earpiece 12 may function as a master and/or slave within the piconet and exchange data with the other elements within the piconet.

[0045] FIG. 7 is a schematic block diagram of wearable microphone 14 that includes audio input module 80, transmitter module 82, transmit receive switch 122, antenna 102, receiver module 132, input module 140 and display module 138. Input module 140 is operable to receive user input commands 142 and convert these commands into digital command messages 144. Digital command messages 144 may be similar to digital command messages 124 and may further include establish a call, terminate a call, call waiting, or other like functions. Transmitter module 82 converts digital command messages 144 into RF command signals 134 that are transmitted via antenna 102. Similarly, inbound RF command signals 135 may be received by receiver module 132 via antenna 102. Display module 138, which may be a LCD display, plasma display, etc., receives digital command messages 136 and may display corresponding configuration messages. In addition, any display information received from the host and/or microphone module regarding setup, operation, or as part of the data content, may be displayed on display module 138.

[0046] FIGS. 8-10 illustrate various configurations for piconet 149. In FIGS. 8-10, the piconet includes host device 16, wearable earpiece 12 and wearable microphone 14. In FIG. 8, wearable microphone 14 functions as the master such that, as the master, wearable microphone 14 establishes and breakdowns the piconet, provides synchronization information and perform timeslot allocations and/or establish multiple SCO links with host device 16 and wearable earpiece 12. In FIG. 9, host device 16 has master responsibilities, whereas in FIG. 10, wearable earpiece 12 has master responsibilities. As such, by configuring wearable earpiece 12 and wearable microphone 14, as discussed in FIGS. 6 and 7, wearable earpiece 12 and wearable microphone 14 may be completely physically separate devices from each other and from the host device. Alternatively, as discussed with reference to FIGS. 4 and 5, the wearable earpiece and wearable microphone may be physically coupled to establish piconet 140. Once piconet 140 is established, the devices may be physically separated and communicate with host device 16 via separate RF communication pathways as shown in FIGS. 1 and 2.

[0047] FIG. 11 is a schematic block diagram of modular communication device 150, such as a wireless terminal (e.g., cell phone) that includes host module 152, detachable microphone 154 and detachable earpiece 156. In this embodiment, modular communication device 150 may function as a typical device (e.g., cellular telephone, CD player,

cassette player, etc.) when detachable earpiece **156** and detachable microphone **154** are physically connected to host module **152**. The detachable earpiece may be configured as shown in **FIG. 4** or **6**, and the detachable microphone may be configured as shown in **FIG. 5** or **7**. As such, when detachable earpiece **156** is not in physical contact with host module **152**, a wireless connection couples detachable earpiece **156** and host module **152**. Similarly, when detachable microphone **154** is detached from host module **152**, a second wireless connection couples detachable microphone **154** and host module **152**. Alternatively, when detachable earpiece **156** and/or detachable microphone **154** are physically coupled to host module **152**, they may communicate via a physical or wireless link. As one of average skill in the art will appreciate, modular communication device **150** may include multiple detachable earpieces **156**. In addition, modular communication device **150** may omit detachable microphone **154** if host device **152** is a playback type device (e.g., DVD player, CD player, cassette player, etc.). Similarly, modular communication device **150** may omit detachable earpiece **156** when functioning as a recording device (e.g., dictaphone). Detachable ear-piece **156** and microphone **154** may have on-chip operations to support call conferencing, call waiting, flash, and other features associated with telephones. These functions may be accessed and reviewed by a user interface **158** and display **160** within host device **152** or a user interface and display located on either detachable ear-piece **156** or microphone **154**. The user interface and display, located on either the host device or detachable ear-piece **156** and microphone **154** may have a display and button(s) that may be used to program device, perform directory functions including selecting number to call, view caller ID, initiate call waiting, or initiate call conferencing. Additionally, circuitry within the ear-piece **156** and microphone **154** may enable voice activated dialing. The actual voice recognition could be performed within ear-piece **156**, microphone **154**, or host device **152**. Thus, ear-piece **156** and microphone **154** may act to initiate calls and receive calls.

[0048] A link between ear-piece **156** and microphone **154** would allow ear-piece **156** and microphone **154** to share resources, such as batter life, and allow ear-piece **156** and microphone **154** to be recharged from host device **152**. Ear-piece/microphone/base portion are included with cell phone battery. Cell phone battery has openings **162** and **164** located therein for storage/recharging of ear-piece **156** and microphone **154**. When located in these openings, the ear-piece/microphone will be recharged from the cell phone battery. The new cell phone battery may include base portion RF interface and interface to cell phone port. Existing cell phone port technology could be used to treat the ear-piece/microphone in the same manner as wired ear-piece/microphone is treated.

[0049] **FIG. 12** is a logic diagram of a method for wireless communications within a piconet that includes a modular wireless headset and a host device. The process begins at step **160** where the piconet is established to include the host device, the earpiece module and the microphone module. This may be done in a variety of ways. For instance, the piconet may be established by exchanging configuration information via a physical connection between the host device, the earpiece module and the microphone module prior to any RF transmissions there between. Based on the configuration information, the piconet is configured and the

devices are separated. Once separated, RF communications may commence. Alternatively, the piconet may be established by exchanging configuration information via various wireless communication pathways that exist between the host device, the earpiece module and the microphone module prior to data content being transmitted via the communication resources. Once the configuration information is exchanged, the piconet is established and data content RF transmissions may commence.

[0050] The process then proceeds to step **162** where outbound RF signals are transmitted from the microphone module to the host device via a first wireless communication pathway of the piconet. Simultaneously or in a half-duplex mode, step **164** occurs where inbound RF signals are transmitted from the host device to the earpiece module via a second wireless communication resource of the piconet. The communication resources may be different timeslots on the same SCO link or different SCO links. The earpiece module may be configured to block or receive the outbound RF signals transmitted by the microphone module. Such a selection may be user controlled.

[0051] The preceding discussion has presented a modular communication device, modular wireless headset and modular wireless headphones. By physically separating the microphone from the earpiece and/or by separating the earpieces, more discrete components may be produced that are more comfortable to wear and are less cumbersome to use. As one of average skill in the art will appreciate, other embodiments may be derived from the teaching of the present invention without deviating from the scope of the claims.

What is claimed is:

1. A modular wireless headset that comprises:
 - at least one wearable earpiece operable to render inbound radio frequency (RF) signals received from a host device audible, wherein the at least one wearable earpiece includes:
 - receiver module operably coupled to convert the inbound RF signals into low intermediate frequency (IF) signals;
 - data recovery module operably coupled to recover audio signals from the low IF signals; and
 - speaker module operably coupled to render the audio signals audible;
2. The modular wireless headset of claim 1, wherein the at least one wearable earpiece module further comprises:
 - a first wearable earpiece operable to render at least a first portion of the inbound RF signals into first audible signals; and
 - a second wearable earpiece operable to render at least a second portion of the inbound RF signals into second audible signals, wherein the first wearable earpiece is physically separate from the second wearable earpiece.
3. The modular wireless headset of claim 2 further comprises:
 - the first wearable earpiece receiving the first portion of the inbound RF signals via a first RF link, wherein the first audible signals correspond to left channel stereo signals; and

the second wearable earpiece receiving the second portion of the inbound RF signals via a second RF link, wherein the second audible signals correspond to right channel stereo signals.

4. The modular wireless headset of claim 2 further comprises:

the first wearable earpiece receiving the first portion of the inbound RF signals via an RF link, wherein the first audible signals correspond to left channel stereo signals; and

the second wearable earpiece receiving the second portion of the inbound RF signals via the RF link, wherein the second audible signals correspond to right channel stereo signals.

5. The modular wireless headset of claim 1, wherein the at least one wearable earpiece module further comprises:

earpiece transmitter module operably coupled to convert digital command messages into outbound RF command signals, wherein the outbound RF command signals are transmitted to at least one of the host device and the at least one wearable microphone module.

6. The modular wireless headset of claim 5, wherein the at least one wearable earpiece module further comprises:

an input module operably coupled to the earpiece transmitter module, wherein the input module converts user input commands into the digital command messages.

7. The modular wireless headset of claim 5, wherein the digital command messages further comprises at least one of: packet size, synchronization information, frequency hopping initiation information, time slot allocation information, link establishment information, piconet address information, fast forward, play, pause, volume adjust, record, stop, and rewind.

8. The modular wireless headset of claim 1, wherein the at least one wearable earpiece module further comprises:

display module operably coupled to the receiver module for displaying at least one of: configuration messages and video data contained with the inbound RF signals.

9. The modular wireless headset of claim 1, further comprising:

at least one wearable microphone operable to convert received audio signals into outbound RF signals, wherein the at least one wearable microphone transmits the to the outbound RF signals to the host device, wherein the at least one wearable microphone includes:

audio input module operably coupled to convert the received audio signals into digital audio signals; and

transmitter module operably coupled to convert the digital audio signals into the outbound RF signals, wherein the at least one wearable earpiece is physically separate from the at least one wearable microphone.

10. The modular wireless headset of claim 9, wherein the at least one wearable earpiece module further comprises:

separable connection module operable to couple the at least one wearable earpiece to at least one of the host device and the at least one microphone module prior to transmission of the outbound RF signals or reception of the inbound RF signals for configuring the modular headset with the host device.

11. The modular wireless headset of claim 9, wherein the at least one wearable microphone further comprises:

microphone receiver module operably coupled to convert inbound RF command signals into digital command messages, wherein the inbound RF command signals are received from at least one of the host device and the at least one wearable microphone module.

12. The modular wireless headset of claim 11, wherein the at least one wearable microphone further comprises:

display module operably coupled to the microphone receiver module for displaying at least one of: configuration messages and video data contained with the inbound RF signals.

13. The modular wireless headset of claim 9, wherein the at least one wearable microphone further comprises:

an input module operably coupled to the transmitter module, wherein the input module converts user input commands into digital command messages.

14. The modular wireless headset of claim 9, wherein the at least one wearable microphone further comprises:

separable connection module operable to couple the at least one wearable microphone to at least one of the host device and the at least one wearable earpiece module prior to transmission of the outbound RF signals or reception of the inbound RF signals for configuring the modular headset with the host device.

15. The module wireless headset of claim 9, wherein the inbound RF signals and the outbound RF signals are in accordance with one or more versions a Bluetooth specification.

16. A method for wireless communications within a piconet of a modular wireless headset and a host device, wherein the modular wireless headset includes at least one earpiece module and the at least one earpiece module; and

transmitting inbound RF signals from the host device to the at least one earpiece module via a first wireless communication pathway.

17. The method of claim 16 further comprises:

the first wireless communication resource including at least one time slot of a synchronous connection orientated link of a Bluetooth compliant piconet; and

the second wireless communication resource including at least one other time slot of the synchronous connection orientated link of the Bluetooth compliant piconet.

18. The method of claim 16 further comprises:

the first wireless communication resource including a synchronous connection orientated link of a Bluetooth compliant piconet; and

the second wireless communication resource including a second synchronous connection orientated link of the Bluetooth compliant piconet.

19. The method of claim 15 further comprising:

transmitting outbound radio frequency (RF) signals from at least one microphone module to the host device via an additional wireless communication resource of the piconet.

20. The method of claim 19, wherein the establishing the piconet further comprises:

exchanging configuration information via a physical connection between the host device, the at least one earpiece module, and the at least one microphone module prior to the transmitting of the inbound and outbound RF signals; and

configuring the piconet in accordance with the configuration information, wherein one of the host device, the at least one microphone module, and the at least one earpiece module functions as a master for the piconet.

21. The method of claim 20 further comprises:

determining whether the physical connection between the at least one earpiece module and the host device is broken;

when the physical connection between the at least one earpiece module and the host device is broken, transmitting the inbound RF signals from the host device to the at least one earpiece module via the first wireless communication resource, wherein the inbound RF signals are derived from first baseband signals;

when the physical connection between the at least one earpiece module from the host device is not broken, transmitting the first baseband signals from the host device to the at least one earpiece module via the physical connection;

determining whether the physical connection between the at least one microphone module from the host device is broken;

when the physical connection between the at least one microphone module from the host device is broken, transmitting the outbound RF signals from the at least one earpiece module to the host device via the second wireless communication resource, wherein the outbound RF signals are derived from second baseband signals; and

when the physical connection between the at least one microphone module from the host device is not broken, transmitting the second baseband signals from the at least one earpiece module to the host device via the physical connection.

22. The method of claim 19, wherein the establishing the piconet further comprises:

exchanging configuration information via the first and second wireless communication resources between the host device, the at least one earpiece module, and the at least one microphone module prior to the transmitting of the inbound and outbound RF signals, wherein the at least one earpiece module and the at least one microphone module exchange at least a portion of the configuration information via a physical connection; and

configuring the piconet in accordance with the configuration information, wherein one of the host device, the at least one microphone module, and the at least one earpiece module functions as a master for the piconet.

23. The method of claim 19, wherein the establishing the piconet further comprises:

transmitting, by a master of the piconet, a configuration request to slaves of the piconet, wherein one of the host device, the at least one microphone module, and the at least one earpiece module functions as the master and

remaining ones of the host device, the at least one microphone module, and the at least one earpiece module function as the slaves;

providing, by each of the slaves, a response to the master; and

establishing the piconet in accordance with the configuration request and the responses from the slaves.

24. The method of claim 19 further comprises:

receiving the outbound RF signals by the at least one earpiece module; and

converting the outbound RF signals into audible signals when a microphone feedback mode is enabled.

25. A modular communication device comprises:

host module; and

detachable earpiece module, wherein the host module generates inbound RF signals from playback baseband signals, wherein, when the detachable earpiece module is coupled to the host module via a physical connection, the host module provides the playback baseband signals to the detachable earpiece module via the physical connection and when the detachable earpiece module is not coupled to the host module via the physical connection, the host module provides the inbound RF signals to the detachable earpiece module via a wireless communication resource.

26. The modular communication device of claim 25 further comprises:

detachable microphone module, wherein the detachable microphone module generates outbound RF signals from audio record baseband signals, wherein, when the detachable microphone module is coupled to the host module via a second physical connection, the detachable microphone module provides the audio record baseband signals to the host module via the physical connection and when the detachable microphone module is not coupled to the host module via the second physical connection, the detachable module provides the outbound RF signals to the host module via a second wireless communication resource.

27. The modular communication device of claim 26 further comprises:

the first wireless communication resource including at least one time slot of a synchronous connection orientated link of a Bluetooth compliant piconet; and

the second wireless communication resource including at least one other time slot of the synchronous connection orientated link of the Bluetooth compliant piconet.

28. The modular communication device of claim 26 further comprises:

the first wireless communication resource including a synchronous connection orientated link of a Bluetooth compliant piconet; and

the second wireless communication resource including a second synchronous connection orientated link of the Bluetooth compliant piconet.

29. The modular communication device of claim 25, wherein the detachable earpiece module further comprises:

a first earpiece operable to render at least a first portion of the inbound RF signals into first audible signals; and

a second earpiece operable to render at least a second portion of the inbound RF signals into second audible signals, wherein the first wearable earpiece is physically separate from the second wearable earpiece.

30. The modular communication device of claim 29 further comprises:

the first earpiece receiving the first portion of the inbound RF signals via a first RF link, wherein the first audible signals correspond to left channel stereo signals; and

the second earpiece receiving the second portion of the inbound RF signals via a second RF link, wherein the second audible signals correspond to right channel stereo signals.

31. The modular communication device of claim 29 further comprises:

the first earpiece receiving the first portion of the inbound RF signals via an RF link, wherein the first audible signals correspond to left channel stereo signals; and

the wearable earpiece receiving the second portion of the inbound RF signals via the RF link, wherein the second audible signals correspond to right channel stereo signals.

32. The modular communication device of claim 25, wherein the host module further comprises at least one of: a cordless telephone, a cellular telephone, a compact disc player, a DVD player, a computer, a personal digital assistant, and a digital audio playback device.

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