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(54) ELECTRONIC DEVICE FOR PROVIDING AUDIO SERVICE AND METHOD FOR OPERATING SAME

(57) According to an embodiment, an electronic device (101) includes at least one communication circuit (190), at least one processor (120), and memory (130) storing instructions that, when executed by the at least one processor, cause the electronic device to, establish a common audio channel which is an audio service link commonly used by the electronic device and at least one external electronic device (102; 104; 200; 300; 1001; 1003; 1005), based on a set condition, share, with the at least one external electronic device (102; 104; 200; 300; 1001; 1003; 1005) via the at least one communication circuit, information about the common audio channel and time information used for synchronization for the common audio channel, and operate in a reception mode in which the electronic device is capable of receiving audio data from the at least one external electronic device for the common audio channel. In addition, an embodiment may be possible.

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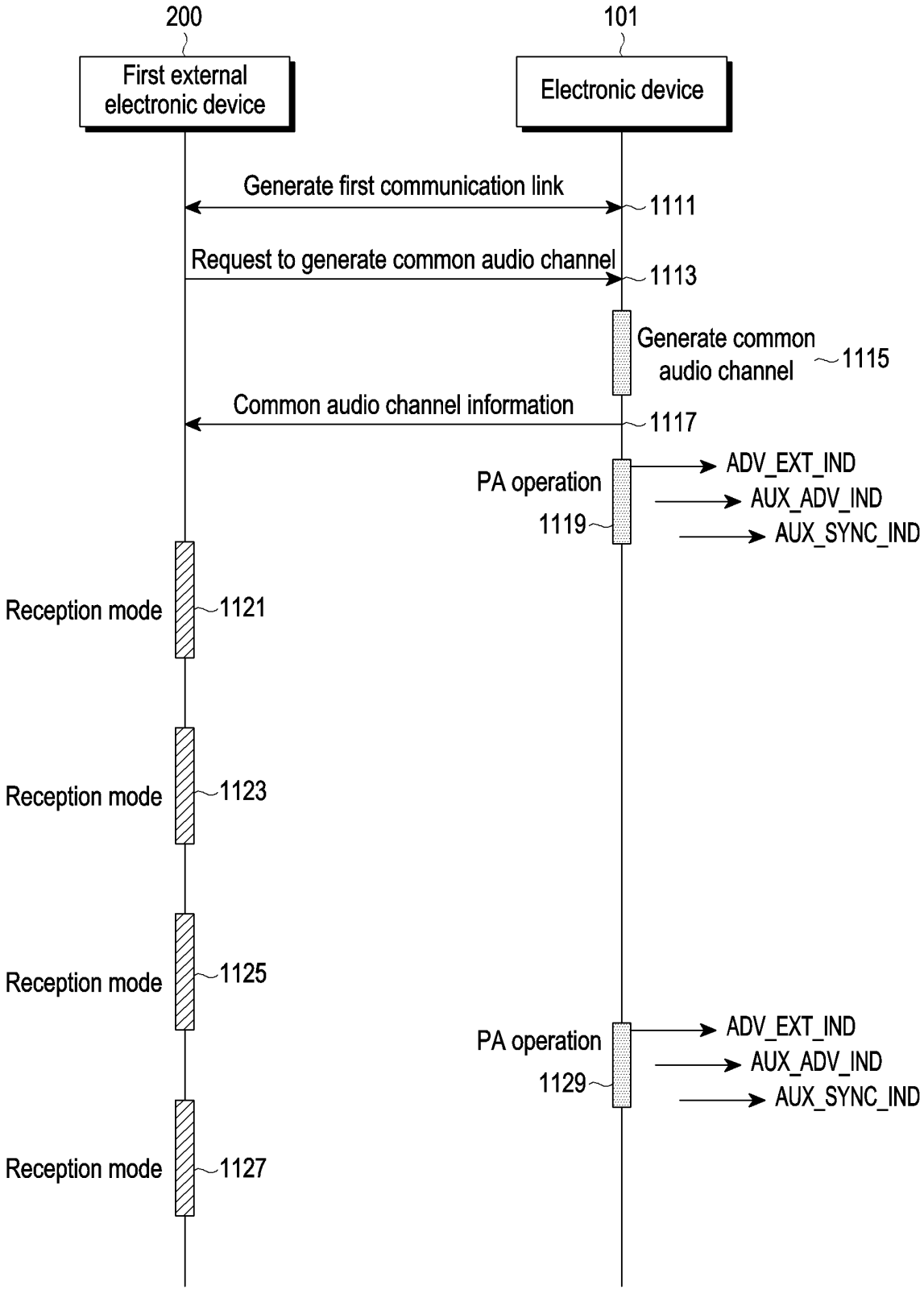
200
First external electronic device
101
Electronic device
Generate first communication link
1111
Request to generate common audio channel
1113
Generate common audio channel
1115
Common audio channel information
1117
PA operation
1119
ADV_EXT_IND
AUX_ADV_IND
AUX_SYNC_IND
Reception mode
1121
Reception mode
1123
Reception mode
1125
Reception mode
1127
PA operation
1129
ADV_EXT_IND
AUX_ADV_IND
AUX_SYNC_IND

FIG. 11

Description

[Technical Field]

[0001] The disclosure relates to an electronic device providing an audio service and an operating method thereof.

[Background Art]

[0002] Recently, with the development of an information communication technology, various wireless communication technologies and various services have been developed. In particular, a Bluetooth scheme which is one of short-range communication schemes has been actively used, and electronic devices using the Bluetooth scheme have been also widely used. In particular, a pair of ear buds which may be respectively worn on both ears of a user have been widely used as an ear-wearable device. The ear-wearable device may provide various functions. For example, the ear-wearable device may use a microphone to input and identify a user's voice, transmit audio data related to the user's voice to an electronic device (e.g., a smart phone), and use a speaker to output audio data received from the electronic device.

[0003] The Bluetooth scheme may include a Bluetooth legacy (or Bluetooth classic) scheme and/or a Bluetooth low energy (BLE) scheme. An electronic device (e.g., a smart phone) that provides an audio service based on the BLE scheme may independently establish a communication link (e.g., a connected isochronous stream (CIS)) with each of external electronic devices (e.g., a first external electronic device and/or a second external electronic device), and transmit and receive data to and from the external electronic devices via the established communication link (e.g., a connection-based communication). The electronic device may establish a communication link (e.g., a broadcast isochronous stream (BIS)) and transmit and receive data to and from the external electronic devices via the established communication link (e.g., a broadcast-based communication).

[0004] Like this, the audio service based on the BLE scheme may be provided via a connection-based CIS or a non-connection-based BIS. If a multi-party audio service is provided via the CIS, all electronic devices (e.g., an electronic device, a first external electronic device, and/or a second external electronic device) participating in the multi-party audio service establish BLE links to each other, and establish CISes based on the established BLE links. If the number of electronic devices participating in a CIS-based multi-party audio service increases, the number of links which need to be established between the electronic devices participating in the CIS-based multi-party audio service may increase exponentially, and this exponential increase in the number of links may make it difficult to provide the CIS-based multi-party audio service and may also make it impossible for the CIS-based multi-party audio service to be provided.

[0005] If the multi-party audio service is provided via a BIS connection, the electronic devices participating in the multi-party audio service may transmit audio data. However, the Bluetooth scheme does not currently specifically define a scheme for receiving audio data via the BIS connection if the multi-party audio service is provided via the BIS connection, so it is impossible to define at what point and in what scheme electronic devices participating in the multi-party audio service may receive the audio data, thus making it difficult or impossible to provide the multi-party audio service.

[Detailed Description of the Invention]

[Technical Solution]

[0006] An embodiment of the disclosure may provide an electronic device which provides an audio service and an operating method thereof.

[0007] An embodiment of the disclosure may provide an electronic device which provides a multi-party audio service and an operating method thereof.

[0008] According to an embodiment of the disclosure, an electronic device includes at least one communication circuit, at least one processor, and memory storing instructions.

[0009] According to an embodiment of the disclosure, the instructions, when executed by the at least one processor, cause the electronic device to establish a common audio channel which is an audio service link commonly used by the electronic device and at least one external electronic device, based on a set condition.

[0010] According to an embodiment of the disclosure, the instructions, when executed by the at least one processor, cause the electronic device to share, with the at least one external electronic device via the at least one communication circuit, information about the common audio channel and time information used for synchronization for the common audio channel.

[0011] According to an embodiment of the disclosure, the instructions, when executed by the at least one processor, cause the electronic device to operate in a reception mode in which the electronic device is capable of receiving audio data from the at least one external electronic device for the common audio channel.

[0012] According to an embodiment of the disclosure, an electronic device includes at least one communication circuit,

at least one processor, and memory storing instructions.

[0013] According to an embodiment of the disclosure, the instructions, when executed by the at least one processor, cause the electronic device to receive, from at least one external electronic device or a server via the at least one communication circuit, information about a common audio channel which is an audio service link commonly used by the electronic device and the at least one external electronic device and time information used for synchronization for the common audio channel.

[0014] According to an embodiment of the disclosure, the instructions, when executed by the at least one processor, cause the electronic device to perform a synchronization operation for the common audio channel based on the information about the common audio channel and the time information used for synchronization for the common audio channel.

[0015] According to an embodiment of the disclosure, the instructions, when executed by the at least one processor, cause the electronic device to operate in a reception mode in which the electronic device is capable of receiving audio data from the at least one external electronic device for the common audio channel.

[0016] According to an embodiment of the disclosure, a method includes establishing a common audio channel which is an audio service link commonly used by an electronic device and at least one external electronic device, based on a set condition.

[0017] According to an embodiment of the disclosure, the method includes sharing, with the at least one external electronic device, information about the common audio channel and time information used for synchronization for the common audio channel.

[0018] According to an embodiment of the disclosure, the method includes operating in a reception mode in which the electronic device is capable of receiving audio data from the at least one external electronic device for the common audio channel.

[0019] According to an embodiment of the disclosure, a method includes receiving, from at least one external electronic device (101; 104; 300; 1001; 1003; 1005) or a server (108), information about a common audio channel which is an audio service link commonly used by an electronic device and the at least one external electronic device and time information used for synchronization for the common audio channel.

[0020] According to an embodiment of the disclosure, the method includes performing a synchronization operation for the common audio channel based on the information about the common audio channel and the time information used for synchronization for the common audio channel.

[0021] According to an embodiment of the disclosure, the method includes operating in a reception mode in which the electronic device is capable of receiving audio data from the at least one external electronic device for the common audio channel.

[0022] According to an embodiment of the disclosure, a storage medium storing at least one computer-readable instruction is provided.

[0023] According to an embodiment of the disclosure, the at least one instruction, when executed by at least one processor of an electronic device, causes the electronic device to perform at least one operation.

[0024] According to an embodiment of the disclosure, the at least one operation includes establishing a common audio channel which is an audio service link commonly used by the electronic device and at least one external electronic device, based on a set condition.

[0025] According to an embodiment of the disclosure, the at least one operation includes sharing, with the at least one external electronic device, information about the common audio channel and time information used for synchronization for the common audio channel.

[0026] According to an embodiment of the disclosure, the at least one operation includes operating in a reception mode in which the electronic device is capable of receiving audio data from the at least one external electronic device for the common audio channel.

[0027] According to an embodiment of the disclosure, a storage medium storing at least one computer-readable instruction may be provided.

[0028] According to an embodiment of the disclosure, the at least one instruction, when executed by at least one processor of an electronic device, may cause the electronic device to perform at least one operation.

[0029] According to an embodiment of the disclosure, the at least one operation may include receiving, from at least one external electronic device or a server, information about a common audio channel which is an audio service link commonly used by the electronic device and the at least one external electronic device and time information used for synchronization for the common audio channel.

[0030] According to an embodiment of the disclosure, the at least one operation may include performing a synchronization operation for the common audio channel based on the information about the common audio channel and the time information used for synchronization for the common audio channel.

[0031] According to an embodiment of the disclosure, the at least one operation may include operating in a reception mode in which the electronic device is capable of receiving audio data from the at least one external electronic device for

the common audio channel.

[Description of the Drawings]

[0032]

FIG. 1 is a block diagram schematically illustrating an electronic device within a network environment according to an embodiment.

FIG. 2 is a diagram schematically illustrating connections between electronic devices which are based on a Bluetooth scheme in a wireless communication network according to an embodiment.

FIG. 3 is a block diagram schematically illustrating a second external electronic device in a wireless communication network according to an embodiment.

FIG. 4 is a block diagram schematically illustrating a first external electronic device in a wireless communication network according to an embodiment.

FIG. 5 is a diagram schematically illustrating configuration of CIG events and CIS events in a wireless communication network according to an embodiment.

FIG. 6 is a diagram schematically illustrating configuration of BIG events and BIS events in a wireless communication network according to an embodiment.

FIG. 7 is a flowchart schematically illustrating an operating method of an electronic device according to an embodiment.

FIG. 8 is a flowchart schematically illustrating an operating method of a first external electronic device according to an embodiment.

FIG. 9 is a flowchart schematically illustrating an operating method of a first external electronic device according to an embodiment.

FIG. 10 is a diagram schematically illustrating connections between electronic devices which are based on a Bluetooth scheme in a wireless communication network according to an embodiment.

FIG. 11 is a diagram schematically illustrating an operation in which an electronic device establishes a common audio channel in a wireless communication network according to an embodiment.

FIG. 12 is a diagram schematically illustrating a format of a BLE ADV packet in a wireless communication network according to an embodiment.

FIG. 13 is a diagram schematically illustrating a UI displayed on an electronic device in a case that the electronic device receives a BLE ADV packet in a wireless communication network according to an embodiment.

FIG. 14 is a diagram schematically illustrating a common audio channel generated by an electronic device in a wireless communication network according to an embodiment.

FIG. 15 is a diagram schematically illustrating an operation of sharing information about a common audio channel generated by an electronic device and time information used for synchronization for a common audio channel in a wireless communication network according to an embodiment.

FIG. 16 is a diagram schematically illustrating an operation in which a plurality of electronic devices are synchronized with a common audio channel in a wireless communication network according to an embodiment.

FIG. 17 is a diagram schematically illustrating an operation in which a plurality of electronic devices are synchronized to a common audio channel in a wireless communication network according to an embodiment.

FIG. 18 is a diagram schematically illustrating a transmitting operation and a receiving operation performed by an electronic device on a common audio channel in a wireless communication network according to an embodiment.

FIG. 19 is a diagram schematically illustrating a transmitting operation and a receiving operation performed by a first external electronic device on a common audio channel in a wireless communication network according to an embodiment.

FIG. 20 is a diagram schematically illustrating an operation of exchanging audio data between an electronic device and a first external electronic device in a wireless communication network according to an embodiment.

FIG. 21 is a diagram schematically illustrating an operation of exchanging audio data among a first external electronic device, a third external electronic device, and a fourth external electronic device in a wireless communication network according to an embodiment.

FIG. 22 is a diagram schematically illustrating an operation in which an electronic device establishes a common audio channel in a wireless communication network according to an embodiment.

FIG. 23 is a diagram schematically illustrating a receiving operation performed by an electronic device after a common audio channel is generated in a wireless communication network according to an embodiment.

FIG. 24 is a diagram schematically illustrating operations of a second external electronic device, a third external electronic device, and a fourth external electronic device in a wireless communication network according to an embodiment.

FIG. 25 is a diagram schematically illustrating operations of a second external electronic device, a third external electronic device, and a fourth external electronic device in a wireless communication network according to an embodiment.

[Mode for Invention]

[0033] Hereinafter, an embodiment of the disclosure will be described in detail with reference to the accompanying drawings. In the following description of an embodiment of the disclosure, a detailed description of relevant known functions or configurations incorporated herein will be omitted when it is determined that the description may make the subject matter of an embodiment of the disclosure unnecessarily unclear. The terms which will be described below are terms defined in consideration of the functions in the disclosure, and may be different according to users, intentions of the users, or customs. Therefore, the definitions of the terms should be made based on the contents throughout the specification.

[0034] It should be noted that the technical terms used herein are only used to describe specific embodiments, and are not intended to limit an embodiment of the disclosure. Alternatively, the technical terms used herein should be interpreted to have the same meaning as those commonly understood by a person skilled in the art to which the disclosure pertains, and should not be interpreted have excessively comprehensive or excessively restricted meanings unless particularly defined as other meanings. Alternatively, when the technical terms used herein are wrong technical terms that cannot correctly represent the idea of the disclosure, it should be appreciated that they are replaced by technical terms correctly understood by those skilled in the art. Alternatively, the general terms used in an embodiment of the disclosure should be interpreted as defined in dictionaries or interpreted in the context of the relevant part, and should not be interpreted to have excessively restricted meanings.

[0035] Alternatively, a singular expression used herein may include a plural expression unless they are definitely different in the context. As used herein, such an expression as "comprises" or "include", or the like should not be interpreted to necessarily include all elements or all operations described in the specification, and should be interpreted to be allowed to exclude some of them or further include additional elements or operations.

[0036] Alternatively, the terms including an ordinal number, such as expressions "a first" and "a second" may be used to describe various elements, but the corresponding elements should not be limited by such terms. These terms are used merely to distinguish between one element and any other element. For example, a first element may be termed a second element, and similarly, a second element may be termed a first element without departing from the scope of the disclosure.

[0037] It should be understood that when an element is referred to as being "connected" or "coupled" to another element, it may be connected or coupled directly to the other element, or any other element may be interposer between them. In contrast, it should be understood that when an element is referred to as being "directly connected" or "directly coupled" to another element, there are no element interposed between them.

[0038] Hereinafter, an embodiment of the disclosure will be described in detail with reference to the accompanying drawings. Regardless of drawing signs, the same or like elements are provided with the same reference numeral, and a repeated description thereof will be omitted. Alternatively, in describing an embodiment of the disclosure, a detailed description of relevant known technologies will be omitted when it is determined that the description may make the subject matter of the disclosure unclear. Alternatively, it should be noted that the accompanying drawings are presented merely to help easy understanding of the technical idea of the disclosure, and should not be construed to limit the technical idea of the disclosure. The technical idea of the disclosure should be construed to cover all changes, equivalents, and alternatives, in addition to the drawings.

[0039] Hereinafter, an embodiment of the disclosure will describe an electronic device, but the electronic device may be referred to as a terminal, a mobile station, a mobile equipment (ME), a user equipment (UE), a user terminal (UT), a subscriber station (SS), a wireless device, a handheld device, and an access terminal (AT). Alternatively, in an embodiment of the disclosure, the electronic device may be a device having a communication function such as, for example, a mobile phone, a personal digital assistant (PDA), a smart phone, a wireless MODEM, and a notebook.

[0040] In a detailed description of an embodiment of the disclosure, a standard specified by Bluetooth special interest group (SIG) is referred to, but the main subject of the disclosure can be somewhat modified and applied to other communication systems having a similar technical background without departing from the scope of the disclosure, and the modifications can be made on the basis of determination of those skilled in the art.

[0041] FIG. 1 is a block diagram illustrating an electronic device 101 in a network environment 100 according to various embodiments.

[0042] Referring to FIG. 1, the electronic device 101 in the network environment 100 may communicate with an electronic device 102 via a first network 198 (e.g., a short-range wireless communication network), or an electronic device 104 or a server 108 via a second network 199 (e.g., a long-range wireless communication network). According to an embodiment, the electronic device 101 may communicate with the electronic device 104 via the server 108. According to an embodiment, the electronic device 101 may include a processor 120, memory 130, an input module 150, a sound output

module 155, a display module 160, an audio module 170, a sensor module 176, an interface 177, a connecting terminal 178, a haptic module 179, a camera module 180, a power management module 188, a battery 189, a communication module 190, a subscriber identification module (SIM) 196, or an antenna module 197. In some embodiments, at least one of the components (e.g., the connecting terminal 178) may be omitted from the electronic device 101, or one or more other components may be added in the electronic device 101. In some embodiments, some of the components (e.g., the sensor module 176, the camera module 180, or the antenna module 197) may be implemented as a single component (e.g., the display module 160).

[0043] The processor 120 may execute, for example, software (e.g., a program 140) to control at least one other component (e.g., a hardware or software component) of the electronic device 101 coupled with the processor 120, and may perform various data processing or computation. According to one embodiment, as at least part of the data processing or computation, the processor 120 may store a command or data received from another component (e.g., the sensor module 176 or the communication module 190) in volatile memory 132, process the command or the data stored in the volatile memory 132, and store resulting data in non-volatile memory 134. According to an embodiment, the processor 120 may include a main processor 121 (e.g., a central processing unit (CPU) or an application processor (AP)), or an auxiliary processor 123 (e.g., a graphics processing unit (GPU), a neural processing unit (NPU), an image signal processor (ISP), a sensor hub processor, or a communication processor (CP)) that is operable independently from, or in conjunction with, the main processor 121. For example, when the electronic device 101 includes the main processor 121 and the auxiliary processor 123, the auxiliary processor 123 may be adapted to consume less power than the main processor 121, or to be specific to a specified function. The auxiliary processor 123 may be implemented as separate from, or as part of the main processor 121.

[0044] The auxiliary processor 123 may control, for example, at least some of functions or states related to at least one component (e.g., the display module 160, the sensor module 176, or the communication module 190) among the components of the electronic device 101, instead of the main processor 121 while the main processor 121 is in an inactive (e.g., sleep) state, or together with the main processor 121 while the main processor 121 is in an active (e.g., executing an application) state. According to an embodiment, the auxiliary processor 123 (e.g., an image signal processor or a communication processor) may be implemented as part of another component (e.g., the camera module 180 or the communication module 190) functionally related to the auxiliary processor 123. According to an embodiment, the auxiliary processor 123 (e.g., the neural processing unit) may include a hardware structure specified for artificial intelligence model processing. An artificial intelligence model may be generated by machine learning. Such learning may be performed, e.g., by the electronic device 101 where the artificial intelligence model is performed or via a separate server (e.g., the server 108). Learning algorithms may include, but are not limited to, e.g., supervised learning, unsupervised learning, semi-supervised learning, or reinforcement learning. The artificial intelligence model may include a plurality of artificial neural network layers. The artificial neural network may be a deep neural network (DNN), a convolutional neural network (CNN), a recurrent neural network (RNN), a restricted boltzmann machine (RBM), a deep belief network (DBN), a bidirectional recurrent deep neural network (BRDNN), deep Q-network or a combination of two or more thereof but is not limited thereto. The artificial intelligence model may, additionally or alternatively, include a software structure other than the hardware structure.

[0045] The memory 130 may store various data used by at least one component (e.g., the processor 120 or the sensor module 176) of the electronic device 101. The various data may include, for example, software (e.g., the program 140) and input data or output data for a command related thereto. The memory 130 may include the volatile memory 132 or the non-volatile memory 134.

[0046] The program 140 may be stored in the memory 130 as software, and may include, for example, an operating system (OS) 142, middleware 144, or an application 146.

[0047] The input module 150 may receive a command or data to be used by another component (e.g., the processor 120) of the electronic device 101, from the outside (e.g., a user) of the electronic device 101. The input module 150 may include, for example, a microphone, a mouse, a keyboard, a key (e.g., a button), or a digital pen (e.g., a stylus pen).

[0048] The sound output module 155 may output sound signals to the outside of the electronic device 101. The sound output module 155 may include, for example, a speaker or a receiver. The speaker may be used for general purposes, such as playing multimedia or playing record. The receiver may be used for receiving incoming calls. According to an embodiment, the receiver may be implemented as separate from, or as part of the speaker.

[0049] The display module 160 may visually provide information to the outside (e.g., a user) of the electronic device 101. The display module 160 may include, for example, a display, a hologram device, or a projector and control circuitry to control a corresponding one of the display, hologram device, and projector. According to an embodiment, the display module 160 may include a touch sensor adapted to detect a touch, or a pressure sensor adapted to measure the intensity of force incurred by the touch.

[0050] The audio module 170 may convert a sound into an electrical signal and vice versa. According to an embodiment, the audio module 170 may obtain the sound via the input module 150, or output the sound via the sound output module 155 or an external electronic device (e.g., an electronic device 102 (e.g., a speaker or a headphone)) directly or wirelessly

coupled with the electronic device 101.

[0051] The sensor module 176 may detect an operational state (e.g., power or temperature) of the electronic device 101 or an environmental state (e.g., a state of a user) external to the electronic device 101, and then generate an electrical signal or data value corresponding to the detected state. According to an embodiment, the sensor module 176 may include, for example, a gesture sensor, a gyro sensor, an atmospheric pressure sensor, a magnetic sensor, an acceleration sensor, a grip sensor, a proximity sensor, a color sensor, an infrared (IR) sensor, a biometric sensor, a temperature sensor, a humidity sensor, or an illuminance sensor.

[0052] The interface 177 may support one or more specified protocols to be used for the electronic device 101 to be coupled with the external electronic device (e.g., the electronic device 102) directly or wirelessly. According to an embodiment, the interface 177 may include, for example, a high definition multimedia interface (HDMI), a universal serial bus (USB) interface, a secure digital (SD) card interface, or an audio interface.

[0053] A connecting terminal 178 may include a connector via which the electronic device 101 may be physically connected with the external electronic device (e.g., the electronic device 102). According to an embodiment, the connecting terminal 178 may include, for example, a HDMI connector, a USB connector, a SD card connector, or an audio connector (e.g., a headphone connector).

[0054] The haptic module 179 may convert an electrical signal into a mechanical stimulus (e.g., a vibration or a movement) or electrical stimulus which may be recognized by a user via his tactile sensation or kinesthetic sensation. According to an embodiment, the haptic module 179 may include, for example, a motor, a piezoelectric element, or an electric stimulator.

[0055] The camera module 180 may capture a still image or moving images. According to an embodiment, the camera module 180 may include one or more lenses, image sensors, image signal processors, or flashes.

[0056] The power management module 188 may manage power supplied to the electronic device 101. According to one embodiment, the power management module 188 may be implemented as at least part of, for example, a power management integrated circuit (PMIC).

[0057] The battery 189 may supply power to at least one component of the electronic device 101. According to an embodiment, the battery 189 may include, for example, a primary cell which is not rechargeable, a secondary cell which is rechargeable, or a fuel cell.

[0058] The communication module 190 may support establishing a direct (e.g., wired) communication channel or a wireless communication channel between the electronic device 101 and the external electronic device (e.g., the electronic device 102, the electronic device 104, or the server 108) and performing communication via the established communication channel. The communication module 190 may include one or more communication processors that are operable independently from the processor 120 (e.g., the application processor (AP)) and supports a direct (e.g., wired) communication or a wireless communication. According to an embodiment, the communication module 190 may include a wireless communication module 192 (e.g., a cellular communication module, a short-range wireless communication module, or a global navigation satellite system (GNSS) communication module) or a wired communication module 194 (e.g., a local area network (LAN) communication module or a power line communication (PLC) module). A corresponding one of these communication modules may communicate with the external electronic device 104 via the first network 198 (e.g., a short-range communication network, such as Bluetooth™, wireless-fidelity (Wi-Fi) direct, or infrared data association (IrDA)) or the second network 199 (e.g., a long-range communication network, such as a legacy cellular network, a 5G network, a next-generation communication network, the Internet, or a computer network (e.g., LAN or wide area network (WAN)). These various types of communication modules may be implemented as a single component (e.g., a single chip), or may be implemented as multi components (e.g., multi chips) separate from each other. The wireless communication module 192 may identify or authenticate the electronic device 101 in a communication network, such as the first network 198 or the second network 199, using subscriber information (e.g., international mobile subscriber identity (IMSI)) stored in the subscriber identification module 196.

[0059] The wireless communication module 192 may support a 5G network, after a 4G network, and next-generation communication technology, e.g., new radio (NR) access technology. The NR access technology may support enhanced mobile broadband (eMBB), massive machine type communications (mMTC), or ultra-reliable and low-latency communications (URLLC). The wireless communication module 192 may support a high-frequency band (e.g., the mmWave band) to achieve, e.g., a high data transmission rate. The wireless communication module 192 may support various technologies for securing performance on a high-frequency band, such as, e.g., beamforming, massive multiple-input and multiple-output (massive MIMO), full dimensional MIMO (FD-MIMO), array antenna, analog beam-forming, or large scale antenna. The wireless communication module 192 may support various requirements specified in the electronic device 101, an external electronic device (e.g., the electronic device 104), or a network system (e.g., the second network 199). According to an embodiment, the wireless communication module 192 may support a peak data rate (e.g., 20 Gbps or more) for implementing eMBB, loss coverage (e.g., 164 dB or less) for implementing mMTC, or U-plane latency (e.g., 0.5 ms or less for each of downlink (DL) and uplink (UL), or a round trip of 1 ms or less) for implementing URLLC.

[0060] The antenna module 197 may transmit or receive a signal or power to or from the outside (e.g., the external

electronic device) of the electronic device 101. According to an embodiment, the antenna module 197 may include an antenna including a radiating element composed of a conductive material or a conductive pattern formed in or on a substrate (e.g., a printed circuit board (PCB)). According to an embodiment, the antenna module 197 may include a plurality of antennas (e.g., array antennas). In such a case, at least one antenna appropriate for a communication scheme used in the communication network, such as the first network 198 or the second network 199, may be selected, for example, by the communication module 190 from the plurality of antennas. The signal or the power may then be transmitted or received between the communication module 190 and the external electronic device via the selected at least one antenna. According to an embodiment, another component (e.g., a radio frequency integrated circuit (RFIC)) other than the radiating element may be additionally formed as part of the antenna module 197.

[0061] According to various embodiments, the antenna module 197 may form a mmWave antenna module. According to an embodiment, the mmWave antenna module may include a printed circuit board, an RFIC disposed on a first surface (e.g., the bottom surface) of the printed circuit board, or adjacent to the first surface and capable of supporting a designated high-frequency band (e.g., the mmWave band), and a plurality of antennas (e.g., array antennas) disposed on a second surface (e.g., the top or a side surface) of the printed circuit board, or adjacent to the second surface and capable of transmitting or receiving signals of the designated high-frequency band.

[0062] At least some of the above-described components may be coupled mutually and communicate signals (e.g., commands or data) therebetween via an inter-peripheral communication scheme (e.g., a bus, general purpose input and output (GPIO), serial peripheral interface (SPI), or mobile industry processor interface (MIPI)).

[0063] According to an embodiment, commands or data may be transmitted or received between the electronic device 101 and the external electronic device 104 via the server 108 coupled with the second network 199. Each of the electronic devices 102 or 104 may be a device of a same type as, or a different type, from the electronic device 101. According to an embodiment, all or some of operations to be executed at the electronic device 101 may be executed at one or more of the external electronic devices 102, 104, or 108. For example, if the electronic device 101 should perform a function or a service automatically, or in response to a request from a user or another device, the electronic device 101, instead of, or in addition to, executing the function or the service, may request the one or more external electronic devices to perform at least part of the function or the service. The one or more external electronic devices receiving the request may perform the at least part of the function or the service requested, or an additional function or an additional service related to the request, and transfer an outcome of the performing to the electronic device 101. The electronic device 101 may provide the outcome, with or without further processing of the outcome, as at least part of a reply to the request. To that end, a cloud computing, distributed computing, mobile edge computing (MEC), or client-server computing technology may be used, for example. The electronic device 101 may provide ultra low-latency services using, e.g., distributed computing or mobile edge computing. In another embodiment, the external electronic device 104 may include an internet-of things (IoT) device. The server 108 may be an intelligent server using machine learning and/or a neural network. According to an embodiment, the external electronic device 104 or the server 108 may be included in the second network 199. The electronic device 101 may be applied to intelligent services (e.g., smart home, smart city, smart car, or healthcare) based on 5G communication technology or IoT-related technology.

[0064] The electronic device according to various embodiments may be one of various types of electronic devices. The electronic devices may include, for example, a portable communication device (e.g., a smartphone), a computer device, a portable multimedia device, a portable medical device, a camera, a wearable device, or a home appliance. According to an embodiment of the disclosure, the electronic devices are not limited to those described above.

[0065] It should be appreciated that various embodiments of the disclosure and the terms used therein are not intended to limit the technological features set forth herein to particular embodiments and include various changes, equivalents, or replacements for a corresponding embodiment. With regard to the description of the drawings, similar reference numerals may be used to refer to similar or related elements. It is to be understood that a singular form of a noun corresponding to an item may include one or more of the things, unless the relevant context clearly indicates otherwise. As used herein, each of such phrases as "A or B," "at least one of A and B," "at least one of A or B," "A, B, or C," "at least one of A, B, and C," and "at least one of A, B, or C," may include any one of, or all possible combinations of the items enumerated together in a corresponding one of the phrases. As used herein, such terms as "1st" and "2nd," or "first" and "second" may be used to simply distinguish a corresponding component from another, and does not limit the components in other aspect (e.g., importance or order). It is to be understood that if an element (e.g., a first element) is referred to, with or without the term "operatively" or "communicatively", as "coupled with," "coupled to," "connected with," or "connected to" another element (e.g., a second element), it means that the element may be coupled with the other element directly (e.g., wiredly), wirelessly, or via a third element.

[0066] As used in connection with various embodiments of the disclosure, the term "module" may include a unit implemented in hardware, software, or firmware, and may interchangeably be used with other terms, for example, "logic," "logic block," "part," or "circuitry". A module may be a single integral component, or a minimum unit or part thereof, adapted to perform one or two or more functions. For example, according to an embodiment, the module may be implemented in a form of an application-specific integrated circuit (ASIC).

[0067] Various embodiments as set forth herein may be implemented as software (e.g., the program 140) including one or more instructions that are stored in a storage medium (e.g., internal memory 136 or external memory 138) that is readable by a machine (e.g., the electronic device 101). For example, a processor (e.g., the processor 120) of the machine (e.g., the electronic device 101) may invoke at least one of the one or more instructions stored in the storage medium, and execute it. This allows the machine to be operated to perform at least one function according to the at least one instruction invoked. The one or more instructions may include a code generated by a complier or a code executable by an interpreter. The machine-readable storage medium may be provided in the form of a non-transitory storage medium. Wherein, the term "non-transitory" simply means that the storage medium is a tangible device, and does not include a signal (e.g., an electromagnetic wave), but this term does not differentiate between where data is semi-permanently stored in the storage medium and where the data is temporarily stored in the storage medium.

[0068] According to an embodiment, a method according to various embodiments of the disclosure may be included and provided in a computer program product. The computer program product may be traded as a product between a seller and a buyer. The computer program product may be distributed in the form of a machine-readable storage medium (e.g., compact disc read only memory (CD-ROM)), or be distributed (e.g., downloaded or uploaded) online via an application store (e.g., PlayStore™), or between two user devices (e.g., smart phones) directly. If distributed online, at least part of the computer program product may be temporarily generated or at least temporarily stored in the machine-readable storage medium, such as memory of the manufacturer's server, a server of the application store, or a relay server.

[0069] According to various embodiments, each component (e.g., a module or a program) of the above-described components may include a single entity or multiple entities, and some of the multiple entities may be separately disposed in different components. According to various embodiments, one or more of the above-described components or operations may be omitted, or one or more other components or operations may be added. Alternatively or additionally, a plurality of components (e.g., modules or programs) may be integrated into a single component. In such a case, the integrated component may still perform one or more functions of each of the plurality of components in the same or similar manner as they are performed by a corresponding one of the plurality of components before the integration. According to various embodiments, operations performed by the module, the program, or another component may be carried out sequentially, in parallel, repeatedly, or heuristically, or one or more of the operations may be executed in a different order or omitted, or one or more other operations may be added.

[0070] FIG. 2 is a diagram schematically illustrating connections between electronic devices which are based on a Bluetooth scheme in a wireless communication network according to an embodiment.

[0071] Referring to FIG. 2, an electronic device 101 (e.g., an electronic device 101 in FIG. 1) may be connected wirelessly to a first external electronic device 200 (e.g., an ear-wearable device (e.g., an electronic device 102 in FIG. 1)). In an embodiment, the electronic device 101 may be a smart phone. The first external electronic device 200 may include a first earbud 202 (e.g., a left earbud) and/or a second earbud 204 (e.g., a right earbud). The first earbud 202 may perform a first audio channel (e.g., left audio channel) role, and the second earbud 204 may perform a second audio channel (e.g., right audio channel) role. In an embodiment, if the electronic device 101, the left earbud 202, and the right earbud 204 connected based on the Bluetooth scheme provide an audio service, each of the left earbud 202 and the right earbud 204 may operate as an audio sink device, and the electronic device 101 may operate as an audio source device. In an embodiment, the Bluetooth scheme may include a Bluetooth legacy (or Bluetooth classic) scheme and/or a Bluetooth low energy (BLE) scheme.

[0072] In an embodiment, it is assumed that the first earbud 202 and/or the second earbud 204 are included in the first external electronic device 200 (e.g., the ear-wearable device), but the first earbud 202 and/or the second earbud 204 may be included in any electronic device as long as the first earbud 202 and the second earbud 204 may operate as a pair as well as the first external electronic device 200. According to an embodiment, the first earbud 202 and the second earbud 204 may be implemented to include the same or similar components.

[0073] According to an embodiment, the electronic device 101 and the first earbud 202 and/or the second earbud 204 may establish a connection (e.g., a communication link) with one another and transmit and/or receive data (e.g., audio data) to and from one another via the established connection. For example, the electronic device 101 and each of the first earbud 202 and/or the second earbud 204 may establish a communication link based on at least one of a Wi-Fi scheme or a Bluetooth scheme, however, a scheme for establishing the communication link in the electronic device 101 and each of the first earbud 202 and the second earbud 204 is not limited to at least one of the Wi-Fi scheme and/or the Bluetooth scheme. If the scheme of establishing the communication link between the electronic device 101 and the first earbud 202 and/or the second earbud 204 is the Bluetooth scheme, the communication link established between the electronic device 101 and the first earbud 202 and the second earbud 204 may be a connected isochronous stream (CIS) or a broadcast isochronous stream (BIS).

[0074] In an embodiment, the electronic device 101 may establish a communication link with only one of the first earbud 202 and the second earbud 204 or may establish a communication link with each of the first earbud 202 and the second earbud 204.

[0075] In an embodiment, the first earbud 202 and/or the second earbud 204 may establish a communication link based

on at least one of the Wi-Fi scheme or the Bluetooth scheme, however, a scheme for establishing the communication link in the first earbud 202 and the second earbud 204 is not limited to at least one of the Wi-Fi scheme or the Bluetooth scheme. For example, if the scheme of establishing the communication link between the first earbud 202 and the second earbud 204 is the Bluetooth scheme, the communication link may be the CIS.

[0076] In an embodiment, one of the first earbud 202 and/or the second earbud 204 may be a central device (or a master device, a primary device, or a main device), and the other one may operate as a peripheral device (or a slave device, a secondary device, or a sub device). An electronic device operating as a central device may transmit data to an electronic device operating as a peripheral device. For example, when the first earbud 202 and the second earbud 204 establish a communication link with each other, one of the first earbud 202 and the second earbud 204 may be selected as a central device, and the other one may be selected as a peripheral device.

[0077] In FIG. 2, a case that the electronic device 101 and the first external electronic device 200 (e.g., the first earbud 202 and/or the second earbud 204) establish the connection has been described as an example, however, the electronic device 101 may establish a connection with not only the first external electronic device 200 but also another external electronic device (e.g., a second external electronic device (not shown in FIG. 2) (e.g., an electronic device 104 in FIG. 1) or a server (e.g., a server 108 in FIG. 1). The electronic device 101, the first external electronic device 200, and/or the second external electronic device may be electronic devices participating in a multi-party audio service. In an embodiment, the server may be connected to the electronic device 101, the first external electronic device 200, and other external electronic devices, and perform a management and control operation for the electronic device 101, the first external electronic device 200, and the other external electronic devices.

[0078] The first earbud 202 and/or the second earbud 204 may communicate directly or indirectly with an earbuds case device 206. In an embodiment, the earbuds case device 206 may be a device which stores and charges the first earbud 202 and/or the second earbud 204. In an embodiment, the earbuds case device 206 may include at least one processor (or at least one communication chip), at least one communication circuit, and/or a display. In an embodiment, the earbuds case device 206 may include additional components as well as the at least one processor (or the at least one communication chip), the at least one communication circuit, and/or the display. In an embodiment, the earbuds case device 206 may perform an operation related to a common audio channel (e.g., an operation of generating the common audio channel) based on a user input via the display. The first external electronic device 200 may generate a common audio channel, and may share, with the electronic device 101 or other external electronic devices, information about the generated common audio channel and information used for synchronizing with the common audio channel. In an embodiment, the earbuds case device 206 may also generate a common audio channel, and share, with the electronic device 101, the first external device 200, or other external electronic devices, information about the generated common audio channel and information used for synchronizing with the common audio channel.

[0079] FIG. 3 is a block diagram schematically illustrating a second external electronic device in a wireless communication network according to an embodiment.

[0080] Referring to FIG. 3, a second external electronic device 300 (e.g., an electronic device 104 in FIG. 1) may be a device implementing a Bluetooth scheme (e.g., a Bluetooth legacy scheme and/or a BLE scheme). The second external electronic device 300 may include a communication circuit 302 (e.g., a communication module 190 in FIG. 1) which transmits and receives signals with another electronic device (e.g., an electronic device 101 in FIG. 1 or FIG. 2, or an electronic device 102 in FIG. 1 or FIG. 2), for example, a peer device by using one or more antennas 301. In an embodiment, the other electronic device may include at least one of a first earbud 202 or a second earbud 204.

[0081] The second external electronic device 300 may include a processor 304 (e.g., a processor 120 in FIG. 1) which [HEJ1]may be implemented in one or more single-core processors or one or more multi-core processors, and memory 306 (e.g., memory 130 in FIG. 1) which stores instructions for an operation of the second external electronic device 300.

[0082] The second external electronic device 300 may include an interface module 308 (e.g., an interface 177 in FIG. 1). The interface module 308 may provide a wired and/or wireless interface for communicating with components outside a network. For example, at least a portion of the one or more antennas 301, the communication circuit 302, or the interface module 308 may be implemented as at least a portion of the communication module 190 and the antenna module 197 in FIG. 1.

[0083] According to an embodiment, the second external electronic device 300 may include a plurality of communication circuits. One of the plurality of communication circuits may be a communication circuit which is based on a Wi-Fi scheme, and another of the plurality of communication circuits may be a communication circuit which is based on a Bluetooth scheme, e.g., a BLE scheme. According to an embodiment, the plurality of communication circuits may include a communication circuit 302, and the communication circuit 302 may be a communication circuit which is based on the Wi-Fi scheme or a communication circuit which is based on the BLE scheme.

[0084] According to an embodiment, the second external electronic device 300 may not separately include a communication circuit which is based on the Wi-Fi scheme and a communication circuit which is based on the BLE scheme, and may include one communication circuit capable of supporting both the Wi-Fi scheme and the BLE scheme. According to an embodiment, the one communication circuit capable of supporting both the Wi-Fi scheme and the BLE scheme may

be the communication circuit 302.

[0085] FIG. 4 is a block diagram schematically illustrating a first external electronic device in a wireless communication network according to an embodiment.

[0086] Referring to FIG. 4, an electronic device 101 (e.g., an electronic device 101 in FIG. 1 or FIG. 2) may be connected wirelessly to a first external electronic device 200 (e.g., an electronic device 102 in FIG. 1 or a first external electronic device 200). The first external electronic device 200 may include a first earbud 202 (e.g., a left earbud) and a second earbud 204 (e.g., a right earbud). In an embodiment, the electronic device 101 may be a smart phone.

[0087] In FIG. 4, it is described that each of the first earbud 202 and the second earbud 204 is implemented as an earbud, but the first earbud 202 and the second earbud 204 may be implemented as one of various types of devices (e.g., a smart watch, a head-mounted display device, and devices for measuring a biometric signal (e.g., an electrocardiogram patch)) which may include at least one electrode and sensor device to be described below. According to an embodiment, the first earbud 202 and the second earbud 204 may compose a pair. According to an embodiment, the first earbud 202 and the second earbud 204 may be implemented to include the same or substantially similar components.

[0088] According to an embodiment, the electronic device 101, the first earbud 202, and the second earbud 204 may establish a connection (e.g., a communication link) with one another and transmit and/or receive data to and from one another via the established connection. For example, the electronic device 101 and each of the first earbud 202 and the second earbud 204 may establish a communication link using at least one of a Wi-Fi scheme or a Bluetooth scheme, however, a scheme for establishing the communication link in the electronic device 101 and each of the first earbud 202 and the second earbud 204 is not limited to at least one of the Wi-Fi scheme or the Bluetooth scheme.

[0089] In an embodiment, the electronic device 101 may connect a communication link to only one (e.g., a central earbud) of the first earbud 202 and the second earbud 204 or may establish communication links with both the first earbud 202 and the second earbud 204.

[0090] In an embodiment, the first earbud 202 and the second earbud 204 may establish a communication link based on at least one of the Wi-Fi scheme or the Bluetooth scheme, however, a scheme for establishing the communication link in the first earbud 202 and the second earbud 204 is not limited to at least one of the Wi-Fi scheme or the Bluetooth scheme.

[0091] In an embodiment, the first earbud 202 may include the same or substantially similar components to at least one of the components (e.g., modules) of the electronic device 101. The first earbud 202 may include a communication circuit 420 (e.g., a communication module 190 in FIG. 1), an input device 430 (e.g., an input module 150 in FIG. 1), a sensor 440 (e.g., a sensor module 176 in FIG. 1), an audio processing module 450 (e.g., an audio module 170 in FIG. 1), memory 490 (e.g., memory 130 in FIG. 1), a power management module 460 (e.g., a power management module 188 in FIG. 1), a battery 470 (e.g., a battery 189 in FIG. 1), an interface 480 (e.g., an interface 177 in FIG. 1), and a processor 410 (e.g., a processor 120 in FIG. 1).

[0092] According to an embodiment, the communication circuit 420 may include at least one of a wireless communication module (e.g., a Bluetooth communication module, a cellular communication module, a wireless-fidelity (Wi-Fi) communication module, a near-field communication (NFC) communication module, or a GNSS communication module) or a wired communication module (e.g., a LAN communication module or a power line communication (PLC) communication module).

[0093] The communication circuit 420 may directly or indirectly communicate with at least one of the electronic device 101, an earbuds case device 206, or the second earbud 204 through a first network (e.g., a first network 198 in FIG. 1), using at least one communication module. The second earbud 204 may compose a pair together with the first earbud 202. The communication circuit 420 may include one or more communication processors which are operable independently from the processor 410 and supports wired or wireless communication.

[0094] According to an embodiment, the communication circuit 420 may be connected to one or a plurality of antennas for transmitting signals or information to another electronic device (e.g., the electronic device 101, the second earbud 204, the earbuds case device 206, and/or a second external electronic device (e.g., an electronic device 104 in FIG. 1 or a second external electronic device 300 in FIG. 3)) or receiving signals or information from the other electronic device. According to an embodiment, at least one antenna appropriate for a communication scheme used in a communication network, such as the first network (e.g., the first network 198 of FIG. 1) or the second network (e.g., the second network 199 of FIG. 2), may be selected from the plurality of antennas by the communication circuit 420. The signal or information may then be transmitted or received between the communication circuit 420 and another electronic device via the selected at least one antenna.

[0095] According to an embodiment, the input device 430 may be configured to generate various input signals that may be used for operation of the first earbud 202. The input device 430 may include at least one of a touch pad, a touch panel, or a button.

[0096] According to an embodiment, the input device 430 may generate a user input related to the turn-on or turn-off of the first earbud 202. According to an embodiment, the input device 430 may receive a user input for establishing a communication link between the first earbud 202 and the second earbud 204. According to an embodiment, the input device 430 may receive a user input related to audio data (or audio content). For example, the user input may be

associated with functions of starting playback of audio data, pausing playback, stopping playback, adjusting playback speed, adjusting playback volume, or muting.

[0097] According to an embodiment, the sensor 440 may obtain a location or an operation state of the first earbud 202. The sensor 440 may convert an obtained signal into an electric signal. For example, the sensor 440 may include at least one of a magnetic sensor, an acceleration sensor, a gyro sensor, a geomagnetic sensor, a proximity sensor, a gesture sensor, a grip sensor, a biometric sensor, and/or an optical sensor.

[0098] According to an embodiment, the processor 410 may obtain data (e.g., audio data) from a packet (e.g., an audio packet) received from the electronic device 101, and process the obtained data via the audio processing module 450 to output the processed data to the speaker 454. The audio processing module 450 may support an audio data gathering function and reproduce the gathered audio data.

[0099] According to an embodiment, the audio processing module 450 may include an audio decoder (not shown) and a D/A converter (not shown). The audio decoder may convert audio data stored in the memory 490 or received from the electronic device 101 via communication circuit 420 into a digital audio signal. The D/A converter may convert the digital audio signal converted by the audio decoder into an analog audio signal. According to an embodiment, the audio decoder may convert audio data received from the electronic device 101 via the communication circuit 420 and stored in the memory 490 into a digital audio signal. The speaker 454 may output the analog audio signal converted by the D/A converter.

[0100] According to an embodiment, the audio processing module 450 may include an A/D converter (not shown). The A/D converter may convert the analog audio signal transferred via a microphone 452 into a digital voice signal. The microphone 452 may include at least one air conduction microphone and/or at least one bone conduction microphone for obtaining voice and/or sound.

[0101] According to an embodiment, the audio processing module 450 may play various audio data set in the operation of the first earbud 202. For example, the processor 410 may be designed to identify insertion or removal of the first earbud 202 into/from the user's ear via the sensor 440 and reproduce audio data regarding an effect sound or guide sound via the audio processing module 450. The output of the sound effect or guide sound may be omitted according to the user setting or the designer's intention.

[0102] According to an embodiment, the memory 490 may store various data used by at least one component (e.g., the processor 410 or the sensor 440) of the first earbud 202. For example, data may include software and input data or output data for an instruction related thereto. The memory 490 may include a volatile memory or a non-volatile memory.

[0103] According to an embodiment, the power management module 460 may manage power supplied to the first earbud 202. According to one embodiment, the power management module 460 may be implemented as at least part of a power management integrated circuit (PMIC). According to an embodiment, the power management module 460 may include a battery charging module. According to an embodiment, if another electronic device (e.g., one of the electronic device 101, the second earbud 204, the earbuds case device 206, and/or a second external electronic device) is electrically (wirelessly or wiredly) connected to the first earbud 202, the power management module 460 may receive power from the other electronic device to charge the battery 470.

[0104] According to an embodiment, the battery 470 may supply power to at least one component of the first earbud 202. According to an embodiment, the battery 470 may include a rechargeable battery. According to an embodiment, if the first earbud 202 is mounted in the earbuds case device 206, the first earbud 202 may charge the battery 470 to a designated charge level and then power on the first earbud 202 or turn on at least part of the communication circuit 420.

[0105] According to an embodiment, the interface 480 may support one or more designated protocols which may be used for the first earbud 202 to directly (e.g., wiredly) connect to the electronic device 101, the earbuds case device 206, the second earbud 204, the second external electronic device, or another electronic device. According to an embodiment, the interface 480 may include at least one of a high definition multimedia interface (HDMI), a USB interface, an SD card interface, a power line communication (PLC) interface, or an audio interface. According to an embodiment, the interface 480 may include at least one connection port for establishing a physical connection with the earbuds case device 206.

[0106] According to an embodiment, the processor 410 may execute software to control at least one other component (e.g., a hardware or software component) of the first earbud 202 connected with the processor 410 and may process or compute various data. According to an embodiment, as at least part of the data processing or computation, the processor 410 may load an instruction or data received from another component (e.g., the sensor 440 or communication circuit 420) onto a volatile memory 490, process the instruction or the data stored in the volatile memory 490, and store resulting data in a non-volatile memory.

[0107] According to an embodiment, the processor 410 may establish a communication link with the electronic device 101 via the communication circuit 420 and receive data (e.g., audio data) from the electronic device 101 through the established communication link. According to an embodiment, the processor 410 may transmit the data, received from the electronic device 101 via the communication circuit 420, to the second earbud 204. According to an embodiment, the processor 410 may perform operations of the first earbud 202 which are to be described below.

[0108] According to an embodiment, the first earbud 202 may further include various modules depending on the form in

which it is provided. There are many variations according to the convergence trend of digital devices, so it is not possible to list them all, but components equivalent to the above-mentioned components may be further included in the first earbud 202. Further, it is apparent that in the first earbud 202 according to an embodiment, specific components may be excluded from the components described in FIG. 4 or the specific components may be replaced with other components according to the form in which it is provided.

[0109] According to an embodiment, the second earbud 204 configured in pair with the first earbud 202 may include the same or substantially similar components to those included in the first earbud 202 and may perform all or some of operations of the first earbud 202 to be described below.

[0110] In FIG. 4, the case of establishing the connection between the electronic device 101 and the first external electronic device 200 (e.g., the first earbud 202 and the second earbud 204) has been described as an example, however, the electronic device 101 may establish a connection with another external electronic devices (e.g., a second external electronic device (not shown in FIG. 4))(e.g., an electronic device 104 in FIG. 1 or a second external electronic device 300 in FIG. 3) as well as the first external electronic device 200. The electronic device 101, the first external electronic device, and/or the second external electronic device may be electronic devices participating in a multi-party audio service.

[0111] According to an embodiment of the disclosure, an electronic device (101) may include at least one communication circuit (190), at least one processor (120), and memory (130) storing instructions.

[0112] According to an embodiment of the disclosure, the instructions, when executed by the at least one processor, may cause the electronic device to establish a common audio channel which is an audio service link commonly used by the electronic device and at least one external electronic device (102; 104; 200; 300; 1001; 1003; 1005), based on a set condition.

[0113] According to an embodiment of the disclosure, the instructions, when executed by the at least one processor, may cause the electronic device to share, with the at least one external electronic device (102; 104; 200; 300; 1001; 1003; 1005) via the at least one communication circuit, information about the common audio channel and time information used for synchronization for the common audio channel.

[0114] According to an embodiment of the disclosure, the instructions, when executed by the at least one processor, may cause the electronic device to operate in a reception mode in which the electronic device is capable of receiving audio data from the at least one external electronic device for the common audio channel.

[0115] According to an embodiment of the disclosure, the instructions, when executed by the at least one processor, may cause the electronic device to identify that audio data to be transmitted to the at least one external electronic device exists while operating in the reception mode.

[0116] According to an embodiment of the disclosure, the instructions, when executed by the at least one processor, may cause the electronic device to switch from the reception mode to a transmission mode based on identifying existence of the audio data.

[0117] According to an embodiment of the disclosure, the instructions, when executed by the at least one processor, may cause the electronic device to transmit, on the common audio channel via the at least one communication circuit, the audio data in the transmission mode.

[0118] According to an embodiment of the disclosure, the instructions, when executed by the at least one processor, may cause the electronic device to switch to the reception mode for the common audio channel, based on completion of transmission of the audio data.

[0119] According to an embodiment of the disclosure, the set condition may include at least one of a condition for receiving a packet requesting to generate the common audio channel from at least one of the at least one external electronic device, a condition for identifying a user input requesting to generate the common audio channel, a condition for identifying that a set application is executed, or a condition for identifying that the electronic device enters a set area.

[0120] According to an embodiment of the disclosure, the instructions, when executed by the at least one processor, may cause the electronic device to broadcast, via the at least one communication circuit, the information about the common audio channel and the time information used for synchronization for the common audio channel in a period of periodic advertising.

[0121] According to an embodiment of the disclosure, the instructions, when executed by the at least one processor, may cause the electronic device to transmit, via the at least one communication circuit, the information about the common audio channel and the time information used for synchronization for the common audio channel in a communication link established between the electronic device and the at least one external electronic device.

[0122] According to an embodiment of the disclosure, the instructions, when executed by the at least one processor, may cause the electronic device to transmit, to a server connected to the electronic device and the at least one external electronic device via the at least one communication circuit, the information about the common audio channel and the time information used for synchronization for the common audio channel.

[0123] According to an embodiment of the disclosure, the instructions, when executed by the at least one processor, may cause the electronic device to determine at least one of an audio transmission service type, a physical link type, an access address, a channel map, audio transmission service parameters, or an audio data transmission/reception timing.

[0124] According to an embodiment of the disclosure, the instructions, when executed by the at least one processor, may cause the electronic device to generate the common audio channel based on the determined at least one of the audio transmission service type, the physical link type, the access address, the channel map, the audio transmission service parameters, or the audio data transmission/reception timing.

[0125] According to an embodiment of the disclosure, the audio transmission service type may include at least one of a broadcast isochronous stream (BIS) type or a connected isochronous stream (CIS) type.

[0126] According to an embodiment of the disclosure, if the audio transmission service type is the BIS type, the audio transmission service parameters may include BIS attribute information corresponding to the BIS type.

[0127] According to an embodiment of the disclosure, if the audio transmission service type is the CIS type, the audio transmission service parameters include CIS attribute information corresponding to the CIS type.

[0128] According to an embodiment of the disclosure, an electronic device (102; 200) may include at least one communication circuit (190), at least one processor (120), and memory (130) storing instructions.

[0129] According to an embodiment of the disclosure, the instructions , when executed by the at least one processor, may cause the electronic device to receive, from at least one external electronic device (101; 104; 300; 1001; 1003; 1005) or a server (108) via the at least one communication circuit, information about a common audio channel which is an audio service link commonly used by the electronic device and the at least one external electronic device and time information used for synchronization for the common audio channel.

[0130] According to an embodiment of the disclosure, the instructions, when executed by the at least one processor, may cause the electronic device to perform a synchronization operation for the common audio channel based on the information about the common audio channel and the time information used for synchronization for the common audio channel.

[0131] According to an embodiment of the disclosure, the instructions, when executed by the at least one processor, may cause the electronic device to operate in a reception mode in which the electronic device is capable of receiving audio data from the at least one external electronic device for the common audio channel.

[0132] According to an embodiment of the disclosure, the instructions, when executed by the at least one processor, may cause the electronic device to receive data from the at least one external electronic device via the at least one communication circuit while operating in the reception mode.

[0133] According to an embodiment of the disclosure, the instructions, when executed by the at least one processor, may cause the electronic device to identify that audio data to be transmitted to the at least one external electronic device exists while operating in the reception mode.

[0134] According to an embodiment of the disclosure, the instructions, when executed by the at least one processor, may cause the electronic device to switch from the reception mode to a transmission mode based on identifying existence of the audio data.

[0135] According to an embodiment of the disclosure, the instructions, when executed by the at least one processor, may cause the electronic device to transmit, on the common audio channel via the at least one communication circuit, the audio data in the transmission mode.

[0136] According to an embodiment of the disclosure, the instructions, when executed by the at least one processor, may cause the electronic device to transmit, to one external electronic device (101) of the at least one external electronic device via the at least one communication circuit, a packet requesting to generate the common audio channel based on the set condition.

[0137] According to an embodiment of the disclosure, the set condition may include at least one of a condition for identifying a user input requesting to generate the common audio channel, a condition for identifying that a set application is executed, or a condition for identifying that the electronic device enters a set area.

[0138] According to an embodiment of the disclosure, the instructions, when executed by the at least one processor, may cause the electronic device to receive, from the at least one external electronic device via the at least one communication circuit, the information about the common audio channel and the time information used for synchronization for the common audio channel in a period of periodic advertising.

[0139] According to an embodiment of the disclosure, the instructions, when executed by the at least one processor, may cause the electronic device to receive, via the at least one communication circuit, the information about the common audio channel and the time information used for synchronization for the common audio channel in a communication link established between the electronic device and the at least one external electronic device.

[0140] According to an embodiment of the disclosure, the instructions, when executed by the at least one processor, may cause the electronic device to receive, from a server connected to the electronic device and the at least one external electronic device via the at least one communication circuit, the information about the common audio channel and the time information used for synchronization for the common audio channel.

[0141] According to an embodiment of the disclosure, the common audio channel may be generated based on at least one of an audio transmission service type, a physical link type, an access address, a channel map, audio transmission service parameters, or an audio data transmission/reception timing.

[0142] According to an embodiment of the disclosure, the audio transmission service type may include at least one of a broadcast isochronous stream (BIS) type or a connected isochronous stream (CIS) type.

[0143] According to an embodiment of the disclosure, if the audio transmission service type is the BIS type, the audio transmission service parameters may include BIS attribute information corresponding to the BIS type.

[0144] According to an embodiment of the disclosure, if the audio transmission service type is the CIS type, the audio transmission service parameters may include CIS attribute information corresponding to the CIS type.

[0145] The Bluetooth scheme may include a Bluetooth legacy (or Bluetooth classic) scheme and/or a Bluetooth low energy (BLE) scheme. An electronic device (e.g., an electronic device 101 in FIG. 1, 2, or 4)(e.g., a smart phone) that provides an audio service based on the BLE scheme may independently establish a communication link (e.g., a connected isochronous stream (CIS)) with each of external electronic devices (e.g., a first external electronic device (e.g., an electronic device 101 in FIG. 1, or a first external electronic device 200 in FIG. 2 or 4)(e.g., earbuds), and/or a second external electronic device (e.g., an electronic device 104 in FIG. 1 or a second external electronic device 300 in FIG. 3)), and transmit and receive data to and from the external electronic devices via the established communication link (e.g., a connection-based communication). The electronic device may establish a communication link (e.g., a broadcast isochronous stream (BIS)) and transmit and receive data to and from the external electronic devices via the established communication link (e.g., a broadcast-based communication).

[0146] Like this, an audio service based on the BLE scheme may be provided via a connection-based CIS or a non-connection-based BIS.

[0147] First, a case that a multi-party audio service is provided via a CIS will be described.

[0148] If the multi-party audio service is provided via the CIS, all electronic devices participating in the multi-party audio service (e.g., an electronic device, a first external electronic device, and/or a second external electronic device) establish BLE links with each other, and establish CISes based on the established BLE links.

[0149] A CIS may be an asynchronous connection-oriented (ACL)-based link. For example, in a multi-party audio service, a case that a connection between an electronic device A and an electronic device B has been established may mean that a first communication link has been established using a first access address. If an electronic device C participates in the multi-party audio service, a second communication link between the electronic device A and the electronic device C may need to be established using a second access address, and a third communication link between the electronic device B and the electronic device C may need to be established using a third access address. After all communication links (e.g., the first communication link, the second communication link, and/or the third communication link) are generated between electronic devices (e.g., the electronic device A, the electronic device B, and/or the electronic device C) participating in the multi-party audio service, CISes may be generated. The CISes may be generated using access addresses different from the access addresses used in the first communication link to the third communication link, a CIS generated corresponding to the first communication link is a first CIS, a CIS generated corresponding to the second communication link is a second CIS, and a CIS generated corresponding to the third communication link is a third CIS.

[0150] If the number of electronic devices participating in a CIS-based multi-party audio service increases, the number of links which need to be established between the electronic devices participating in the CIS-based multi-party audio service may increase exponentially, and this exponential increase in the number of links may make it difficult to provide the CIS-based multi-party audio service and may also make it impossible for the CIS-based multi-party audio service to be provided. More specifically, the number of links which need to be established between the electronic devices participating in the CIS-based multi-party audio service may increase exponentially, and as the number of links which need to be established increases, link operation time during which a link is operated may overlap, and it may also be difficult to secure minimum unit of time required to operate the link, so it may be difficult to normally provide a CIS-based multi-party audio service.

[0151] Second, a case that a multi-party audio service is provided via a BIS will be described.

[0152] If the multi-party audio service is provided via a BIS, electronic devices participating in the multi-party audio service may operate as a BIS source device, and thus transmit audio data.

[0153] Currently, a Bluetooth scheme does not specifically define a scheme of receiving audio data via a BIS connection if a multi-party audio service is provided via the BIS connection, so it is impossible to define at what time point and in what scheme electronic devices participating in the multi-party audio service may receive the audio data, thus making it difficult or impossible to provide the multi-party audio service. Like this, if the multi-party audio service is provided via the BIS, service stability may not be secured because there is no separate standard related to receiving the audio data.

[0154] The disclosure may provide an electronic device for providing an audio service and operating method thereof which reduce the number of links required.

[0155] The disclosure may provide an electronic device for providing an audio service and operating method thereof which ensure service stability.

[0156] An audio service provided in a BLE scheme may be a next-generation Bluetooth audio service. In a Bluetooth legacy scheme, a Bluetooth basic rate/enhanced data rate (BR/EDR) scheme is used, and an advanced audio distribution profile (A2DP) or a hands-free profile (HFP) is used, whereas in the BLE scheme, a broadcast audio scheme for a multi-

stream audio scheme and an audio sharing scheme is used.

[0157] In the multi-stream audio scheme, independent audio streams may be transmitted to one or more electronic devices. A connected isochronous group (CIG) or a CIS has been introduced to support the multi-stream audio scheme.

[0158] The CIG may be generated by a central device and may include two or more CISes. For example, the CIG may include two or more CISes with the same time interval (e.g., ISO_Interval).

[0159] The CIS is a logical transport which enables connected devices to transfer isochronous data in either direction. The CIS is based on a point-to-point scheme and is based on acknowledgment (ACK)-based two-way communication.

[0160] An isochronous connection may be used to transfer isochronous data between a central device and a peripheral device using a logical transport called CIS. The CIS may include CIS events which occur at regular intervals (e.g., a specified ISO_Interval). A CIS event may be an opportunity for the central device and peripheral device to exchange audio packets.

[0161] Each CIS event may include one or more subevents. Each subevent may be used by the central device to transmit an audio packet and the peripheral device to respond to the master device. In each subevent, the central device transmits once and the peripheral device may respond. If the central device and the peripheral device completed transferring scheduled isochronous data in a CIS event, all remaining subevents in the CIS event will have no radio transmissions, so the CIS event may be closed.

[0162] Each subevent may use a physical channel which is determined by using a channel selection algorithm. The physical channel which is used for a subevent may be marked as ISO Ch(eventcount, subeventcount). The eventcount may represent a count value of a corresponding CIS event, and the subeventcount may represent a count value of a subevent in the corresponding CIS event.

[0163] A CIG event may include CIS events of CISes included in a CIG. Each CIG event starts at an anchor point of the earliest (in terms of transmission order) CIS and ends at the end of the last subevent of the latest (in terms of transmission order) CIS of the same CIG event. Two CIG events on the same CIG may not overlap. For example, the last CIS event of a given CIG event may end before the first CIS anchor point of the next CIG event.

[0164] FIG. 5 is a diagram schematically illustrating configuration of CIG events and CIS events in a wireless communication network according to an embodiment.

[0165] Referring to FIG. 5, one CIG event (e.g., a CIG event n 500) may include two CIS events (e.g., a CIS1 event n 501 and a CIS2 event n 503). For example, the CIS 1 event n 501 may be a CIS event corresponding to a CIS1, and the CIS2 event n 503 may be a CIS event corresponding to a CIS2.

[0166] CISes included in a CIG may be arranged sequentially or interleaved by appropriately adjusting values of Sub_Interval and spacing between CIS anchor points, and a case that the CIS1 event n 501 and the CIS2 event n 503 included in the CIG event n 500 are arranged sequentially is illustrated in FIG. 5. For example, the CIG event n 500 illustrated in FIG. 5 may be a CIG event including the CIS1 event n 501 and the CIS2 event n 503 in sequential arrangement.

[0167] If the CIS1 event n 501 and the CIS2 event n 503 are arranged sequentially, CIS events of other CISes may not overlap, so subevents of a CIS event may also not overlap. For example, if the CIS1 event n 501 and the CIS2 event n 503 are arranged sequentially, the CIS1 event n 501 and the CIS2 event n 503 may not overlap, so subevents included in the CIS1 event n 501 (e.g., a subevent 1 511, a subevent 2 512, a subevent 3 513, a subevent 4 514) and subevents included in the CIS2 event n 503 (e.g., a subevent 1 541, a subevent 2 542, a subevent 3 543, and a subevent 4 544) may not overlap.

[0168] A case that the CIS events of the other CISes may not overlap if the CIS1 event n 501 and the CIS2 event n 503 are arranged sequentially, so the subevents of the CIS event may also not overlap has been described as an example in FIG. 5.

[0169] Alternatively, subevents of a plurality of CIS events may overlap. For example, at least one of the subevents included in the CIS1 event n 501 and at least one of the subevents included in the CIS2 event n 503 may overlap. For example, it will be assumed that there are six subevents (the subevent 1 511, the subevent 2 512, the subevent 3 513, the subevent 4 514, the subevent 1 541, and the subevent 2 542), and two of the six subevents overlap. For example, it will be assumed that the CIS1 event n 501 includes the subevent 1 511, the subevent 2 512, the subevent 3 513, and the subevent 4 514, and the CIS2 event n 503 includes the subevent 3 513, the subevent 4 514, the subevent 1 541, and the subevent 2 542. In this case, if the subevent 1511 and the subevent 2 512 are used in the CIS1 event n 501, the subevent 3 513, the subevent 4 514, the subevent 1 541, and the subevent 2 542 may be used, and alternatively, if the subevent 1 511, the subevent 2 512, the subevent 3 513, and the subevent 4 514 are used in the CIS1 event n 501, the subevent 1 541 and the subevent 2 542 may be used the CIS2 event n 503.

[0170] For each adjacent pair of CISes, an interval between CIS anchor points of the CISes may be at least number of subevent (NSE) Y Sub _Interval. NSE may represent the number of subevents and may represent the maximum number of subevents included in each CIS event. In FIG. 5, "C" may represent a central device, "P1" may represent a first peripheral device, and "P2" may represent a second peripheral device.

[0171] The central device may transmit a connected isochronous protocol data unit (PDU) 521 in the subevent 1 511, the central device may transmit a connected isochronous PDU 522 in the subevent 2 512, the central device may transmit a connected isochronous PDU 523 in the subevent 3 513, and the central device may transmit a connected isochronous

PDU 524 in the subevent 4 514. Each of the connected isochronous PDU 521, the connected isochronous PDU 522, the connected isochronous PDU 523, and the connected isochronous PDU 524 may be a connected isochronous PDU transmitted from a central device to a peripheral device.

[0172] The first peripheral device may transmit a connected isochronous PDU 531 in the subevent 1 511, the first peripheral device may transmit a connected isochronous PDU 532 in the subevent 2 512, the first peripheral device may transmit a connected isochronous PDU 533 in the subevent 3 513, and the first peripheral device may transmit a connected isochronous PDU 534 in the subevent 4 514. Each of the connected isochronous PDU 531, the connected isochronous PDU 532, the connected isochronous PDU 533, and the connected isochronous PDU 534 may be a connected isochronous PDU transmitted from the first peripheral device to the central device. T_IFS may represent time inter frame space and may indicate a time interval between consecutive packets on the same channel index. T_MSS may represent minimum subevent space, and may be, for example, 150 μs.

[0173] The central device may transmit a connected isochronous PDU 551 in the subevent 1 541, the central device may transmit a connected isochronous PDU 552 in the subevent 2 542, the central device may transmit a connected isochronous PDU 553 in the subevent 3 543, and the central device may transmit a connected isochronous PDU 554 in the subevent 4 544. Each of the connected isochronous PDU 551, the connected isochronous PDU 552, the connected isochronous PDU 553, and the connected isochronous PDU 554 may be a connected isochronous PDU transmitted from the central device to the peripheral device.

[0174] The second peripheral device may transmit a connected isochronous PDU 561 in the subevent 1 541, the second peripheral device may transmit a connected isochronous PDU 562 in the subevent 2 542, the second peripheral device may transmit a connected isochronous PDU 563 in the subevent 3 543, and the first peripheral device may transmit a connected isochronous PDU 564 in the subevent 4 564. Each of the connected isochronous PDU 561, the connected isochronous PDU 562, the connected isochronous PDU 563, and the connected isochronous PDU 564 may be a connected isochronous PDU transmitted from the second peripheral device to the central device.

[0175] In an audio sharing scheme, one or more audio packets may be provided to an infinite number of audio sink devices. To support the audio sharing scheme, a broadcast isochronous group (BIG) and a broadcast isochronous stream (BIS) have been proposed. In the audio sharing scheme, an isochronous broadcaster and a synchronized receiver may be required.

[0176] The BIS may be a logical transport used to transfer one or more isochronous data streams to all devices for the BIS within a range. The BIS may include one or more subevents for transmitting isochronous data packets. A subevent may include time durations in which at least one synchronized receiver may receive a broadcast isochronous PDU. The BIS may support transmission of a plurality of new isochronous data packets in every BIS event. There is no acknowledgment protocol for the BIS, so traffic is unidirectional from a broadcasting device.

[0177] The BIG may be generated by the isochronous broadcaster. The BIG may include one or more BISes. A plurality of BISes included in the BIG may have a common timing reference based on a broadcaster and may be synchronized in a time domain. For example, a left channel and a right channel of an audio stereo stream, received by separate devices, may need to be rendered simultaneously. The plurality of BISes included in the BIG may be scheduled sequentially or in an interleaved arrangement.

[0178] FIG. 6 is a diagram schematically illustrating configuration of BIG events and BIS events in a wireless communication network according to an embodiment.

[0179] Referring to FIG. 6, each of BIG events (e.g., a BIG event x 601, a BIG event x+1 603, and a BIG event x+2 603) may include two BIS events. For example, the BIG event x 601 may include a BIS1 event x 611 and a BIS2 event x 613, the BIG event x+1 603 may include a BIS 1 event x+1 621 and a BIS2 event x+ 1 623, and the BIG event x+2 605 may include a BIS 1 event x+2 631 and a BIS2 event x+2 633.

[0180] A BIG event may include one or more BIS PDUs. A link layer may transmit BIS PDUs only in BIG events. The link layer may transmit only BIS PDUs as part of the BIG event. Each BIG event may be divided into Num_BIS BIS events and a control subevent (if present). Each BIS event may be divided into NSE subevents. Each BIS event starts at a moment called BIS anchor point and ends after the last subevent of each BIS event. Each BIG event starts at a moment called BIG anchor point, and ends after one control subevent if there is the one control subevent, and otherwise, at the end of the last constituent BIS event.

[0181] BIG anchor points may be spaced regularly at ISO_Intervals. BIS anchor points for a BIS n of a BIG may be (n - 1) Y BIS_Spacing after the BIG anchor points, so may be also spaced regularly, ISO_Interval apart. BIS_Spacing may be time between start of subevents in adjacent BISes included in the BIG and also time between start of the first subevent of the last BIS and a control subevent, if present. Subevents of each BIS may be Sub_Interval apart. The Isochronous broadcaster may close each BIG event at least T_IPS before a BIG anchor point of the next BIG event.

[0182] In the BIS 1 event x 611, a broadcast isochronous PDU 641, a broadcast isochronous PDU 643, and a broadcast isochronous PDU 645 may be transmitted.

[0183] In the BIS2 event x 613, a broadcast isochronous PDU 651, a broadcast isochronous PDU 653, and a broadcast isochronous PDU 655 may be transmitted.

[0184] In the BIS 1 event x+1 621, a broadcast isochronous PDU 661, a broadcast isochronous PDU 663, and a broadcast isochronous PDU 665 may be transmitted.

[0185] In the BIS2 event x+1 623, a broadcast isochronous PDU 671, a broadcast isochronous PDU 673, and a broadcast isochronous PDU 675 may be transmitted.

[0186] In the BIS 1 event x+2 631, a broadcast isochronous PDU 681, a broadcast isochronous PDU 683, and a broadcast isochronous PDU 685 may be transmitted.

[0187] In the BIS2 event x+2 633, a broadcast isochronous PDU 691, a broadcast isochronous PDU 693, and a broadcast isochronous PDU 695 may be transmitted.

[0188] FIG. 7 is a flowchart schematically illustrating an operating method of an electronic device according to an embodiment.

[0189] Referring to FIG. 7, an electronic device (e.g., an electronic device 101 in FIG. 1, 2, or 4, 10, 11, 16, 17, 18, 20, 22, or 23) (e.g., a processor 120 in FIG. 1) may establish a common audio channel based on a set condition in operation 711. In an embodiment, the common audio channel may be a low energy audio service (LE audio service) link which may be commonly used by a plurality of electronic devices (e.g., an electronic device and at least one external electronic device). The LE audio service may be an audio service based on a BLE scheme. In an embodiment, the common audio channel may be a channel which may be used for a multi-party audio service based on the BLE scheme. In an embodiment, the common audio channel may be commonly used by the electronic device and the at least one external electronic device. In an embodiment, the common audio channel may be based on the BLE scheme. In an embodiment, the common audio channel may be provided via a connection-based CIS or a non-connection-based BIS.

[0190] In an embodiment, the set condition may include at least one of a condition for receiving a packet (e.g., an audio channel generation request packet) requesting to generate the common audio channel from at least one of the at least one external electronic device (e.g., a first external electronic device (e.g., an electronic device 102 in FIG. 1, or a first external electronic device 200 in FIG. 2, 4, 10, 11, 16, 17, 19, 20, or 21), a second external electronic device (e.g., an electronic device 104 in FIG. 1, or a second external electronic device 300 in FIG. 3, 4, 16, or 17), a third external electronic device (e.g., a third external electronic device 1001 in FIG. 10, 16, 17, or 21), a fourth external electronic device (e.g., a fourth external electronic device 1003 in FIG. 10, 16, or 21), or a fifth external electronic device (e.g., a fifth external electronic device 1005 in FIG. 10)), a condition for identifying a user input requesting to generate the common audio channel, a condition for identifying that a set application is executed, or a condition for identifying that the electronic device enters a set area. The set condition will be described below with reference to FIG. 11, so a detailed description thereof will be omitted herein. In an embodiment, the electronic device may determine at least one of an audio transmission service type, a physical link type, an access address, a channel map, audio transmission service parameters, or an audio data transmission/reception timing, and generate the common audio channel based on the determined at least one of the audio transmission service type, the physical link type, the access address, the channel map, the audio transmission service parameters, or the audio data transmission/reception timing. The audio transmission service type, the physical link type, the access address, the channel map, the audio transmission service parameters, or the audio data transmission/-reception timing will be described below with reference to FIG. 11, so a detailed description thereof will be omitted herein.

[0191] When establishing the common audio channel based on the set condition, the electronic device may share, with the at least one external electronic device via at least one communication circuit (e.g., a communication module 190 in FIG. 1), information about the common audio channel and time information used for synchronization for the common audio channel in operation 713. In an embodiment, as the electronic device shares, with the at least one external electronic device, the information about the common audio channel and the time information used for synchronization for the common audio channel, the at least one external electronic device may receive BIS audio data. In an embodiment, the time information used for synchronization for the common audio channel may include link information including a transmission order of BIS audio data and/or information about a timing at which transmission of the BIS audio data starts. In an embodiment, the electronic device may share, with the at least one external electronic device, the information about the common audio channel and the time information used for synchronization for the common audio channel by broadcasting, via the at least one communication circuit, the information about the common audio channel and the time information used for synchronization for the common audio channel in a period of periodic advertising. In an embodiment, the electronic device may share, with the at least one external electronic device, the information about the common audio channel and the time information used for synchronization for the common audio channel by transmitting, via the at least one communication circuit, the information about the common audio channel and the time information used for synchronization for the common audio channel in a communication link established between the electronic device and the at least one external electronic device. In an embodiment, the electronic device may share, with the at least one external electronic device, the information about the common audio channel and the time information used for synchronization for the common audio channel by transmitting, to a server connected to the electronic device and the at least one external electronic device via the at least one communication circuit, the information about the common audio channel and the time information used for synchronization for the common audio channel. An operation in which the electronic device shares, with the at least one external electronic device, the information about the common audio channel and the time information

used for synchronization for the common audio channel will be described below with reference to FIG. 11, so a detailed description thereof will be omitted herein.

[0192] In an embodiment, the electronic device may share information about a common audio channel and time information used for synchronization for the common audio channel (e.g., information about a common audio channel and time information used for synchronization for the common audio channel which are generated by a server) which are not directly generated by the electronic device.

[0193] In an embodiment, if the electronic device is an earbuds case, the earbuds case may share information about a common audio channel and time information used for synchronization for the common audio channel which are obtained from the electronic device connected to the earbuds case.

[0194] The electronic device, which shares, with the at least one external electronic device, the information about the common audio channel and the time information used for synchronization for the common audio channel, may operate in a reception mode in which the electronic device is capable of receiving audio data from the at least one external electronic device for the common audio channel in operation 715.

[0195] A reception mode and a transmission mode according to an embodiment may be described as follows.

[0196] For an electronic device which performs a low energy audio service (LE audio service), a time duration for transmitting data (e.g., audio data) or a time duration for receiving data (e.g., audio data) is determined. For example, for a CIS, one subevent may include a time duration from a central device to a peripheral device (C->P) + time inter frame spacing (T_IFS) + a time duration from the peripheral device to the central device (P->C) + T_MSS. T_MSS may represent a minimum subevent space. For a BIS, one subevent may include a transmission time duration for which audio data is transmitted from a BIS source device (e.g., a device performing a BIS source role) + T_MSS.

[0197] Alternatively, electronic devices participating in the common audio channel may freely operate in either the transmission mode or the reception mode for corresponding time durations according to states of the electronic devices without time duration fixed for transmission or reception.

[0198] In an embodiment, the transmission mode may be a mode in which an electronic device participating in a common audio channel identifies that there is data (e.g., audio data) to be transmitted to external electronic devices (e.g., external electronic devices around the electronic device), and transmits the identified data to the external electronic devices around the electronic device.

[0199] In an embodiment, the reception mode may be a mode in which the electronic device participating in the common audio channel does not have data to be transmitted to the external electronic devices (e.g., the external electronic devices around the electronic device), and receives data (e.g., audio data) transmitted from the external electronic devices around the electronic device.

[0200] In an embodiment, the reception mode may be a mode in which an electronic device may receive actual audio data from at least one external electronic device, or may monitor whether audio data is received from the at least one external electronic device, or may exist in a sleep state.

[0201] In an embodiment, the electronic device may operate in the reception mode by default after establishing the common audio channel. In an embodiment, the electronic device may operate in the reception mode for the common audio channel after establishing the common audio channel.

[0202] Although not separately illustrated in FIG. 7, the electronic device may identify that audio data to be transmitted exists while operating in the reception mode for the common audio channel.

[0203] When identifying that the audio data to be transmitted exists while operating in the reception mode for the common audio channel, the electronic device may switch from the reception mode to the transmission mode. In an embodiment, the transmission mode may be a mode in which the electronic device participating in the common audio channel may identify that there is data (e.g., audio data) to be transmitted to external electronic devices (e.g., external electronic devices around the electronic device), and transmit the identified data to the external electronic devices around the electronic device. In an embodiment, the transmission mode may be a mode in which the electronic device may transmit audio data. The electronic device may transmit the audio data on the common audio channel via at least one communication circuit in the transmission mode. In an embodiment, if the electronic device generates the common audio channel and the earbuds are connected to the electronic device, the electronic device and the earbuds may transmit audio data for the same utterance at the same time. In an embodiment, if the electronic device generates the common audio channel and the earbuds are connected to the electronic device, the electronic device may not transmit the audio data for the same utterance, and only the earbuds may transmit the audio data for the same utterance.

[0204] Although not separately illustrated in FIG. 7, the electronic device, which transmits the audio data in the transmission mode, may switch back to the reception mode for the common audio channel based on the completion of transmission of the audio data.

[0205] FIG. 8 is a flowchart schematically illustrating an operating method of a first external electronic device according to an embodiment.

[0206] Before describing FIG. 8, the operating method of the first external electronic device (e.g., an electronic device 102 in FIG. 1, or a first external electronic device 200 in FIG. 2, 4, 10, 11, 16, 17, 19, 20, or 21) (e.g., a processor 120 in FIG.

1) illustrated in FIG. 8 may be an operating method in a case that the first external electronic device does not transmit, to an electronic device (e.g., an electronic device 101 in FIG. 1, 2, 4, 10, 11, 16, 17, 18, 20, 22, or 23), a packet (e.g., a common audio channel generation request packet) requesting to generate a common audio channel, and obtains, from the electronic device, information about the common audio channel and time information used for synchronization for the common audio channel.

[0207] Referring to FIG. 8, in operation 811, the first external electronic device may receive the information about the common audio channel and the time information used for synchronization for the common audio channel from the electronic device via at least one communication circuit (e.g., a communication module 190 in FIG. 1). In an embodiment, the first external electronic device may receive, from the electronic device via the at least one communication circuit, the information about the common audio channel and the time information used for synchronization for the common audio channel in a periodic advertising interval. In an embodiment, the first external electronic device may receive, via the at least one communication circuit, the information about the common audio channel and the time information used for synchronization for the common audio channel in a communication link established between the electronic device and the first external electronic device. In an embodiment, the electronic device may receive, from a server connected to the electronic device and the first external electronic device via at least one communication circuit, the information about the common audio channel and the time information used for synchronization for the common audio channel. An operation in which the first electronic device shares, with the electronic device, the information about the common audio channel and the time information used for synchronization for the common audio channel will be described below with reference to FIG. 11, so a detailed description thereof will be omitted herein. In operation 811, a case that the common audio channel is generated based on a BIS has been described as an example, but the common audio channel may also be generated based on a CIS. For example, all of the BIS and the CIS may be the same in that a time duration for transmission is configured, but there may be one transmission occasion in a subevent in the BIS, and there may be a total of two transmission opportunities including a transmission occasion from a central device to a peripheral device (C->P) and a transmission occasion from the peripheral device to the central device (P->C) in the subevent in the CIS. In the case of BIS, audio data may be transmitted in a time duration configured in the subevent. In the case of CIS, it may be determined which of the two transmission opportunities existing in the subevent will be applied to the common audio channel, and the determined transmission opportunity may be applied to the common audio channel.

[0208] In FIG. 8, a case that the first external electronic device receives the information about the common audio channel and the time information used for synchronization for the common audio channel from the electronic device has been described as an example, however, the first external electronic device may receive the information about the common audio channel and the time information used for synchronization for the common audio channel from at least one of at least one other external electronic device (e.g., a second external electronic device (e.g., an electronic device 104 in FIG. 1, or a second external electronic device 300 in FIG. 3, 4, 16, or 17), a third external electronic device (e.g., a third external electronic device 1001 in FIG. 10, 16, 17, or 21), a fourth external electronic device (e.g., a fourth external electronic device 1003 in FIG. 10, 16, or 21), or a fifth external electronic device (e.g., a fifth external electronic device 1005 in FIG. 10)) or a server (e.g., a server 108 in FIG. 1) as well as the electronic device. When receiving the information about the common audio channel and the time information used for synchronization for the common audio channel from the electronic device, the first external electronic device may synchronize to the common audio channel (for example, may perform a synchronization operation on the common audio channel) based on the received information about the common audio channel and time information used for synchronization for the common audio channel in operation 813. In an embodiment, electronic devices which may commonly use the common audio channel may be electronic devices which have previously been authenticated as being capable of participating in the common audio channel via an authentication process. In an embodiment, the electronic devices which may commonly use the common audio channel may be electronic devices which satisfy a set condition. In an embodiment, the set condition may include a condition for being authenticated with set authentication information, a condition for using the same user account, and/or a condition for inputting the same QR code, the set condition may be implemented in various forms considering a security level for the common audio channel, and there may be no limitation on the set condition. According to an embodiment, there may be no separate limitation on electronic devices which may commonly use the common audio channel. For example, any electronic device may use the common audio channel as long as it may perform a synchronization operation for the common audio channel based on information about the common audio channel and time information used for synchronization for the common audio channel.

[0209] The first external electronic device, which performs the synchronization operation for the common audio channel based on the received information about the common audio channel and time information used for synchronization for the common audio channel, may operate in a reception mode in which the first external electronic device may receive audio data from the electronic device or at least one other electronic device for the common audio channel in operation 815. The transmission mode and the reception mode have been described in FIG. 7, so a detailed description thereof may be omitted herein. In an embodiment, the first external electronic device may, in the reception mode, actually receive audio data from the electronic device or the at least one other external electronic device, or monitor whether audio data is

received from the electronic device or the at least one other external electronic device, or may exist in a sleep state. In an embodiment, the first external electronic device may operate in the reception mode by default after synchronizing to the common audio channel. In an embodiment, the first external electronic device may perform a synchronization operation for the common audio channel and then operate in the reception mode for the common audio channel.

[0210] Although not separately illustrated in FIG. 8, the first external electronic device may identify that audio data to be transmitted exists while operating in the reception mode for the common audio channel.

[0211] After identifying that the audio data to be transmitted exists while operating in the reception mode for the common audio channel, the first external electronic device may switch from the reception mode to the transmission mode. The transmission mode may be a mode in which the first external electronic device may transmit audio data. The first external electronic device may transmit audio data on the common audio channel via the at least one communication circuit in the transmission mode.

[0212] Although not separately illustrated FIG. 8, the first external electronic device, which transmits the audio data in the transmission mode, may switch back to the reception mode for the common audio channel based on completion of the transmission of the audio data.

[0213] Although not separately illustrated FIG. 8, while operating in the reception mode for the common audio channel, the first external electronic device may receive audio data from the at least one of the electronic device or the at least one other external electronic device on the common audio channel via the at least one communication circuit.

[0214] In FIG. 8, the operation of the first external electronic device receiving the audio data from the at least one of the electronic device or the at least one other external electronic device may be performed before the operation of the first external electronic device transmitting the audio data to the at least one of the electronic device or the at least one other external electronic device. Alternatively, the operation of the first external electronic device transmitting the audio data to the at least one of the electronic device or the at least one other external electronic device may be performed before the operation of the first external electronic device receiving the audio data from the at least one of the electronic device or the at least one other external electronic device.

[0215] FIG. 9 is a flowchart schematically illustrating an operating method of a first external electronic device according to an embodiment.

[0216] Before describing FIG. 9, the operating method of the first external electronic device (e.g., an electronic device 102 in FIG. 1, or a first external electronic device 200 in FIG. 2, 4, 10, 11, 16, 17, 19, 20, or 21) (e.g., a processor 120 in FIG. 1) illustrated in FIG. 9 may be an operating method in a case that the first external electronic device transmits, to an electronic device (e.g., an electronic device 101 in FIG. 1, 2, 4, 10, 11, 16, 17, 18, 20, 22, or 23), a packet (e.g., a common audio channel generation request packet) requesting to generate a common audio channel, and obtains, from the electronic device, information about the common audio channel and time information used for synchronization for the common audio channel.

[0217] Referring to FIG. 9, in operation 911, the first external electronic device may transmit, to the electronic device, a packet (e.g., a common audio channel generation request packet) requesting to generate a common audio channel via at least one communication circuit (e.g., a communication module 190 in FIG. 1). In FIG. 9, the case in which the first external electronic device transmits, to the electronic device, the packet requesting to generate the common audio channel has been described as an example, however, the first external electronic device may transmit the packet requesting to generate the common audio channel to at least one of at least one other external electronic device (e.g., a second external electronic device (e.g., an electronic device 104 in FIG. 1, or a second external electronic device 300 in FIG. 3, 4, 16, or 17), a third external electronic device (e.g., a third external electronic device 1001 in FIG. 10, 16, 17, or 21), a fourth external electronic device (e.g., a fourth external electronic device 1003 in FIG. 10, 16, or 21), or a fifth external electronic device (e.g., a fifth external electronic device 1005 in FIG. 10)) as well as the electronic device. In this case, an operation between the first external electronic device and the at least one of the at least one other external electronic device may be similar or substantially the same as an operation between the first external electronic device and the electronic device described in FIG. 9.

[0218] In an embodiment, a connection (e.g., a communication link) may be established between the first external electronic device and the electronic device. In an embodiment, the first external electronic device may transmit, to the electronic device, the packet requesting to generate the common audio channel based on a set condition. The set condition may include a condition for identifying a user input requesting to generate the common audio channel, a condition for identifying that a set application is executed, or a condition for identifying that the first external electronic device enters a set area. The set condition will be described in detail below with reference to FIG. 11, so a detailed description thereof will be omitted herein.

[0219] In FIG. 9, the case that the first external electronic device transmits, to the electronic device, the packet requesting to generate the common audio channel has been explained as an example, however, if the electronic device is an earbuds case, the earbuds case may generate the common audio channel when a set operation (or a user input) (e.g., an operation of opening the earbud case and touching the left earbud and the right earbud a set number of times (e.g., 3 times)) is identified even though the first external electronic device does not receive the packet requesting to generate the

common audio channel from the first external electronic device (e.g., a left earbud and a right earbud). In this case, the earbud case may share information about the generated common audio channel and time information used for synchronization for the common audio channel with the left earbud and the right earbud via a PA operation (e.g., via a PLC or wirelessly).

[0220] The first external electronic device, which transmits the packet requesting to generate the common audio channel to the electronic device, may receive the information about the common audio channel and the time information used for synchronization for the common audio channel from the electronic device via the at least one communication circuit in operation 913. In an embodiment, the first external electronic device may receive, from the electronic device via the at least one communication circuit, the information about the common audio channel and the time information used for synchronization for the common audio channel in a periodic advertising interval. In an embodiment, the first external electronic device may receive, via the at least one communication circuit, the information about the common audio channel and the time information used for synchronization for the common audio channel in a communication link established between the electronic device and the first external electronic device. In an embodiment, the first external electronic device may receive, from a server connected to the electronic device and the first external electronic device via at least one communication circuit, the information about the common audio channel and the time information used for synchronization for the common audio channel. An operation in which the first electronic device shares, with the electronic device, the information about the common audio channel and the time information used for synchronization for the common audio channel will be described below with reference to FIG. 11, so a detailed description thereof will be omitted herein.

[0221] The first external electronic device, which receives the information about the common audio channel and the time information used for synchronization for the common audio channel from the electronic device, may be synchronized to the common audio channel based on the received information about the common audio channel and time information used for synchronization for the common audio channel in operation 915.

[0222] The first external electronic device, which is synchronized to the common audio channel based on the received information about the common audio channel and time information used for synchronization for the common audio channel, may operate in a reception mode in which the first external electronic device may receive audio data from the electronic device or at least one other electronic device for the common audio channel in operation 917. The transmission mode and the reception mode have been described in FIG. 7, so a detailed description thereof may be omitted herein. In an embodiment, the first external electronic device may, in the reception mode, actually receive audio data from the electronic device or the at least one other external electronic device, or monitor whether audio data is received from the electronic device or the at least one other external electronic device, or may exist in a sleep state. In an embodiment, the first external electronic device may operate in the reception mode by default after synchronizing to the common audio channel. In an embodiment, the first external electronic device may perform a synchronization operation for the common audio channel and then operate in the reception mode for the common audio channel.

[0223] Although not separately illustrated in FIG. 9, the first external electronic device may identify that audio data to be transmitted exists while operating in the reception mode for the common audio channel.

[0224] The first external electronic device, which identifies that the audio data to be transmitted exists while operating in the reception mode for the common audio channel, may switch from the reception mode to the transmission mode. The transmission mode may be a mode in which the first external electronic device may transmit audio data. The first external electronic device may transmit audio data on the common audio channel via the at least one communication circuit in the transmission mode.

[0225] Although not separately illustrated FIG. 9, the first external electronic device, which transmits the audio data in the transmission mode, may switch back to the reception mode for the common audio channel based on completion of the transmission of the audio data.

[0226] Although not separately illustrated FIG. 9, while operating in the reception mode for the common audio channel, the first external electronic device may receive audio data from the at least one of the electronic device or the at least one other external electronic device on the common audio channel via the at least one communication circuit.

[0227] In FIG. 9, the operation of the first external electronic device receiving the audio data from the at least one of the electronic device or the at least one other external electronic device may be performed before the operation of the first external electronic device transmitting the audio data to the at least one of the electronic device or the at least one other external electronic device. Alternatively, the operation of the first external electronic device transmitting the audio data to the at least one of the electronic device or the at least one other external electronic device may be performed before the operation of the first external electronic device receiving the audio data from the at least one of the electronic device or the at least one other external electronic device.

[0228] FIG. 10 is a diagram schematically illustrating connections between electronic devices which are based on a Bluetooth scheme in a wireless communication network according to an embodiment.

[0229] Referring to FIG. 10, a plurality of electronic devices may participate in a multi-party audio service. The plurality of electronic devices participating in the multi-party audio service may include an electronic device 101 (e.g., an electronic device 101 in FIG 1, 2, 4, 11, 16, 17, 18, 20, 22, or 23), a first external electronic device 200 (e.g., an electronic device 102 in

FIG. 1, or a first external electronic device 200 in FIG. 2, 4, 11, 16, 17, 19, 20, or 21), a second external electronic device 300 (e.g., an electronic device 104 in FIG. 1, or a second external electronic device 300 in FIG. 3, 4, 16, or 17), a third external electronic device 1001 (e.g., a third external electronic device 1001 in FIG. 16, 17, or 21), a fourth external electronic device 1003 (e.g., a fourth external electronic device 1003 in FIG. 16 or 21), and/or a fifth external electronic device 1005.

[0230] In an embodiment, the electronic device 101 may be a smartphone. The first external electronic device 200 may be an ear-wearable device, and the first external electronic device 200 may include a first earbud 202 (e.g., a left earbud) and/or a second earbud 204 (e.g., a light earbud). The first earbud 202 may perform a first audio channel (e.g., a left audio channel) role, and the second earbud 204 may perform a second audio channel (e.g., a right audio channel) role. In an embodiment, at least one of the third external electronic device 1001, the fourth external electronic device 1003, and/or the fifth external electronic device 1005 may be another ear-wearable device. In an embodiment, the at least one of the third external electronic device 1001, the fourth external electronic device 1003, and/or the fifth external electronic device 1005 may be another smartphone. In an embodiment, the at least one of the third external electronic device 1001, the fourth external electronic device 1003, and/or the fifth external electronic device 1005 may be a smart watch. In an embodiment, the at least one of the third external electronic device 1001, the fourth external electronic device 1003, and/or the fifth external electronic device 1005 may be an earbuds case.

[0231] In the multi-party audio service, at least one of the electronic device 101, the first external electronic device 200, the second external electronic device 300, the third external electronic device 1001, the fourth external electronic device 1003, and/or the fifth external electronic device 1005 may be an electronic device performing a BIS source role.

[0232] In the multi-party audio service, the at least one of the electronic device 101, the first external electronic device 200, the second external electronic device 300, the third external electronic device 1001, the fourth external electronic device 1003, and/or the fifth external electronic device 1005 may be an electronic device performing a BIS sink role.

[0233] In the multi-party audio service, the at least one of the electronic device 101, the first external electronic device 200, the second external electronic device 300, the third external electronic device 1001, the fourth external electronic device 1003, and/or the fifth external electronic device 1005 may be an electronic device performing a BIS assistant role. In an embodiment, the BIS assistant may perform an operation for searching for surrounding BIS sources. In an embodiment, if the corresponding electronic device is earbuds, the earbuds directly search for the surrounding BIS sources, and the earbuds directly output audio data, the earbuds may be an electronic device performing the BIS sink role along with the BIS assistant role.

[0234] The electronic device 101, the first external electronic device 200, the second external electronic device 300, the third external electronic device 1001, the fourth external electronic device 1003, and/or the fifth external electronic device 1005 may be electronic devices which have decided to participate in a common audio channel for the multi-party audio service. In an embodiment, a plurality of common audio channels may be generated, and the electronic device 101, the first external electronic device 200, the second external electronic device 300, the third external electronic device 1001, the fourth external electronic device 1003, and/or the fifth external electronic device 1005 may decide to participate in the plurality of common audio channels. In an embodiment, if the plurality of common audio channels are generated, each of the plurality of common audio channels may be allocated to at least one group, and electronic devices included in the at least one group may participate in the multi-party audio service via the common audio channel allocated to the at least one group. In an embodiment, if the plurality of common audio channels are generated, at least one of the plurality of common audio channels may be allocated to the at least one group, and the electronic devices included in the at least one group may participate in the multi-party audio service via the at least one common audio channel allocated to the at least one group. In an embodiment, two or more common audio channels may be allocated per group, and in this case, electronic devices included in a group may participate in the multi-party audio service via two or more common audio channels allocated to the group, and the electronic devices included in the group may share the two or more common audio channels based on a set condition.

[0235] The electronic device 101, the first external electronic device 200, the second external electronic device 300, the third external electronic device 1001, the fourth external electronic device 1003, and/or the fifth external electronic device 1005 may be electronic devices which have been authenticated in advance as being capable of participating in a common audio channel via an authentication process. In an embodiment, the electronic devices capable of participating in the common audio channel may share a key (e.g., a broadcast code) applied to encryption for the common audio channel if the common audio channel is encrypted, and only electronic devices which share the key applied to the encryption for the common audio channel may participate in the common audio channel. In an embodiment, the electronic devices which may commonly use the common audio channel may be electronic devices which satisfy a set condition. In an embodiment, the set condition may include a condition for being authenticated with set authentication information, a condition for using the same user account, and/or a condition for inputting the same QR code, the set condition may be implemented in various forms considering a security level for the common audio channel, and there may be no limitation on the set condition. According to an embodiment, there may be no separate limitation on electronic devices which may commonly use the common audio channel. For example, any electronic device may use the common audio channel as long as it may perform a synchronization operation for the common audio channel based on information about the common audio channel and

time information used for synchronization for the common audio channel.

[0236] The electronic device 101, the first external electronic device 200, the second external electronic device 300, the third external electronic device 1001, the fourth external electronic device 1003, and/or the fifth external electronic device 1005 may use the common audio channel which uses the same access address. The common audio channel may be generated by any one of the electronic device 101, the first external electronic device 200, the second external electronic device 300, the third external electronic device 1001, the fourth external electronic device 1003, and/or the fifth external electronic device 1005. If the electronic device 101 generates the common audio channel, the electronic device 101 may share information about the generated common audio channel and time information used for synchronization for the common audio channel with the first external electronic device 200, the second external electronic device 300, the third external electronic device 1001, the fourth external electronic device 1003, and/or the fifth external electronic device 1005. In an embodiment, if the electronic device 101 shares the information about the generated common audio channel with external electronic devices around the electronic device 101 via periodic advertising, the time information used for synchronization for the common audio channel may include time difference from a time point at which a periodic advertising operation starts to a time point at which the common audio channel starts. In an embodiment, the information about the common audio channel may include BIGInfo included in an AUX_SYNC_IND PDU transmitted via advertising, and the time information used for synchronization for the common audio channel may include timing information included in the AUX_SYNC_IND PDU transmitted via the periodic advertising. The operation of the electronic device 101 sharing the information about the common audio channel and the time information used for synchronization for the common audio channel with the first external electronic device 200, the second external electronic device 300, the third external electronic device 1001, the fourth external electronic device 1003, and/or the fifth external electronic device 1005 will be described below with reference to FIG. 11, so a detailed description thereof will be omitted herein.

[0237] FIG. 11 is a diagram schematically illustrating an operation in which an electronic device establishes a common audio channel in a wireless communication network according to an embodiment.

[0238] Referring to FIG. 11, a structure of a wireless communication network may be implemented similarly to a structure of a wireless communication network described in FIG. 10, so a detailed description thereof will be omitted.

[0239] An electronic device 101 (e.g., an electronic device 101 in FIG. 1, 4, 10, 16, 17, 18, 20, 22, or 23) may identify a first external electronic device 200 (e.g., an electronic device 102 in FIG. 1, or a first external electronic device 200 in FIG. 2, 4, 10, 16, 17, 18, 20, or 21) based on a BLE scheme.

[0240] The first external electronic device 200 (e.g., a first earbud 202 and/or a second earbud 204 in FIG. 2) may transmit a BLE advertising (BLE ADV) signal (e.g., a BLE ADV packet) in a multicast scheme or a broadcast scheme. According to an embodiment, the BLE ADV packet may be a packet for transmitting information related to a connection or an account (e.g., pairing) to unspecified neighbor electronic devices (e.g., the electronic device 101). For example, the first external electronic device 200 may be stored in an earbuds case device (not illustrated in FIG. 11) (e.g., an earbuds case device 206 in FIG. 2). The earbuds case device may be a device which stores and charges the first external electronic device 200. In FIG. 11, it will be assumed that the first external electronic device 200 is stored in an earbuds case for convenience of a description.

[0241] In an embodiment, the first external electronic device 200 may start transmitting a BLE ADV packet if the earbuds case is opened in a state that the first external electronic device 200 is stored in the earbuds case. In an embodiment, while the first external electronic device 200 is stored in the earbuds case, if a button equipped in the earbuds case is inputted, the first external electronic device 200 may start transmitting the BLE ADV packet. In an embodiment, the first external electronic device 200 may start periodically transmitting the BLE ADV packet. A period at which the BLE ADV packet is transmitted may be variable as needed. The first external electronic device 200 may transmit the BLE ADV packet based on a set period. In an embodiment, the BLE ADV packet may include at least one of identification information of the first external electronic device 200, user account information of the first external electronic device 200, information about an electronic device with which the first external electronic device 200 is currently paired, information about an electronic device which has performed a pairing process with the first external electronic device 200, information about electronic devices which may be paired at the same time, transmission power, a sensing area, information about a remaining battery level of the first external electronic device 200, and/or audio channel role information. In an embodiment, an audio channel role may be a first audio channel (e.g., a left audio channel) role and/or a first audio channel (e.g., a right audio channel) role.

[0242] FIG. 12 is a diagram schematically illustrating a format of a BLE ADV packet in a wireless communication network according to an embodiment.

[0243] Referring to FIG. 12, a BLE ADV packet 1200 may include a preamble field 1202, an advertising access address field 1204, a packet data unit (PDU) field 1206, and a cyclic redundancy check (CRC) field 1208.

[0244] In FIG. 12, it will be assumed that the BLE ADV packet 1200 is transmitted by a first external electronic device (e.g., an electronic device 102 in FIG. 1, or a first external electronic device 200 in FIG. 2, 4, 10, 11, 16, 17, 19, 20, or 21). In an embodiment, the preamble field 1202 may include information used for an electronic device (e.g., an electronic device 101 in FIG. 1, 2, 4, 10, 11, 16, 17, 18, 20, 22, or 23) which receives the BLE ADV packet 1200 to perform frequency

synchronization and/or symbol timing estimation. For example, the preamble field 1202 may be implemented with one byte. In an embodiment, the preamble field 1202 may include a fixed sequence of one byte in length consisting of alternating a bit value 0 and a bit value 1 based on address information included in the advertising access address field 1204. For example, the preamble field 1202 may include "10101010" if the address information included in the advertising access address field 1204 starts with 1. As another example, the preamble field 1202 may include "01010101" if the address information included in the advertising access address field 1204 starts with 0.

[0245] In an embodiment, the advertising access address field 1204 may include address information related to the BLE ADV packet 1200. For example, the advertising access address field 1204 may be implemented with 4 bytes.

[0246] In an embodiment, the PDU field 1206 may have a variable length from a minimum of 2 bytes to a maximum of 39 bytes. The PDU field 1206 may include a header field 1210 and a payload field 1212.

[0247] In an embodiment, the header field 1210 may include information indicating a type and length of data included in the payload field 1212. In an embodiment, the header field 1210 may include information indicating that a type of the data included in the payload field 1212 is advertising data. For example, the header field 1210 may be implemented with 2 bytes.

[0248] In an embodiment, the payload field 1212 may have a variable length of 37 bytes or less, and include an advertising address (AdvA) field 1214 and an advertising data (AdvData) field 1216.

[0249] In an embodiment, the AdvA field 1214 may include an address 1218 of a first external electronic device which transmits the BLE ADV packet 1200. In an embodiment, the address 1218 of the electronic device may be a medium access control (MAC) address of the first external electronic device. In an embodiment, the address 1218 of the first external electronic device may be a resolvable private address (RPA). The RPA may be implemented with 48 bits. For example, the RPA may be divided into a first part (e.g., prand which is a 24-bit random part) and a second part (e.g., hash which is a 24-bit hash part). A least significant octet of the PRA may be a least significant octet of the hash, and a most significant octet of the PRA may be a most significant octet of the prand.

[0250] In an embodiment, the AdvData field 1216 may include advertising data 1220 of up to 31 bytes. In an embodiment, the AdvData field 1216 may include at least one of identification information of the first external electronic device, user account information of the first external electronic device, information about an electronic device with which the first external electronic device is currently paired, information about an electronic device which has performed a pairing process with the first external electronic device, information about electronic devices with which the first external electronic device may be paired at the same time, transmission power, a sensing area, information about remaining battery amount of the first external electronic device, or audio channel role information. In an embodiment, an audio channel role of the first external electronic device may be a first audio channel (e.g., a left audio channel) role and/or a second audio channel (e.g., a right audio channel) role.

[0251] In an embodiment, the AdvData field 1216 may include one or two or more advertising data (AD) elements. The one or two or more AD elements may be, for example, N AD elements including an AD_0 element 1222 to an AD_N element 1226.

[0252] In an embodiment, each of the one or two or more AD elements may include a length field, a type field, and an AD data field. FIG. 12 illustrates a length field 1228, a type field 1230, and an AD data field 1232 included in the AD_0 element 1222. Although not shown in FIG. 12, the ADrr element 1226 may include a length field, a type field, and an AD data field, like the AD_0 element 1222.

[0253] In an embodiment, the length field 1228 may include length information of the AD data field 1232, and the type field 1230 may include type information of data included in the AD data field 1232. In an embodiment, the type field 1232 may include information indicating one of data types as shown in Table 1 below.

<Table 1>

Data type	Description
Universally unique identifier (UUID)	Identifier information of a service provided by an electronic device
Manufacturer specific data	May include at least one of data defined by manufacturer of an electronic device or data set by an electronic device.
Transmit power level	Information about a transmit power level used for an electronic device to transmit a BLE ADV packet
Slave connection interval range	Connection interval range to be used by an external electronic device receiving a BLE ADV packet
Service solicitation	Information about one or two or more services for receiving through an external electronic device, and it is used for inviting the external electronic device for connection.

(continued)

Data type	Description
Service data	Data associated with a service provided by an electronic device (may include a service UUID)
Uniform resource identifier (URI)	URI associated with a service provided by an electronic device

[0254] In an embodiment, the CRC field 1208 may include information used for an electronic device to detect an error for a received BLE ADV packet. For example, the CRC field 1208 may be implemented with 3 bytes.

[0255] Referring back to FIG. 11, the first external electronic device 200 may transmit a BLE ADV packet based on a set condition. In an embodiment, the set condition may include at least one of a condition in which power is supplied to the first external electronic device 200, a condition in which a set period is reached, or a user input. The electronic device 101 may perform a BLE scan operation in a set scan period.

[0256] As the BLE scan operation is performed, the electronic device 101 may receive at least one BLE ADV packet from among BLE ADV packets transmitted from the first external electronic device 200. The electronic device 101 receiving the BLE ADV packet may display a user interface (UI) via a display module (e.g., a display module 160 in FIG. 1). The electronic device 101 may display the UI via the display module based on information included in the received BLE ADV packet and the set condition. In an embodiment, the UI may include an image corresponding to the first external electronic device 200. In an embodiment, the UI may include device recognition information, and the device recognition information may be information generated according to a result of the electronic device 101 recognizing the first external electronic device 200. For example, the electronic device 101 may recognize that the first external electronic device 200 is Samsung Galaxy buds, and may generate information related to the Samsung Galaxy buds as the device recognition information. The generated device recognition information may be included in the UI, and the UI including the device recognition information may be displayed via the display module. An example of the UI displayed via the display module of the electronic device 101 may be as shown in FIG. 13.

[0257] FIG. 13 is a diagram schematically illustrating a UI displayed on an electronic device in a case that the electronic device receives a BLE ADV packet in a wireless communication network according to an embodiment.

[0258] Referring to FIG. 13, when receiving a BLE ADV packet from a first external electronic device (e.g., an electronic device 102 in FIG. 1, or a first external electronic device 200 in FIG. 2, 4, 10, 11, 16, 17, 19, 20, or 21), an electronic device (e.g., an electronic device 101 in FIG. 1, 2, 4, 10, 11, 16, 17, 18, 20, 22, or 23) may display a UI via a display module (e.g., a display module 160 in FIG. 1). The electronic device may display the UI via the display module based on information included in the received BLE ADV packet and a set condition. In an embodiment, the UI may include device recognition information, and the device recognition information may be information generated according to a result of the electronic device recognizing the first external electronic device. For example, the electronic device may recognize that the first external electronic device is Samsung Galaxy buds, and may generate information related to the Samsung Galaxy buds as the device recognition information. In an embodiment, the device recognition information may indicate whether the electronic device has been previously paired with the first external electronic device, or may be generated based on a user account of the first external electronic device.

[0259] For example, the electronic device may recognize the first external electronic device by receiving the BLE ADV packet from the first external electronic device, and output the UI for informing a user of the recognized first external electronic device via the display of the electronic device. In an embodiment, the UI may include at least one of an image 1300 representing a shape of the first external electronic device (e.g., a first earbud 202 and/or a second earbud 204 in FIG. 2) or a text representing a device name (e.g., My Galaxy Buds) of the first external electronic device. In an embodiment, the UI may further include an image 1310 indicating a battery state of the first external electronic device.

[0260] Referring back to FIG. 11, the electronic device 101 receiving the BLE ADV packet may generate a scan request (SCAN_REQ) packet based on information included in the BLE ADV packet, and transmit the generated SCAN_REQ packet to the first external electronic device 200. Upon receiving the SCAN_REQ packet from the electronic device 101, the first external electronic device 200 may generate a scan response (SCAN_RSP) packet as a response packet to the SCAN_REQ packet based on information included in the SCAN_REQ packet, and transmit the generated SCAN_RSP packet to the electronic device 101.

[0261] When receiving the SCAN_RSP packet from the first external electronic device 200, the electronic device 101 may determine whether it is required to establish a connection with the first external electronic device 200 based on information included in the SCAN_RSP packet. When determining that it is required to establish the connection with the first external electronic device 200, the electronic device 101 may transmit, to the first external electronic device 200, a connection indication (CONNECT_IND) packet requesting to establish a connection. In an embodiment, the CONNECT_IND packet may include at least one of an access address (AA), a coding indicator (CI), a transmit window offset, and/or

a transmit window of the electronic device 101. FIG. 11 illustrates a case in which the electronic device 101 performs a BLE scan operation based on an active scan scheme, and if the electronic device 101 performs a passive scan operation, the operation of exchanging the SCAN_REQ packet and the SCAN_RSP packet performed between the electronic device 101 and the first external electronic device 200 may be omitted.

[0262] When receiving the CONNECT_IND packet from the electronic device 101, the first external electronic device 200 may determine whether to establish a connection with the electronic device 101 based on information included in the CONNECT_IND packet. When determining to establish the connection with the electronic device 101, the first external electronic device 200 may establish the connection (e.g., a first communication link) with the electronic device 101 (operation 1111). In an embodiment, the electronic device 101 which transmits the CONNECT_IND packet may operate as a central, and the first external electronic device 200 which receives the CONNECT_IND packet may operate as a peripheral.

[0263] In operation 1111, as the first communication link is established between the electronic device 101 and the first external electronic device 200, the electronic device 101 and the first external electronic device 200 may exchange (for example, transmit and/or receive) data (e.g., control data and/or a control message) via the first communication link. In an embodiment, the control data and/or the control message may include data required to generate a common audio channel for a multi-party audio service. In an embodiment, the multi-party audio service may include an audio service in which at least two electronic devices (e.g., the electronic device 101 and the first external electronic device 200) participate. In an embodiment, the common audio channel used in the multi-party audio service may include a channel which shares the same access code. In an embodiment, a case in which the common audio channel is implemented as a BIS will be described as an example, but of course, the common audio channel may be also implemented as a CIS as well as the BIS. For example, at least two electronic devices participating in the multi-party audio service via the common audio channel implemented as the BIS or the CIS may exchange audio data by sharing the same access code.

[0264] In operation 1113, the first external electronic device 200 may transmit, to the electronic device 101, a packet (e.g., a common audio channel generation request packet) requesting to generate a common audio channel via the first communication link based on a set condition. In an embodiment, the common audio channel generation request packet may include information requesting to generate the common audio channel, and there may be no limitation on a format thereof. In an embodiment, the set condition may include a user input requesting to generate the common audio channel for the multi-party audio service, execution of a set application, and/or entry into a set area. In an embodiment, the user input may include a set physical user interface (PUI), and/or voice command. In an embodiment, the set application may include a dedicated application for the multi-party audio service. In an embodiment, the set area may include an area where the multi-party audio service is performed. In an embodiment, the set area may include a conference room, and/or a classroom. In an embodiment, the set area may be set based on a signal or input (e.g., user input) obtained by the first external electronic device 200, and there may be no limitation on a condition under which the area in which the multi-party audio service may be performed is set. In an embodiment, the first external electronic device 200 may identify the area where the multi-party audio service may be performed based on a condition in which various parameters may be considered.

[0265] The electronic device 101, which receives the common audio channel generation request packet from the first external electronic device 200, may generate the common audio channel in operation 1115. In an embodiment, an operation in which the electronic device 101 generates the common audio channel will be described in detail as follows.

(1) The electronic device 101 may determine an audio transmission service type to be applied to the common audio channel. The audio transmission service type may include a low energy (LE) audio service type, an ACL type, and/or an advertising type. In an embodiment, the LE audio service type may include a BIS type and/or a CIS type.

(2) The electronic device 101 may determine a physical link type to be applied to the common audio channel. In an embodiment, the physical link type may include a physical link type to be used when transmitting audio data on the common audio channel. In an embodiment, the physical link type may include an uncoded type, a coded type, a physical link type for a high-speed transmission, and/or a physical link type for which variable operation is possible. The uncoded type may include 1M LE PHY and/or 2M LE PHY, and the coded type may include an S=2 coded type and/or an S=8 coded type.

(3) The electronic device 101 may determine an access address to be applied to the common audio channel. In an embodiment, a unique access address may be determined per common audio channel. In an embodiment, the access address may be a 32-bit value, and may be generated based on a set rule, and a corresponding access address may be uniquely determined whenever the common audio channel is generated.

(4) The electronic device 101 may determine a channel map to be applied to the common audio channel. In an embodiment, if a surrounding environment of the electronic device 101 is a noisy environment, the electronic device 101 may determine a channel map so that only the minimum number of physical channels may be used. In an embodiment, the noisy environment may be an environment in which noise whose noise level is greater than or equal to a set noise level is measured. If the surrounding environment of the electronic device 101 is a clean environment, a

channel map may be determined so that all physical channels may be used. In an embodiment, the clean environment may be an environment in which noise whose noise level is less than the set noise level is measured.

(5) The electronic device 101 may determine audio transmission service parameters to be applied to the common audio channel. In an embodiment, the audio transmission service parameter may be determined based on an audio transmission service type to be applied to the common audio channel.

[0266] First, if the audio transmission service type to be applied to the common audio channel is a BIS type, the audio transmission service parameters may include BIS attribute information corresponding to the BIS type. In an embodiment, the BIS attribute information may include Num_BIS, ISO_Interval, BIS_Spacing, Sub_Interval, Max_PDU, Max_SDU, MPT, BN, PTO, IRC, NSE, Framed, and/or Encrypted.

- Num_BIS may indicate the number of BISes included in a BIG. A total of Num_BIS BIS_Numbers from 1 to Num_BIS may be uniquely allocated to the BISes included in the BIG.
- ISO_Interval may indicate a time interval in units of 1.25ms between two adjacent BIG anchor points. ISO_Interval may be set to any value between 4 and 3200. For example, if a value of ISO_Interval is set to "4", the time interval between the two adjacent BIG anchor points may be 5ms, and if the value of ISO_Interval is set to "3200", the time interval between the two adjacent BIG anchor points may be 4s.
- BIS_Spacing may indicate time between start time points of corresponding subevents in adjacent BISes in the BIG, and/or time between a start time point of the first subevent of the last BIS and a start time point of a control subevent, if present.
- Sub_Interval may indicate time between start time points of two consecutive subevents of each BIS.
- Max_PDU may indicate the maximum number of data octets (excluding message integrity check (MIC)) which may be transmitted in each BIS data PDU in the BIG. A value of Max_PDU may be a value between 1 and 251.
- Max_SDU may indicate a maximum size of a service data unit (SDU) on the BIG. A value of Max_SDU may be a value between 1 and 4095 octets.
- MPT may be equal to time taken to transmit a packet including a BIS Data PDU with a payload of Max_PDU octets on a PHY being used for a BIS, and on an LE Coded PHY, S=8 coding may be assumed.
- Burst Number (BN), Pre-Transmission Offset (PTO), and Immediate Repetition Count (IRC) may control which data is transmitted in each BIG event. A value of BN may be a value between 1 and 7, a value of PTO may be a value between 0 and 15, and a value of IRC may be a value between 1 and 15.
- NSE may indicate the number of subevents per BIS in each BIG event. A value of NSE may be a value between 1 and 31 and may be an integer multiple of BN.
- Framed may indicate whether the BIG carries framed data or unframed data.
- Encrypted may indicate whether the BIG is encrypted.

[0267] Second, if the audio transmission service type to be applied to the common audio channel is a CIS type, the audio transmission service parameters may include CIS attribute information corresponding to the CIS type. In an embodiment, the CIS attribute information may include ISO_Interval, Sub_Interval, SE_Length, Max_PDU, Max_SDU, MTP_C, MTP_P, NSE, BN, FT, Framed, and/or Encrypted.

- ISO_Interval may indicate time between CIS anchor points of adjacent CIS events.
- Sub_Interval may indicate time between start time points of two consecutive subevents of a CIS.
- SE_Length may indicate maximum length of a subevent.
- Max_PDU may indicate the maximum number of data bytes which may be carried in each CIS data PDU, and a value of Max_PDU may be different in each direction.
- Max_SDU may indicate a maximum size of an SDU on the corresponding CIS, and a value of Max_SDU may be different in each direction.
- MPT_C and MPT_P may be equal to time taken to transmit a packet including a CIS PDU with a payload of Max_PDU octets (for that direction) on a PHY being used for the CIS, and on an LE Coded PHY, S=8 coding may be assumed. A value of MPT_C and a value of MPT_P may include an MIC if it is possible that the CIS will be encrypted.
- NSE may indicate the maximum number of subevents per CIS event.
- BN and FT may control which data is transmitted in each CIS event, and a value of BN and a value of FT may be different in each direction.
- Framed may indicate whether the CIS carries framed, and the value of Framed may be the same in both directions.

[0268] Third, if the audio transmission service type to be applied to the common audio channel is an ACL type, the audio transmission service parameters may include ACL attribute information corresponding to the ACL type. In an embodiment, the ACL attribute information may include Connection Interval, Peripheral Latency, and/or Subrate Factor.

- Connection Interval
- Peripheral Latency
- Subrate Factor

[0269] Fourth, if the audio transmission service type to be applied to the common audio channel is an advertising type, the audio transmission service parameters may include advertising attribute information corresponding to the advertising type. In an embodiment, the advertising attribute information may include Advertising Interval, Advertising type, and/or Advertising Channel.

- Advertising Interval
- Advertising type
- Advertising Channel

[0270] (6) The electronic device 101 may determine audio data transmission/reception timing to be applied to the common audio channel. In an embodiment, the audio data transmission/reception timing may include timing at which audio data may be transmitted and/or timing at which audio data may be received on the common audio channel.

[0271] In operation 1115, the electronic device 101 may generate the common audio channel based on the determined audio transmission service type to be applied to the common audio channel, the determined physical link type to be used for the audio data transmission, the determined access address to be applied to the common audio channel, the determined channel map to be applied to the common audio channel, the determined audio transmission service parameters, and/or the audio data transmission/reception timing. For example, information about the common audio channel generated by the electronic device 101 may include PHY 2M LE, Type BIS, Access Address Code 0x19790206, Channel Map 0x1088472554, Num_BIS 1, ISO_Interval 30ms, BIS_Spacing 0, Sub_Interval 594μs, Max_PDU 100byte, Max_SDU 100byte, MTP 444 μs, BN 3, PTO 0, IRC 2, NSE 6, Unframed, and/or Unencrypted.

[0272] FIG. 14 is a diagram schematically illustrating a common audio channel generated by an electronic device in a wireless communication network according to an embodiment.

[0273] Referring to FIG. 14, if it is required to generate a common audio channel, an electronic device (e.g., an electronic device 101 in FIG. 1, 2, 4, 10, 11, 16, 17, 18, 20, 22, or 23) may determine an audio transmission service type to be applied to a common audio channel, a physical link type to be used for audio data transmission, an access address to be applied to the common audio channel, a channel map to be applied to the common audio channel, audio transmission service parameters, and/or audio data transmission/reception timing. An operation in which the electronic device determines the audio transmission service type to be applied to the common audio channel, the physical link type to be used for audio data transmission, the access address to be applied to the common audio channel, the channel map to be applied to the common audio channel, the audio transmission service parameters, and/or the audio data transmission/reception timing may be similar or substantially the same as an operation of generating a common audio channel in operation 1115 in FIG. 11, so a detailed description thereof will be omitted herein.

[0274] The electronic device may generate the common audio channel based on the determined audio transmission service type to be applied to the common audio channel, the determined physical link type to be used for the audio data transmission, the determined access address to be applied to the common audio channel, the determined channel map to be applied to the common audio channel, the determined audio transmission service parameters, and/or the audio data transmission/reception timing. For example, information about the common audio channels generated by electronic device may include PHY 2M LE, Type BIS, Access Address Code 0x19790206, Channel Map 0x1088472554, Num_BIS 1, ISO_Interval 30ms, BIS_Spacing 0, Sub_Interval 594μs, Max_PDU 100byte, Max_SDU 100byte, MTP 444 μs, BN 3, PTO 0, IRC 2, NSE 6, Unframed, and/or Unencrypted.

[0275] As illustrated in FIG. 14, the electronic device may generate a common audio channel 1400 corresponding to PHY 2M LE, Type BIS, Access Address Code 0x19790206, Channel Map 0x1088472554, Num_BIS 1, ISO_Interval 30ms, BIS_Spacing 0, Sub_Interval 594μs, Max_PDU 100byte, Max_SDU 100byte, MTP 444 μs, BN 3, PTO 0, IRC 2, NSE 6, Unframed, and/or Unencrypted. In the common audio channel 1400, it may be seen that an access address is set to 0x19790206, and a channel map is set to 0x1088472554.

[0276] In FIG. 14, an event counter may be a 39-bit counter related to a BIG, a value of the event counter may be set to "0" for the first BIG event, and as the number of BIG events increases by one, the value of the event counter may increase by one.

[0277] In FIG. 14, a case is illustrated that a channel 24, a channel 15, a channel 38, channel 15, a channel 3, and a channel 11 (CH24, CH15, CH38, CH15, CH3, and CH11) may be used as a common audio channel in a BIG corresponding to an event counter 0, a channel 5, a channel 33, a channel 15, a channel 20, a channel 11, and a channel 19 (CH5, CH33, CH15, CH20, CH11, and CH19) may be used as a common audio channel in a BIG corresponding to an event counter 1, a channel 5, a channel 33, a channel 5, a channel 15, a channel 7, and a channel 38 (CH5, CH33, CH5, CH15, CH7, and CH38) may be used as a common audio channel in a BIG corresponding to an event counter 2, and channels 20, ...

(CH20, ...) may be used as a common audio channel in a BIG corresponding to an event counter 3.

[0278] Referring back to FIG. 11, in operation 1117, the electronic device 101 may share information about the generated common audio channel with a first external electronic device 200 (e.g., an electronic device 102 in FIG. 1 or a first external electronic device 200 in FIG. 2, 4, 10, 11, 16, 17, 19, 20, or 21) based on one of various schemes. The electronic device 101 may share the information about the generated common audio channel with the first external electronic device 200 based on the one of various schemes.

[0279] In an embodiment, the electronic device 101 may share the information about the generated common audio channel with external electronic devices around the electronic device 101 via periodic advertising.

[0280] In an embodiment, the electronic device 101 may share the information about the generated common audio channel with external electronic devices through a separate external electronic device (e.g., a server (e.g., a server 108 in FIG. 1)). The separate external electronic device may be connected to the external electronic devices including the electronic device 101 and the first external electronic device 200, and manage the electronic device 101 and the external electronic devices.

[0281] In an embodiment, the electronic device 101 may share the information about the generated common audio channel via a direct connection (e.g., a first communication link) established between the electronic device 101 and the external electronic device 101.

[0282] In operation 1117, the electronic device 101 may share time information used for synchronization for the common audio channel along with the information about the generated common audio channel with the first external electronic device 200 based on one of various schemes. In an embodiment, if the common audio channel is encrypted, the electronic device 101 may share an encryption key applied to the common audio channel along with the information about the generated common audio channel with the first external electronic device 200 based on one of various schemes.

[0283] In an embodiment, if the electronic device 101 shares the information about the generated common audio channel with external electronic devices around the electronic device 101 via periodic advertising, the time information used for synchronization for the common audio channel may include time difference from a time point at which a periodic advertising operation starts to a time point at which the common audio channel starts.

[0284] FIG. 15 is a diagram schematically illustrating an operation of sharing information about a common audio channel generated by an electronic device and time information used for synchronization for a common audio channel in a wireless communication network according to an embodiment.

[0285] Referring to FIG. 15, an electronic device (e.g., an electronic device 101 in FIG. 1, 2, 4, 10, 11, 16, 17, 18, 20, 22, or 23) may generate a common audio channel based on an audio transmission service type to be applied to the common audio channel, a physical link type to be used for audio data transmission, an access address to be applied to the common audio channel, a channel map to be applied to the common audio channel, audio transmission service parameters, and/or an audio data transmission/reception timing, as described in FIG. 11 or 14. For example, information about the common audio channels generated by electronic device may include PHY 2M LE, Type BIS, Access Address Code 0x19790206, Channel Map 0x1088472554, Num_BIS 1, ISO_Interval 30ms, BIS_Spacing 0, Sub_Interval 594μs, Max_PDU 100byte, Max_SDU 100byte, MTP 444 μs, BN 3, PTO 0, IRC 2, NSE 6, Unframed, and/or Unencrypted.

[0286] As illustrated in FIG. 15, the electronic device may generate a common audio channel 1500 corresponding to PHY 2M LE, Type BIS, Access Address Code 0x19790206, Channel Map 0x1088472554, Num_BIS 1, ISO_Interval 30ms, BIS_Spacing 0, Sub_Interval 594μs, Max_PDU 100byte, Max_SDU 100byte, MTP 444 μs, BN 3, PTO 0, IRC 2, NSE 6, Unframed, and/or Unencrypted. In the common audio channel 1500, it may be seen that an access address is set to 0x19790206, and a channel map is set to 0x1088472554.

[0287] In FIG. 15, an event counter may be a 39-bit counter related to a BIG, a value of the event counter may be set to "0" for the first BIG event, and as the number of BIG events increases by one, the value of the event counter may increase by one.

[0288] In FIG. 15, a case is illustrated that a channel 24, a channel 15, a channel 38, channel 15, a channel 3, and a channel 11 (CH24, CH15, CH38, CH15, CH3, and CH11) may be used as a common audio channel in a BIG corresponding to an event counter 0, a channel 5, a channel 33, a channel 15, a channel 20, a channel 11, and a channel 19 (CH5, CH33, CH15, CH20, CH11, and CH19) may be used as a common audio channel in a BIG corresponding to an event counter 1, a channel 5, a channel 33, a channel 5, a channel 15, a channel 7, and a channel 38 (CH5, CH33, CH5, CH15, CH7, and CH38) may be used as a common audio channel in a BIG corresponding to an event counter 2, and channels 20, ... (CH20, ...) may be used as a common audio channel in a BIG corresponding to an event counter 3.

[0289] In an embodiment, the electronic device may share, with external electronic devices around the electronic device, information about the common audio channel and time information used for synchronization for the common audio channel via a periodic advertising (PA) operation in operation 1511. The electronic device shares the information about the common audio channel and the time information used for synchronization for the common audio channel in operation 1511, so the external electronic devices around the electronic device may be synchronized to the common audio channel based on the time information used for synchronization for the common audio channel in operation 1513.

[0290] FIG. 16 is a diagram schematically illustrating an operation in which a plurality of electronic devices are

synchronized to a common audio channel in a wireless communication network according to an embodiment.

[0291] Referring to FIG. 16, an electronic device 101 (e.g., an electronic device 101 in FIG. 1, 2, 4, 10, 11, 17, 18, 20, 22, or 23) may generate a common audio channel based on an audio transmission service type to be applied to the common audio channel, a physical link type to be used for audio data transmission, an access address to be applied to the common audio channel, a channel map to be applied to the common audio channel, audio transmission service parameters, and/or an audio data transmission/reception timing. An operation of the electronic device 101 to generate the common audio channel may be similar to or substantially the same as that described in FIG. 11 or FIG. 14, so a detailed description thereof will be omitted herein. The electronic device may generate a common audio channel 1500 corresponding to PHY 2M LE, Type BIS, Access Address Code 0x19790206, Channel Map 0x1088472554, Num_BIS 1, ISO_Interval 30ms, BIS_Spacing 0, Sub_Interval 594μs, Max_PDU 100byte, Max_SDU 100byte, MTP 444 μs, BN 3, PTO 0, IRC 2, NSE 6, Unframed, and/or Unencrypted. In the common audio channel 1600, it may be seen that an access address is set to 0x19790206, and a channel map is set to 0x1088472554.

[0292] In an embodiment, the electronic device 101 may share (broadcast) information about the common audio channel and time information used for synchronization for the common audio channel via a periodic advertising (PA) operation in operation 1613, 1615, and 1617. External electronic devices around the electronic device 101 (e.g., a first external electronic device 200 (e.g., an electronic device 102 in FIG. 1 or a first external electronic device 200 in FIG. 2, 4, 10, 11, 17, 19, 20, or 21), a second external electronic device 300 (e.g., an electronic device 104 in FIG. 1, or a second external electronic device 300 in FIG. 3, 4, or 17), a third external electronic device 1001 (e.g., a third external electronic device 1001 in FIG. 10, 17, or 21), and/or a fourth external electronic device 1003 (e.g., a fourth external electronic device 1003 in FIG. 10) may obtain the information about the common audio channel and the time information used for synchronization for the common audio channel via this PA operation of the electronic device 101. The electronic device 101 shares the information about the common audio channel and the time information used for synchronization for the common audio channel in operation 1613, 1615, and 1617, so the external electronic devices around the electronic device 101 may be synchronized to the common audio channel based on the time information used for synchronization for the common audio channel.

[0293] In operation 1611, the electronic device 101 may receive an audio packet #0, an audio packet #1, an audio packet #2, an audio packet #0, an audio packet #1, and an audio packet #2 via the common audio channel in a reception mode. In an embodiment, n may represent a sequence number for an audio packet, and an audio packet #n may represent the nth audio packet transmitted via the common audio channel after the common audio channel is established. In an embodiment, in a case of the common audio channel, the same audio packets may be repeatedly transmitted m times (e.g., m = 2) based on BIS attribute information, and if electronic devices receiving the corresponding audio packets receive normally the audio packets in the first transmission even if the audio packets are repeatedly transmitted m times, the electronic devices may not receive audio packets transmitted in the remaining m-1 transmissions.

[0294] An audio packet transmission operation or an audio packet reception operation of the electronic device 101, the first external electronic device 200, the second external electronic device 300, the third external electronic device 1001, or the fourth external electronic device 1003 in BIG events for a common audio channel 1600 generated by the electronic device 101 is illustrated in FIG. 16. The audio packet transmission operation or the audio packet reception operation of the electronic device 101, the first external electronic device 200, the second external electronic device 300, the third external electronic device 1001, or the fourth external electronic device 1003 may be similar to or substantially the same as an audio packet transmission operation or an audio packet reception operation of the electronic device 101 to be described with reference to FIG. 18 below, so a detailed description thereof will be omitted herein.

[0295] In an embodiment, the electronic device 101 may operate in a reception mode by default for the common audio channel, and may operate in a transmission mode as needed. In an embodiment, the electronic device 101 may transmit audio data in the transmission mode. In an embodiment, if the common audio channel is established, the electronic device 101 may operate in the reception mode by default for the common audio channel. When identifying that audio data to be transmitted occurs while operating in the reception mode for the common audio channel (for example, when identifying that data is inputted into a transmission queue (Tx queue)), the electronic device 101 may switch from the reception mode to the transmission mode, and transmit audio data via the common audio channel in the transmission mode.

[0296] The first external electronic device 200 may be synchronized to the common audio channel in operation 1619 according to the PA operation of the electronic device 101 in operation 1613. For example, the first external electronic device 200 may be synchronized to the common audio channel according to the information about the common audio channel and the time information used for synchronization for the common audio channel which are shared according to the PA operation of the electronic device 101 in operation 1613, and use the common audio channel. So, the first external electronic device 200 may be able to use the common audio channel starting from the second BIG event. The first external electronic device 200 may operate in the reception mode by default on the common audio channel, and may operate in the transmission mode as needed. According to an embodiment, the first external electronic device 200 may transmit audio data in the transmission mode.

[0297] The second external electronic device 300 may be synchronized to the common audio channel in operation 1621

according to the PA operation of the electronic device 101 in operation 1615. For example, the second external electronic device 300 may be synchronized to the common audio channel according to the information about the common audio channel and the time information used for synchronization for the common audio channel which are shared according to the PA operation of the electronic device 101 in operation 1615, and use the common audio channel. So, the second external electronic device 300 may be able to use the common audio channel starting from the fourth BIG event. The second external electronic device 300 may operate in the reception mode by default for the common audio channel, and may operate in the transmission mode as needed. According to an embodiment, the second external electronic device 300 may transmit audio data in the transmission mode.

[0298] The third external electronic device 1001 may be synchronized to the common audio channel in operation 1623 according to the PA operation of the electronic device 101 in operation 1617. For example, the third external electronic device 1001 may be synchronized to the common audio channel according to the information about the common audio channel and the time information used for synchronization for the common audio channel which are shared according to the PA operation of the electronic device 101 in operation 1617, and use the common audio channel. So, the third external electronic device 1001 may be able to use the common audio channel starting from the sixth BIG event. The third external electronic device 1001 may operate in the reception mode by default on the common audio channel, and may operate in the transmission mode as needed. According to an embodiment, the third external electronic device 1001 may transmit audio data in the transmission mode.

[0299] The fourth external electronic device 1003 may be synchronized to the common audio channel in operation 1625 according to the PA operation of the electronic device 101 in operation 1613. For example, the fourth external electronic device 1003 may be synchronized to the common audio channel according to the information about the common audio channel and the time information used for synchronization for the common audio channel which are shared according to the PA operation of the electronic device 101 in operation 1613, and use the common audio channel. So, the fourth external electronic device 1003 may be able to use the common audio channel starting from the second BIG event. The fourth external electronic device 1003 may operate in the reception mode by default on the common audio channel, and may operate in the transmission mode as needed. According to an embodiment, the fourth external electronic device 1003 may transmit audio data in the transmission mode.

[0300] Referring back to FIG. 11, in an embodiment, if the electronic device 101 shares the information about the common audio signal generated via a direct connection (e.g., a first communication link) established between the electronic device 101 and the first external electronic device 200, the time information used for synchronization for the common audio channel may include time difference between a time point at which a communication in the first communication link starts and a time point at which the common audio channel starts.

[0301] A case that the electronic device 101 shares the information about the common audio channel with the first external electronic device 200 by transmitting the information about the common audio channel to the first external electronic device 200 via the first communication link established between the electronic device 101 and the first external electronic device 200 is illustrated in FIG. 11. A case that a periodic advertising (PA) operation is performed every three time intervals (e.g., three BIG events) is illustrated in FIG. 11, however, there may be no limitation on a period at which the periodic advertising operation is performed. In an embodiment, information about a location where the next BIS audio data is transmitted may be provided via the PA operation, and the reception mode and the transmission mode have been described in FIG. 7, so a detailed description thereof will be omitted herein. The electronic device 101, which shares the information about the common audio channel and the time information used for synchronization for the common audio channel via the first communication link, may perform the PA operation in operation 1119. In an embodiment, the PA operation may include an operation of transmitting an AUX_SYNC_IND PDU. In an embodiment, an operation of transmitting an EXT_IND PDU, and/or an operation of transmitting an AUX_ADV_IND PDU may be an extended advertising operation and may be connected to the PA operation in the form of a train. An interval of the PA operation (e.g., a PA period) may be an interval between start time points of AUX_SYNC_IND PDUs. So, the electronic device 101 may perform the PA operation in operation 1129. In an embodiment, a format of the ADV_EXT_IND PDU, the AUX_ADV_IND PDU, and/or the AUX_SYNC_IND PDU may be similar to or substantially the same as a format of a BLE ADV packet described in FIG. 12, and the information about the common audio channel and the time information used for synchronization for the common audio channel may be included in advertising data 1220.

[0302] The first external electronic device 200, which receives the information about the common audio channel and the time information used for synchronization for the common audio channel from the electronic device 101 via the first communication link, may be synchronized to the common audio channel according to the information about the common audio channel and the time information used for synchronization for the common audio channel, and use the common audio channel. The first external electronic device 200 may operate in the reception mode by default for the common audio channel, and may operate in the transmission mode as needed. So, the first external electronic device 200 may in the reception mode by default for the common audio channel in operation 1121, 1123, 1125, and 1127.

[0303] FIG. 17 is a diagram schematically illustrating an operation in which a plurality of electronic devices are synchronized to a common audio channel in a wireless communication network according to an embodiment.

[0304] Referring to FIG. 17, an electronic device 101 (e.g., an electronic device 101 in FIG. 1, 2, 4, 10, 11, 16, 18, 20, 22, or 23) may generate a common audio channel based on an audio transmission service type to be applied to the common audio channel, a physical link type to be used for audio data transmission, an access address to be applied to the common audio channel, a channel map to be applied to the common audio channel, audio transmission service parameters, and/or an audio data transmission/reception timing. An operation of the electronic device 101 to generate the common audio channel may be similar to or substantially the same as that described in FIG. 11 or FIG. 14, so a detailed description thereof will be omitted herein. For example, the electronic device may generate a common audio channel corresponding to PHY 2M LE, Type BIS, Access Address Code 0x19790206, Channel Map 0x1088472554, Num_BIS 1, ISO_Interval 30ms, BIS_Spacing 0, Sub_Interval 594μs, Max_PDU 100byte, Max_SDU 100byte, MTP 444 μs, BN 3, PTO 0, IRC 2, NSE 6, Unframed, and/or Unencrypted. In the common audio channel, it may be seen that an access address is set to 0x19790206, and a channel map is set to 0x1088472554.

[0305] In an embodiment, the electronic device 101 may establish a communication link (e.g., a first communication link) in advance with a first external electronic device 200 (e.g., an electronic device 102 in FIG. 1, or a first external electronic device 200 in FIG. 2, 4, 10, 11, 16, 19, 20, or 21), and share information about the common audio channel and time information used for synchronization for the common audio channel via the first communication link. In this case, the first external electronic device 200 may be synchronized to the common audio channel according to the information about the common audio channel and the time information used for synchronization for the common audio channel which are received via the first communication link, and use the common audio channel. So, the first external electronic device 200 may operate in a reception mode by default for the common audio channel in operation 1711, 1713, 1715, and 1717, and may operate in a transmission mode as necessary.

[0306] Alternatively, although not separately shown, the electronic device 101 may share the information about the common audio channel and the time information used for synchronization for the common audio channel via a PA operation, and the first external electronic device 200 may be synchronized to the common audio channel according to the information about the common audio channel and the time information used for synchronization for the common audio channel which are received via the first communication link, and use the common audio channel. In this case, the first external electronic device 200 may operate in a reception mode by default for the common audio channel in operation 1711, 1713, 1715, and 1717, and may operate in a transmission mode as necessary.

[0307] The electronic device 101 may share (broadcast) information about the common audio channel and time information used for synchronization for the common audio channel via a PA operation in operation 1719 and 1721. In an embodiment, the PA operation may include an operation of transmitting an AUX_SYNC_IND PDU, and the PA operation may be connected to an EA operation including an operation of transmitting an EXT_IND PDU, and/or an operation of transmitting an AUX_ADV_IND PDU in the form of a train. External electronic devices around the electronic device 101 (e.g., a second external electronic device 300 (e.g., an electronic device 104 in FIG. 1, or a second external electronic device 300 in FIG. 3, 4, or 16), and a third external electronic device 1001 (e.g., a third external electronic device 1001 in FIG. 10, 16, or 21)) may obtain the information about the common audio channel and the time information used for synchronization for the common audio channel via this PA operation of the electronic device 101. The electronic device 101 shares the information about the common audio channel and the time information used for synchronization for the common audio channel in operation 1719 and 1721, so the external electronic devices around the electronic device 101 may be synchronized to the common audio channel based on the time information used for synchronization for the common audio channel.

[0308] The second external electronic device 300 may be synchronized to the common audio channel in operation 1720 according to the PA operation of the electronic device 101 in operation 1719. For example, the second external electronic device 300 may be synchronized to the common audio channel according to the information about the common audio channel and the time information used for synchronization for the common audio channel which are shared according to the PA operation of the electronic device 101 in operation 1719, and use the common audio channel. So, the second external electronic device 300 may operate in the reception mode by default for the common audio channel in operation 1723, 1725, 1727, and 1729, and may operate in the transmission mode as needed.

[0309] The third external electronic device 1001 may be synchronized to the common audio channel according to the PA operation of the electronic device 101 in operation 1721. For example, the third external electronic device 1001 may be synchronized to the common audio channel according to the information about the common audio channel and the time information used for synchronization for the common audio channel which are shared according to the PA operation of the electronic device 101 in operation 1721, and use the common audio channel. The third external electronic device 1001, which performs a synchronization operation for the common audio channel according to the information about the common audio channel and the time information used for synchronization for the common audio channel which are shared according to the PA operation of the electronic device 101 in operation 1721, may operate in the reception mode by default for the common audio channel in operation 1731, and may operate in the transmission mode as needed.

[0310] FIG. 18 is a diagram schematically illustrating a transmitting operation and a receiving operation performed by an electronic device on a common audio channel in a wireless communication network according to an embodiment.

[0311] Referring to FIG. 18, an electronic device 101 (e.g., an electronic device 101 in FIG. 1, 2, 4, 10, 11, 16, 17, 20, 22, or 23) may generate a common audio channel based on an audio transmission service type to be applied to the common audio channel, a physical link type to be used for audio data transmission, an access address to be applied to the common audio channel, a channel map to be applied to the common audio channel, audio transmission service parameters, and/or an audio data transmission/reception timing. An operation of the electronic device 101 to generate the common audio channel may be similar to or substantially the same as that described in FIG. 11 or FIG. 14, so a detailed description thereof will be omitted herein. The electronic device 101 may operate in a reception mode by default for the common audio channel and may operate in a transmission mode as needed. The reception mode and the transmission mode have been described in FIG. 7, so a detailed description thereof will be omitted herein.

[0312] In operation 1811, the electronic device 101 may receive an audio packet #60, an audio packet #61, an audio packet #62, an audio packet #60, an audio packet #61, and an audio packet #62 via the common audio channel in a reception mode. In an embodiment, n may represent a sequence number for an audio packet, and an audio packet #n may represent the nth audio packet transmitted via the common audio channel after the common audio channel is established. In an embodiment, in a case of the common audio channel, the same audio packets may be repeatedly transmitted m times (e.g., m = 2) based on BIS attribute information, and if electronic devices receiving the corresponding audio packets receive normally the audio packets in the first transmission even if the audio packets are repeatedly transmitted m times, the electronic devices may not receive audio packets transmitted in the remaining m-1 transmissions.

[0313] In an embodiment, the electronic device 101 may operate in a reception mode by default for the common audio channel after generating the common audio channel, and share (broadcast) information about the common audio channel and time information used for synchronization for the common audio channel via a PA operation in operation 1813, 1815, and 1817. In FIG. 18, a case that the electronic device 101 generates the common audio channel, operates in the reception mode after generating the common audio channel, and shares the information about the common audio channel and the time information used for synchronization for the common audio channel via the PA operation has been described as an example, however, the electronic device 101 may perform only the operation of generating the common audio channel and may not perform other remaining operations related to the common audio channel (e.g., the operation of sharing the information about the common audio channel and the time information used for synchronization for the common audio channel). In this case, for example, the information about the common audio channel and the time information used for synchronization for the common audio channel may be shared via a server (e.g., a server 108 in FIG. 1). External electronic devices around the electronic device 101 (e.g., a first external electronic device (e.g., an electronic device 102 in FIG. 1 or a first external electronic device 200 in FIG. 2, 4, 10, 11, 16, 17, 19, 20, or 21), a second external electronic device (e.g., an electronic device 104 in FIG. 1, or a second external electronic device 300 in FIG. 3, 4, 16, or 17), a third external electronic device (e.g., a third external electronic device 1001 in FIG. 10, 16, 17, or 21), a fourth external electronic device (e.g., a fourth external electronic device 1003 in FIG. 10, 16, or 21), and/or a fifth external electronic device (e.g., a fifth external electronic device 1005 in FIG. 10) may obtain the information about the common audio channel and the time information used for synchronization for the common audio channel via the PA operation of the electronic device 101. In an embodiment, the time information used for synchronization for the common audio channel may indicate time difference between an AUX_SYNC_IND PDU and a transmission time point of audio data. For example, the time information used for synchronization for the common audio channel may be time information indicating how soon the audio data will be transmitted from the AUX_SYNC_IND PDU. In FIG. 18, a case that the electronic device 101 shares the information about the common audio channel and the time information used for synchronization for the common audio channel via the PA operation as an example, however, the electronic device 101 may cause external electronic devices around the electronic device 101 to obtain the information about the common audio channel and the time information used for synchronization for the common audio channel by transmitting the information about the common audio channel and the time information used for synchronization for the common audio channel via a server (e.g., a server 108 in FIG. 1) to which the electronic device 101 and the external electronic devices around the electronic device 101 are connected. The electronic device 101 shares the information about the common audio channel and the time information used for synchronization for the common audio channel in operation 1813, 1815, and 1817, so the external electronic devices around the electronic device 101 may be synchronized to the common audio channel based on the time information used for synchronization for the common audio channel.

[0314] In FIG. 18, a case has been illustrated that the electronic device 101 may receive an audio packet #60, an audio packet #61, an audio packet #62, the audio packet #60, the audio packet #61, and the audio packet #62 for a common audio channel 1800 in the first BIG event, may receive an audio packet #63, an audio packet #64, an audio packet #65, the audio packet #63, the audio packet #64, and the audio packet #65 in the second BIG event, may receive an audio packet #66, an audio packet #67, an audio packet #68, the audio packet #66, the audio packet #67, and the audio packet #68 in the third BIG event, may receive an audio packet #69, transmit an audio packet #70 and an audio packet #71, receive the audio packet #69, and transmit an audio packet #, and the audio packet #71 in the fourth BIG event, may transmit an audio packet #72, an audio packet #73, an audio packet #74, the audio packet #72, the audio packet #73, and the audio packet #74 in the fifth BIG event, and may receive an audio packet #75, an audio packet #76, an audio packet #77, the audio packet #75, the

audio packet #76, and an audio packet # in the sixth BIG event.

[0315] The electronic device 101 may operate only in the reception mode in the first BIG event.

[0316] The electronic device 101 may operate only in the reception mode in the second BIG event.

[0317] The electronic device 101 may operate only in the reception mode in the third BIG event.

[0318] The electronic device 101 may operate in the reception mode and the transmission mode in the fourth BIG event.

[0319] The electronic device 101 may operate only in the transmission mode in the fifth BIG event. In an embodiment, if the electronic device 101 is earbuds, audio data to be transmitted may include audio data inputted via a microphone of the earbuds. If volume of the inputted audio sound exceeds threshold volume, the electronic device 101 may transmit audio data corresponding to an audio sound, or transmit audio data inputted after a set operation (e.g., a user input for the earbuds (e.g., a user touch)) is detected.

[0320] The electronic device 101 may operate only in the reception mode in the sixth BIG event. In FIG. 18, in the fifth BIG event, the electronic device 101 operates in the transmission mode in which audio data is transmitted, the other external electronic devices around the electronic device 101 may not perform a transmission mode operation. In order to prevent this case, the electronic device 101 may not perform the transmission mode operation in some time durations in a corresponding BIG event, and in this case, the other external electronic devices around the electronic device 101 may perform the transmission mode operation in a time duration in which the electronic device 101 does not perform the transmission mode operation.

[0321] FIG. 19 is a diagram schematically illustrating a transmitting operation and a receiving operation performed by a first external electronic device on a common audio channel in a wireless communication network according to an embodiment.

[0322] Referring to FIG. 19, an electronic device (not illustrated in FIG. 19) (e.g., an electronic device 101 in FIG. 1, 2, 4, 10, 11, 16, 17, 18, 20, 22, or 23) may generate a common audio channel based on an audio transmission service type to be applied to the common audio channel, a physical link type to be used for audio data transmission, an access address to be applied to the common audio channel, a channel map to be applied to the common audio channel, audio transmission service parameters, and/or an audio data transmission/reception timing. An operation of the electronic device 101 to generate the common audio channel may be similar to or substantially the same as that described in FIG. 11 or FIG. 14, so a detailed description thereof will be omitted herein. The electronic device may operate in a reception mode by default for the common audio channel and may operate in a transmission mode as needed.

[0323] In an embodiment, the electronic device may share (broadcast) information about the common audio channel and time information used for synchronization for the common audio channel via a PA operation after generating the common audio channel as described in FIG. 18. External electronic devices around the electronic device 101 (e.g., a first external electronic device (e.g., an electronic device 102 in FIG. 1 or a first external electronic device 200 in FIG. 2, 4, 10, 11, 16, 17, 19, 20, or 21), a second external electronic device (e.g., an electronic device 104 in FIG. 1, or a second external electronic device 300 in FIG. 3, 4, 16, or 17), a third external electronic device (e.g., a third external electronic device 1001 in FIG. 10, 16, 17, or 21), a fourth external electronic device (e.g., a fourth external electronic device 1003 in FIG. 10, 16, or 21), and/or a fifth external electronic device (e.g., a fifth external electronic device 1005 in FIG. 10) may obtain the information about the common audio channel and the time information used for synchronization for the common audio channel via this PA operation of the electronic device. The electronic device shares the information about the common audio channel and the time information used for synchronization for the common audio channel in the PA operation, so the first external electronic device 200 may be synchronized to the common audio channel based on the time information used for synchronization for the common audio channel.

[0324] An operation of transmitting an audio data packet or an operation of receiving an audio data packet of the first external electronic device 200 in BIG events for a common audio channel 1900 generated by the electronic device is illustrated in FIG. 19. Each number illustrated in FIG. 19 may represent a sequence number of the audio packet, and the operation of transmitting the audio data packet or the operation of receiving the audio data packet of the first external electronic device 200 of FIG. 19 may be similar to or substantially the same as operation of transmitting an audio data packet or an operation of receiving an audio data packet of an electronic device 101 in FIG. 1, so a detailed description thereof will be omitted herein.

[0325] FIG. 20 is a diagram schematically illustrating an operation of exchanging audio data between an electronic device and a first external electronic device in a wireless communication network according to an embodiment.

[0326] Referring to FIG. 20, an electronic device 101 (e.g., an electronic device 101 in FIG. 1, 2, 4, 10, 11, 16, 17, 18, 19, 22, or 23) may generate a common audio channel based on an audio transmission service type to be applied to the common audio channel, a physical link type to be used for audio data transmission, an access address to be applied to the common audio channel, a channel map to be applied to the common audio channel, audio transmission service parameters, and/or an audio data transmission/reception timing. An operation of the electronic device 101 to generate the common audio channel may be similar to or substantially the same as that described in FIG. 11 or FIG. 14, so a detailed description thereof will be omitted herein. The electronic device 101 may operate in a reception mode by default for the common audio channel and may operate in a transmission mode as needed.

[0327] In an embodiment, the electronic device 101 may share (broadcast) information about the common audio channel and time information used for synchronization for the common audio channel via a PA operation after generating the common audio channel as described in FIG. 18. External electronic devices around the electronic device 101 (e.g., a first external electronic device (e.g., an electronic device 102 in FIG. 1 or a first external electronic device 200 in FIG. 2, 4, 10, 11, 16, 17, 19, or 21), a second external electronic device (e.g., an electronic device 104 in FIG. 1, or a second external electronic device 300 in FIG. 3, 4, 16, or 17), a third external electronic device (e.g., a third external electronic device 1001 in FIG. 10, 16, 17, or 21), a fourth external electronic device (e.g., a fourth external electronic device 1003 in FIG. 10, 16, or 21), and/or a fifth external electronic device (e.g., a fifth external electronic device 1005 in FIG. 10) may obtain the information about the common audio channel and the time information used for synchronization for the common audio channel via this PA operation of the electronic device 101. The electronic device shares the information about the common audio channel and the time information used for synchronization for the common audio channel in the PA operation, so the first external electronic device 200 may be synchronized to the common audio channel based on the time information used for synchronization for the common audio channel.

[0328] An operation of transmitting an audio data packet or an operation of receiving an audio data packet of the electronic device 101, and an operation of transmitting an audio data packet or an operation of receiving an audio data packet of the first external electronic device 200 in BIG events for a common audio channel 2000 generated by the electronic device 101 is illustrated in FIG. 20. Each number illustrated in FIG. 20 may represent a sequence number of the audio packet, and the operation of transmitting the audio data packet or the operation of receiving the audio data packet of the electronic device 101 and the operation of transmitting the audio data packet or the operation of receiving the audio data packet of the first external electronic device 200 of FIG. 20 may be similar to or substantially the same as operation of transmitting an audio data packet or an operation of receiving an audio data packet of an electronic device 101 in FIG. 18, so a detailed description thereof will be omitted herein.

[0329] FIG. 21 is a diagram schematically illustrating an operation of exchanging audio data among a first external electronic device, a third external electronic device, and a fourth external electronic device in a wireless communication network according to an embodiment.

[0330] Referring to FIG. 21, an electronic device (not illustrated) (e.g., an electronic device 101 in FIG. 1, 2, 4, 10, 11, 16, 17, 18, 19, 22, or 23) may generate a common audio channel 2100 based on an audio transmission service type to be applied to the common audio channel, a physical link type to be used for audio data transmission, an access address to be applied to the common audio channel, a channel map to be applied to the common audio channel, audio transmission service parameters, and/or an audio data transmission/reception timing. An operation of the electronic device to generate the common audio channel 2100 may be similar to or substantially the same as that described in FIG. 11 or FIG. 14, so a detailed description thereof will be omitted herein.

[0331] An operation of transmitting an audio data packet or an operation of receiving an audio data packet of the electronic device 101, an operation of transmitting an audio data packet or an operation of receiving an audio data packet of the third external electronic device 1001, and an operation of transmitting an audio data packet or an operation of receiving an audio data packet of the fourth external electronic device 1003, in BIG events for a common audio channel 2100 is illustrated in FIG. 21. Each number illustrated in FIG. 21 may represent a sequence number of the audio packet, and the operation of transmitting the audio data packet or the operation of receiving the audio data packet of the electronic device 101, the operation of transmitting the audio data packet or the operation of receiving the audio data packet of the third external electronic device 1001, and the operation of transmitting the audio data packet or the operation of receiving the audio data packet of the fourth external electronic device 1003 of FIG. 21 may be similar to or substantially the same as operation of transmitting an audio data packet or an operation of receiving an audio data packet of an electronic device 101 in FIG. 1, so a detailed description thereof will be omitted herein.

[0332] In this way, if two or more electronic devices simultaneously perform a transmission operation (for example, if the two or more electronic devices transmit audio data simultaneously) at the same BIG event (e.g., at the same anchor point or a start time point of the same subevent), electronic devices operating in a reception mode may simultaneously process audio data for an electronic device which receives a preamble signal first among electronic devices operating in a transmission mode.

[0333] Alternatively, even if two or more electronic devices operate in the transmission mode simultaneously (for example, even if the two or more electronic devices transmit audio data simultaneously) at the same BIG event (e.g., at the same anchor point or a start time point of the same subevent), if electronic devices operating in the reception mode includes two or more modems (e.g., Bluetooth modems), audio data transmitted from two or more electronic devices using the two or more modems may be processed simultaneously. In an embodiment, the two or more modems may simultaneously process the audio data transmitted from the two or more electronic devices without interference if a distance between antennas is longer than a set distance (e.g., 7.5 cm, 15 cm, etc.). For example, it has been difficult for the third external electronic device 1001 to normally process audio packets not indicated by arrows because collisions occur for the audio packets not indicated by arrows, however, as suggested in the disclosure, if audio data transmitted from the two or more electronic devices is simultaneously processed using the two or more modems, the audio packets not

indicated by arrows may be normally processed.

[0334] FIG. 22 is a diagram schematically illustrating an operation in which an electronic device establishes a common audio channel in a wireless communication network according to an embodiment.

[0335] Referring to FIG. 22, a structure of a wireless communication network may be implemented similarly to a structure of a wireless communication network described in FIG. 10, so a detailed description thereof will be omitted.

[0336] An operation of an electronic device (e.g., an electronic device 101 in FIG. 1, 2, 4, 10, 11, 16, 17, 18, 20, 22, or 23) illustrated in FIG. 22 may be different from an operation of an electronic device as described in FIG. 11 in that the electronic device may generate a common audio channel based on a set condition even if the electronic device does not receive, from an external electronic device (e.g., a first external electronic device (e.g., an electronic device 102 in FIG. 1, or a first external electronic device 200 in FIG. 2, 4, 10, 11, 16, 17, 19, 20, or 21), a second external electronic device (e.g., an electronic device 104 in FIG. 1, or a second external electronic device 300 in FIG. 3, 4, 16, or 17), a third external electronic device (e.g., a third external electronic device 1001 in FIG. 10, 16, 17, or 21), a fourth external electronic device (e.g., a fourth external electronic device in FIG. 10, 16, or 21), and/or a fifth external electronic device (e.g., a fifth external electronic device 1005 in FIG. 10)), a packet (e.g., a common audio channel generation request packet) requesting to generate the common audio channel.

[0337] In operation 2211, the electronic device may generate the common audio channel based on a set condition. In an embodiment, the set condition may include a user input requesting to generate the common audio channel for the multi-party audio service, execution of a set application, and/or entry into a set area. In an embodiment, the user input may include a set physical user interface (PUI), and/or voice command. In an embodiment, the set application may include a dedicated application for the multi-party audio service. In an embodiment, the set area may include an area where the multi-party audio service is performed. In an embodiment, the set area may include a conference room, and/or a classroom. The operation of the electronic device to generate the common audio channel is similar to or substantially the same as described in FIGS. 11 and 14, so a detailed description thereof will be omitted herein.

[0338] In operation 2213, the electronic device, which generates the common audio channel based on the set condition, may share information about the common audio channel and time information used for synchronization for the common audio channel with external electronic devices around the electronic device by broadcasting the information about the common audio channel and the time information used for synchronization for the common audio channel via a periodic advertising operation. The operation of sharing the information about the common audio channel and time information used for synchronization for the common audio channel with the external electronic devices around the electronic device is similar or substantially the same as described in FIG. 11, so a detailed description thereof will be omitted herein.

[0339] In this way, the electronic device, which shares the information about the common audio channel and time information used for synchronization for the common audio channel, may operate in a reception mode by default in operation 2215. While operating in the reception mode in operation 2217 and 2219, the electronic device may perform a periodic advertising operation in operation 2221 corresponding to a periodic advertising period, and then operate in the reception mode again in operation 2223.

[0340] Although not separately illustrated in FIG. 22, if the electronic device identifies that audio data to be transmitted occurs while operating in the reception mode by default after generating the common audio channel, the electronic device may transmit the audio data at a transmission timing of the common audio channel.

[0341] FIG. 23 is a diagram schematically illustrating a receiving operation performed by an electronic device after a common audio channel is generated in a wireless communication network according to an embodiment.

[0342] Referring to FIG. 23, if it is required to generate a common audio channel, an electronic device (e.g., an electronic device 101 in FIG. 1, 2, 4, 10, 11, 16, 17, 18, 20, or 22) may determine an audio transmission service type to be applied to a common audio channel, a physical link type to be used for audio data transmission, an access address to be applied to the common audio channel, a channel map to be applied to the common audio channel, audio transmission service parameters, and/or audio data transmission/reception timing. An operation in which the electronic device determines the audio transmission service type to be applied to the common audio channel, the physical link type to be used for audio data transmission, the access address to be applied to the common audio channel, the channel map to be applied to the common audio channel, the audio transmission service parameters, and/or the audio data transmission/reception timing may be similar or substantially the same as an operation of generating a common audio channel in operation 1115 in FIG. 11, so a detailed description thereof will be omitted herein.

[0343] The electronic device may generate the common audio channel 2300 based on the determined audio transmission service type to be applied to the common audio channel, the determined physical link type to be used for the audio data transmission, the determined access address to be applied to the common audio channel, the determined channel map to be applied to the common audio channel, the determined audio transmission service parameters, and/or the audio data transmission/reception timing.

[0344] An operation of transmitting an audio data packet or an operation of receiving an audio data packet of the electronic device in BIG events for the common audio channel 2300 generated by the electronic device 101 is illustrated in FIG. 23. Each number illustrated in FIG. 23 may represent a sequence number of the audio packet, and the operation of

transmitting the audio data packet or the operation of receiving the audio data packet of the electronic device 101 of FIG. 23 may be similar to or substantially the same as operation of transmitting an audio data packet or an operation of receiving an audio data packet of an electronic device 101 in FIG. 18, so a detailed description thereof will be omitted herein. In this way, after generating the common audio channel 2300, the electronic device may operate in a reception mode by default. Although not separately illustrated in FIG. 23, if the electronic device identifies that audio data to be transmitted occurs while operating in the reception mode by default, the electronic device may switch from the reception mode to a transmission mode and transmit audio data via the common audio channel in the transmission mode.

[0345] In the disclosure, an operation of transmitting audio data or an operation of receiving audio data via a common audio channel after the common audio channel is established has been described, however, the common audio channel may be released if an electronic device and other external electronic devices no longer need to perform a multi-party audio service via the common audio channel. A condition under which the common audio channel is released may be implemented by a user input or various parameters, and there may be no limitation on the condition under which the common audio channel is released.

[0346] FIG. 24 is a diagram schematically illustrating operations of a second external electronic device, a third external electronic device, and a fourth external electronic device in a wireless communication network according to an embodiment.

[0347] Referring to FIG. 24, in a case of BIS, each of a plurality of electronic devices (e.g., a second external electronic device 300 (e.g., an electronic device 104 in FIG. 1, or a second external electronic device 300 in FIG. 3, 4, 16, or 17), a third external electronic device 1001 (e.g., a third external electronic device 1001 in FIG. 10, 16, 17, or 21), and/or a fourth external electronic device 1003 (e.g., a fourth external electronic device 1003 in FIG. 10, 16, or 21)) may perform a BIS source role, so the second external electronic device 300, the third external electronic device 1001, and/or the fourth external electronic device 1003 may generate a BIG and perform a PA operation. In the case of BIS, each of the second external electronic device 300, the third external electronic device 1001, and/or the fourth external electronic device 1003 performs the BIS source role, so each of the second external electronic device 200, the third external electronic device 1001, and/or the fourth external electronic device 1003 may perform a transmission operation in each BIG event.

[0348] FIG. 25 is a diagram schematically illustrating operations of a second external electronic device, a third external electronic device, and a fourth external electronic device in a wireless communication network according to an embodiment.

[0349] Before describing FIG. 25, as described in FIG. 24, there may be a plurality of electronic devices (e.g., a second external electronic device 300 (e.g., an electronic device 104 in FIG. 1, or a second external electronic device 300 in FIG. 3, 4, 16, or 17), a third external electronic device 1001 (e.g., a third external electronic device 1001 in FIG. 10, 16, 17, or 21), and/or a fourth external electronic device 1003 (e.g., a fourth external electronic device 1003 in FIG. 10, 16, or 21)) in a wireless communication network. The second external electronic device 200, the third external electronic device 1001, and/or the fourth external electronic device 1003 may not generate a common audio channel, and may provide a set service (e.g., a multi-party audio service) via a general audio channel. In this case, the set service may be performed by considering a resource and a timing electronic devices which simultaneously participate or will simultaneously participate in the set service (e.g., the multi-party audio service). For example, the second external electronic device 200 may generate a BIG via a set application (e.g., Samsung BIS), and share information about the generated BIG with other external electronic devices around the second external electronic device 200 via a PA operation. In this case, an external electronic device (e.g., the third external electronic device 1001) performing the same application (e.g., Samsung BIS) may generate a new BIG so as not to overlap with a transmission timing of the second external electronic device 300 after obtaining BIG parameters and a timing which are operated by the second external electronic device 300, or after obtaining the BIG parameters and the timing which are operated by the second external electronic device 300, and adjusting the obtained BIG parameters and timing with the second external electronic device 300.

[0350] Similarly, another external electronic device (e.g., the fourth external electronic device 1003) which performs the same application (e.g., Samsung BIS) may generate a new BIG so as not to overlap with a transmission timing of the second external electronic device 300 and the third external electronic device 1001 after obtaining BIG parameters and a timing which are operated by the second external electronic device 300 and the third external electronic device 1001, or after obtaining the BIG parameters and the timing which are operated by the second external electronic device 300 and the third external electronic device 1001, and adjusting the obtained BIG parameters and timing with the second external electronic device 300 and the third external electronic device 1001. Electronic devices that first generates the BIG may identify information (e.g., BIG parameters and timings operated by other electronic devices) of the other electronic devices performing the same application (e.g., Samsung BIS), and perform a synchronization operation for transmission timings based on the identified information about the other electronic devices. So, a plurality of electronic devices performing the same application (e.g., Samsung BIS) may transmit audio data without collision via each BIS audio channel.

[0351] For example, if a BIS is a BIS corresponding to the set service (e.g., the multi-party audio service), the second external electronic device 300, the third external electronic device 1001, and/or the fourth external electronic device 1003 may adjust a transmission timing, a reception timing, and/or a transmission resource based on a set protocol which

performs a negotiation operation, or an adjustment operation for a transmission time duration and/or a reception time duration.

[0352] The second external electronic device 300, the third external electronic device 1001, and/or the fourth external electronic device 1003 may perform the set service (e.g., the multi-party audio service) based on the adjusted transmission timing, reception timing, and/or transmission resource, and in this case, not only a transmission operation but also a reception operation may be performed via the BIS, thereby improving efficiency at service operation. Like this, the plurality of electronic devices (e.g., the second external electronic device 300, the third external electronic device 1001, and/or the fourth external electronic device 1003) perform the multi-party audio service by dividing a defined (e.g., limited) transmission resource, so the number of electronic devices which may participate in the multi-party audio service may be limited to less than a set number to maintain service quality.

[0353] According to an embodiment of the disclosure, a method may include establishing a common audio channel which is an audio service link commonly used by an electronic device (101) and at least one external electronic device (102; 104; 200; 300; 1001; 1003; 1005), based on a set condition.

[0354] According to an embodiment of the disclosure, the method may include sharing, with the at least one external electronic device (102; 104; 200; 300; 1001; 1003; 1005), information about the common audio channel and time information used for synchronization for the common audio channel.

[0355] According to an embodiment of the disclosure, the method may include operating in a reception mode in which the electronic device is capable of receiving audio data from the at least one external electronic device for the common audio channel.

[0356] According to an embodiment of the disclosure, the method may include identifying that audio data to be transmitted to the at least one external electronic device exists while operating in the reception mode.

[0357] According to an embodiment of the disclosure, the method may include switching from the reception mode to a transmission mode based on identifying existence of the audio data.

[0358] According to an embodiment of the disclosure, the method may include transmitting, on the common audio channel, the audio data in the transmission mode.

[0359] According to an embodiment of the disclosure, the method may include switching to the reception mode for the common audio channel, based on completion of transmission of the audio data.

[0360] According to an embodiment of the disclosure, the set condition may include at least one of a condition for receiving a packet requesting to generate the common audio channel from at least one of the at least one external electronic device, a condition for identifying a user input requesting to generate the common audio channel, a condition for identifying that a set application is executed, or a condition for identifying that the electronic device enters a set area.

[0361] According to an embodiment of the disclosure, sharing, with the at least one external electronic device, the information about the common audio channel and the time information used for synchronization for the common audio channel may include broadcasting the information about the common audio channel and the time information used for synchronization for the common audio channel in a period of periodic advertising.

[0362] According to an embodiment of the disclosure, sharing, with the at least one external electronic device, the information about the common audio channel and the time information used for synchronization for the common audio channel may include transmitting the information about the common audio channel and the time information used for synchronization for the common audio channel in a communication link established between the electronic device and the at least one external electronic device.

[0363] According to an embodiment of the disclosure, sharing, with the at least one external electronic device, the information about the common audio channel and the time information used for synchronization for the common audio channel may include transmitting, to a server connected to the electronic device and the at least one external electronic device, the information about the common audio channel and the time information used for synchronization for the common audio channel.

[0364] According to an embodiment of the disclosure, establishing the common audio channel which is the audio service link commonly used by the electronic device and the at least one external electronic device, based on the set condition may include determining at least one of an audio transmission service type, a physical link type, an access address, a channel map, audio transmission service parameters, or an audio data transmission/reception timing.

[0365] According to an embodiment of the disclosure, establishing the common audio channel which is the audio service link commonly used by the electronic device and the at least one external electronic device, based on the set condition may include generating the common audio channel based on the determined at least one of the audio transmission service type, the physical link type, the access address, the channel map, the audio transmission service parameters, or the audio data transmission/reception timing.

[0366] According to an embodiment of the disclosure, the audio transmission service type may include at least one of a broadcast isochronous stream (BIS) type or a connected isochronous stream (CIS) type.

[0367] According to an embodiment of the disclosure, if the audio transmission service type is the BIS type, the audio transmission service parameters may include BIS attribute information corresponding to the BIS type.

[0368] According to an embodiment of the disclosure, if the audio transmission service type is the CIS type, the audio transmission service parameters include CIS attribute information corresponding to the CIS type.

[0369] According to an embodiment of the disclosure, a method may include receiving, from at least one external electronic device (101; 104; 300; 1001; 1003; 1005) or a server (108), information about a common audio channel which is an audio service link commonly used by an electronic device (102; 200) and the at least one external electronic device and time information used for synchronization for the common audio channel.

[0370] According to an embodiment of the disclosure, the method may include performing a synchronization operation for the common audio channel based on the information about the common audio channel and the time information used for synchronization for the common audio channel.

[0371] According to an embodiment of the disclosure, the method may include operating in a reception mode in which the electronic device is capable of receiving audio data from the at least one external electronic device for the common audio channel.

[0372] According to an embodiment of the disclosure, the method may include receiving data from the at least one external electronic device while operating in the reception mode.

[0373] According to an embodiment of the disclosure, the method may include identifying that audio data to be transmitted to the at least one external electronic device exists while operating in the reception mode.

[0374] According to an embodiment of the disclosure, the method may include switching from the reception mode to a transmission mode based on identifying existence of the audio data.

[0375] According to an embodiment of the disclosure, the method may include transmitting, on the common audio channel, the audio data in the transmission mode.

[0376] According to an embodiment of the disclosure, the method may include transmitting, to one external electronic device (101) of the at least one external electronic device, a packet requesting to generate the common audio channel based on the set condition.

[0377] According to an embodiment of the disclosure, the set condition may include at least one of a condition for identifying a user input requesting to generate the common audio channel, a condition for identifying that a set application is executed, or a condition for identifying that the electronic device enters a set area.

[0378] According to an embodiment of the disclosure, receiving, from the at least one external electronic device or the server, the information about the common audio channel which is the audio service link commonly used by the electronic device and the at least one external electronic device and the time information used for synchronization for the common audio channel may include receiving, from the at least one external electronic device, the information about the common audio channel and the time information used for synchronization for the common audio channel in a period of periodic advertising.

[0379] According to an embodiment of the disclosure, receiving, from the at least one external electronic device or the server, the information about the common audio channel which is the audio service link commonly used by the electronic device and the at least one external electronic device and the time information used for synchronization for the common audio channel may include receiving the information about the common audio channel and the time information used for synchronization for the common audio channel in a communication link established between the electronic device and the at least one external electronic device.

[0380] According to an embodiment of the disclosure, receiving, from the at least one external electronic device or the server, the information about the common audio channel which is the audio service link commonly used by the electronic device and the at least one external electronic device and the time information used for synchronization for the common audio channel may include receiving, from a server connected to the electronic device and the at least one external electronic device, the information about the common audio channel and the time information used for synchronization for the common audio channel.

[0381] According to an embodiment of the disclosure, the common audio channel may be generated based on at least one of an audio transmission service type, a physical link type, an access address, a channel map, audio transmission service parameters, or an audio data transmission/reception timing.

[0382] According to an embodiment of the disclosure, the audio transmission service type may include at least one of a broadcast isochronous stream (BIS) type or a connected isochronous stream (CIS) type.

[0383] According to an embodiment of the disclosure, if the audio transmission service type is the BIS type, the audio transmission service parameters may include BIS attribute information corresponding to the BIS type.

[0384] According to an embodiment of the disclosure, if the audio transmission service type is the CIS type, the audio transmission service parameters may include CIS attribute information corresponding to the CIS type.

[0385] According to an embodiment of the disclosure, a storage medium storing at least one computer-readable instruction may be provided.

[0386] According to an embodiment of the disclosure, the at least one instruction, when executed by at least one processor (120) of an electronic device (101), may cause the electronic device to perform at least one operation.

[0387] According to an embodiment of the disclosure, the at least one operation may include establishing a common

audio channel which is an audio service link commonly used by the electronic device and at least one external electronic device (102; 104; 200; 300; 1001; 1003; 1005), based on a set condition.

[0388] According to an embodiment of the disclosure, the at least one operation may include sharing, with the at least one external electronic device (102; 104; 200; 300; 1001; 1003; 1005), information about the common audio channel and time information used for synchronization for the common audio channel.

[0389] According to an embodiment of the disclosure, the at least one operation may include operating in a reception mode in which the electronic device is capable of receiving audio data from the at least one external electronic device for the common audio channel.

[0390] According to an embodiment of the disclosure, a storage medium storing at least one computer-readable instruction may be provided.

[0391] According to an embodiment of the disclosure, the at least one instruction, when executed by at least one processor (120) of an electronic device (102; 200), may cause the electronic device to perform at least one operation.

[0392] According to an embodiment of the disclosure, the at least one operation includes receiving, from at least one external electronic device (101; 104; 300; 1001; 1003; 1005) or a server (108) via the at least one communication circuit, information about a common audio channel which is an audio service link commonly used by the electronic device and the at least one external electronic device and time information used for synchronization for the common audio channel.

[0393] According to an embodiment of the disclosure, the at least one operation may include performing a synchronization operation for the common audio channel based on the information about the common audio channel and the time information used for synchronization for the common audio channel.

[0394] According to an embodiment of the disclosure, the at least one operation may include operating in a reception mode in which the electronic device is capable of receiving audio data from the at least one external electronic device for the common audio channel.

Claims

1. An electronic device (101), comprising:

at least one communication circuit (190);
at least one processor (120); and
memory (130) storing instructions that, when executed by the at least one processor, cause the electronic device to:

establish a common audio channel which is an audio service link commonly used by the electronic device and at least one external electronic device (102; 104; 200; 300; 1001; 1003; 1005), based on a set condition,
share, with the at least one external electronic device (102; 104; 200; 300; 1001; 1003; 1005) via the at least one communication circuit, information about the common audio channel and time information used for synchronization for the common audio channel, and
operate in a reception mode in which the electronic device is capable of receiving audio data from the at least one external electronic device for the common audio channel.

2. The electronic device of claim 1, wherein the instructions, when executed by the at least one processor, cause the electronic device to:

identify that audio data to be transmitted to the at least one external electronic device exists while operating in the reception mode,
switch from the reception mode to a transmission mode based on identifying existence of the audio data, and transmit, on the common audio channel via the at least one communication circuit, the audio data in the transmission mode.

3. The electronic device of claim 2, wherein the instructions, when executed by the at least one processor, cause the electronic device to:
switch to the reception mode for the common audio channel, based on completion of transmission of the audio data.

4. The electronic device of any one of claims 1 to 3, wherein the set condition includes at least one of:

a condition for receiving a packet requesting to generate the common audio channel from at least one of the at least one external electronic device,

a condition for identifying a user input requesting to generate the common audio channel,
a condition for identifying that a set application is executed, or
a condition for identifying that the electronic device enters a set area.

5. The electronic device of any one of claims 1 to 4, wherein the instructions, when executed by the at least one processor, cause the electronic device to:
broadcast, via the at least one communication circuit, the information about the common audio channel and the time information used for synchronization for the common audio channel in a period of periodic advertising.

6. The electronic device of any one of claims 1 to 4, wherein the instructions, when executed by the at least one processor, cause the electronic device to:

transmit, via the at least one communication circuit, the information about the common audio channel and the time information used for synchronization for the common audio channel in a communication link established between the electronic device and the at least one external electronic device, or
transmit, to a server connected to the electronic device and the at least one external electronic device via the at least one communication circuit, the information about the common audio channel and the time information used for synchronization for the common audio channel.

7. The electronic device of any one of claims 1 to 6, wherein the instructions, when executed by the at least one processor, cause the electronic device to:

determine at least one of an audio transmission service type, a physical link type, an access address, a channel map, audio transmission service parameters, or an audio data transmission/reception timing, and
generate the common audio channel based on the determined at least one of the audio transmission service type, the physical link type, the access address, the channel map, the audio transmission service parameters, or the audio data transmission/reception timing.

8. The electronic device of claim 7, wherein the audio transmission service type includes at least one of a broadcast isochronous stream (BIS) type or a connected isochronous stream (CIS) type.

9. The electronic device of claim 8, wherein, if the audio transmission service type is the BIS type, the audio transmission service parameters include BIS attribute information corresponding to the BIS type, or
wherein, if the audio transmission service type is the CIS type, the audio transmission service parameters include CIS attribute information corresponding to the CIS type.

10. An electronic device (102; 200), comprising:

at least one communication circuit (190);
at least one processor (120); and
memory (130) storing instructions that, when executed by the at least one processor, cause the electronic device to:

receive, from at least one external electronic device (101; 104; 300; 1001; 1003; 1005) or a server (108) via the at least one communication circuit, information about a common audio channel which is an audio service link commonly used by the electronic device and the at least one external electronic device and time information used for synchronization for the common audio channel,
perform a synchronization operation for the common audio channel based on the information about the common audio channel and the time information used for synchronization for the common audio channel, and
operate in a reception mode in which the electronic device is capable of receiving audio data from the at least one external electronic device for the common audio channel.

11. The electronic device of claim 10, wherein the instructions, when executed by the at least one processor, cause the electronic device to:
receive data from the at least one external electronic device via the at least one communication circuit while operating in the reception mode.

12. The electronic device of claim 10, wherein the instructions, when executed by the at least one processor, cause the electronic device to:

identify that audio data to be transmitted to the at least one external electronic device exists while operating in the reception mode,
switch from the reception mode to a transmission mode based on identifying existence of the audio data, and transmit, on the common audio channel via the at least one communication circuit, the audio data in the transmission mode.

13. The electronic device of any one of claims 10 to 12, wherein the instructions, when executed by the at least one processor, cause the electronic device to:

transmit, to one external electronic device (101) of the at least one external electronic device via the at least one communication circuit, a packet requesting to generate the common audio channel based on the set condition, and
wherein the set condition includes at least one of:

a condition for identifying a user input requesting to generate the common audio channel,
a condition for identifying that a set application is executed, or
a condition for identifying that the electronic device enters a set area.

14. The electronic device of any one of claims 10 to 13, wherein the instructions, when executed by the at least one processor, cause the electronic device to:
receive, from the at least one external electronic device via the at least one communication circuit, the information about the common audio channel and the time information used for synchronization for the common audio channel in a period of periodic advertising.

15. A storage medium storing at least one computer-readable instruction, the at least one instruction that, when executed by at least one processor (120) of an electronic device (101), cause the electronic device to perform at least one operation, the at least one operation comprising:

establishing a common audio channel which is an audio service link commonly used by the electronic device and at least one external electronic device (102; 104; 200; 300; 1001; 1003; 1005), based on a set condition,
sharing, with the at least one external electronic device (102; 104; 200; 300; 1001; 1003; 1005), information about the common audio channel and time information used for synchronization for the common audio channel, and
operating in a reception mode in which the electronic device is capable of receiving audio data from the at least one external electronic device for the common audio channel.

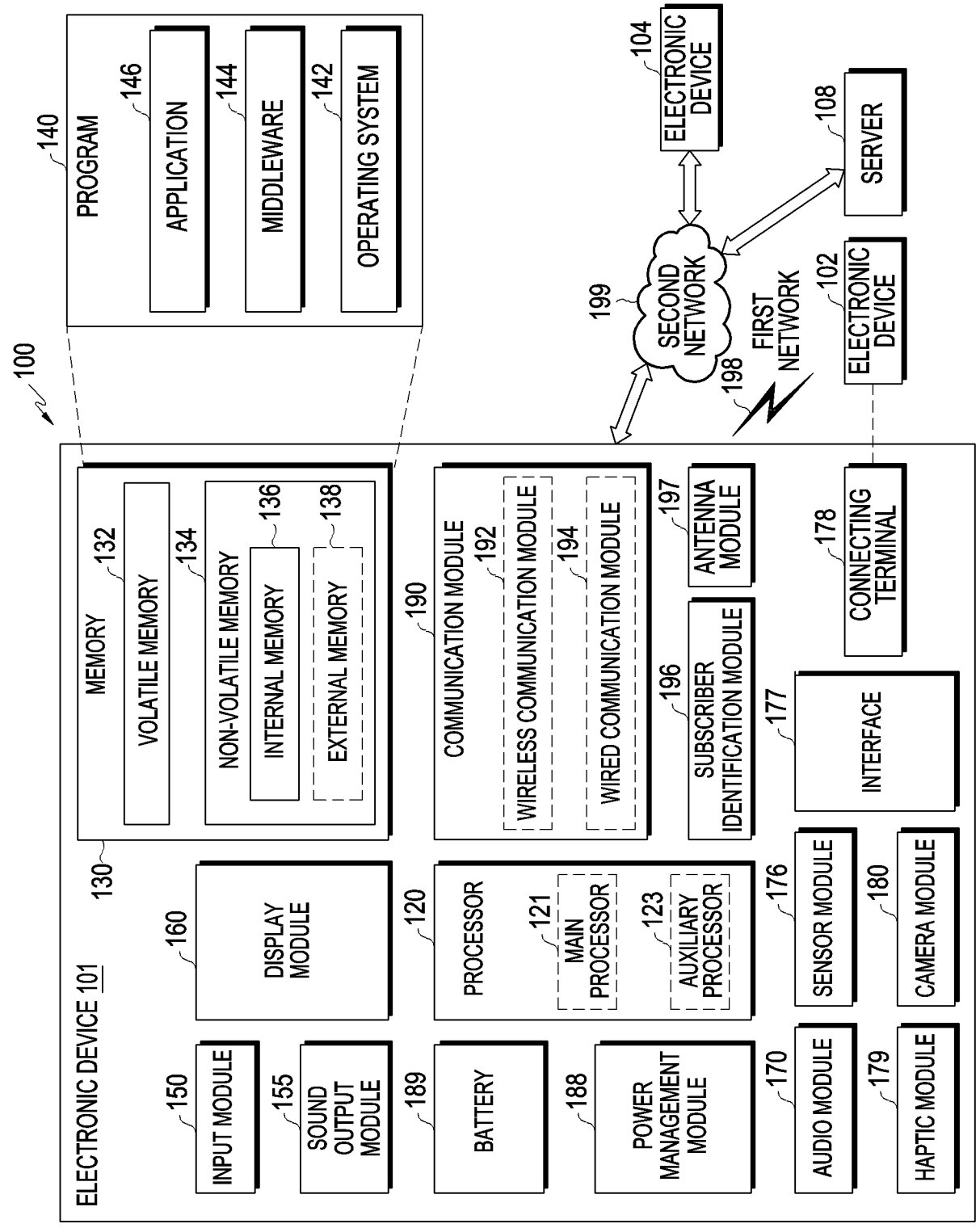
100
ELECTRONIC DEVICE 101
130
PROGRAM
140
APPLICATION
146
MIDDLEWARE
144
OPERATING SYSTEM
142
MEMORY
132
VOLATILE MEMORY
134
NON-VOLATILE MEMORY
136
INTERNAL MEMORY
138
EXTERNAL MEMORY
COMMUNICATION MODULE
190
WIRELESS COMMUNICATION MODULE
192
WIRED COMMUNICATION MODULE
194
ANTENNA MODULE
197
SUBSCRIBER IDENTIFICATION MODULE
196
CONNECTING TERMINAL
178
INTERFACE
177
DISPLAY MODULE
160
PROCESSOR
120
MAIN PROCESSOR
121
AUXILIARY PROCESSOR
123
SENSOR MODULE
176
CAMERA MODULE
180
INPUT MODULE
150
SOUND OUTPUT MODULE
155
BATTERY
189
POWER MANAGEMENT MODULE
188
AUDIO MODULE
170
HAPTIC MODULE
179
199
SECOND NETWORK
198
FIRST NETWORK
ELECTRONIC DEVICE
104
SERVER
108
ELECTRONIC DEVICE
102

FIG. 1

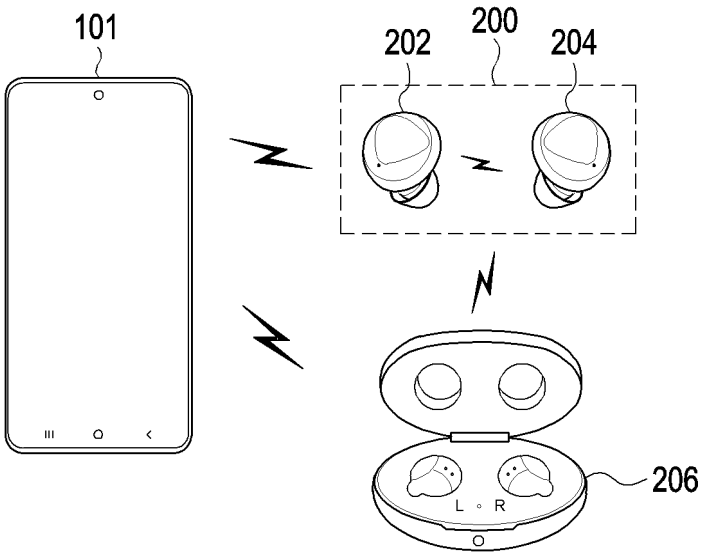
101
202
200
204
206
L R

FIG. 2

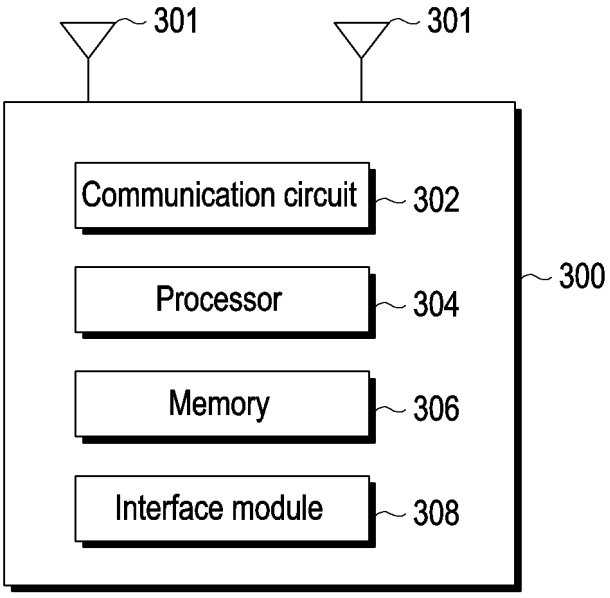
301
301
Communication circuit
302
Processor
304
Memory
306
Interface module
308
300

FIG. 3

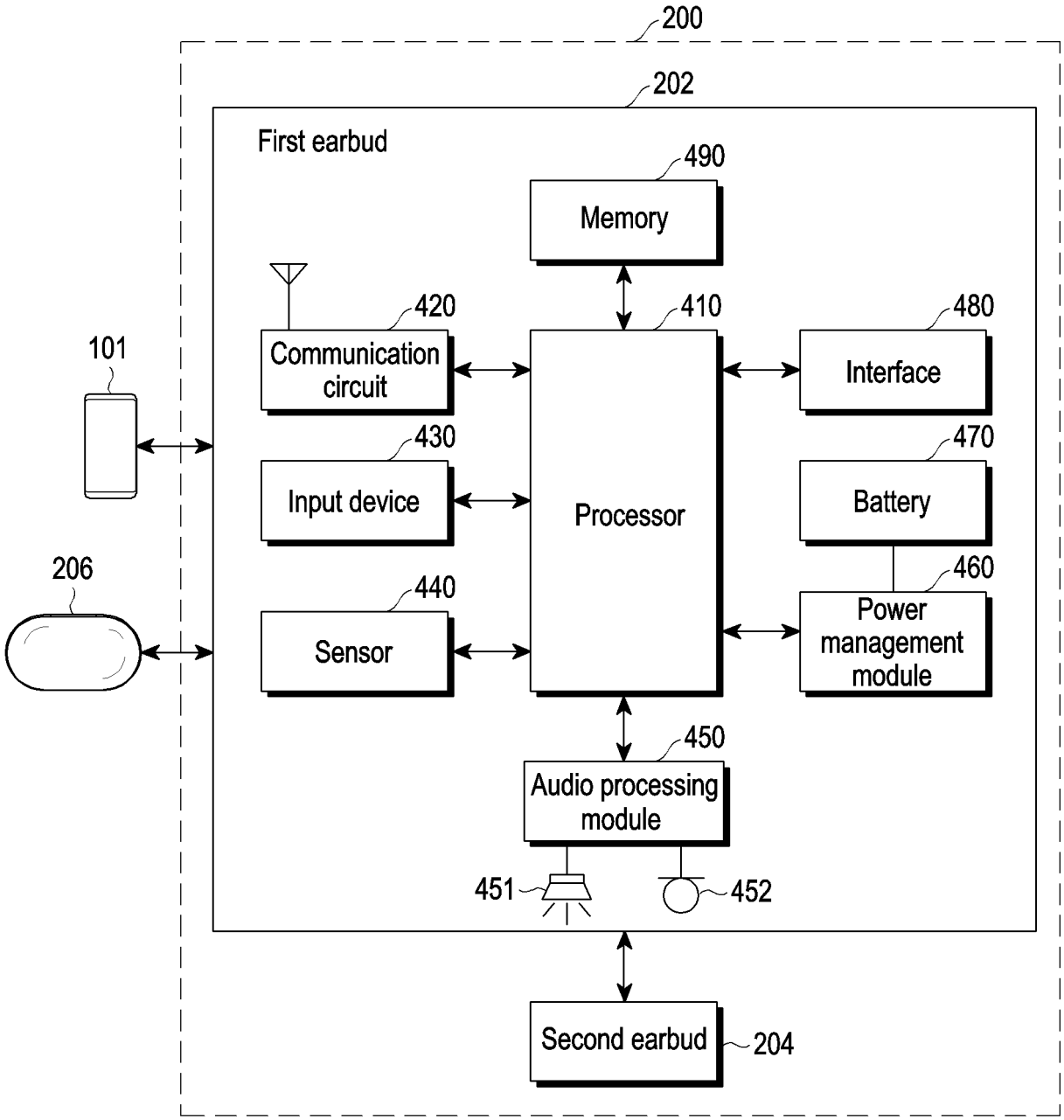
200
202
First earbud
490
Memory
420
410
480
Communication circuit
Interface
101
430
470
Input device
Processor
Battery
206
440
460
Sensor
Power management module
450
Audio processing module
451
452
Second earbud
204

FIG. 4

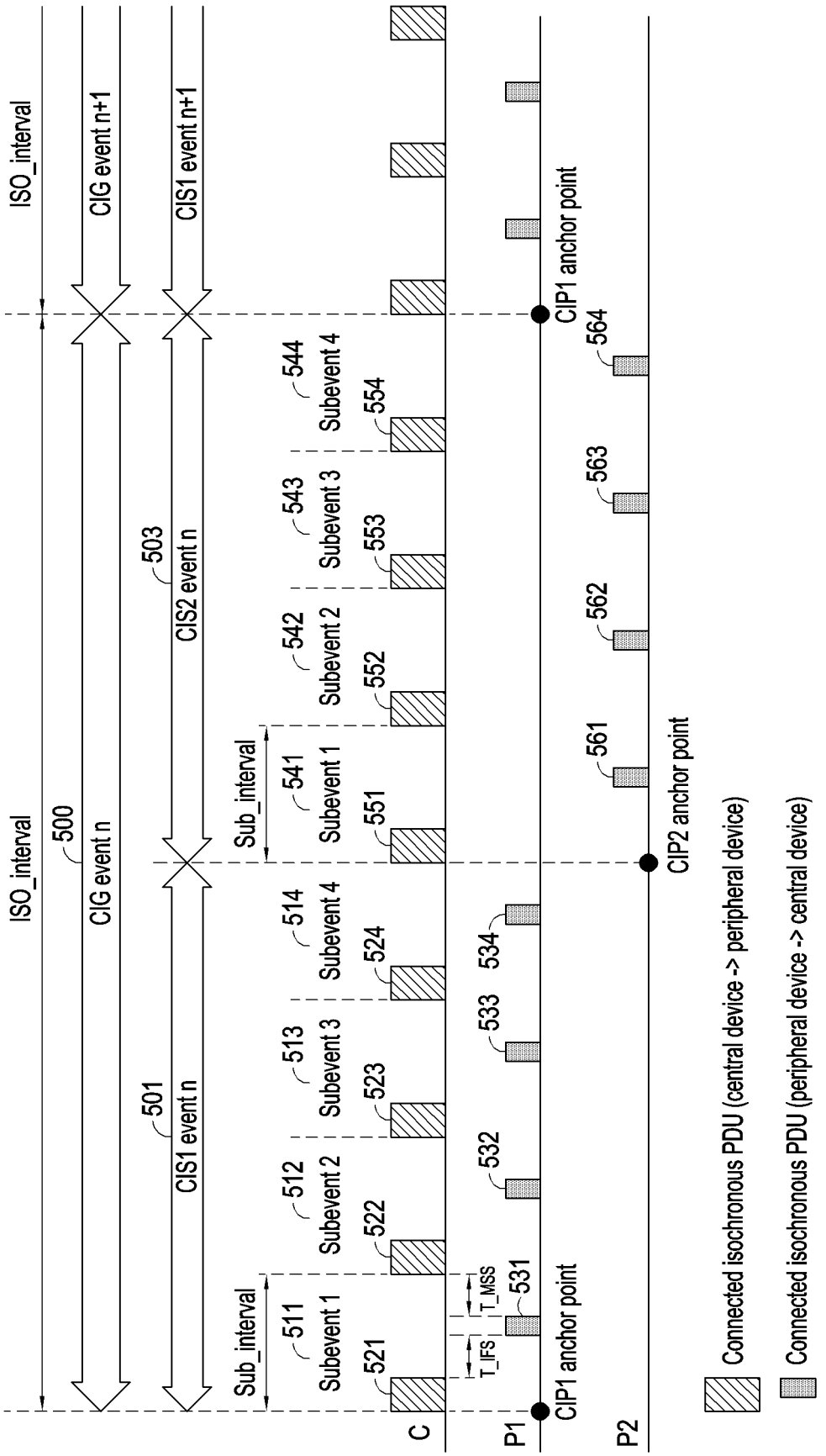
ISO_interval
500
CIG event n
CIG event n+1
501
CIS1 event n
503
CIS2 event n
CIS1 event n+1
Sub_interval
511
Subevent 1
512
Subevent 2
513
Subevent 3
514
Subevent 4
541
Subevent 1
542
Subevent 2
543
Subevent 3
544
Subevent 4
521
522
523
524
531
532
533
534
551
552
553
554
561
562
563
564
T_IFS
T_MSS
C
P1
P2
CIP1 anchor point
CIP2 anchor point
Connected isochronous PDU (central device -> peripheral device)
Connected isochronous PDU (peripheral device -> central device)

FIG. 5

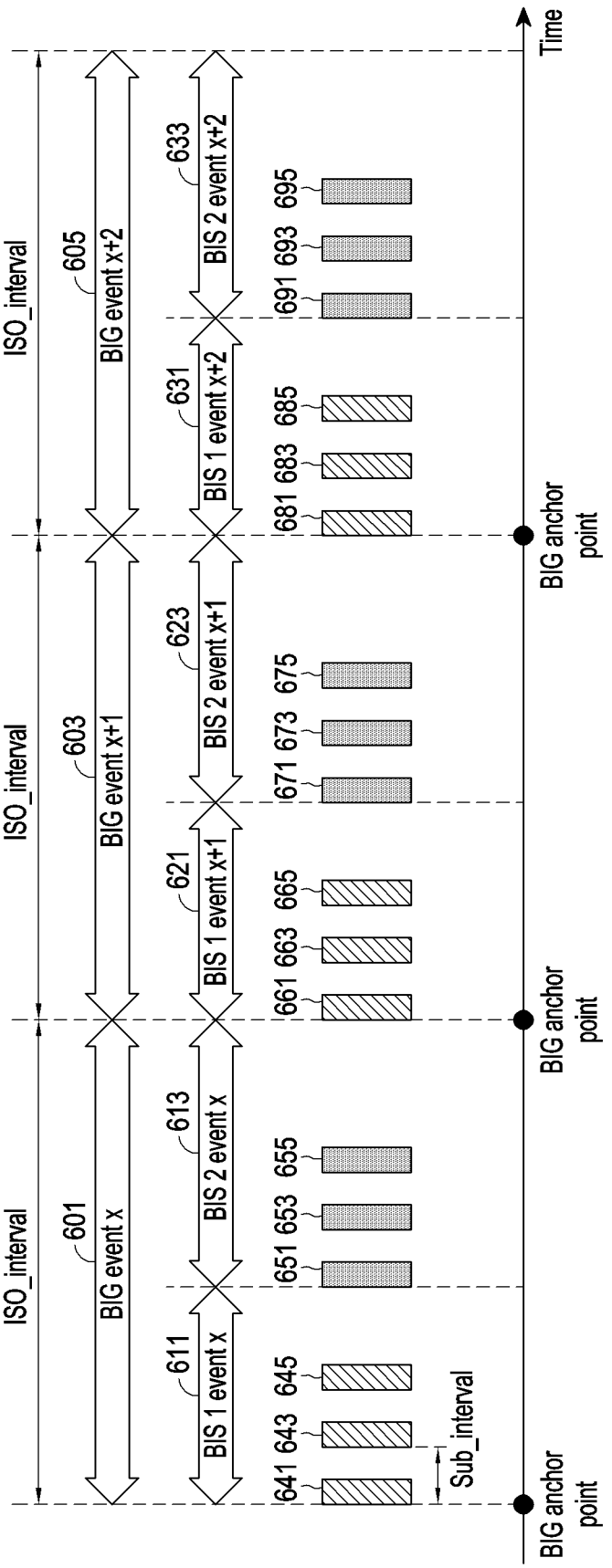
Time
ISO_interval
ISO_interval
ISO_interval
601
BIG event x
603
BIG event x+1
605
BIG event x+2
611
BIS 1 event x
613
BIS 2 event x
621
BIS 1 event x+1
623
BIS 2 event x+1
631
BIS 1 event x+2
633
BIS 2 event x+2
641 643 645
651 653 655
661 663 665
671 673 675
681 683 685
691 693 695
Sub_interval
BIG anchor point
BIG anchor point
BIG anchor point
Broadcast isochronous PDU in BIS1
Broadcast isochronous PDU in BIS2

FIG. 6

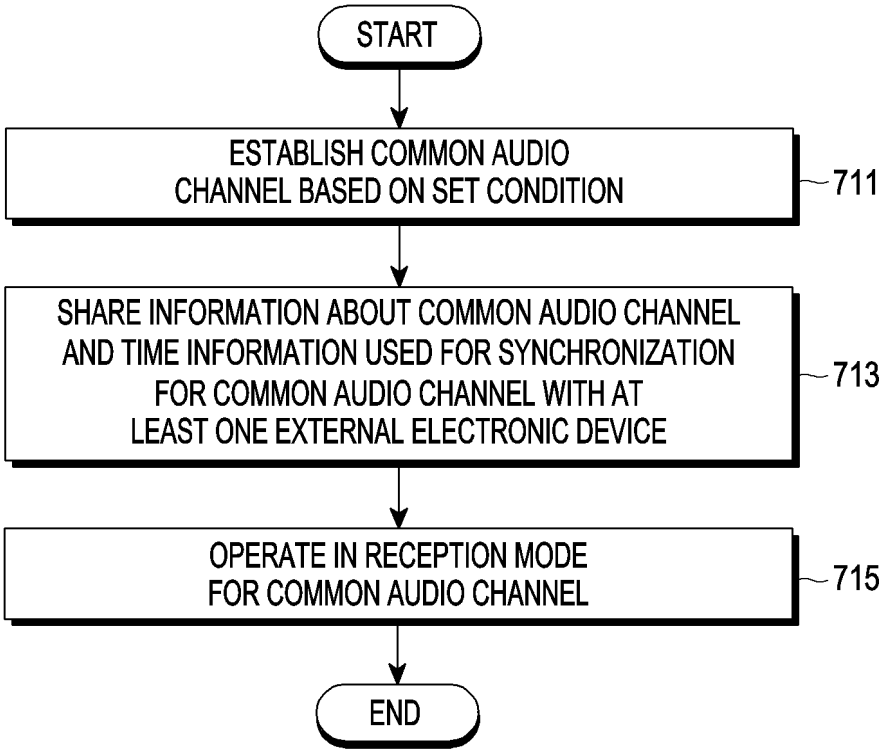
START
ESTABLISH COMMON AUDIO CHANNEL BASED ON SET CONDITION
711
SHARE INFORMATION ABOUT COMMON AUDIO CHANNEL AND TIME INFORMATION USED FOR SYNCHRONIZATION FOR COMMON AUDIO CHANNEL WITH AT LEAST ONE EXTERNAL ELECTRONIC DEVICE
713
OPERATE IN RECEPTION MODE FOR COMMON AUDIO CHANNEL
715
END

FIG. 7

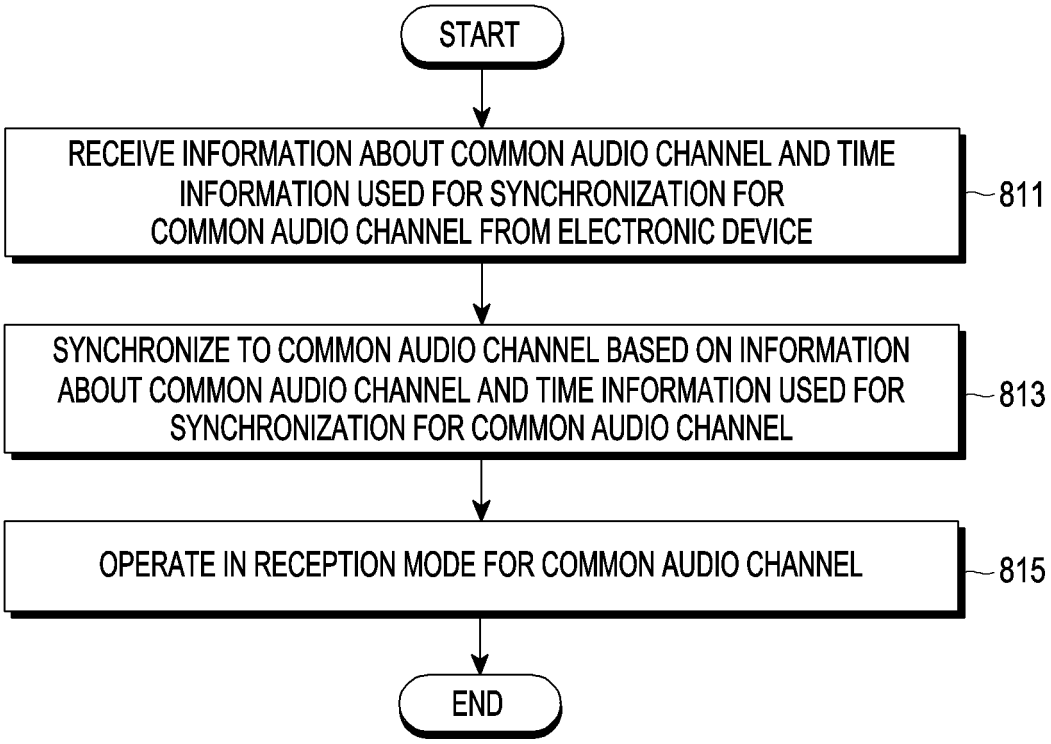
START
RECEIVE INFORMATION ABOUT COMMON AUDIO CHANNEL AND TIME INFORMATION USED FOR SYNCHRONIZATION FOR COMMON AUDIO CHANNEL FROM ELECTRONIC DEVICE
811
SYNCHRONIZE TO COMMON AUDIO CHANNEL BASED ON INFORMATION ABOUT COMMON AUDIO CHANNEL AND TIME INFORMATION USED FOR SYNCHRONIZATION FOR COMMON AUDIO CHANNEL
813
OPERATE IN RECEPTION MODE FOR COMMON AUDIO CHANNEL
815
END

FIG. 8

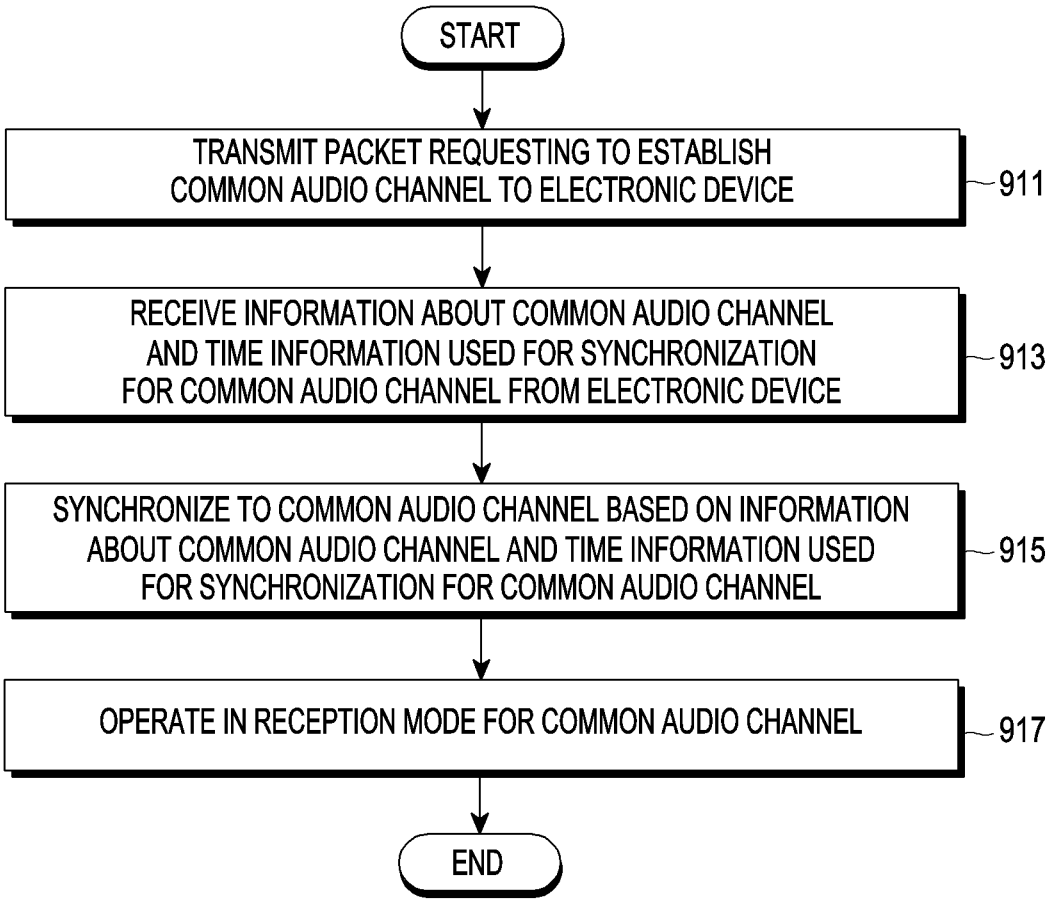
START
TRANSMIT PACKET REQUESTING TO ESTABLISH COMMON AUDIO CHANNEL TO ELECTRONIC DEVICE
911
RECEIVE INFORMATION ABOUT COMMON AUDIO CHANNEL AND TIME INFORMATION USED FOR SYNCHRONIZATION FOR COMMON AUDIO CHANNEL FROM ELECTRONIC DEVICE
913
SYNCHRONIZE TO COMMON AUDIO CHANNEL BASED ON INFORMATION ABOUT COMMON AUDIO CHANNEL AND TIME INFORMATION USED FOR SYNCHRONIZATION FOR COMMON AUDIO CHANNEL
915
OPERATE IN RECEPTION MODE FOR COMMON AUDIO CHANNEL
917
END

FIG. 9

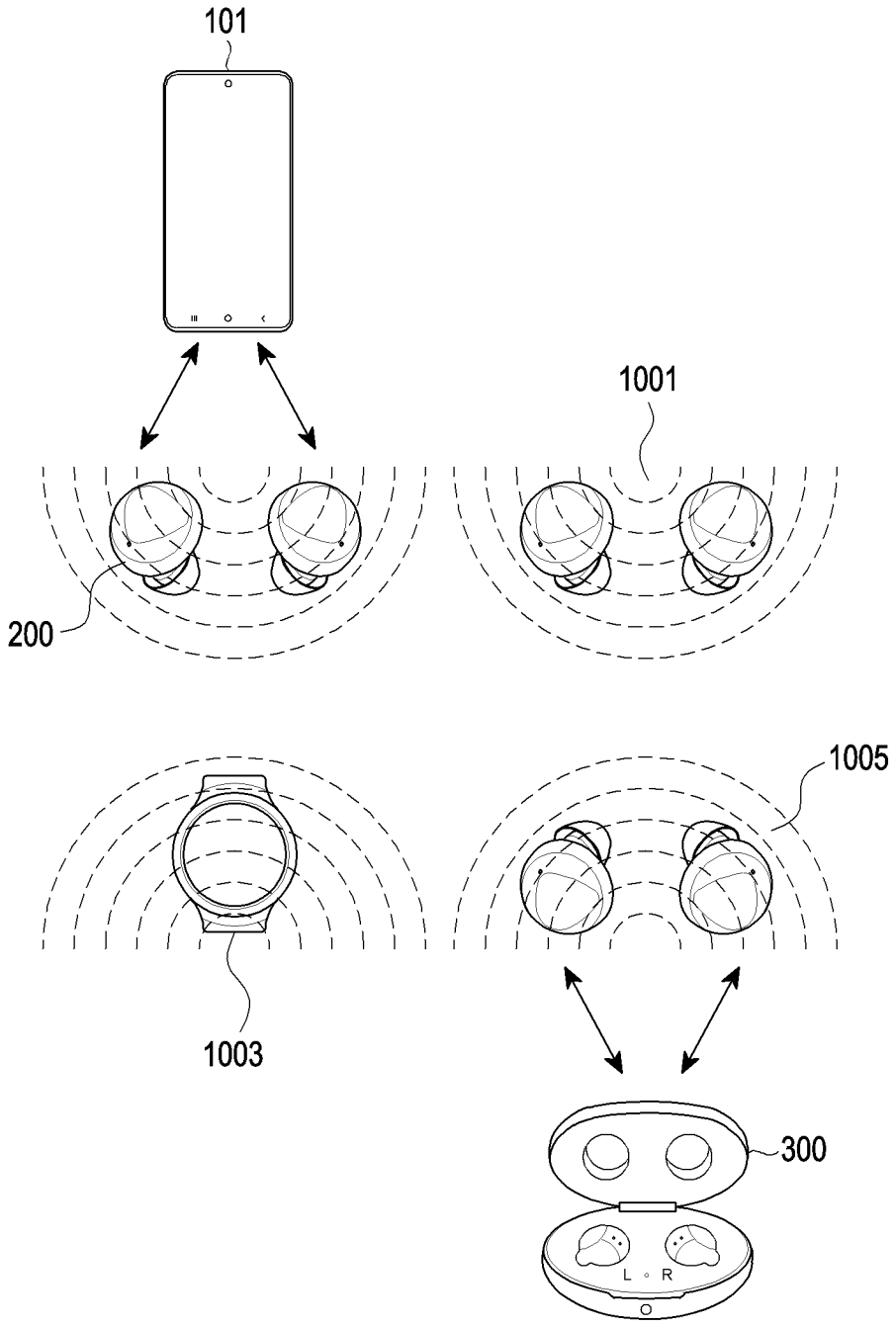

FIG. 10

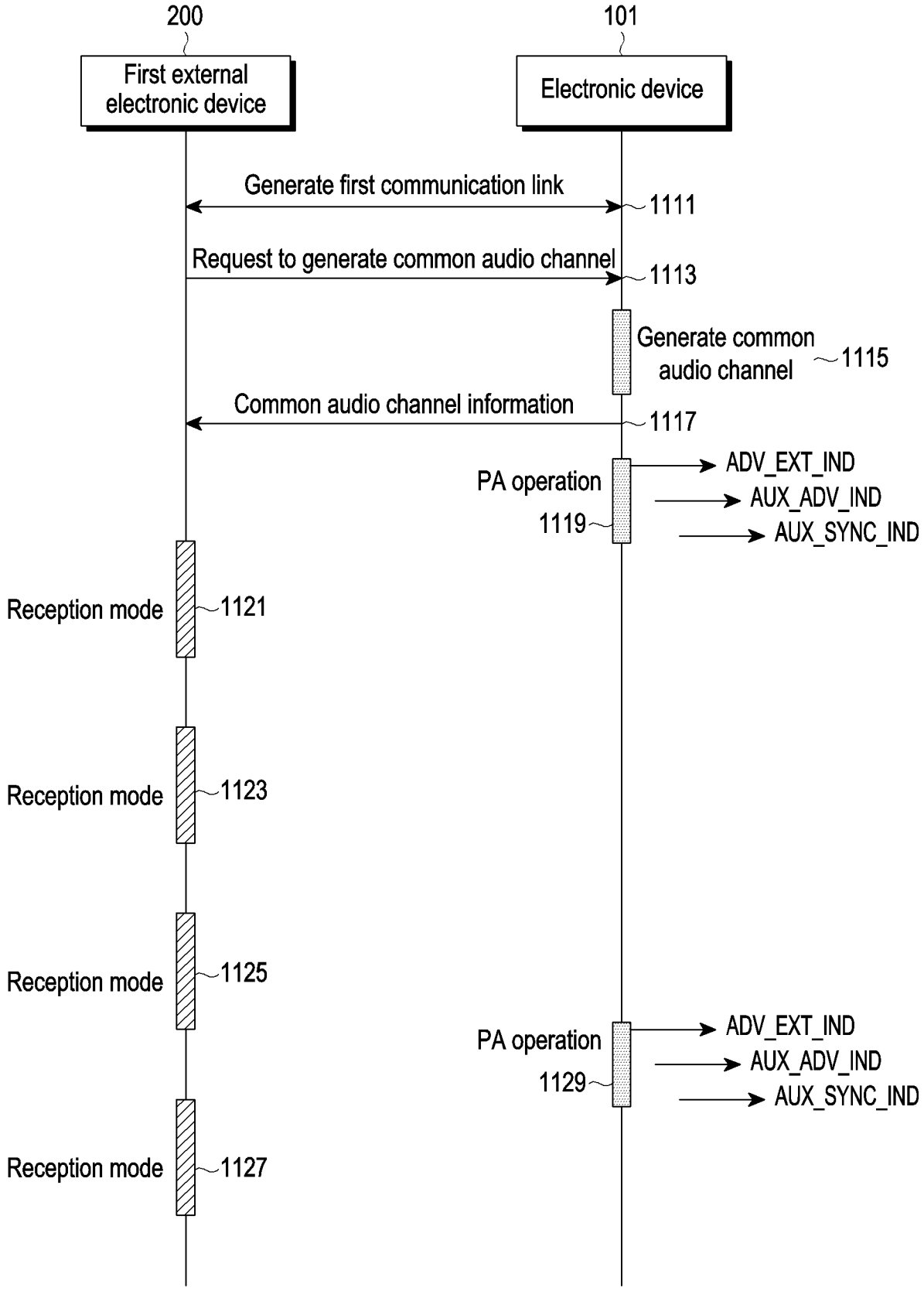
200
First external electronic device
101
Electronic device
Generate first communication link
1111
Request to generate common audio channel
1113
Generate common audio channel
1115
Common audio channel information
1117
PA operation
1119
ADV_EXT_IND
AUX_ADV_IND
AUX_SYNC_IND
Reception mode
1121
Reception mode
1123
Reception mode
1125
Reception mode
1127
PA operation
1129
ADV_EXT_IND
AUX_ADV_IND
AUX_SYNC_IND

FIG. 11

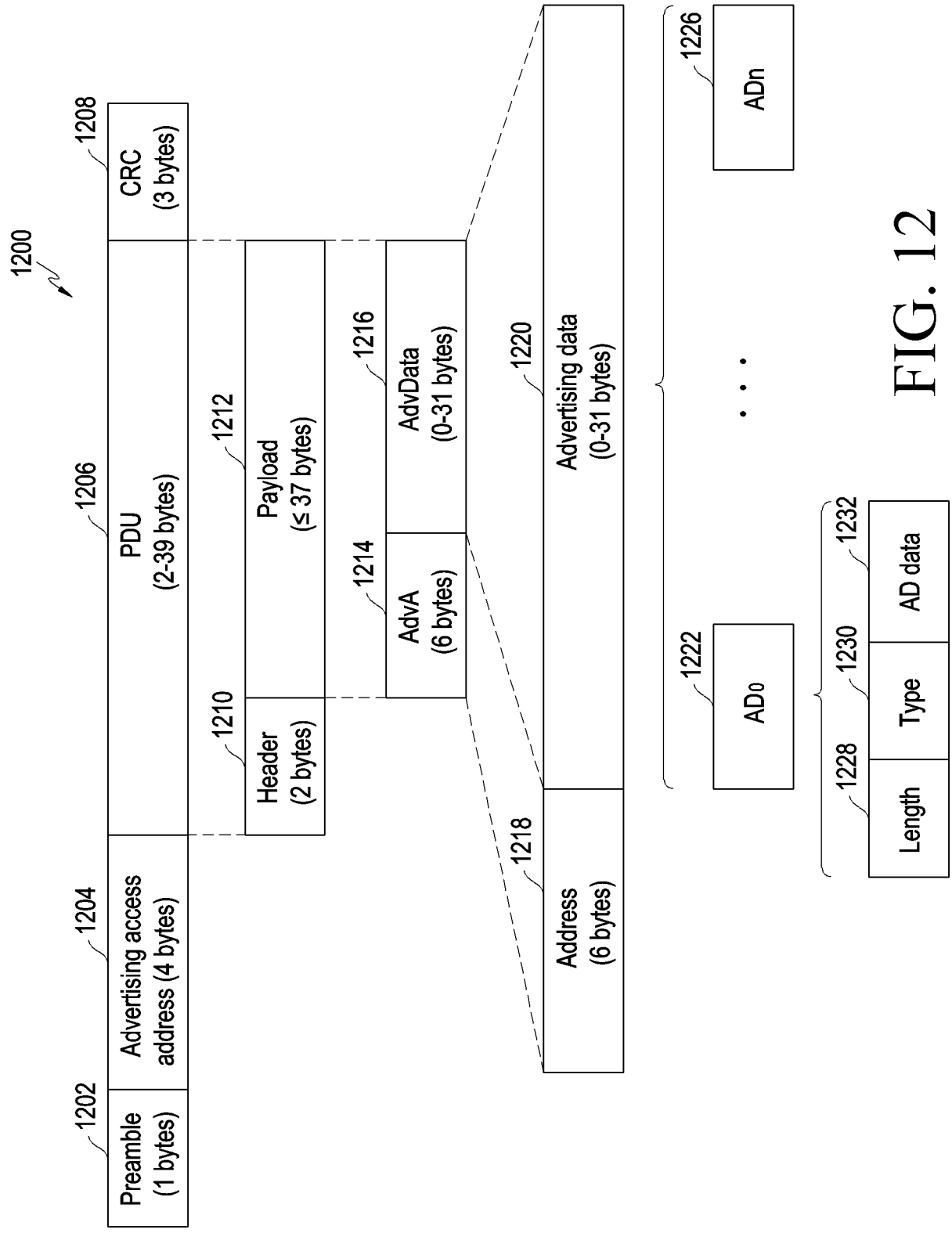
1200
1202
Preamble (1 bytes)
1204
Advertising access address (4 bytes)
1206
PDU (2-39 bytes)
1208
CRC (3 bytes)
1210
Header (2 bytes)
1212
Payload (≤ 37 bytes)
1214
AdvA (6 bytes)
1216
AdvData (0-31 bytes)
1218
Address (6 bytes)
1220
Advertising data (0-31 bytes)
1222
AD0
1226
ADn
1228
Length
1230
Type
1232
AD data

FIG. 12

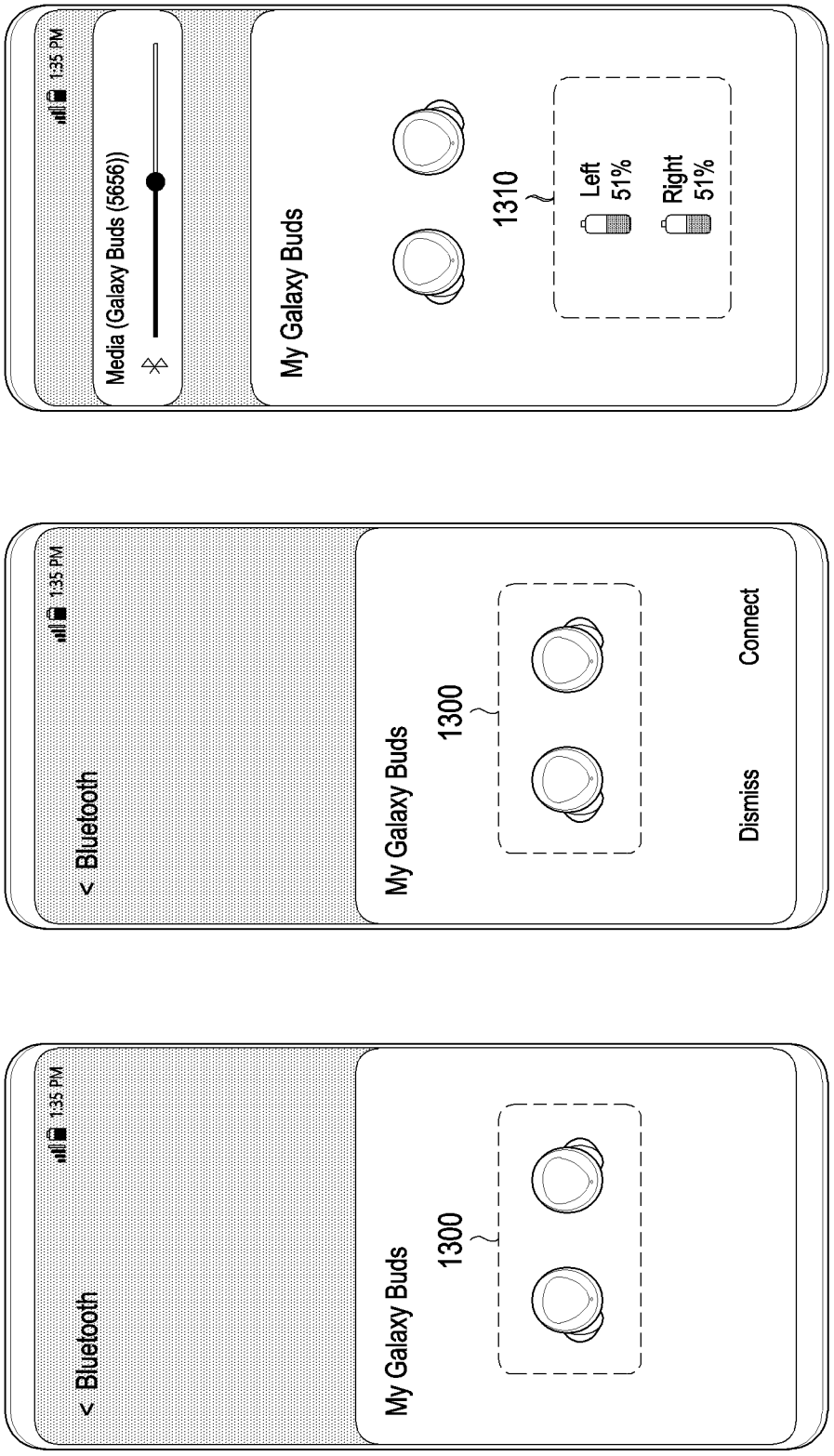
1:35 PM
< Bluetooth
My Galaxy Buds
1300
Dismiss
Connect
1:35 PM
< Bluetooth
My Galaxy Buds
1300
1:35 PM
Media (Galaxy Buds (5656))
My Galaxy Buds
1310
Left
51%
Right
51%

FIG. 13

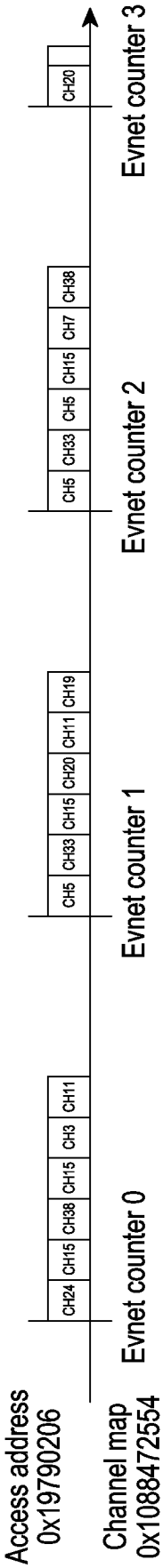
1400
Access address
0x19790206
Channel map
0x1088472554
Evnet counter 0
Evnet counter 1
Evnet counter 2
Evnet counter 3
CH24
CH15
CH38
CH15
CH3
CH11
CH5
CH33
CH15
CH20
CH11
CH19
CH5
CH33
CH5
CH15
CH7
CH38
CH20

FIG. 14

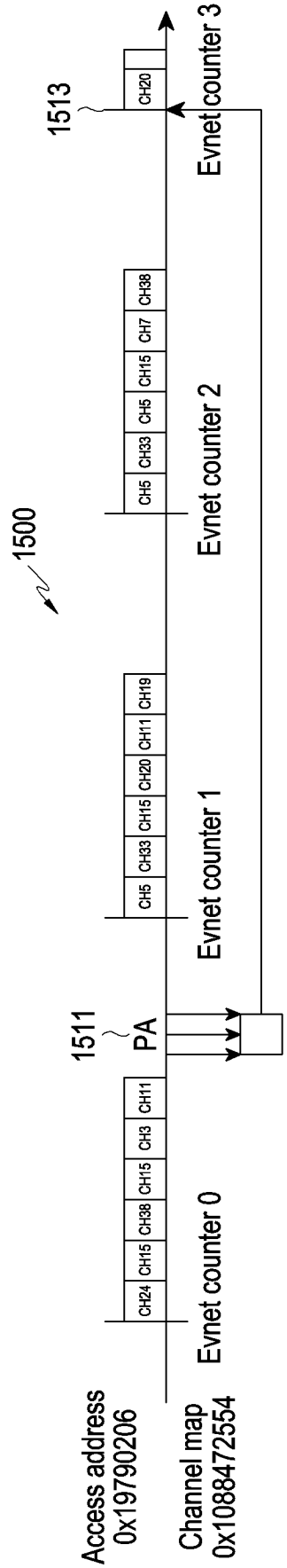
1500
1513
1511
PA
Access address
0x19790206
Channel map
0x1088472554
Evnet counter 0
Evnet counter 1
Evnet counter 2
Evnet counter 3
CH24
CH15
CH38
CH15
CH3
CH11
CH5
CH33
CH15
CH20
CH11
CH19
CH5
CH33
CH5
CH15
CH7
CH38
CH20

FIG. 15

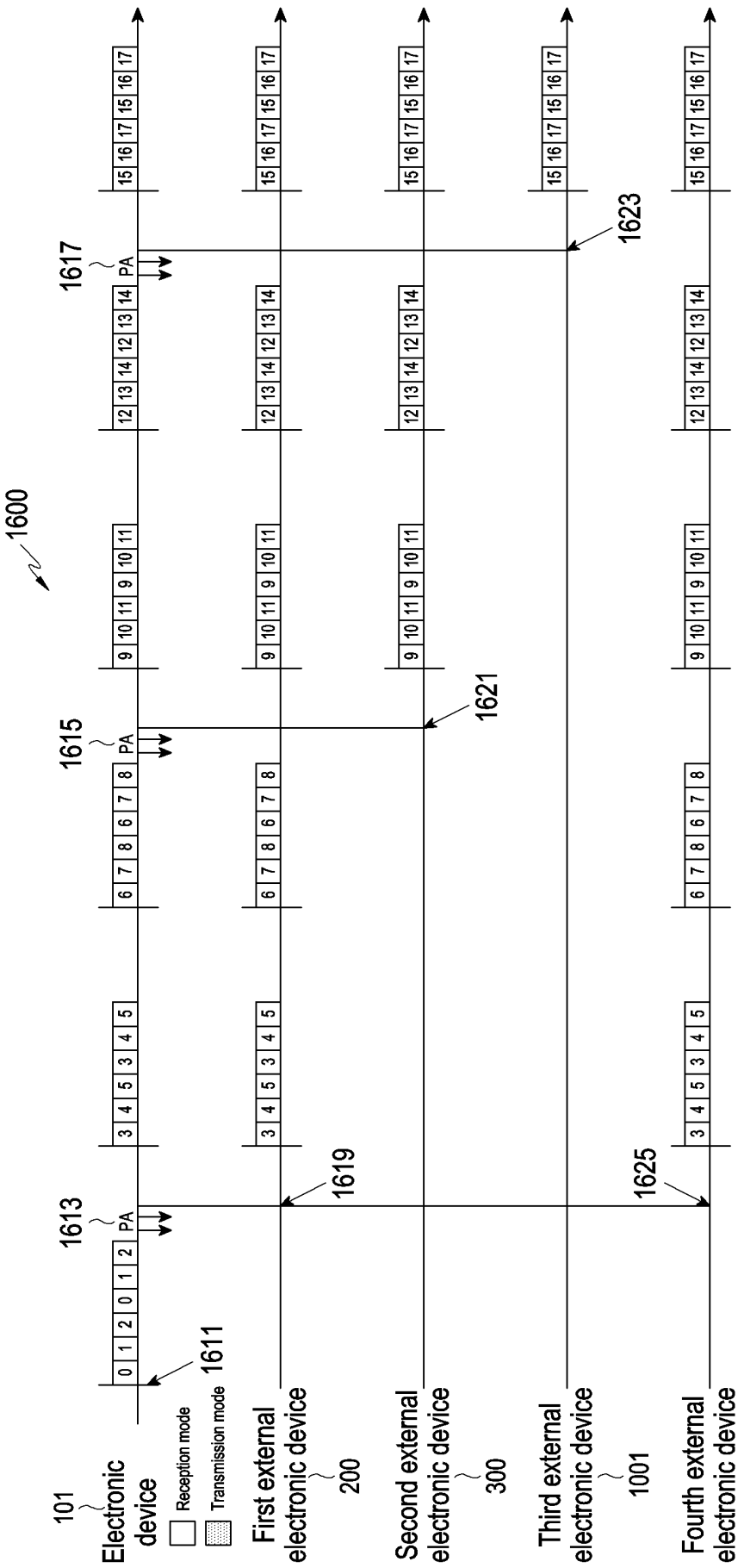
1600
1611
1613
1615
1617
1619
1621
1623
1625
PA
Electronic device
101
Reception mode
Transmission mode
First external electronic device
200
Second external electronic device
300
Third external electronic device
1001
Fourth external electronic device
1003

FIG. 16

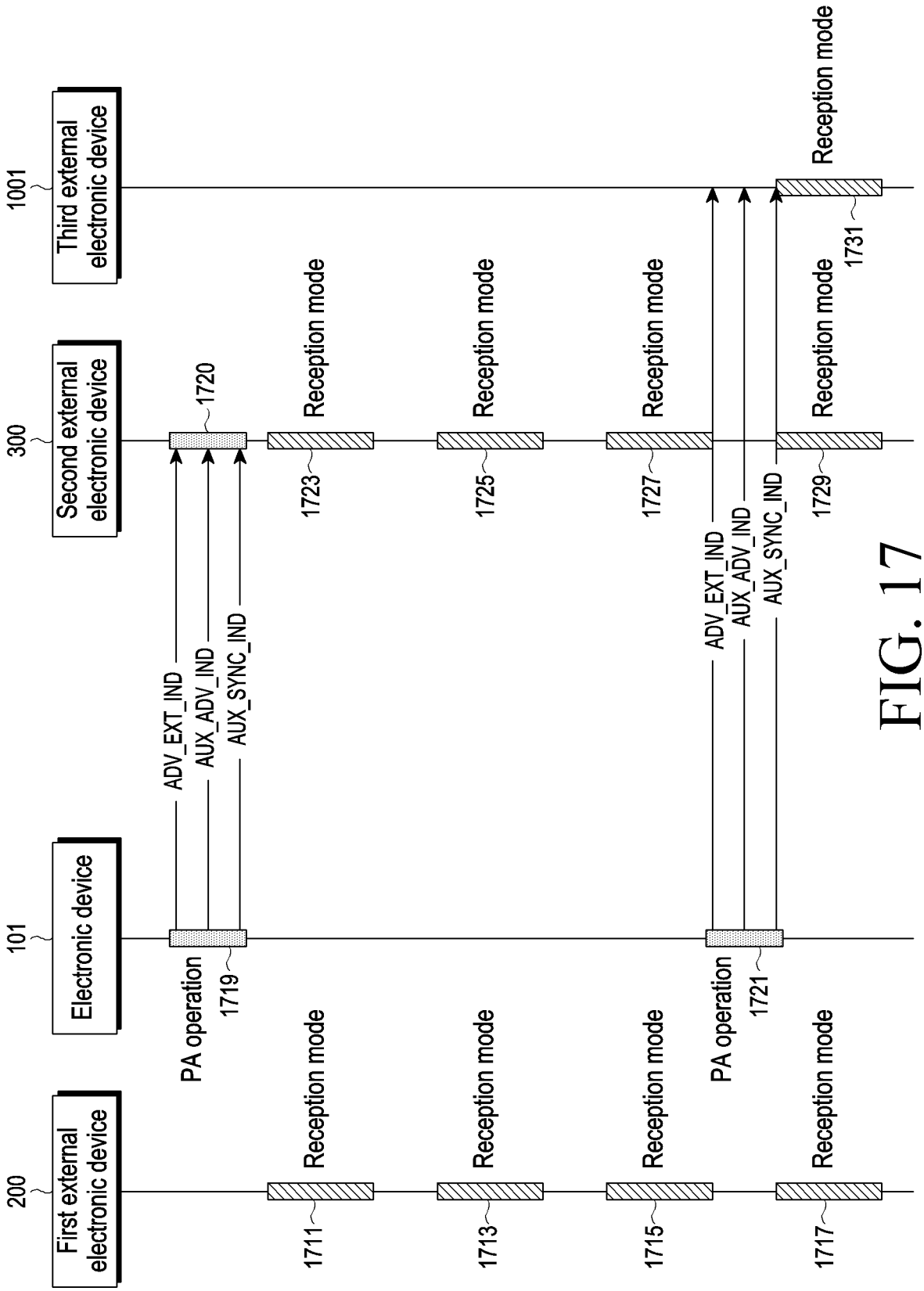
200
First external electronic device
101
Electronic device
300
Second external electronic device
1001
Third external electronic device
ADV_EXT_IND
AUX_ADV_IND
AUX_SYNC_IND
PA operation
1719
1720
Reception mode
1711
1713
1715
1717
1721
1723
1725
1727
1729
1731

FIG. 17

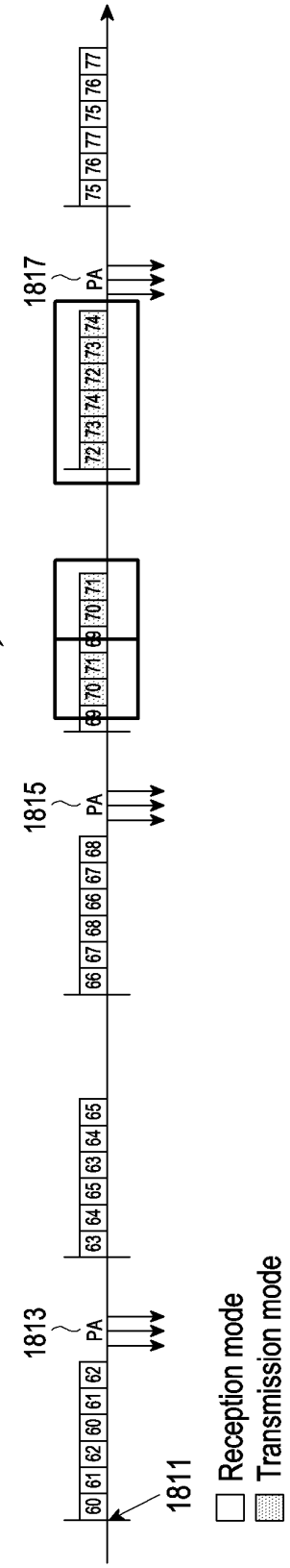
101
Electronic device
1800
1811
1813
PA
1815
PA
1817
PA
Reception mode
Transmission mode

FIG. 18

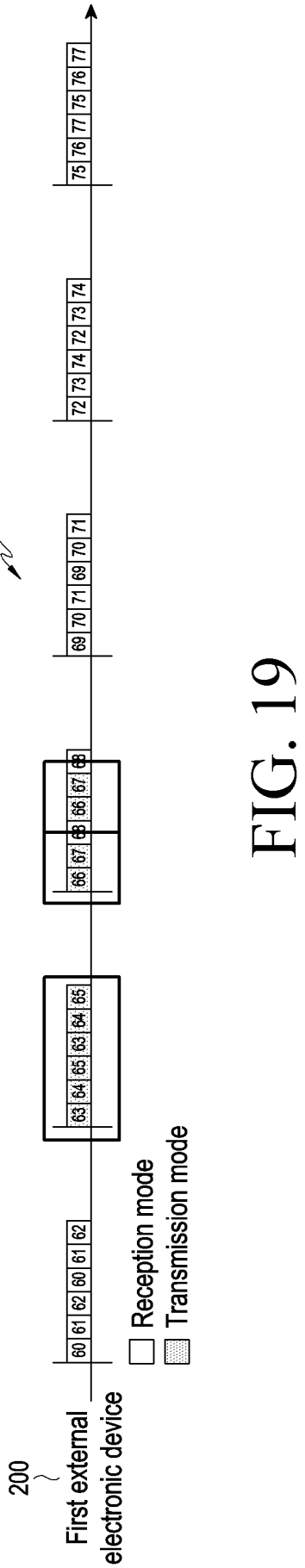
200
First external electronic device
1900
Reception mode
Transmission mode

FIG. 19

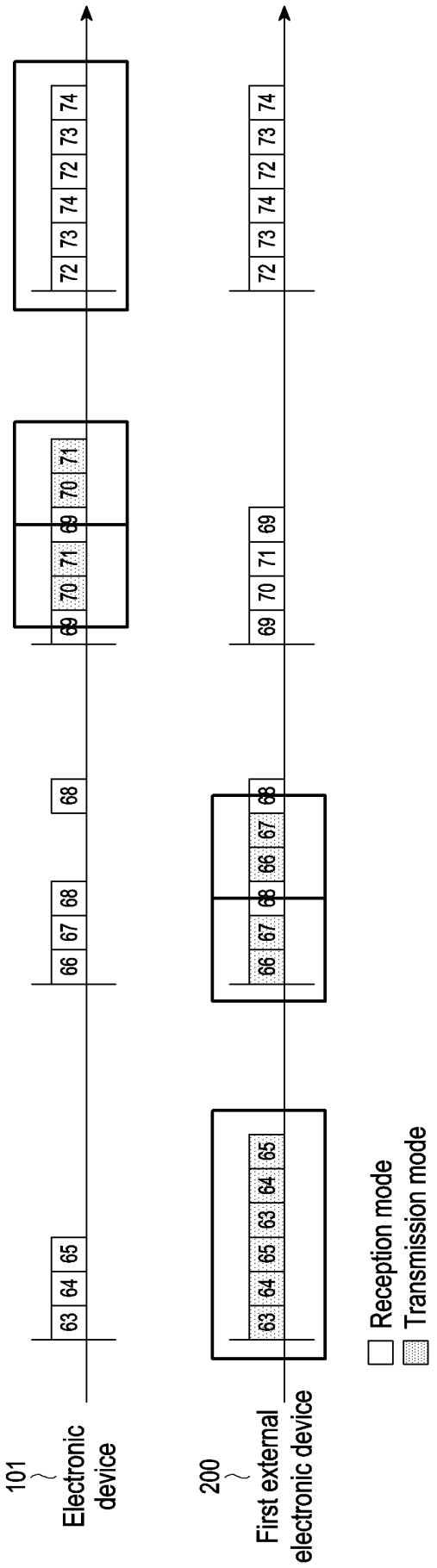
2000
101
Electronic device
200
First external electronic device
Reception mode
Transmission mode

FIG. 20

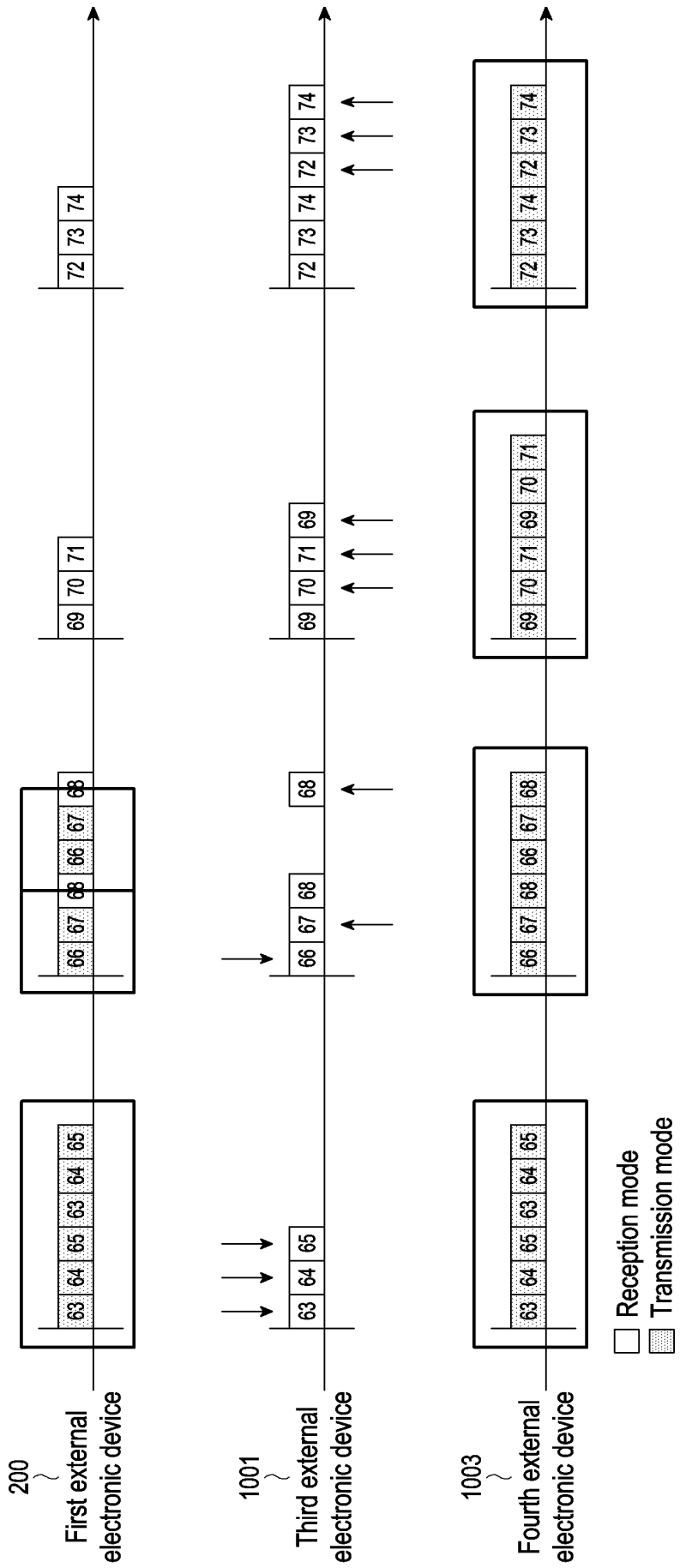
2100
200
First external electronic device
1001
Third external electronic device
1003
Fourth external electronic device
Reception mode
Transmission mode

FIG. 21

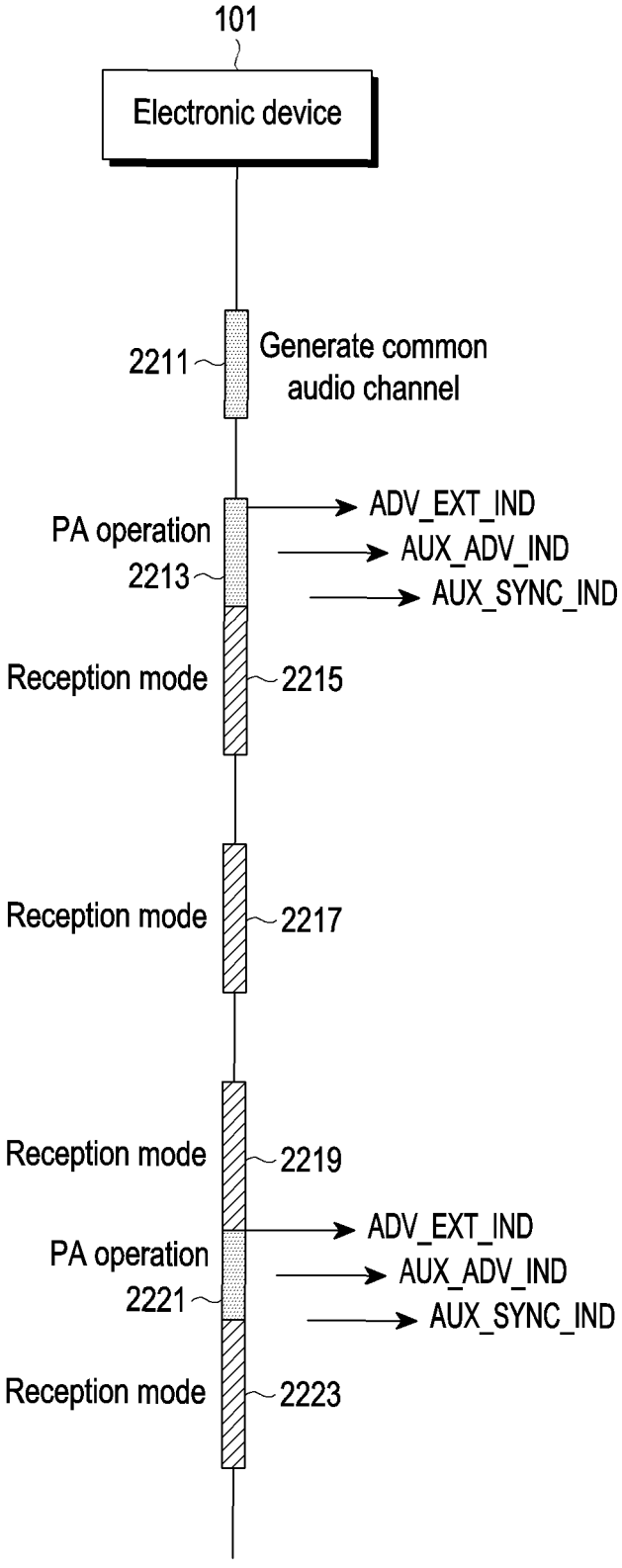
101
Electronic device
2211
Generate common audio channel
PA operation
2213
ADV_EXT_IND
AUX_ADV_IND
AUX_SYNC_IND
Reception mode
2215
Reception mode
2217
Reception mode
2219
PA operation
2221
ADV_EXT_IND
AUX_ADV_IND
AUX_SYNC_IND
Reception mode
2223

FIG. 22

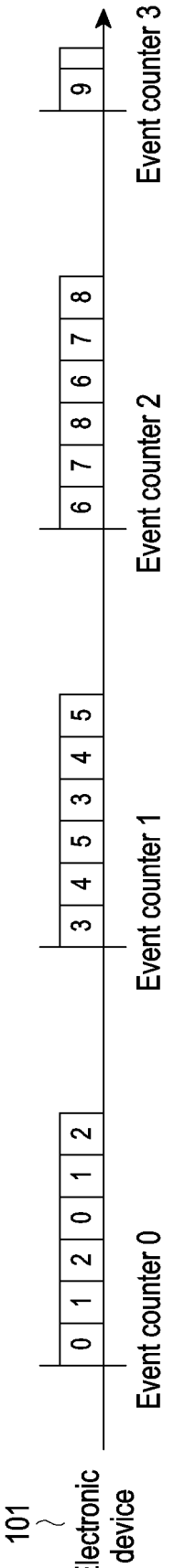
2300
0 1 2 0 1 2
3 4 5 3 4 5
6 7 8 6 7 8 9
Event counter 0
Event counter 1
Event counter 2
Event counter 3
Reception mode
101
Electronic device

FIG. 23

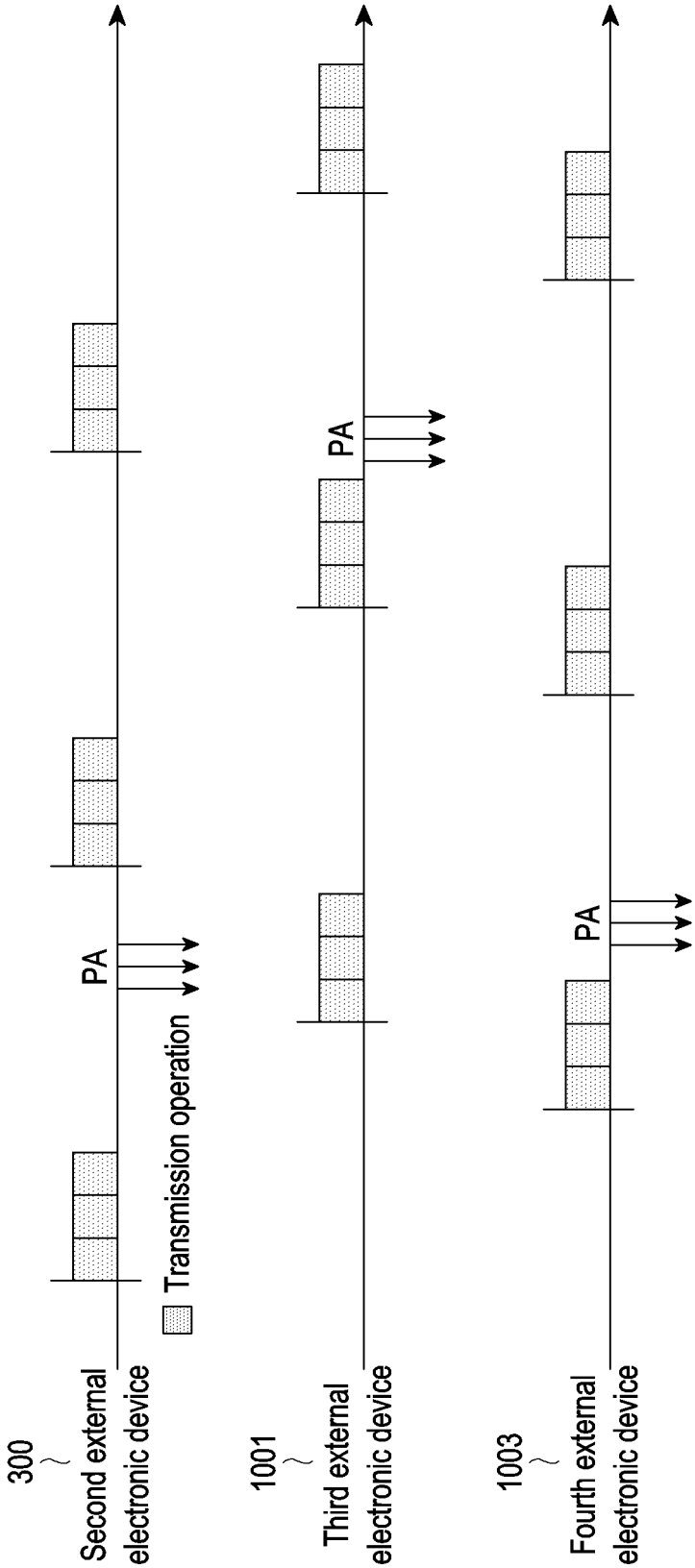
300
Second external electronic device
PA
Transmission operation
1001
Third external electronic device
PA
1003
Fourth external electronic device
PA

FIG. 24

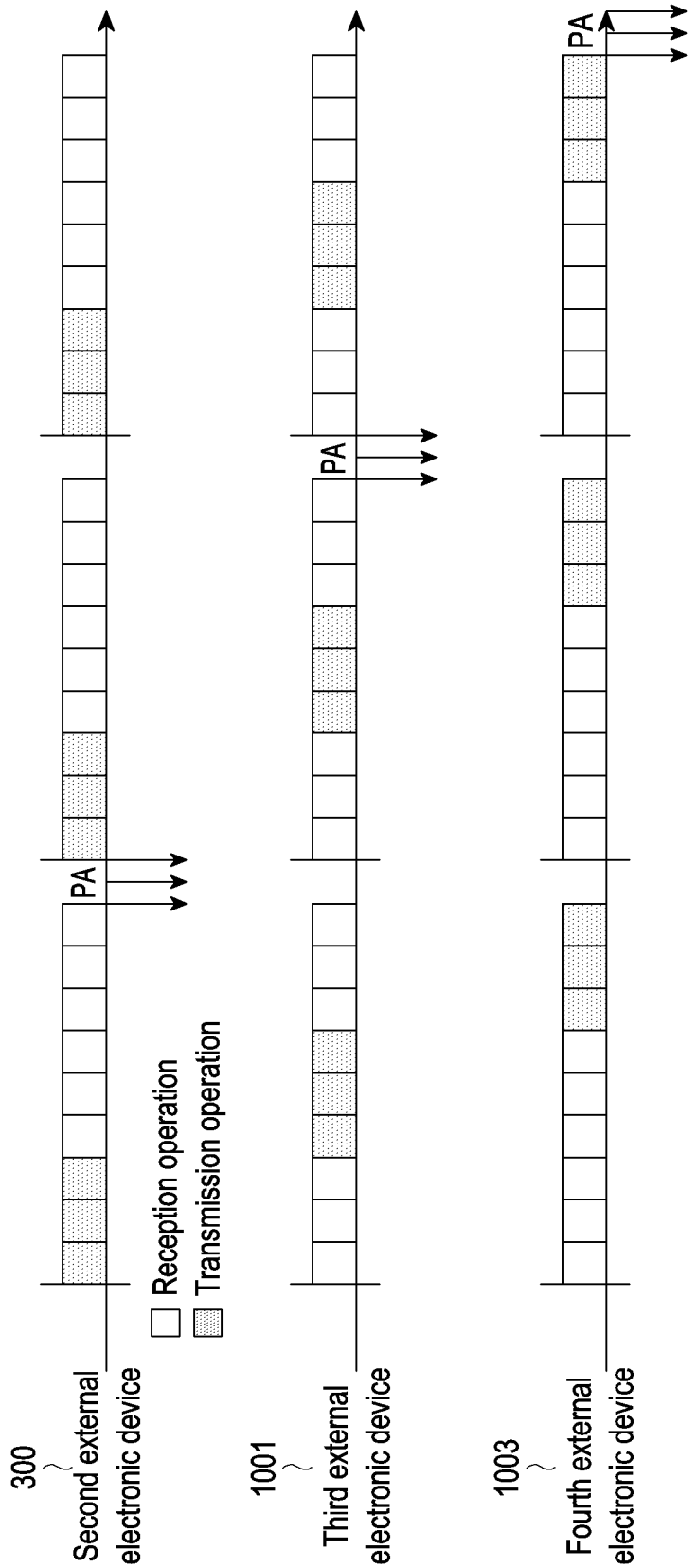
300
Second external electronic device
1001
Third external electronic device
1003
Fourth external electronic device
PA
PA
PA
Reception operation
Transmission operation

FIG. 25

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2024/003160

A. CLASSIFICATION OF SUBJECT MATTER

H04R 1/10(2006.01)i

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)

H04R 1/10(2006.01); H04B 5/00(2006.01); H04B 7/00(2006.01); H04N 21/2368(2011.01); H04N 21/439(2011.01); H04R 3/00(2006.01); H04W 4/80(2018.01); H04W 76/11(2018.01); H04W 76/14(2018.01)

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

Korean utility models and applications for utility models: IPC as above
Japanese utility models and applications for utility models: IPC as above

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

eKOMPASS (KIPO internal) & keywords: 전자장치(electronic device), 음향(audio), 공통 오디오(common audio), 동기화(synchronization), 수신(receive), 시간(time), 통신(communication)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	KR 10-2022-0104898 A (SAMSUNG ELECTRONICS CO., LTD.) 26 July 2022 (2022-07-26) See paragraphs [0058]-[0158].	1-4,10-13,15
Y	KR 10-2014-0115247 A (SAMSUNG ELECTRONICS CO., LTD.) 30 September 2014 (2014-09-30) See claims 1 and 6.	1-4,10-13,15
Y	KR 10-2018-0050890 A (SAMSUNG ELECTRONICS CO., LTD.) 16 May 2018 (2018-05-16) See claims 1 and 7.	1-4,10-13,15
A	KR 10-2022-0164313 A (SAMSUNG ELECTRONICS CO., LTD.) 13 December 2022 (2022-12-13) See claims 1-8.	1-4,10-13,15
A	US 2013-0266152 A1 (HAYNIE, Joel L. et al.) 10 October 2013 (2013-10-10) See entire document.	1-4,10-13,15

☐ 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
"D" document cited by the applicant in the international application
"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
12 June 2024	**13 June 2024**
Name and mailing address of the ISA/KR **Korean Intellectual Property Office** **Government Complex-Daejeon Building 4, 189 Cheongsa-ro, Seo-gu, Daejeon 35208** Facsimile No. **+82-42-481-8578**	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 2022)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2024/003160

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

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

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

2. ☑ Claims Nos.: **8-9**
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

Claims 8-9 refer to multiple dependent claims not meeting the requirement of PCT Rule 6.4(a), and thus are unclear.

3. ☑ Claims Nos.: **5-7, 14**
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Form PCT/ISA/210 (continuation of first sheet) (July 2022)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/KR2024/003160

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
KR 10-2022-0104898 A	26 July 2022	WO 2022-158787 A1	28 July 2022
KR 10-2014-0115247 A	30 September 2014	CN 104053039 A	17 September 2014
		CN 104053039 B	28 June 2019
		CN 104053040 A	17 September 2014
		CN 104053040 B	10 May 2019
		EP 2779577 A2	17 September 2014
		EP 2779577 A3	07 January 2015
		EP 2779577 B1	01 May 2019
		EP 2779578 A2	17 September 2014
		EP 2779578 A3	07 January 2015
		EP 2779578 B1	20 November 2019
		JP 2016-513930 A	16 May 2016
		JP 2016-515352 A	26 May 2016
		JP 6514648 B2	15 May 2019
		JP 6514649 B2	22 May 2019
		KR 10-2014-0115245 A	30 September 2014
		KR 10-2180826 B1	20 November 2020
		KR 10-2201826 B1	12 January 2021
		TW 201438460 A	01 October 2014
		TW 201442494 A	01 November 2014
		TW I625056 B	21 May 2018
		TW I666931 B	21 July 2019
		US 10356484 B2	16 July 2019
		US 2014-0267905 A1	18 September 2014
		US 2014-0282706 A1	18 September 2014
		US 9723245 B2	01 August 2017
		WO 2014-142626 A1	18 September 2014
		WO 2014-142627 A1	18 September 2014
KR 10-2018-0050890 A	16 May 2018	CN 108076411 A	25 May 2018
		CN 108076411 B	16 June 2020
		EP 3319340 A1	09 May 2018
		EP 3319340 B1	01 December 2021
		JP 2020-500476 A	09 January 2020
		KR 10-2555485 B1	14 July 2023
		US 10237653 B2	19 March 2019
		US 11095982 B2	17 August 2021
		US 2018-0132039 A1	10 May 2018
		US 2019-0174230 A1	06 June 2019
		WO 2018-084483 A1	11 May 2018
KR 10-2022-0164313 A	13 December 2022	US 2024-0107293 A1	28 March 2024
		WO 2022-255671 A1	08 December 2022
US 2013-0266152 A1	10 October 2013	WO 2013-151878 A1	10 October 2013

Form PCT/ISA/210 (patent family annex) (July 2022)