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Li et al.

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(54) **ROUTING POLICIES FOR BIOLOGICAL HOSTS**

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Related U.S. Application Data

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(51) **Int. Cl.**
G06N 3/06 (2006.01)
G06F 3/01 (2006.01)

(52) **U.S. Cl.**
CPC ***G06N 3/061*** (2013.01); ***G06F 3/015*** (2013.01)

(58) **Field of Classification Search**
None
See application file for complete search history.

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(74) *Attorney, Agent, or Firm* — Hartman & Citrin LLC

(57) **ABSTRACT**

Methods, systems, and products provide interfaces between intrahost networks and interhost networks within biological hosts. Neuroregional translations are performed to route communications to and from the biological hosts. Bioregional translations may also be performed to route communications to and from the biological hosts.

19 Claims, 19 Drawing Sheets

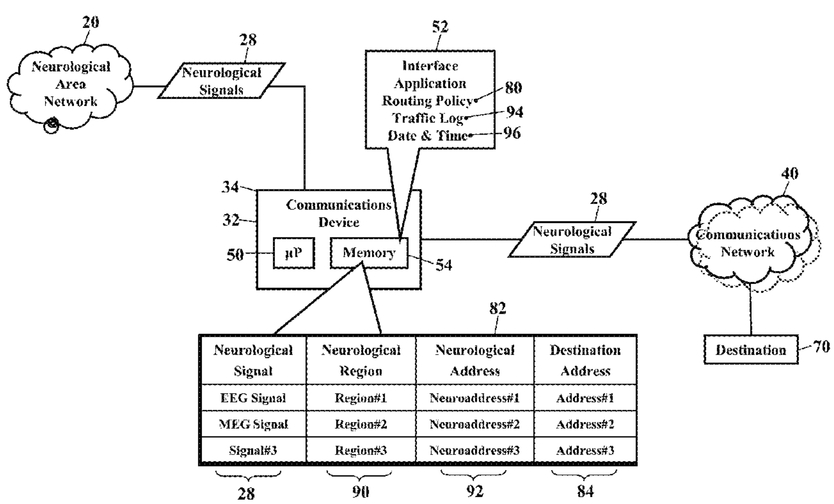

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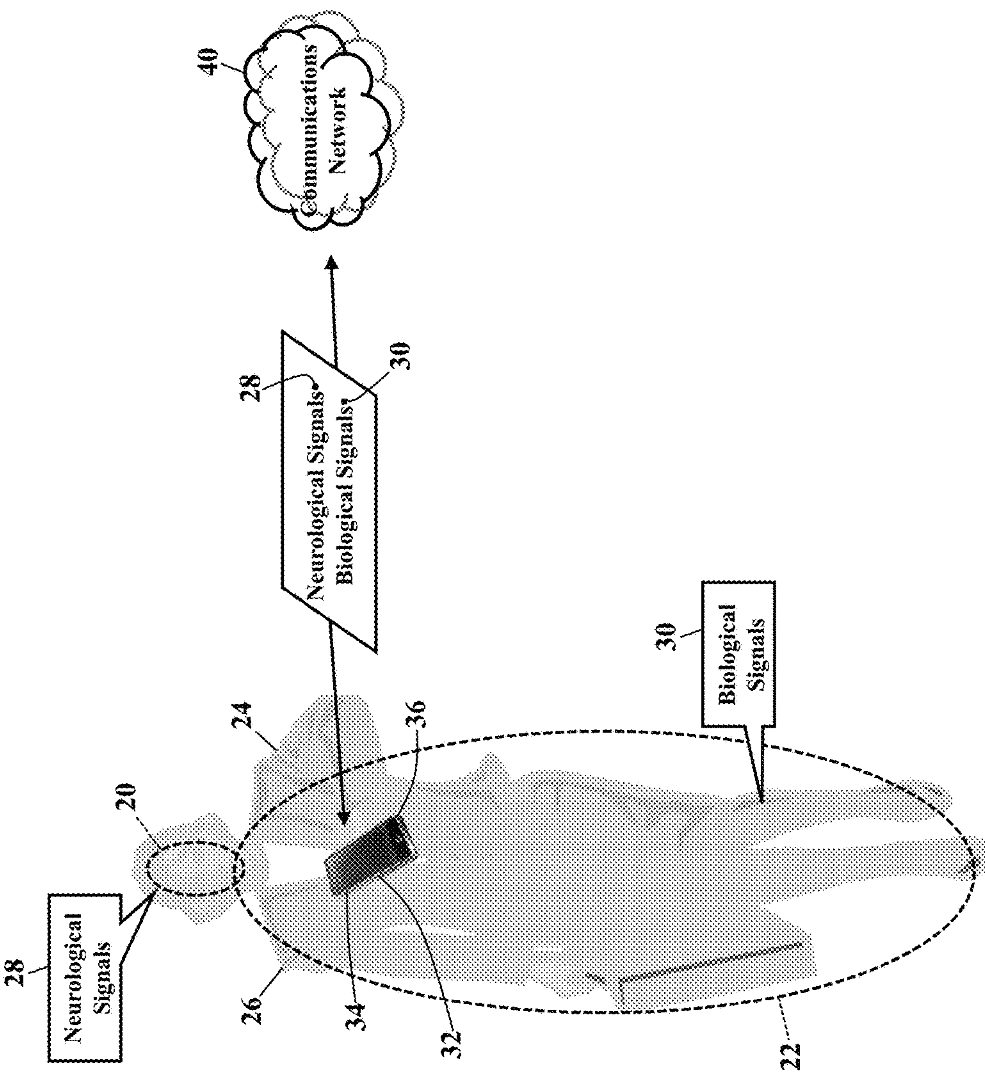
FIG. 1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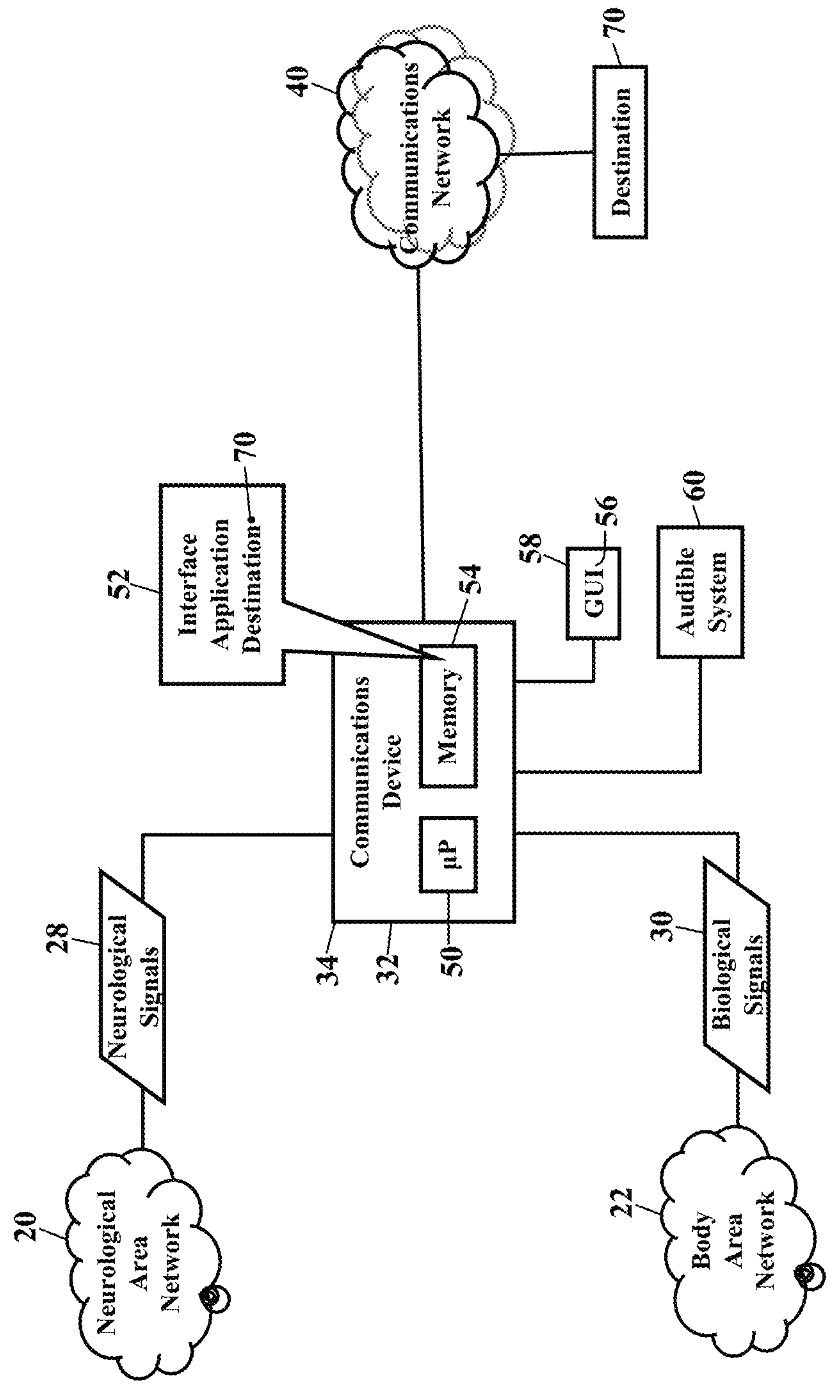
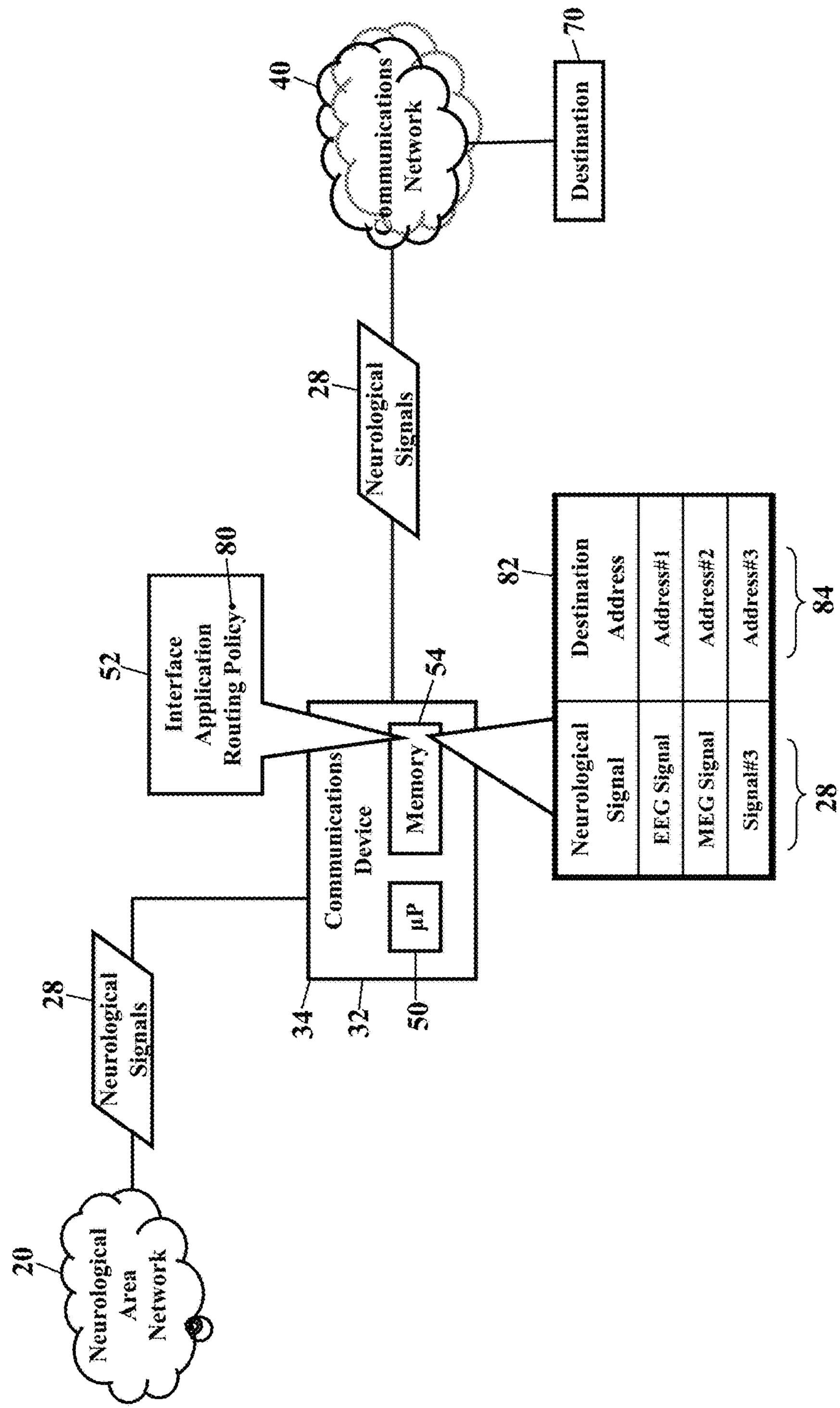
Communications Network
28
30
Neurological Signals
Biological Signals
30
Biological Signals
28
Neurological Signals
20
24
26
36
34
32
22

FIG. 2



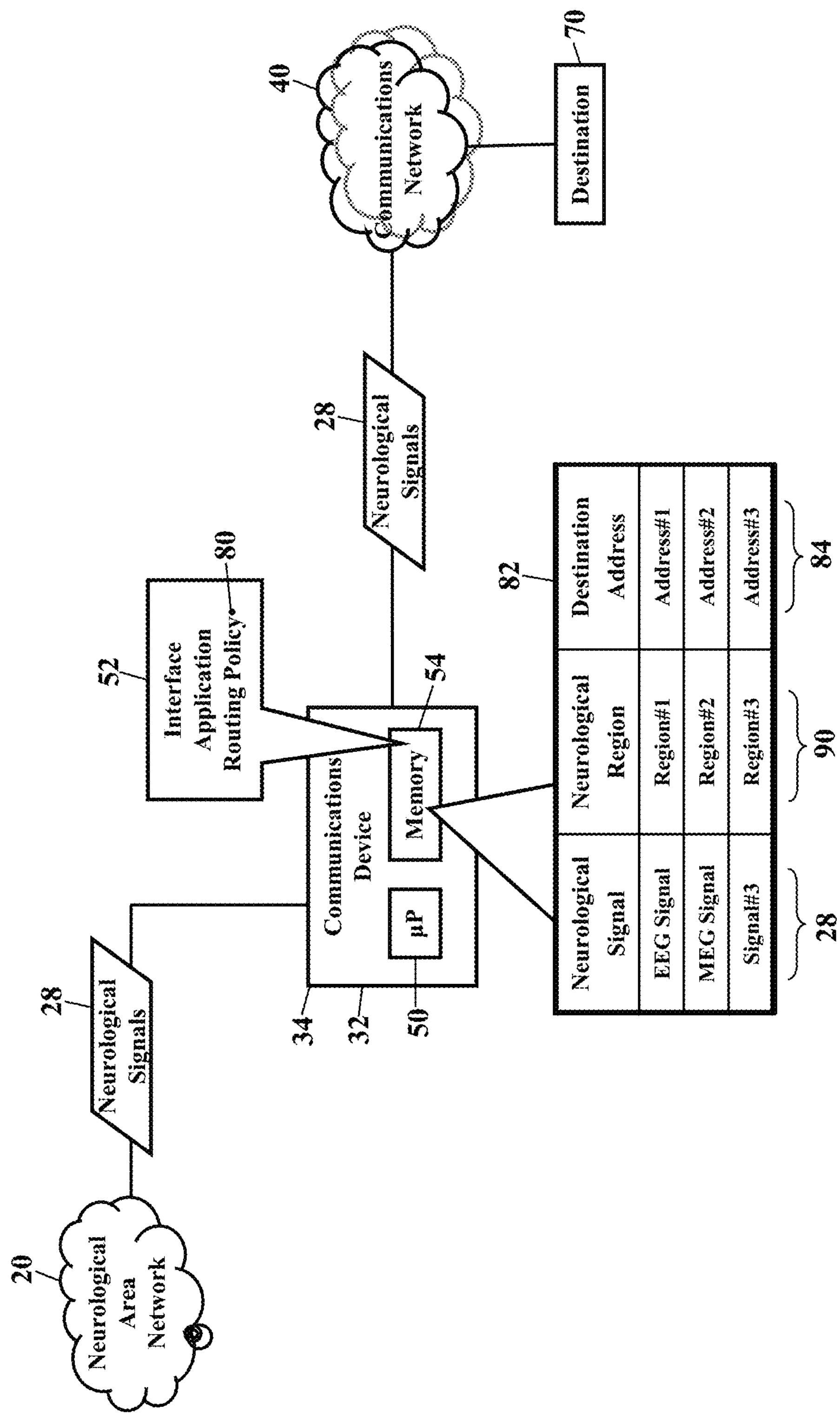
40
Communications Network
70
Destination
52
Interface Application Destination
70
54
58
56
GUI
60
Audible System
Communications Device
Memory
µP
28
Neurological Signals
34
32
50
30
Biological Signals
20
Neurological Area Network
22
Body Area Network

FIG. 3



20
Neurological Area Network
28
Neurological Signals
34
32
50
Communications Device
µP
Memory
54
52
Interface Application Routing Policy
80
28
Neurological Signals
40
Communications Network
70
Destination
82
Neurological Signal
Destination Address
EEG Signal
Address#1
MEG Signal
Address#2
Signal#3
Address#3
28
84

FIG. 4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20
Neurological Signals
28
Communications Device
34
32
µP
50
Memory
54
Interface Application Routing Policy
52
80
Neurological Signals
28
Communications Network
40
Destination
70
82
Neurological Signal
EEG Signal
MEG Signal
Signal#3
Neurological Region
Region#1
Region#2
Region#3
Destination Address
Address#1
Address#2
Address#3
28
90
84

FIG. 5

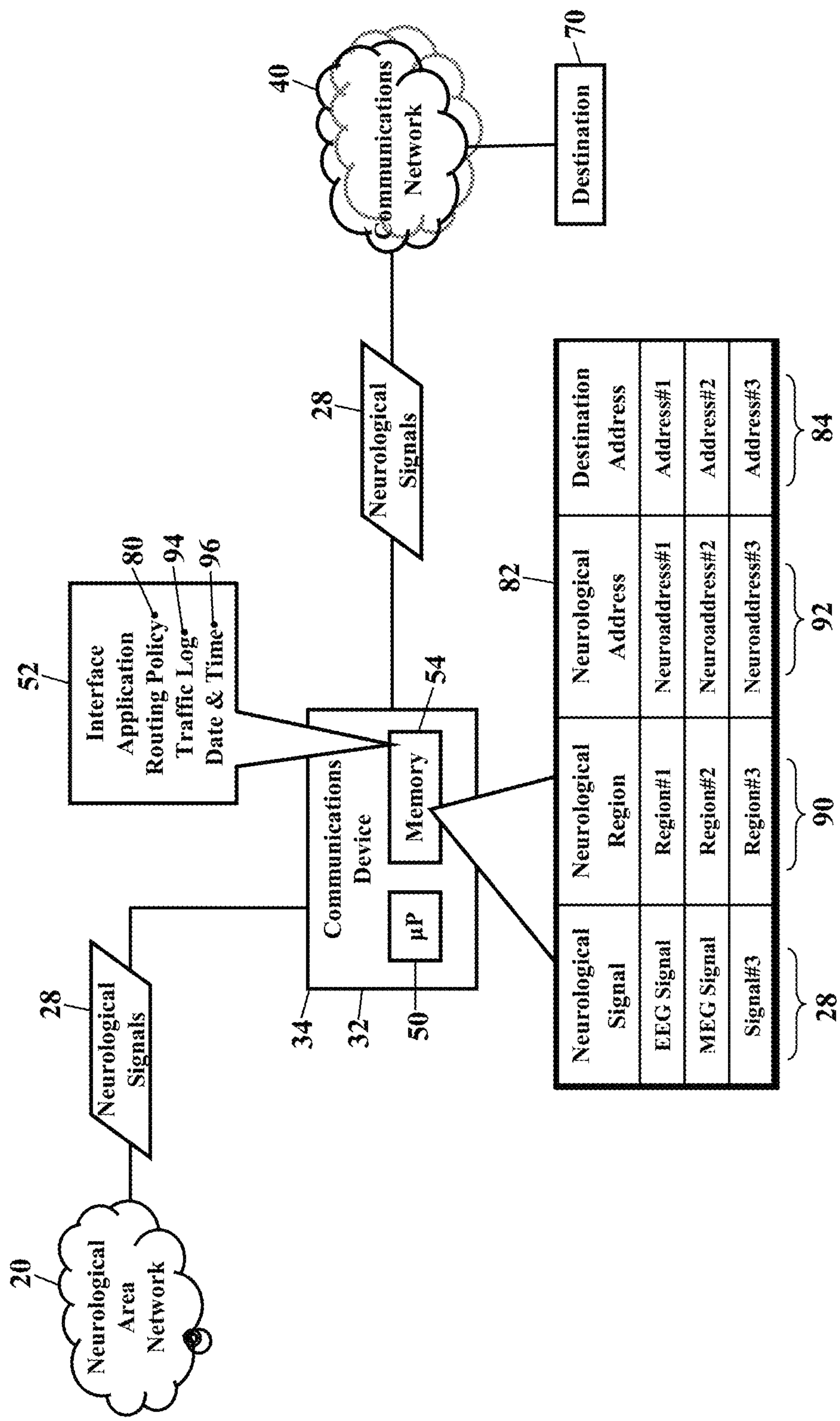

20
Neurological Area Network
28
Neurological Signals
34
32
50
μP
Communications Device
Memory
54
52
Interface Application
Routing Policy
Traffic Log
Date & Time
80
94
96
28
Neurological Signals
40
Communications Network
70
Destination
82
Neurological Signal
EEG Signal
MEG Signal
Signal#3
Neurological Region
Region#1
Region#2
Region#3
Neurological Address
Neuroaddress#1
Neuroaddress#2
Neuroaddress#3
Destination Address
Address#1
Address#2
Address#3
28
90
92
84

FIG. 6

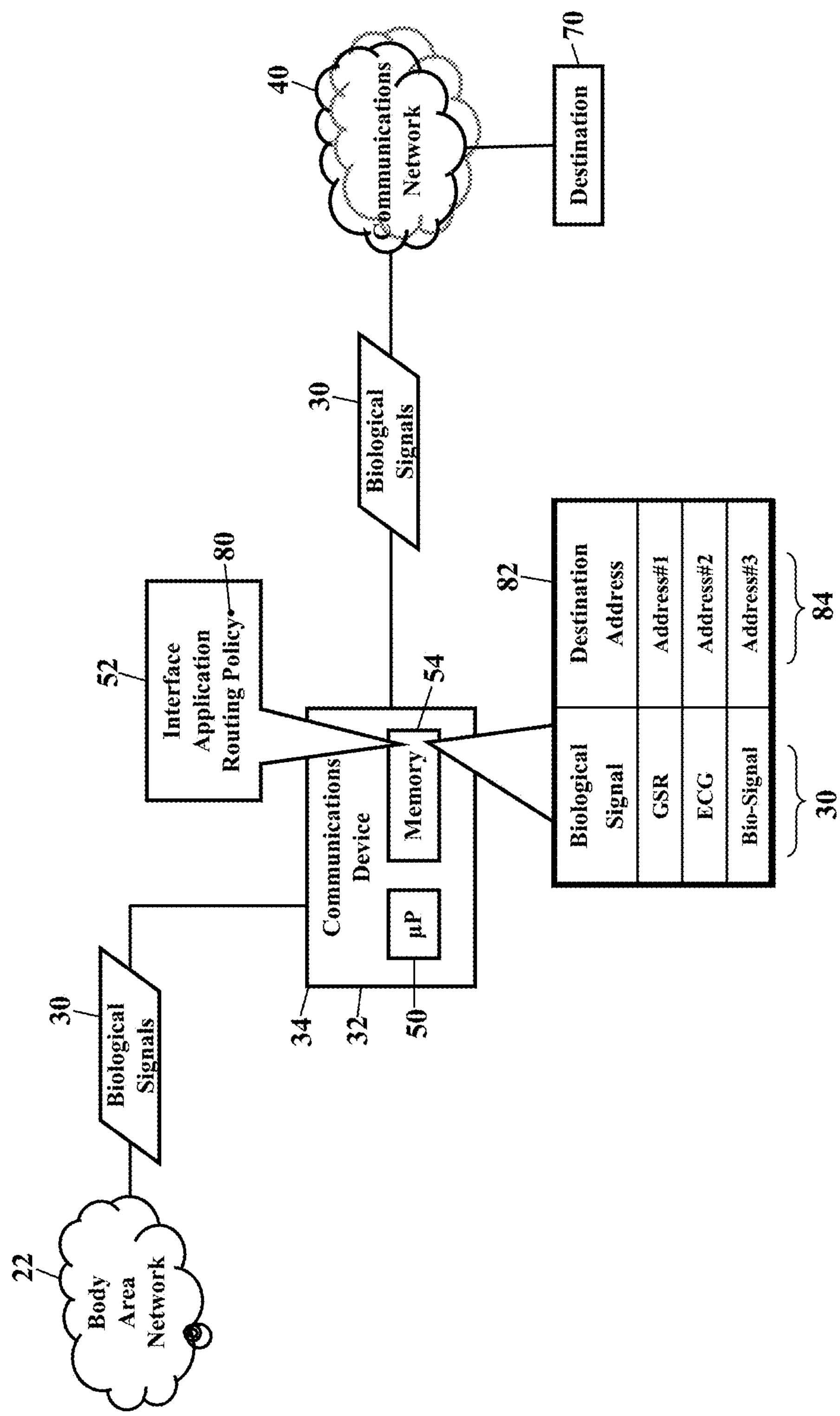

22
Body Area Network
30
Biological Signals
34
32
50
Communications Device
μP
Memory
54
52
Interface Application Routing Policy
80
30
Biological Signals
40
Communications Network
70
Destination
82
Biological Signal
Destination Address
GSR
Address#1
ECG
Address#2
Bio-Signal
Address#3
30
84

FIG. 7

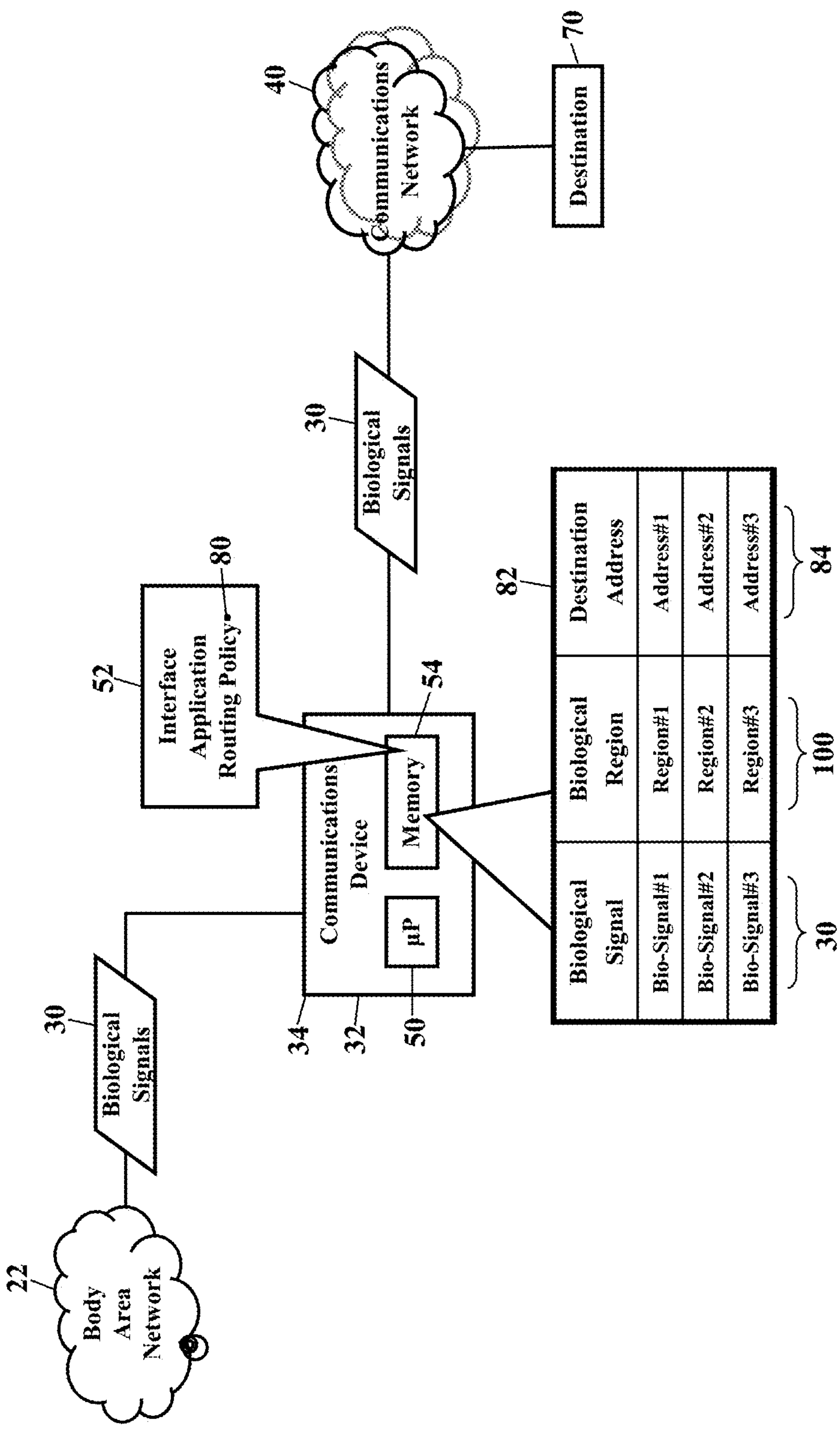

22
Body Area Network
30
Biological Signals
34
32
Communications Device
50
µP
Memory
54
52
Interface Application
Routing Policy
80
30
Biological Signals
40
Communications Network
70
Destination
82
Biological Signal
Biological Region
Destination Address
Bio-Signal#1
Region#1
Address#1
Bio-Signal#2
Region#2
Address#2
Bio-Signal#3
Region#3
Address#3
30
100
84

FIG. 8

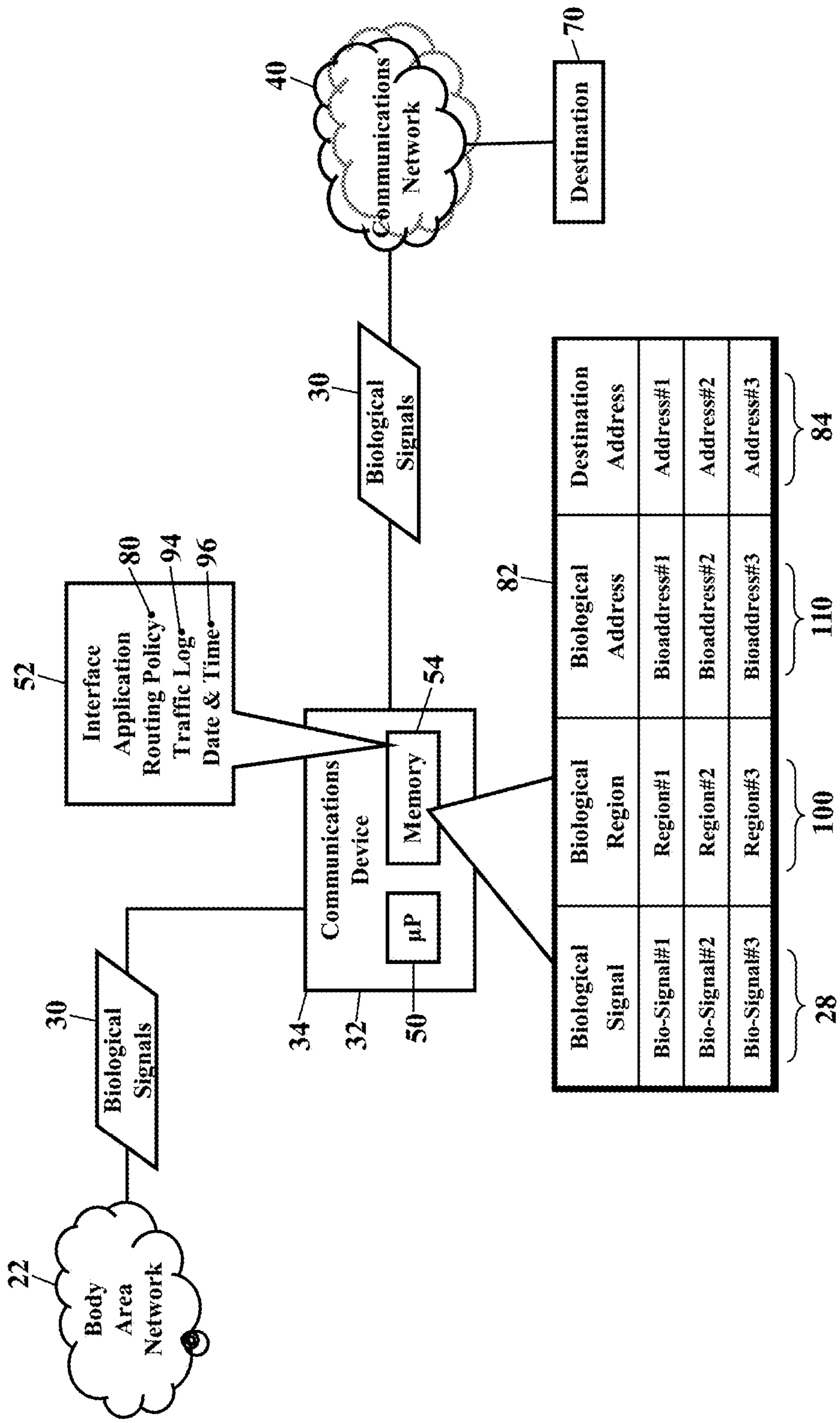

22
Body Area Network
30
Biological Signals
34
32
Communications Device
50
µP
54
Memory
52
Interface Application
Routing Policy
Traffic Log
Date & Time
80
94
96
30
Biological Signals
40
Communications Network
70
Destination
82
Biological Signal
Biological Region
Biological Address
Destination Address
Bio-Signal#1
Region#1
Bioaddress#1
Address#1
Bio-Signal#2
Region#2
Bioaddress#2
Address#2
Bio-Signal#3
Region#3
Bioaddress#3
Address#3
28
100
110
84

FIG. 9

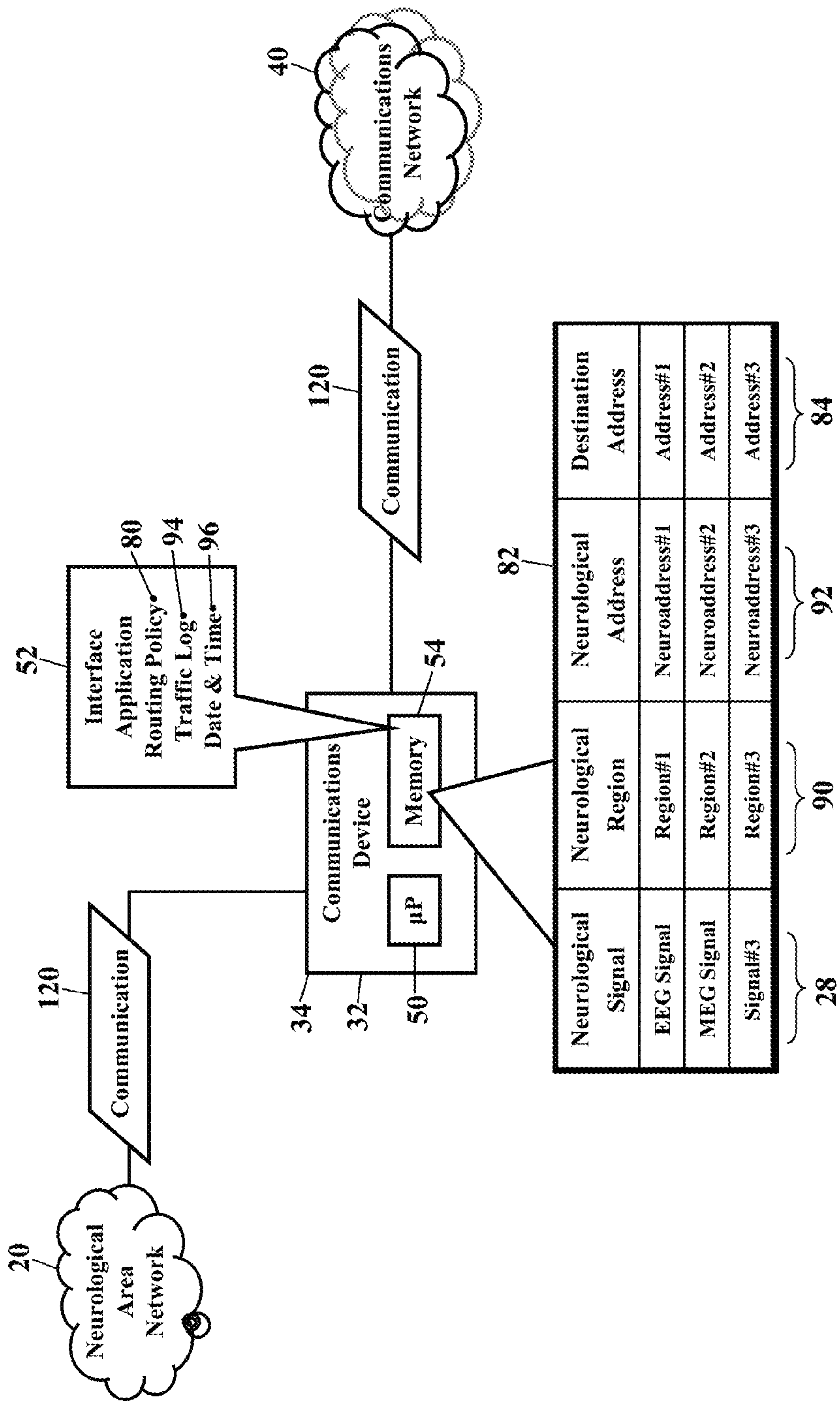

20
Neurological Area Network
120
Communication
34
32
50
Communications Device
µP
Memory
54
52
Interface Application
Routing Policy
Traffic Log
Date & Time
80
94
96
120
Communication
40
Communications Network
82
Neurological Signal
Neurological Region
Neurological Address
Destination Address
EEG Signal
Region#1
Neuroaddress#1
Address#1
MEG Signal
Region#2
Neuroaddress#2
Address#2
Signal#3
Region#3
Neuroaddress#3
Address#3
28
90
92
84

FIG. 10

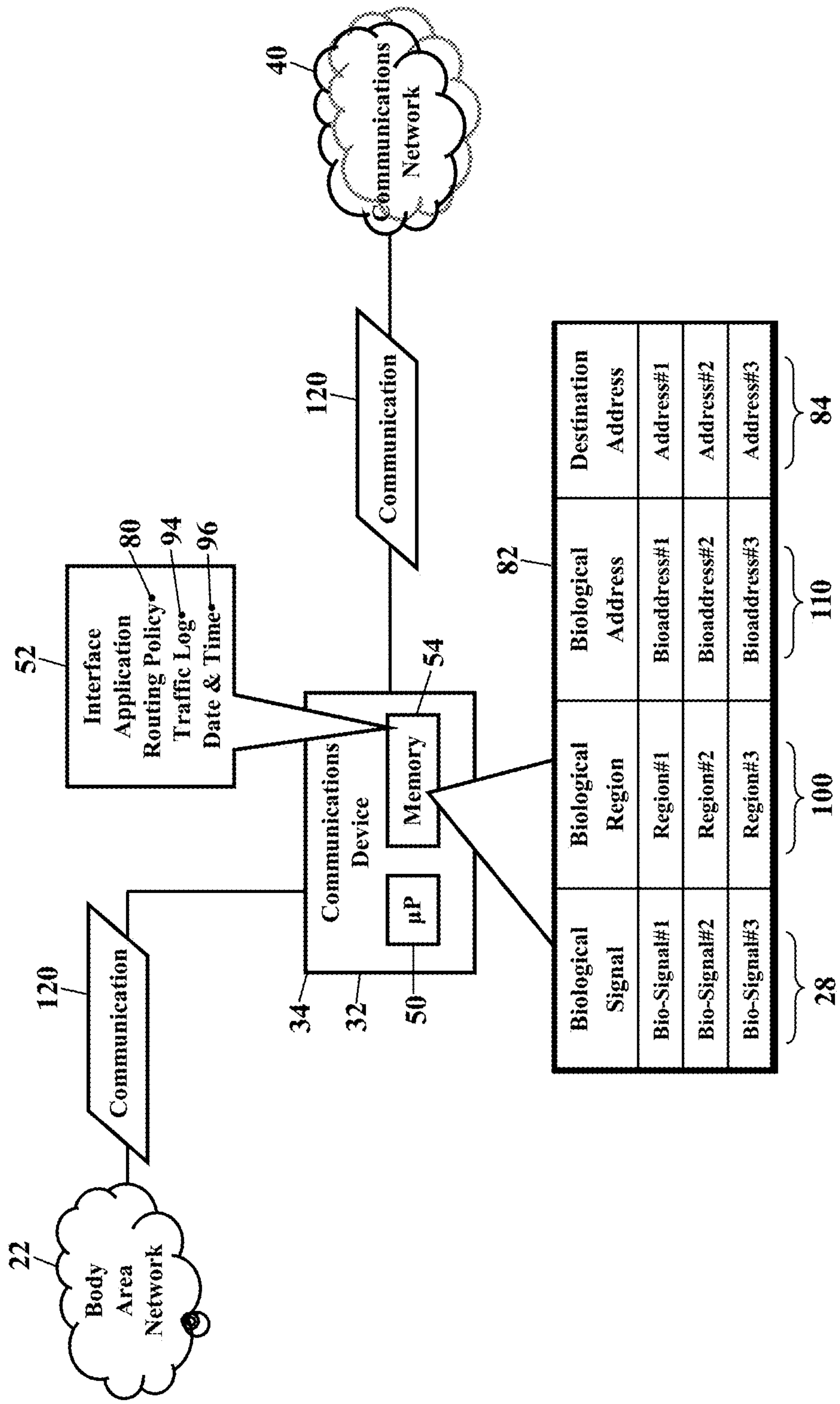
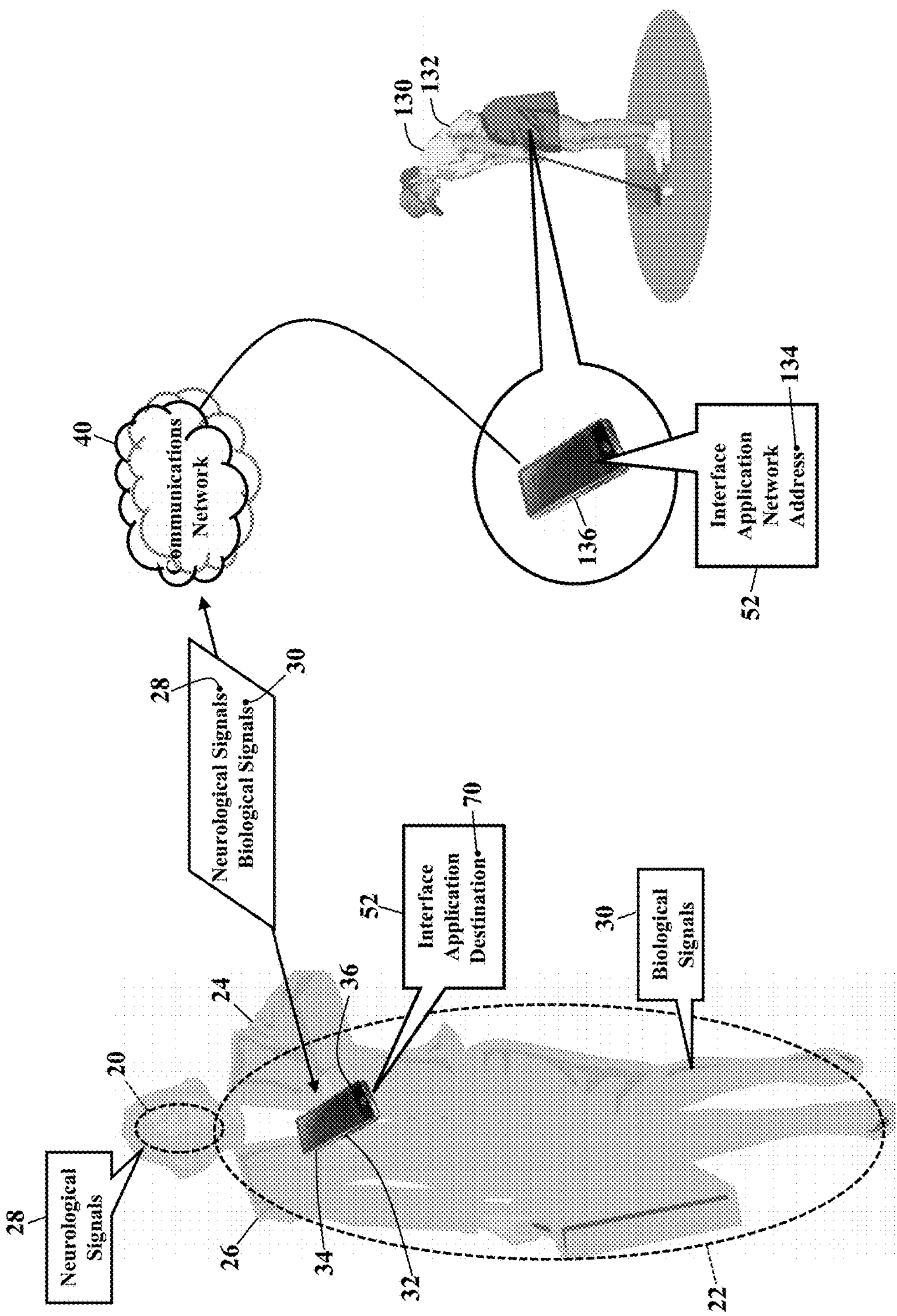

22
Body Area Network
120
Communication
34
32
Communications Device
μP
50
Memory
54
52
Interface Application
Routing Policy
80
Traffic Log
94
Date & Time
96
120
Communication
40
Communications Network
82
Biological Signal
Biological Region
Biological Address
Destination Address
Bio-Signal#1
Region#1
Bioaddress#1
Address#1
Bio-Signal#2
Region#2
Bioaddress#2
Address#2
Bio-Signal#3
Region#3
Bioaddress#3
Address#3
28
100
110
84

FIG. 11



28
Neurological Signals
20
24
26
34
32
36
22
52
Interface Application Destination
70
30
Biological Signals
Neurological Signals
Biological Signals
28
30
40
Communications Network
136
Interface Application Network Address
134
52
130
132

FIG. 12

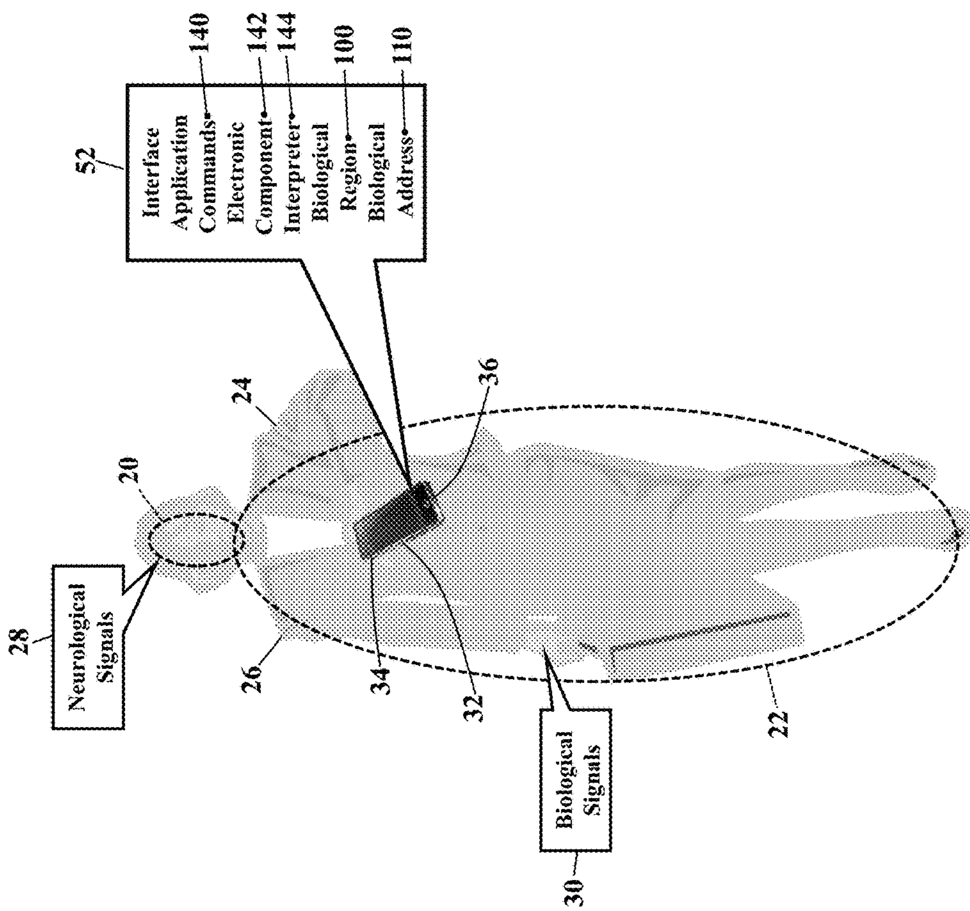

52
Interface Application Commands
140
Electronic Component Interpreter
142
144
Biological Region
100
Biological Address
110
24
20
36
28
Neurological Signals
26
34
32
Biological Signals
30
22

FIG. 13

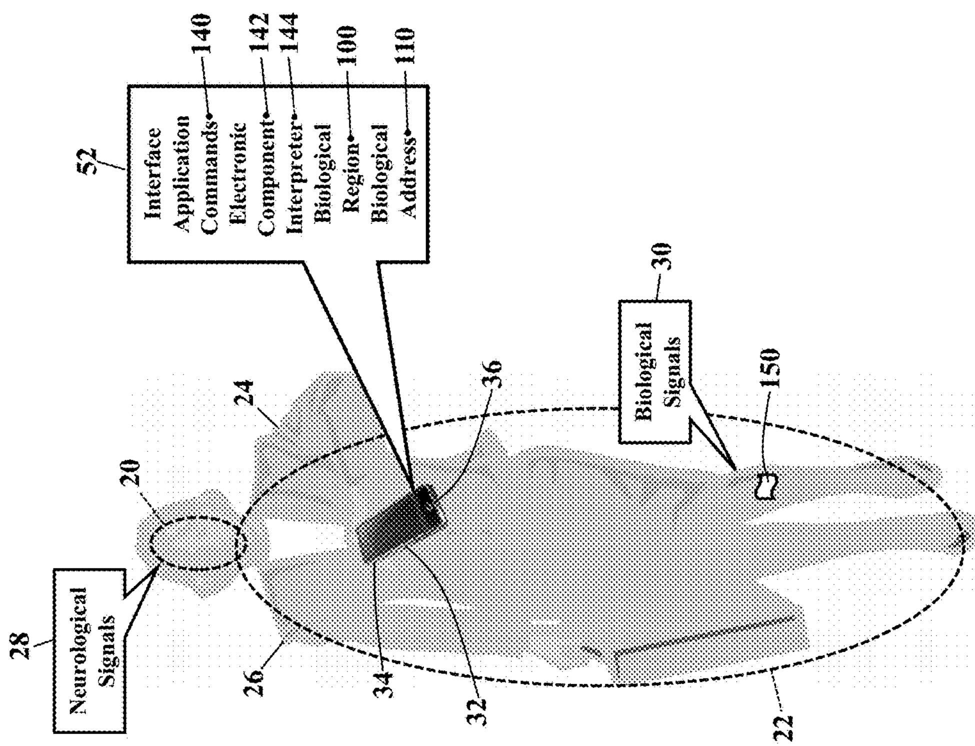

Neurological Signals
Biological Signals
Interface Application Commands
Electronic Component Interpreter
Biological Region
Biological Address
20
22
24
26
28
30
32
34
36
52
100
110
140
142
144
150

FIG. 14

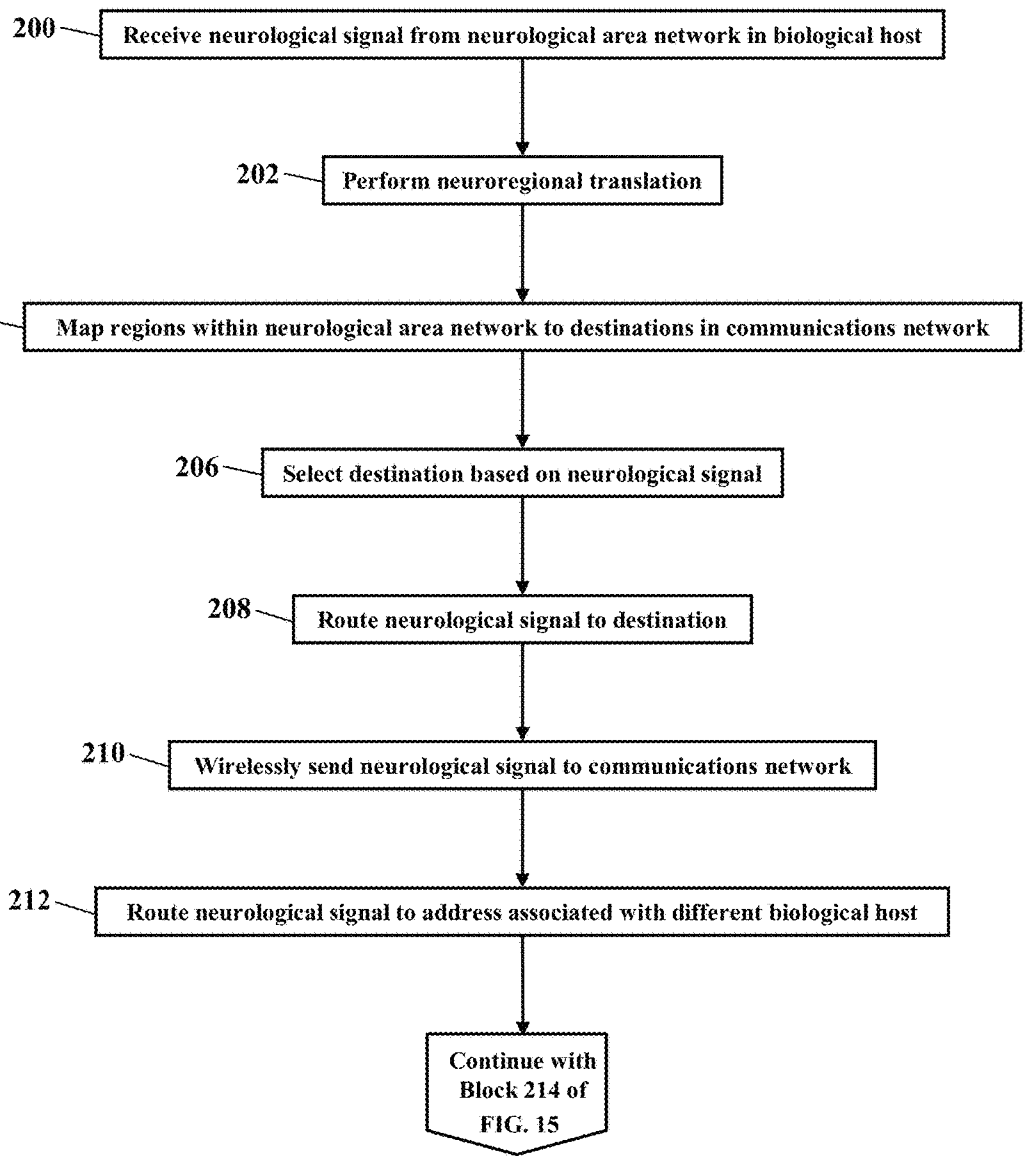

200
Receive neurological signal from neurological area network in biological host
202
Perform neuroregional translation
204
Map regions within neurological area network to destinations in communications network
206
Select destination based on neurological signal
208
Route neurological signal to destination
210
Wirelessly send neurological signal to communications network
212
Route neurological signal to address associated with different biological host
Continue with Block 214 of FIG. 15

FIG. 15

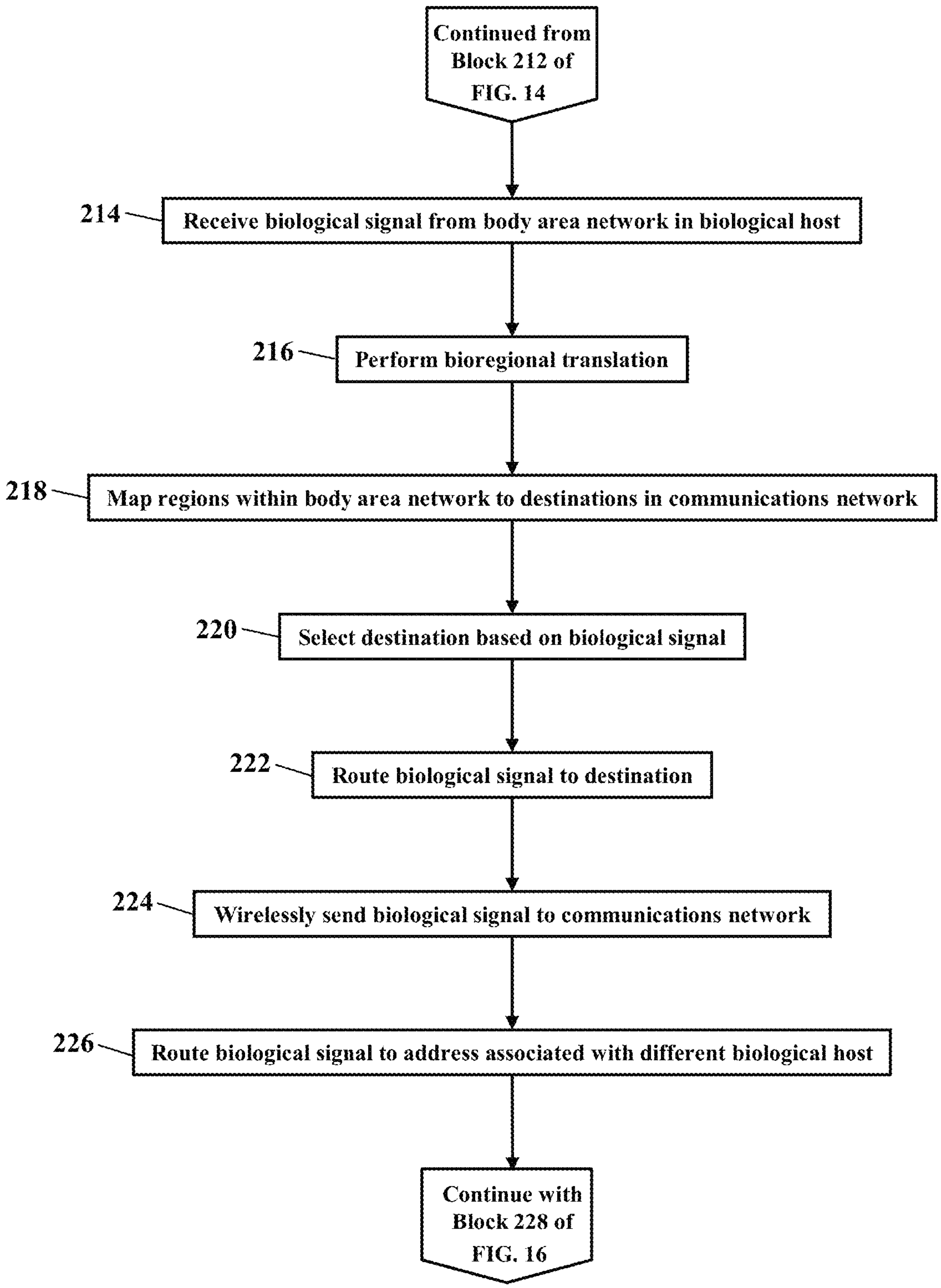

Continued from Block 212 of FIG. 14
214
Receive biological signal from body area network in biological host
216
Perform bioregional translation
218
Map regions within body area network to destinations in communications network
220
Select destination based on biological signal
222
Route biological signal to destination
224
Wirelessly send biological signal to communications network
226
Route biological signal to address associated with different biological host
Continue with Block 228 of FIG. 16

FIG. 16

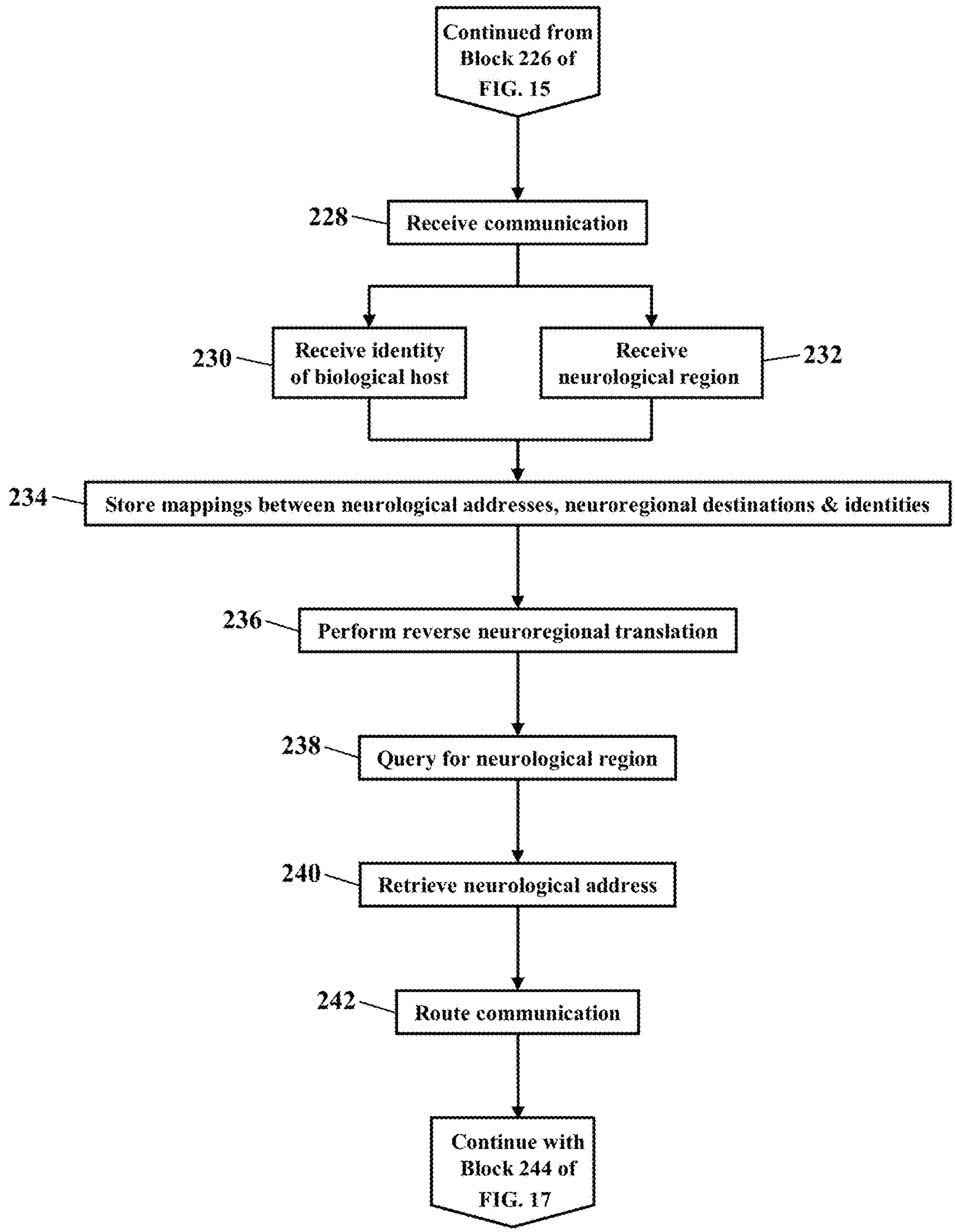

Continued from Block 226 of FIG. 15
228
Receive communication
230
Receive identity of biological host
Receive neurological region
232
234
Store mappings between neurological addresses, neuroregional destinations & identities
236
Perform reverse neuroregional translation
238
Query for neurological region
240
Retrieve neurological address
242
Route communication
Continue with Block 244 of FIG. 17

FIG. 17

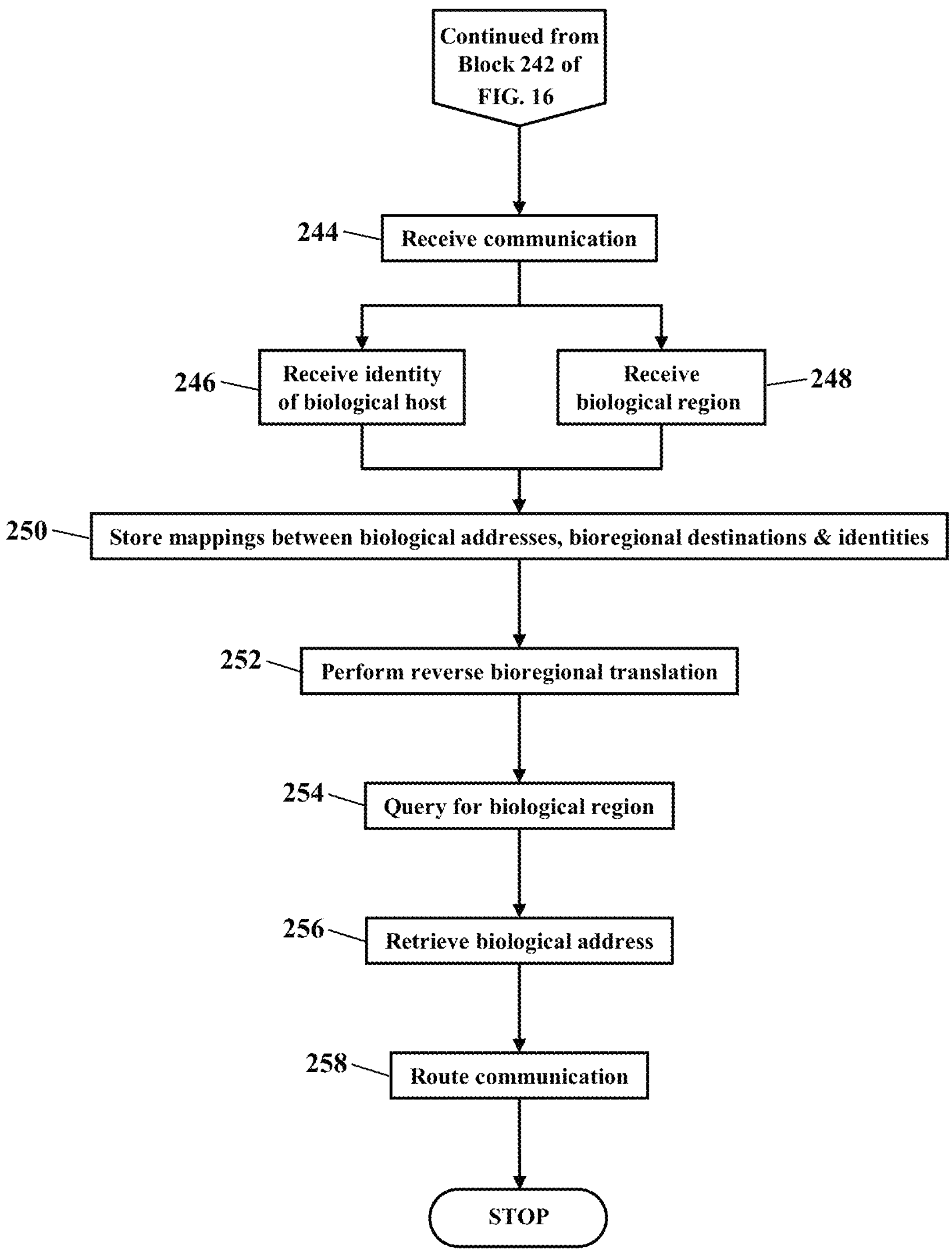

Continued from Block 242 of FIG. 16
244
Receive communication
246
Receive identity of biological host
248
Receive biological region
250
Store mappings between biological addresses, bioregional destinations & identities
252
Perform reverse bioregional translation
254
Query for biological region
256
Retrieve biological address
258
Route communication
STOP

FIG. 18

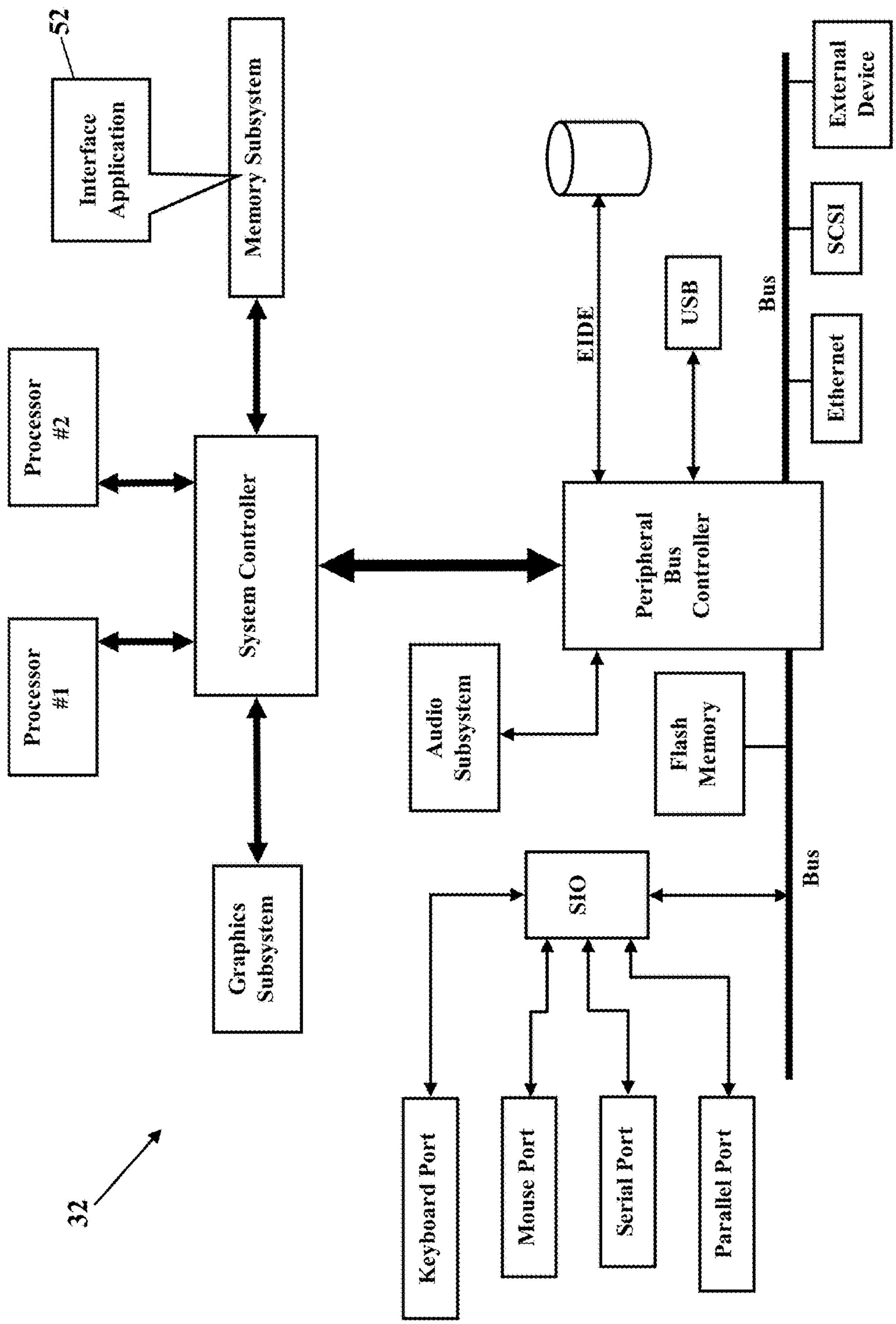
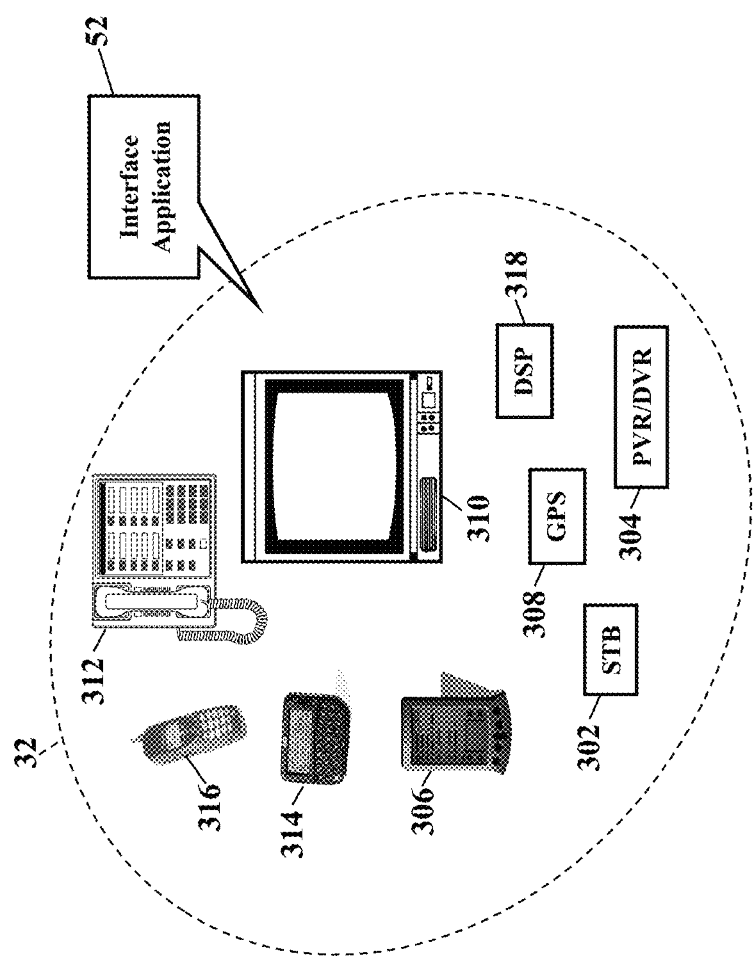

52
Interface Application
Memory Subsystem
Processor #2
Processor #1
System Controller
Graphics Subsystem
EIDE
USB
Bus
External Device
SCSI
Ethernet
Peripheral Bus Controller
Audio Subsystem
Flash Memory
SIO
Bus
Keyboard Port
Mouse Port
Serial Port
Parallel Port
32

FIG. 19


52
Interface Application
318
DSP
PVR/DVR
304
GPS
308
STB
302
310
312
32
316
314
306

ROUTING POLICIES FOR BIOLOGICAL HOSTS

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of U.S. patent application Ser. No. 13/647,422 filed Oct. 9, 2012, now issued as U.S. Pat. No. 9,015,087, which is incorporated herein by reference in its entirety.

BACKGROUND

Neuroscience has shown that the brain is very intricate. Neuroscientists even refer to the brain as a network of interconnected neural pathways. Modern networking concepts may thus lead to an even greater understanding of neural and biological networks.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

The features, aspects, and advantages of the exemplary embodiments are understood when the following Detailed Description is read with reference to the accompanying drawings, wherein:

FIG. **1** is a simplified schematic illustrating an environment in which exemplary embodiments may be implemented;

FIG. **2** is a more detailed schematic illustrating an operating environment, according to exemplary embodiments;

FIGS. **3-4** are schematics illustrating routing of neurological signals, according to exemplary embodiments;

FIG. **5** is a schematic illustrating neuroregional translations, according to exemplary embodiments;

FIGS. **6-7** are schematics illustrating routing of biological signals, according to exemplary embodiments;

FIG. **8** is a schematic illustrating bioregional translations, according to exemplary embodiments;

FIGS. **9-10** are schematics illustrating receipt of signals, according to exemplary embodiments;

FIG. **11** is a schematic illustrating interhost translation, according to exemplary embodiments;

FIGS. **12-13** are schematics illustrating machine translation, according to exemplary embodiments;

FIGS. **14-17** are flowcharts illustrating a method or algorithm for interfacing with neural and body networks, according to exemplary embodiments; and

FIGS. **18-19** depict still more operating environments for additional aspects of the exemplary embodiments.

DETAILED DESCRIPTION

The exemplary embodiments will now be described more fully hereinafter with reference to the accompanying drawings. The exemplary embodiments may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein. These embodiments are provided so that this disclosure will be thorough and complete and will fully convey the exemplary embodiments to those of ordinary skill in the art. Moreover, all statements herein reciting embodiments, as well as specific examples thereof, are intended to encompass both structural and functional equivalents thereof. Additionally, it is intended that such equivalents include both currently known equivalents as well as equivalents developed in the

future (i.e., any elements developed that perform the same function, regardless of structure).

Thus, for example, it will be appreciated by those of ordinary skill in the art that the diagrams, schematics, illustrations, and the like represent conceptual views or processes illustrating the exemplary embodiments. The functions of the various elements shown in the figures may be provided through the use of dedicated hardware as well as hardware capable of executing associated software. Those of ordinary skill in the art further understand that the exemplary hardware, software, processes, methods, and/or operating systems described herein are for illustrative purposes and, thus, are not intended to be limited to any particular named manufacturer.

As used herein, the singular forms "a," "an," and "the" are intended to include the plural forms as well, unless expressly stated otherwise. It will be further understood that the terms "includes," "comprises," "including," and/or "comprising," when used in this specification, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof. It will be understood that when an element is referred to as being "connected" or "coupled" to another element, it can be directly connected or coupled to the other element or intervening elements may be present. Furthermore, "connected" or "coupled" as used herein may include wirelessly connected or coupled. As used herein, the term "and/or" includes any and all combinations of one or more of the associated listed items.

It will also be understood that, although the terms first, second, etc. may be used herein to describe various elements, these elements should not be limited by these terms. These terms are only used to distinguish one element from another. For example, a first device could be termed a second device, and, similarly, a second device could be termed a first device without departing from the teachings of the disclosure.

FIG. **1** is a simplified schematic illustrating an environment in which exemplary embodiments may be implemented. FIG. **1** illustrates a neurological area network **20** and a body area network **22** of a biological host **24**. The biological host **24** is illustrated as a human woman **26**, but the biological host **24** may be any animal or other living organism. Whatever the biological host **24**, science has shown that electrical signals are transmitted throughout the brain and body. Neuroscientists, for example, have shown that neurological signals **28** are transmitted along the neurological area network **20** in the brain. Medical science has also shown that biological signals **30** are transmitted throughout the body of the biological host **24**. The biological signals **30**, for example, are transmitted between the tissue, cells, organs, and nervous system in the biological host **24**. As science continues to advance, the brain can be considered its own separate network (hence the neurological area network **20**) that sends and receives the neurological signals **28**. The body, too, may be considered its own separate body area network **22** that sends and receives the biological signals **30**.

Exemplary embodiments provide an interface **32** between these separate networks. The interface **32** is illustrated as a communications device **34**, such as a smart phone **36**. The interface **32**, though, may be any processor-controlled device (as later paragraphs will explain). As the woman **26** carries, wears, or uses the communications device **34**, the communications device **34** communicates with the neurological area network **20** and the body area network **22**. That is, the communications device **34** is capable of receiving and interpreting the neurological signals **28** that are transmitted from or along the neurological area network **20** in the woman's brain. The communications device **34** is also capable of receiving and interpreting the biological signals **30** that are transmitted from or along the woman's body area network **22**. The communications device **34** thus provides the interface **32** between these two separate networks.

Exemplary embodiments, however, also interface with an external communications network **40**. As most readers know, the communications device **34** also communicates with a wireless network, such as a cellular network and/or a WI-FI® network. The communications device **34** may wirelessly send signals to, and wirelessly receive signals from, the communications network **40**. Web pages, music, movies, and any other data may be routed to the woman's communications device **34**. So, as the woman **26** carries her communications device **34**, she can send and receive data.

Exemplary embodiments thus provide the interface **32** between the different networks. The communications device **34** may receive the neurological signals **28** from the neurological area network **20** in the woman's brain. The communications device **34** may then forward or route those neurological signals **28** to the external communications network **40**. The woman's neurological signals **28** may thus be transmitted and sent into a cellular data network and/or a WI-FI® network for routing to some distant destination for analysis. The woman's communications device **34** may also receive signals from the external communications network **40** that are destined for her neurological area network **20**. The communications device **34**, likewise, may receive the biological signals **30** from the body area network **22** and send those biological signals **30** into the external communications network **40**. The woman's communications device **34** may also receive signals from the external communications network **40** that are destined for her body area network **22**. Exemplary embodiments thus provide the interface **32** between the neurological area network **20** in the woman's brain, the body area network **22** in the woman's body, and the external communications network **40**.

Exemplary embodiments also describe nested communications. The neurological area network **20**, the body area network **22**, and the external communications network **40** may have a nested arrangement based on frequency. Science has shown that the human brain processes the neurological signals **28** at an extremely high frequency. Indeed, the brain's frequency may be much too high for economical transmission into the external communications network **40**. The biological signals **30** in the body area network **22** are a lower frequency, but the biological signals **30** may still be of too high frequency for the external communications network **40**. The woman's communications device **34**, then, may transform the neurological signals **28** and/or the biological signals **30** to be compatible with the external communications network **40** (which later paragraphs will explain).

FIG. **2** is a more detailed schematic illustrating an operating environment, according to exemplary embodiments. Here the communications device **34** again provides the interface **32** between the neurological area network **20** in the brain, the body area network **22** in the body, and the external communications network **40**. The communications device **34** may have a processor **50** (e.g., "μP"), application specific integrated circuit (ASIC), or other component that executes an interface application **52** stored in a local memory **54**. The interface application **52** may instruct the processor **50** to generate and visually display a user interface **56** on a display device **58**. The interface application **52** may also instruct the processor **50** to generate and present audible content from a speaker or other audible system **60**. The communications device **34** receives the neurological signals **28** from the neurological area network **20**. The communications device **34** may have any physical or wireless interface to the neurological area network **20**, such as contacts, electrodes, and any other physiological sensor. The communications device **34** may also receive the biological signals **30** from the body area network **22**. The communications device **34**, likewise, may have any physical or wireless interface to the body area network **22**, such as contacts, electrodes, and any other physiological sensor. The interface application **52** includes instructions, code, and/or programs that cause the processor **50** to determine a destination **70** for the neurological signals **28** and the biological signals **30**.

The destination **70** likely requires routing into the communications network **40**. The brain and the body already have one or more electrical connections. The central nervous system, for example, already provides an extremely fast "pipe" for electrical signals transmitted between the brain and the body. Unless some significant breakthrough is made, it is unlikely that the communications device **34** could provide a faster routing process than the central nervous system. For the foreseeable future, then, the destination **70** will most likely be outside the biological host **24**. That is, the destination **70** will likely be outside the neurological area network **20** and outside body area network **22**. The destination **70** will thus require routing into and through the external communications network **40**. So, the interface application **52** instructs the processor **50** to route the neurological signals **28** and/or the biological signals **30** along the communications network **40** to their destination **70**.

Exemplary embodiments may be applied regardless of networking environment. As the above paragraphs mentioned, the communications network **40** may be a wireless network having cellular, WI-FI®, and/or BLUETOOTH® capability. The communications network **40**, however, may be a cable network operating in the radio-frequency domain and/or the Internet Protocol (IP) domain. The communications network **40**, however, may also include a distributed computing network, such as the Internet (sometimes alternatively known as the "World Wide Web"), an intranet, a local-area network (LAN), and/or a wide-area network (WAN). The communications network **40** may include coaxial cables, copper wires, fiber optic lines, and/or hybrid-coaxial lines. The communications network **40** may even include wireless portions utilizing any portion of the electromagnetic spectrum and any signaling standard (such as the IEEE 802 family of standards, GSM/CDMA/TDMA or any cellular standard, and/or the ISM band). The communications network **40** may even include powerline portions, in which signals are communicated via electrical wiring. The concepts described herein may be applied to any wireless/wireline communications network, regardless of physical componentry, physical configuration, or communications standard(s).

FIG. **3** is a schematic illustrating routing of the neurological signals **28**, according to exemplary embodiments. Here the communications device **34** provides a connection interface between the neurological area network **20** and the external communications network **40**. When the communications device **34** receives the neurological signals **28** from the neurological area network **20**, the interface application **52** implements one or more routing policies **80** that determine the destination **70** of the neurological signals **28**. Each routing policy **80** is stored in the memory **54** of the communications device **34**. FIG. **3**, for simplicity, illustrates the routing policy **80** as a routing table **82** that maps, relates, or associates different neurological signals **28** to different destination addresses **84** within the communications network **40**. The interface application **52** queries the table **82** for the neurological signal **28** received from the neurological area network **20**. The interface application **52** receives the corresponding destination address **84** in response. The interface application **52** then instructs the processor **50** to forward or route the neurological signal **28** to the destination address **84** associated with the destination **70**.

As FIG. **3** illustrates, there may be different types of neurological signals **28**. Different regions or portions of the brain may produce different neurological signals **28**. There may also be different scientific processes that obtain different neurological signals **28**. Electroencephalogram ("EEG") and magnetoencephalogram ("MEG"), for example, are two different neurological signals **28** that may be received from the brain. Each different neurological signal **28** may thus have a different destination address **84**, depending on the type of signal and/or the region of the brain. Exemplary embodiments may thus retrieve the routing policy **80** that specifies the destination address **84** for the neurological signals **28**. The interface application **52** then instructs the processor **50** to direct the neurological signal **28** to the retrieved destination address **84**. The smart phone (illustrated as reference numeral **36** in FIG. **1**), for example, may then wirelessly transmit the neurological signal **28** to the communications network **40**. Network components within the communications network **40** then route the neurological signal **28** to the network destination address **84**.

FIG. **4** is another schematic illustrating routing of the neurological signals **28**, according to exemplary embodiments. Here the neurological signals **28** may be identified and routed according to location in the brain. As the above paragraphs explained, different regions or portions of the brain may produce different neurological signals **28**. Exemplary embodiments may thus differentiate or distinguish between regions of the brain and the neurological signals **28** that originate from a particular region of the brain. Exemplary embodiments, in other words, may select the destination **70** based on the particular region of the brain.

FIG. **4** thus illustrates neuroregional translations. Each neurological signal **28** may be received from, or identified with, a different neurological region **90** within the neurological area network **20**. Studies show that different regions of the brain are used for different processes and tasks (e.g., "right-brain" and "left brain" activities). When the communications device **34** receives the neurological signal **28**, the neurological signal **28** may be identified with a particular neurological region **90** within the neurological area network **20**. The neurological signal **28** may thus be mapped to its corresponding destination address **84** in the communications network **40**, based on the neurological region **90**. Once the network destination address **84** is selected, the interface application **52** then instructs the processor **50** to direct the neurological signal **28** to the retrieved destination address **84**.

FIG. **5** is another schematic illustrating neuroregional translations, according to exemplary embodiments. Here different neurological addresses **92** may be assigned to the different neurological regions **90** within the neurological area network **20**. The routing policy **80**, in other words, may assign network addresses to the different neurological regions **90** within the neurological area network **20**. Each different neurological region **90** may thus be addressable to send/receive communications to/from the communications network **40**. When the communications device **34** receives the neurological signal **28**, the neurological signal **28** may again be identified with its particular neurological region **90** within the neurological area network **20**. Once the neurological region **90** is known, the interface application **52** consults the routing table **82** for the corresponding neurological address **92** assigned to the neurological region **90**. The interface application **52** may then query for the corresponding destination address **84** in the communications network **40**, based on the neurological region **90** and/or the neurological address **92**. The interface application **52** may then log the neurological signal **28** in a traffic log **94**, using a date and time **96** of receipt, the origination neurological address **92** (e.g., the neurological region **90**), and the destination address **84**. Once the network destination address **84** is selected, the interface application **52** then instructs the processor **50** to direct the neurological signal **28** to the retrieved destination address **84**.

FIG. **6** is a schematic illustrating routing of the biological signals **30**, according to exemplary embodiments. Here the communications device **34** provides a connection interface between the body area network **22** and the external communications network **40**. When the communications device **34** receives the biological signal **30** from the body area network **22**, the interface application **52** again implements the routing policy **80** for the biological signals **30**. The routing policy **80** determines the network destination address **84** in the communications network **40**. The interface application **52** queries the table **82** for the biological signal **30** received from the body area network **22**. The interface application **52** receives the corresponding destination address **84** in response. The interface application **52** then instructs the processor **50** to forward or route the biological signal **30** to the destination address **84**.

As FIG. **6** illustrates, there may also be different types of biological signals **30**. There are many different scientific processes that obtain different biological signals **30**. Galvanic skin response (or "GSR"), electrocardiogram ("ECG"), electromyogram ("EMG"), and heart rate variability ("HRV") may be received as the biological signal **30**. Each different biological signal **30** may thus have a different destination address **84**, depending on the type of signal. Exemplary embodiments may thus retrieve the routing policy **80** that specifies the destination address **84** for the biological signal **30**. The interface application **52** then instructs the processor **50** to direct the biological signal **30** to the retrieved destination address **84**. The smart phone (illustrated as reference numeral **36** in FIG. **1**), for example, may then wirelessly transmit the biological signal **30** to the communications network **40**. Network components within the communications network **40** then route the biological signal **30** to the network destination address **84**.

FIG. **7** is another schematic illustrating routing of the biological signal **30**, according to exemplary embodiments. Here the biological signal **30** may be identified and routed according to location in the body. Different regions or portions of the body may produce a different biological signal **30**. Exemplary embodiments may thus differentiate or distinguish between regions of the body and the biological signal **30** that originate from a particular region of the body. Exemplary embodiments, in other words, may select the destination **70** based on the particular region of the body from which the biological signal **30** originates.

FIG. **7** thus illustrates bioregional translations. Each biological signal **30** may be received from, or identified with, a different biological region **100** within the body area network **22**. Some biological signals **30** may originate from, or be identified with, an arm, while others are identified with a leg.

Granularity may even be finer, thus identifying biological signals **30** from a hand, finger, toe, or even a cell. Regardless, when the communications device **34** receives the biological signal **30**, the biological signal **30** may be identified with, or contain information identifying, the biological region **100** within the body area network **22**. The interface application **52** queries the routing policy **80** for the corresponding destination address **84** in the communications network **40**, based on the biological region **100**. Once the destination address **84** is selected, the interface application **52** then instructs the processor **50** to direct the biological signal **30** to the retrieved destination address **84**.

FIG. **8** is another schematic illustrating bioregional translations, according to exemplary embodiments. Because the biological signal **30** may be associated with its corresponding biological region **100** within the body area network **22**, exemplary embodiments may assign different biological addresses **110** to the different biological regions **100** within the body area network **22**. The routing policy **80**, in other words, may assign network addresses to the different biological regions **100** within the body area network **22**. Each different biological region **100** may thus be addressable to send/receive communications to/from the communications network **40**. When the communications device **34** receives the biological signal **30**, the biological signal **30** may again be identified with its particular biological region **100** within the body area network **22**. Once the biological region **100** is known, the interface application **52** consults the routing table **82** for the corresponding biological address **110** assigned to the biological region **100**. The interface application **52** may then query for the corresponding destination address **84** in the communications network **40**, based on the biological region **100** and/or the biological address **110**. The interface application **52** may then log the biological signal **30** in the traffic log **94**, using the date and time **96** of receipt, the origination biological address **110** (e.g., the biological region **100**), and the destination address **84**. Once the destination address **84** is selected, the interface application **52** then instructs the processor **50** to direct the biological signal **30** to the retrieved destination address **84**.

FIGS. **9-10** are schematics illustrating receipt of signals, according to exemplary embodiments. Here the communications device **34** may receive a communication **120** from the communications network **40**. The interface application **52** instructs the processor **50** to inspect the communication **120** for its destination. The interface application **52** then instructs the processor **50** to route the communication **120** to the destination.

Here, though, the destination may lie within one of the intrahost networks. The communication **120**, for example, may be destined for some location within the neurological area network **20**. The communication **120**, in other words, may route to some location within the user's brain. The communications device **34** again provides the interface **32** to the neurological area network **20**.

FIG. **9** thus illustrates reverse neuroregional translations, according to exemplary embodiments. If the communication **120** is neurologically-related, then the communication **120** should be delivered to the proper neurological region **90**. Again, studies have shown that different regions of the brain have different processing capabilities (e.g., the so-called "right brain" and "left brain" activities). In this example the communication **120** is neurologically-related, so the communication **120** may identify its corresponding neurological region **90**. That is, the communication **120** contains information or data that identifies its destination neurological region **90**. So, when the communication **120** is received, the interface application **52** consults the routing policy **80** and performs a reverse neuroregional translation. The interface application **52** queries the routing policy **80** for the neurological region **90** specified in or by the communication **120**. The interface application **52** receives a response that identifies the corresponding neurological address **92** assigned to the neurological region **90**. Once the neurological address **92** is known, the interface application **52** then instructs the processor **50** to direct the communication **120** to the retrieved neurological address **92**. The communication **120** may be directly sent into the neurological region **90** of the brain (such as by wired or wireless electrode). The communication **120** may also be sent into the neurological area network **20** for natural, neurological routing to the proper neurological region **90** of the brain.

Exemplary embodiments may thus receive and route communications to the brain. Because exemplary embodiments provide the interface **32** to the neurological area network **20**, exemplary embodiments may receive and route communications to particular locations within the brain. The communication **120** is received from the external communications network **40** and routed to the proper neurological region **90** of the brain. Exemplary embodiments, in other words, may route communications to addressable locations within the neurological area network **20**.

FIG. **10** illustrates reverse bioregional translations, according to exemplary embodiments. Here again the communication **120** is received from the external communications network **40**. Here, though, the destination of the communication **120** lies within the body area network **22**. The communication **120**, in other words, may route to some location within the user's body. In this example the communication **120** may identify its corresponding biological region **100**. That is, the communication **120** contains information or data that identifies its destination biological region **100**. So, when the communication **120** is received, the interface application **52** consults the routing policy **80** and performs a reverse bioregional translation. The interface application **52** queries the routing policy **80** for the biological region **100** specified in or by the communication **120**. The interface application **52** receives a response that identifies the corresponding biological address **110** assigned to the biological region **100**. Once the biological address **110** is known, the interface application **52** then instructs the processor **50** to direct the communication **120** to the retrieved biological address **110**. The communication **120** may be directly sent into the biological region **100** of the body (such as by wired or wireless electrode). The communication **120** may also be sent into the body area network **22** for natural, biological routing to the proper biological region **100** of the body.

Exemplary embodiments may thus also receive and route communications to the body. Because exemplary embodiments provide the interface **32** to the body area network **22**, exemplary embodiments may receive and route communications to particular locations within the body. The communication **120** is received from the external communications network **40** and routed to the proper biological region **100** of the body. Exemplary embodiments, in other words, may route communications to addressable locations within the body area network **22**.

Exemplary embodiments may include biological subnets (or "bio-subnets"). The above paragraphs explained that communications may be destined for particular neurological regions **90** within the brain and/or to particular biological region **100** within the body. Because exemplary embodiments provide the interface **32** to these addressable locations, subnetwork notations may be used to denote the neurological regions **90** and the biological regions **100**. Exemplary embodiments, in other words, may thus assign biological subnet addresses to existing addressing protocols. Subnet notations may be used by the interface application **52** to ensure addressable routings to the proper logical destinations of neurological and biological communications. The below generic Internet Protocol address (e.g., "IPv6") has a generic subnet

IPv6/bitspec,

where the subnet "/bitspec" indicates that a predetermined number of bits in the IPv6 specification may be reserved for bio-subnets. Each neurological region **90** within the brain and/or each biological region **100** within the body may thus be addressable using its particular subnet. So, just as the communications device **34** may have its own unique Internet Protocol address, each neurological region **90** within the brain and/or each biological region **100** within the body may have its own unique Internet Protocol address. In this way signals and communications may be addressably routed to different destinations within the brain and the body.

FIG. **11** is a schematic illustrating interhost translation, according to exemplary embodiments. The above paragraphs explain how the biological host **24** may have short range intrahost networks. That is, the brain of any human or animal has the neurological area network **20** which can be addressable (using the neurological addresses **92** illustrated in FIG. **9**). The biological host **24** also has the body area network **22** which may be addressable (using the biological addresses **110** illustrated in FIG. **10**). If any biological host **24** has either of these intrahost networks, then communications may be sent between different biological hosts. That is, one person's neurological area network **20** may communicate with a different person's neurological area network **20**. Likewise, one person's body area network **22** may communicate with a different person's body area network **22**. Indeed, one person's neurological area network **20** may communicate with the different person's body area network **22**. As one person's intrahost networks are addressable, different people and animals may conduct interhost communications. In more simple terms, one person's brain may control another person's body and vice-versa.

Each person's communications device **34** may provide the interfacing. As this disclosure explains above, the interface **32** may be needed to communicate electrical signals between the brain, the body, and the external communications network **40**. The communications device **34** thus provides the interface **32** between the communications network **40**, the neurological area network **20**, and the body area network **22**. Each person's communications device **34**, therefore, may provide the interface **32** to a different person's intrahost networks. That is, one person's communications device **34** may send and receive another person's neurological signals **28** and biological signals **30**. Because exemplary embodiments assign network addresses to different regions of the brain and body, communications may be directed between the different regions of different people. In simple terms, exemplary embodiments assign a network address to each different biological host **130**.

FIG. **11** thus illustrates interhost translation. When the communications device **34** receives the neurological signals **28** and/or the biological signals **30**, the interface application **52** determines the destination **70**. Here, though, the destination **70** may be a different biological host **130**. If the neurological signals **28** and/or the biological signals **30** are destined for a different person **132**, for example, the interface application **52** causes the communications device **34** to route the neurological signals **28** and/or the biological signals **30** into the external communications network **40**. The neurological signals **28** and/or the biological signals **30** route along the communications network **40** to a network address **134** associated with a different communications device **136** of the different person **132**. The different person's different communications device **136** may also execute the interface application **52**. The different communications device **136** may thus route the neurological signals **28** and/or the biological signals **30** to their proper destination within the different person **132**, as the above paragraphs explained. The neurological signals **28** and/or the biological signals **30** may thus be routed and exchanged between different people, using their respective communications devices as the interface **32**.

FIGS. **12-13** are schematics illustrating machine translation, according to exemplary embodiments. Here the communications device **34** translates the neurological signals **28** into the biological signals **30**. The woman's smart phone **36** again communicates with her neurological area network **20** and her body area network **22**. Her smart phone **36** thus receives the neurological signals **28** transmitted from her neurological area network **20**. The smart phone **36** interprets the neurological signals **28** and routes the interpretation along the woman's body area network **22**.

As this disclosure already explained, though, the brain and body already have very fast communications. The brain and the body already exchange electrical signals. The central nervous system already provides an extremely fast "pipe" for electrical signals transmitted between the brain and the body. For the foreseeable future, it is unlikely that the communications device **34** could provide a better or faster routing process.

The communications device **34**, then, may perform machine translation. If the woman's smart phone **36** interprets her neurological signals **28**, any interpretation may be unlike existing biological interpretation. That is, the woman's communications device **34** may be used to interpret her neurological signals **28** into machine commands **140** for some electronic component **142**. The interface application **52** may thus include an interpreter **144** that translates the neurological signals **28** into the commands **140**. The commands **140**, for example, may order her communications device **34** to make calls, send text messages, or download content. More interestingly, her neurological signals **28** may be translated into the commands **140** for an artificial heart operating in her own body. Her own thoughts, in other words, may increase or decrease its pumping action. Similarly, a heart pacemaker may be ordered to increase or decrease its rhythm. Controllers in artificial limbs may be instructed to automatically change their parameters. Any electronic component **142** in the woman's body may thus be commanded to change or tune its performance, based on her neurological signals **28** received from the neurological area network **20**. The interpreter **144** of the interface application **52** translates the neurological signals **28** into the commands **140**. The interface application **52** may then convert the commands **140** into the biological signals **30** that are transmitted along the woman's body area network **22**. The biological signals **30** may route to the addressable biological region **100** within the body. Indeed, the biological signals **30** may even route to the biological address **110** associated with the electronic component **142** (such as the heart or hand). The woman may thus be instructed to visualize or think of some parameter change, and the corresponding neurological signals **28** are translated and converted to make physical, operational changes in the electronic component **142**. Exemplary embodiments, in other words, may make physical changes using mental thoughts.

The commands **140** may control appliances. The woman's mental thoughts (e.g., the neurological signals **28** received from the neurological area network **20**) may be used to control lights, televisions, and even cars. Once the interpreter **144** interprets the neurological signals **28**, the interface application **52** may command the communications device **34** itself to take some action. The interface application **52**, in other words, may generate the commands **140** for the communications device **34** itself. The woman's brain, for example, may think "call Bob," and her neurological signals **28** are translated into dialing commands **140** for the communications device **34**. The woman may, likewise, visualize text to be sent to "Bob," and her neurological signals **28** are translated into the commands **140** that send a text message to Bob. Any neurological signals **28** may be interpreted as the commands **140** for channel changes, lights, music players, and appliances.

FIG. **13** further illustrates machine translation. Here the woman's thoughts may control a changeable tattoo **150**. The tattoo **150** is another example of physical response to mental thoughts. The tattoo **150** is capable of changing its visual appearance in response to the neurological signals **28** received from the neurological area network **20**. That is, the tattoo **150** changes in response to the woman's thoughts. The woman thinks about the visual appearance of her tattoo **150**. Her neurological signals **28** are received by her smart phone **36**. The interpreter **144** of the interface application **52** translates the neurological signals **28** into the commands **140** for her tattoo **150**. The interface application **52** converts the commands **140** into the biological signals **30**, and the biological signals **30** are transmitted along the woman's body area network **22**. The biological signals **30** route to the addressable biological region **100** within the body that contains her changeable tattoo **150**. The tattoo **150** is thus commanded to change its visual appearance. The woman merely visualizes the appearance of her tattoo **150**, and her thoughts are interpreted into physical changes of her tattoo **150**.

The changeable tattoo **150**, however, may respond to the commands **140** that originate from the interface application **52**. The interface application **52**, in other words, may itself determine what the tattoo **150** displays. So, whether the user mentally instructs the tattoo **150**, or the interface application **52** issues the commands **140**, the tattoo **150** may respond to the commands **140** regardless of origination.

An example helps explain the changeable tattoo **150**. Because the tattoo **150** may be instructed to change its appearance by the interface application **52**, the tattoo **150** may be considered a biological display device. The tattoo **150**, in other words, may be instructed to display any information, logo, text, or output. The tattoo **150** may also dynamically change its visual appearance as fast as the body area network **22** may process and deliver the biological signals **30**. The interface application **52**, for example, may retrieve an airline boarding pass from its memory **54** and then command the tattoo **150** to display the airline boarding pass. The interface application **52** may also retrieve a photo ID from its memory **54** and command the tattoo **150** to simultaneously display both the airline boarding pass and the photo ID. No physical documents are thus needed to pass airline security.

The changeable tattoo **150** has many other uses. The tattoo **150** may be commanded to display a reminder at a particular date and time, thus helping the user remember important calendar events. The tattoo **150** may be commanded to display web pages, movies, advertisements, or any other content. The tattoo **150** may be commanded to display authentication credentials (such as images and passwords) that unlock a car or provide access to a computer or hotel room. The tattoo **150** may display moods of the user with appropriate colors (e.g., red for "anger" or "blue" for sadness) or images (smiley/sad faces).

The changeable tattoo **150** may also be used in commerce. Because the tattoo **150** may be commanded to display content, the tattoo **150** may display advertising. Just as spam email or text messaging exists, the communications device **34** may receive spam advertising communications for display by the tattoo **150**. Users may thus opt-in or opt-out of this "spam tattooing." Users may establish white lists of approved advertisers and black lists of denied advertisers. The tattoo **150** may display account information, thus allowing the user to make purchases and debit accounts by displaying machine readable account information (such as bar codes).

The tattoo **150** may even respond to the neurological signals **28** of different biological hosts. As earlier paragraphs explained, the interface **32** may exchange neurological signals **28** and biological signals **30** between different biological hosts. Different people, in other words, may exchange their mental and physical signals. When the interface application **52** receives a different person's neurological signals **28**, the interface application **52** may translate the different person's neurological signals **28** into the commands **140** for the woman's own tattoo **150**. The interface application **52**, in other words, may instruct the tattoo **150** to display another person's thoughts. Some people, of course, will want complete control over their own tattoo **150**, while other users may enjoy expressing the thoughts of others. Users may thus opt-in or opt-out of this exogenous tattooing. Users may thus establish white lists of approved people or addresses and black lists of denied people or addresses. Purchasing permissions may be given by adults to children by displaying a machine readable permission code. Parents may thus give authorization for purchases simply by changing the child's tattoo **150**.

The tattoo **150** may also communicate with external systems. Because the tattoo **150** displays any image or text, the visual appearance of the tattoo **150** may be interpreted by sensors. A vision system camera, for example, may be trained or aimed to capture the images and/or text displayed by the tattoo **150**. The images and/or text may then be interpreted by a computer or server. Once the images and/or text are interpreted, actions may be based on the interpretation. The communication **120**, for example, may be sent back to the woman's smart phone **36** as a response to the interpretation. The interface application **52** may then interpret and route the incoming communication **120**, as earlier paragraphs explained. Exemplary embodiments, then, may provide a back-up or redundant path for communications **120** with the brain's cerebral cortex.

FIG. **14-17** are flowcharts illustrating a method or algorithm for interfacing with neural and body networks, according to exemplary embodiments. A neurological signal is received from a neurological area network in a biological host (Block **200**). A neuroregional translation is performed (Block **202**). Regions within the neurological area network may be mapped to different destinations in a communications network (Block **204**). A destination may be selected based on a region in the neurological area network based on the neurological signal (Block **206**). The neurological signal is routed to the destination (Block **208**). The neurological signal may be wirelessly sent to a wireless communications network (Block **210**) and routed to an address associated with a different biological host (Block **212**).

The algorithm continues with FIG. **15**. A biological signal may also be received from a body area network in the biological host (Block **214**). A bioregional translation is performed (Block **216**). Regions within the body area network may be mapped to different destinations in a communications network (Block **218**). A destination may be selected based on a region in the body area network based on the neurological signal (Block **220**). The biological signal is routed to the destination (Block **222**). The biological signal may be wirelessly sent to a wireless communications network (Block **224**) and routed to an address associated with a different biological host (Block **226**).

The algorithm continues with FIG. **16**. A communication is received (Block **228**). The communication may be associated with an identity of the biological host (Block **230**) and/or a neurological region in the neurological area network (Block **232**). Logical mappings are stored between neurological addresses, neuroregional destinations in the neurological area network, and identities of different biological hosts (Block **234**). A reverse neuroregional translation is performed (Block **236**). A query is made for the neurological region associated with the communication (Block **238**). The corresponding neurological address is retrieved (Block **240**). The communication is routed to the neurological address (Block **242**).

The algorithm continues with FIG. **17**. A communication is received (Block **244**) that is associated with an identity of the biological host (Block **246**) and/or a biological region in the body area network (Block **248**). Logical mappings are stored between biological addresses, bioregional destinations in the body area network, and identities of different biological hosts (Block **250**). A reverse bioregional translation is performed (Block **252**). A query is made for the biological region associated with the communication (Block **254**). The corresponding biological address is retrieved (Block **256**). The communication is routed to the biological address (Block **258**).

FIG. **18** is a schematic illustrating still more exemplary embodiments. FIG. **18** is a more detailed diagram illustrating the interface **32**. As earlier paragraphs explained, the interface **32** may be any processor-controlled device. FIG. **18**, then, illustrates the interface application **52** stored in a memory subsystem of the processor-controlled interface **32**. One or more processors communicate with the memory subsystem and execute the interface application **52**. Because the processor-controlled interface **32** illustrated in FIG. **18** is well-known to those of ordinary skill in the art, no further explanation is needed.

FIG. **19** depicts still more operating environments for additional aspects of the exemplary embodiments. FIG. **19** illustrates that the exemplary embodiments may alternatively or additionally operate within other processor-controlled interfaces **32**. FIG. **19**, for example, illustrates that the interface application **52** may entirely or partially operate within a set-top box ("STB") (**302**), a personal/digital video recorder (PVR/DVR) **304**, personal digital assistant (PDA) **306**, a Global Positioning System (GPS) device **308**, an interactive television **310**, an Internet Protocol (IP) phone **312**, a pager **314**, a cellular/satellite phone **316**, or any computer system, communications device, or any processor-controlled device utilizing a digital signal processor (DP/DSP) **318**. The interface **32** may also include watches, radios, vehicle electronics, clocks, printers, gateways, mobile/implantable medical devices, and other apparatuses and systems. Because the architecture and operating principles of the various processor-controlled interfaces **32** are well known, the hardware and software componentry of the various processor-controlled interfaces **32** are not further shown and described.

Exemplary embodiments may be physically embodied on or in a computer-readable storage medium. This computer-readable medium may include CD-ROM, DVD, tape, cassette, floppy disk, memory card, and large-capacity disks. This computer-readable medium, or media, could be distributed to end-subscribers, licensees, and assignees. A computer program product comprises processor-executable instructions for interfacing with neurological area and body area networks, as the above paragraphs explained.

While the exemplary embodiments have been described with respect to various features, aspects, and embodiments, those skilled and unskilled in the art will recognize the exemplary embodiments are not so limited. Other variations, modifications, and alternative embodiments may be made without departing from the spirit and scope of the exemplary embodiments.

The invention claimed is:

1. A method comprising:

receiving, by a processor of a device, an electronic communication from a communications network, the electronic communication specifying a neurological region in a biological host;

retrieving, by the processor of the device, a routing policy that associates the neurological region to a neurological address; and

routing, by the processor of the device, the electronic communication to the neurological address to cause the electronic communication to be sent into the neurological region of the biological host.

2. The method of claim **1**, further comprising retrieving a biological subnet address from the electronic communication.

3. The method of claim **1**, further comprising assigning a biological subnet address to the neurological region.

4. The method of claim **1**, wherein the routing policy is associated with the biological host.

5. The method of claim **1**, further comprising querying the routing policy for the neurological region.

6. The method of claim **1**, wherein the electronic communication is sent into the neurological region of the biological host via an electrode.

7. The method of claim **1**, further comprising:

receiving, by the processor of the device, an additional electronic communication from the communications network, the additional electronic communication specifying a biological region in the biological host;

retrieving, by the processor of the device, the routing policy, wherein the routing policy associates the biological region to a biological address; and

routing, by the processor of the device, the additional electronic communication to the biological address to cause the additional electronic communication to be sent into the biological region of the biological host.

8. A system comprising:

a processor; and

a memory storing code that when executed causes the processor to perform operations, the operations comprising:

receiving packets of data containing an electronic communication specifying a neurological region of a brain in a biological host,

retrieving a routing policy associated with the biological host, the routing policy having database associations between different neurological regions of the brain and different neurological addresses,

determining a neurological address of the different neurological addresses of the routing policy that corresponds to the neurological region of the brain specified by the electronic communication, and

routing the electronic communication to the neurological address to cause the electronic communication to be sent into the neurological region of the brain in the biological host.

9. The system of claim **8**, wherein the operations further comprise:

receiving packets of data containing an additional electronic communication specifying a biological region of a body of the biological host;

retrieving the routing policy, wherein the routing policy associates the biological region of the body of the biological host to a biological address; and

routing the additional electronic communication to the biological address to cause the additional electronic communication to be sent into the biological region of the body of the biological host.

10. The system of claim **8**, wherein the electronic communication is sent into the neurological region of the brain of the biological host via an electrode.

11. The system of claim **8**, wherein the operations further comprise logging the electronic communication with a time of receipt.

12. The system of claim **8**, wherein the operations further comprise logging the electronic communication in a log in association to the neurological region of the brain.

13. The system of claim **8**, wherein the operations further comprise logging the electronic communication in a log in association with the biological host.

14. The system of claim **8**, wherein the operations further comprise logging the electronic communication in a log in association with the neurological address.

15. A memory device storing instructions that when executed by a processor of a system, cause the processor to perform operations comprising:

receiving packets of data containing an electronic communication specifying a neurological region of a brain in a biological host;

retrieving a routing policy associated with the biological host, the routing policy having database associations between different neurological regions of the brain and different neurological addresses;

determining a neurological address of the different neurological addresses of the routing policy that corresponds to the neurological region of the brain specified by the electronic communication; and

routing the electronic communication to the neurological address to cause the electronic communication to be sent into the neurological region of the brain in the biological host.

16. The memory device of claim **15**, wherein the operations further comprise:

receiving packets of data containing an additional electronic communication specifying a biological region of a body of the biological host;

retrieving the routing policy, wherein the routing policy associates the biological region of the body of the biological host to a biological address; and

routing the additional electronic communication to the biological address to cause the additional electronic communication to be sent into the biological region of the body of the biological host.

17. The memory device of claim **15**, wherein the electronic communication is sent into the neurological region of the brain of the biological host via an electrode.

18. The memory device of claim **15**, wherein the operations further comprise logging the electronic communication with a time of receipt.

19. The memory device of claim **15**, wherein the operations further comprise logging the electronic communication in a log in association to the neurological region of the brain.

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