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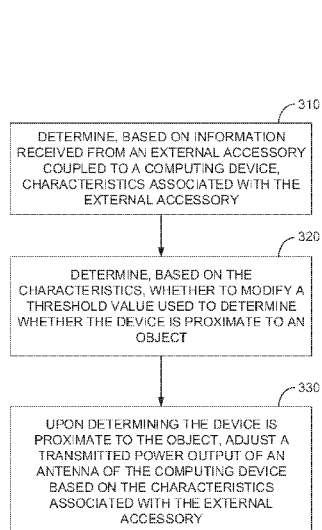


FIG. 3

(57) **Abstract:** An antenna and a proximity sensor coupled to the antenna can determine proximity of an object to a device. The device can include a controller to determine, based on information received from an external accessory coupled to the device, characteristics associated with the external accessory. The controller is to determine, based on the characteristics, whether to modify a threshold value used by the proximity sensor to determine whether the device is proximate to the object and, upon the proximity sensor determining the device is proximate to the object, adjust a transmitted power output of the antenna based on the characteristics associated with the external accessory.

## **ADJUSTING TRANSMITTED POWER OUTPUT OF AN ANTENNA OF A DEVICE**

### **BACKGROUND**

[0001] Wireless capable consumer devices may communicate with other wireless capable devices by exchanging radio frequency (RF) communication signals via an antenna, which may be located internally or externally to the device. Transmitted power output of an antenna may directly impact wireless performance, with higher transmitted power output limits allowing the wireless device to achieve greater throughput and/or broader wireless coverage (e.g., enhanced coverage areas). Government agencies regulate the RF radiation output of various wireless devices to limit the general public's exposure to RF radiation. Specifically, government agencies specify maximum Specific Absorption Rates (SAR) for various RF devices based on different factors. SAR is defined as the rate of RF energy absorption per unit mass at a point in an absorbing body.

### **BRIEF DESCRIPTION OF THE DRAWINGS**

[0002] FIGs. 1A-B illustrate a wireless capable device adapted to connected to a radio communication system, according to an example;

[0003] FIGs. 2A-C illustrate the wireless capable device of FIG. 1 fitted or coupled to an external accessory, according to an example; and

[0004] FIG. 3 is a flow diagram in accordance with an example of the present disclosure.

### **DETAILED DESCRIPTION**

[0005] RF radiation exposure may be related to both transmitted power output of an antenna and separation distance (e.g., the distance separating an extremity of the human body and the RF radiation source), as well as other factors (e.g., shielding, antenna design, etc.). Specifically, the amount of RF radiation absorbed by a human body may increase when the transmitted power output increases, as well as when the separation distance decreases. As an example, a strategy for satisfying SAR compliance criteria may be to reduce the transmitted power output of the antenna to offset a reduction in separation distance (e.g., reducing the transmitted power output

as the extremity of the human body approaches RF radiation source). Other strategies to offset a reduction in separation distance include, but are not limited to, switching to another antenna of the wireless device (e.g., away from the extremity), changing the data rate/modulation, and injecting idle times in the upload stream.

[0006] Various accessories may be used to expand the use of wireless capable devices and/or protect the devices. As an example, the emergence and popularity of mobile computing has made devices, such as tablet computers and all-in-one devices, a staple in today's marketplace. Tablet computers and all-in-one devices generally employ a touchscreen on a display surface of the device that may be used for both viewing and input. As the computing power of such computing devices continue to increase, users may desire to expand the use of such devices, for example, from solely employing the touchscreen on the display surface for both viewing and input. As an example, various peripherals may be used to expand the use of the portable computing devices. An example of such peripherals include, but is not limited to, a keyboard. Accessories are available for portable computing devices that include peripherals such as a physical keyboard for entering characters. Such accessories may be fitted or coupled to a portable computing device, such as a tablet computer, in various form factors.

[0007] When coupling a wireless capable device to an accessory, the accessory may provide additional clearance between the device and the human body and may impact the RF radiation absorbed by the human body. As a result, the strategy for satisfying SAR compliance criteria when the accessory is coupled to the device may differ from the strategy used when the device is not fitted to such accessories.

[0008] Examples disclosed herein provide the ability to modify the strategy used to satisfy SAR compliance criteria based on the accessory that is fitted to the device. Modifying the strategy for satisfying SAR compliance criteria according to the accessory fitted to the device may allow for improved control of the transmitted power output of an antenna of the device, allowing the wireless device to achieve greater throughput and/or broader wireless coverage.

[0009] In one example, a method of operation in a computing device includes determining, based on information received from an external accessory coupled to

the computing device, characteristics associated with the external accessory. The method includes determining, based on the characteristics, whether to modify a first threshold value used to determine whether the device is proximate to an object and, upon determining the device is proximate to the object, adjusting a transmitted power output of an antenna of the computing device based on the characteristics associated with the external accessory.

[0010] In another example, a computing device can include an antenna and a proximity sensor coupled to the antenna to determine whether the device is proximate to an object. The computing device can include a controller to determine, based on information received from an external accessory coupled to the device, a thickness associated with the external accessory. The controller is to determine, based on the thickness, whether to modify a first threshold value used by the proximity sensor to determine whether the device is proximate to an object and, upon the proximity sensor determining the device is proximate to the object, adjust a transmitted power output of the antenna based on the thickness associated with the external accessory.

[0011] In yet another example, a device can include a non-transitory computer-readable storage medium and a plurality of programming instructions stored in the storage medium to cause the device, in response to execution of the programming instructions by a processing resource, to perform a plurality of operations. The operations cause the device to determine, based on information received from an external accessory coupled to the device, characteristics associated with the external accessory. The operations cause the device to determine, based on the characteristics, whether to modify a first threshold value used to determine whether the device is proximate to an object and, upon determining the device is proximate to the object, adjust a transmitted power output of an antenna of the device based on the characteristics associated with the external accessory.

[0012] With reference to the figures, FIG. 1A is a block diagram illustrating a wireless capable device or a portable computing device 100 including a network interface 114 adapted to connect the device 100 to a radio communication system 116, according to an example. The radio communication system 116 may be a structure disposed

remote from the wireless device 100, and they may exchange communications with each other via wireless signals 118. In some embodiments, the radio communication system 116 may be a wireless router, a peripheral computing device adapted to provide a wireless signal, a cell phone station, and the like. The network interface 114 may include an antenna module 102, to allow for transmission and receipt of wireless signals, and a proximity sensor 104 coupled to the antenna module 102. The antenna module 102 may be a structure of a low profile antenna such as a patch antenna. The antenna module 102 may be constructed on a dielectric substrate, and communicatively coupled to the wireless device 100. The wireless device 100 may include one or more antenna modules 102 for wirelessly communicating with different radio communication systems 116, such as a Wi-Fi router and/or a cell phone station.

[0013] The wireless capable device 100 may be, for example, a laptop computer, desktop computer, tablet computer, mobile device, server, or cellular phone, a wearable computing device, among others. The wireless device 100 also includes a processor 106 and a storage device 110. The components of the wireless device 100 may be connected and communicate through a system bus (e.g., PCI, ISA, PCI-Express, HyperTransport®, NuBus, etc.). The processor 106 can be a single core processor, a multi-core processor, a computing cluster, or any number of other configurations. The processor 106 may be implemented as Complex Instruction Set Computer (CISC) or Reduced Instruction Set Computer (RISC) processors, x86 Instruction set compatible processors, multi-core, or any other microprocessor or central processing unit (CPU). In some embodiments, the main processor 106 includes dual-core processor(s), dual-core mobile processor(s), or the like.

[0014] The wireless capable device 100 may include a memory device 108. The memory device 108 can include random access memory (e.g., SRAM, DRAM, zero capacitor RAM, SONOS, eDRAM, EDO RAM, DDR RAM, RRAM, PRAM, etc.), read only memory (e.g., Mask ROM, PROM, EPROM, EEPROM, etc.), flash memory, or any other suitable memory systems.

[0015] The storage device 110 may be a non-transitory computer-readable storage medium. The storage device 110 may have instructions stored thereon that, when

executed by a processing resource, such as the processor 106, cause the wireless capable device 100 to perform operations. In some embodiments, the operations may be executed by a controller (not shown). As an example, the controller may be a microcontroller configured to determine, via the proximity sensor 104, whether a SAR exceeds a threshold for the proximity of the portable computing device 100 relative to an object (e.g., extremities of a human body), as will be further described.

[0016] The proximity sensor 104 may be associated near the antenna module 102 or integrated with circuitry of the antenna module 102, in order to determine proximity of an object near the antenna module 102 of the wireless capable device 100, which may be a source of RF radiation for the wireless device 100. As an example, the wireless device 100 is determined to be in the proximity of an object if the proximity sensor 104 determines that a part of the object is within some predefined distance of the antenna module 102 of the device 100.

[0017] As an example, the proximity sensor 104 may be a capacitive sensor, which capacitively provides an indication of proximity when the wireless capable device 100 is within the predefined distance of the part of the object. The proximity sensor 104 may detect changes in capacitance that may be associated with the proximity of the object. In other examples, other types of proximity sensors may be used for detecting the proximity of the wireless device 100 to an object, such as infrared and/or magnetic sensors, but use of the capacitive sensor will be further described.

[0018] As an example, the proximity sensor 104 may be one conductive element of a capacitor. The other conductive element of the capacitor may be the object exterior to the wireless capable device 100, such as the hands of a user or earth ground. The proximity sensor 104 may utilize capacitive charge and discharge cycles to detect changes in capacitance that may be associated with the proximity of the other conductive element. Since the area of the proximity sensor 104 and the other conductive element may remain constant, and the dielectric of the material between the conductive elements (e.g., air) may also remain constant, a change in capacitance may be a result of a change in the distance between the proximity sensor 104 and the other conductive element. Since capacitance is inversely proportional to the distance between the conductive elements, capacitance may

increase as the distance between the proximity sensor 104 and other conductive element decreases.

[0019] By charging the proximity sensor 104 to a fixed potential, then transferring that charge to a charge detector comprising another known capacitor (e.g., a reference capacitor), the capacitance of the capacitor including the proximity sensor 104 may be readily ascertainable. As a result, the proximity sensor 104 may provide a capacitance based on the environment external to the wireless capable device 100. Detecting a capacitance that exceeds a limit set for the wireless device 100 may indicate proximity of the antenna module 102 of the device 100 to an object. As an example, reaching a threshold value of charge and discharge cycles may be indicative of the antenna module 102 of the portable device 100 being a certain distance (e.g., 1 cm) from the object. Upon reaching the threshold value, the transmitted power output of the antenna module 102, if it is above a certain level to emit RF radiation, may be adjusted to offset the reduction in separation distance between the object and the wireless device 100. As an example, if the separation distance is 0 mm (i.e., the object is in direct contact with the wireless device 100), the transmitted power output of the antenna module 102 may be adjusted appropriately.

[0020] FIG. 1B illustrates a side profile of the computing device 100, such as a tablet computer, according to an example. The tablet computer 100 may include a display surface 130 (e.g., a touchscreen that may be used for both viewing and input) and a back surface 140 opposite the display surface 130. In between the display surface 130 and the back surface 140, the tablet computer 100 may include sidewalls around a perimeter of the tablet 100. As an example, the tablet 100 may include four sidewalls (e.g., a left sidewall, a right sidewall, a top sidewall 150, and a bottom sidewall). Although a user may be able to view the tablet 100 in a portrait or landscape orientation, the top sidewall 150 may refer to the same sidewall of the tablet 100. As an example, the network interface 114, including at least the antenna module 102 and the proximity sensor 104, may be disposed within the tablet 100 near to the top sidewall 150, as illustrated. The placement of the network interface 114 within the tablet 100 may be chosen to allow for the greatest throughput.

[0021] As described above, the proximity sensor 104 may be used to determine the proximity of an object, such as an extremity of the human body, to the antenna module 102 of the tablet 100, which may be a source of RF radiation for the tablet 100. As an example, when the object is within a predefined distance of the antenna module 102, the controller may instruct the network interface 114 to control the transmit power of the antenna module 102 to reduce the overall SAR. As an example, the antenna module 102 may be electrically coupled to a transmitter configured to communicate radio frequencies with the radio communication system 116. Upon detecting the object within the predefined distance of the antenna module 102, the controller may reduce the signal strength of the transmitter.

[0022] In various implementations, the predefined distance, which may correspond to a threshold value of charge and discharge cycles of the capacitor including proximity sensor 104, may be an upper limit determined by, for example, a government agency. As an example, the capacitance values produced by the capacitor including proximity sensor 104 while triggering the threshold may be indicative of the wireless capable device 100 being a certain distance (e.g., 1 cm) from the object.

[0023] As an example, multiple predefined distances may be measured in combination or independently when determining whether to adjust the transmit power of the antenna module 102. Referring to FIG. 1B, the predefined distances may include a distance 120a from the display surface 130, a distance 120b from the top sidewall 150, and/or a distance 120c from the back surface 140. As described above, each predefined distance may be indicated by a threshold value of charge and discharge cycles of the capacitor including proximity sensor 104. Distances 120a-c may be the same or have different values. Although FIG. 1B illustrates the proximity sensor 104 determining whether an object is within a predefined distance of the antenna module 102 according to three different orientations (e.g., from the display surface 130, top sidewall 150, and back surface 140), more or less orientations may be used for determining the proximity of the object.

[0024] As an example, the operations described above may be executed by logic at least partially comprising hardware logic. Hardware logic at least partially includes hardware, and may also include software, or firmware. Hardware logic may include

electronic hardware including interconnected electronic components to perform analog or logic operations on the wireless capable device 100. Electronic hardware may include individual chips/circuits and distributed information processing systems. The operations may include reducing the communication of the antenna module 102 when a user is detected to be nearby. For example, the antenna module 102 may be electrically coupled to a transmitter configured to communicate radio frequencies with the radio communication system 116. If a user is nearby, the wireless capable device 100 may reduce the signal strength of the transmitter.

[0025] FIG. 2A is a block diagram illustrating the computing device 100 of FIG. 1 fitted or coupled to an external accessory 200, according to an example. As described above, various accessories may be used to expand the use of computing device 100 and/or protect the device 100. As an example, tablet computers may be fitted to accessories including peripherals such as a physical keyboard for entering characters. The accessory 200 may include a connector 204 for electrically coupling the peripherals with the computing device 100. As an example, the peripherals may be electrically coupled with the computing device 100 when the connector 204 is connected with a connector port 202 of the computing device 100. As an example, in order to authenticate the accessory 200 for it to be used with the computing device 100, both the accessory 200 and the computing device 100 may be equipped with microcontrollers that enable communication between the accessory 200 and the computing device 100. The authentication may be performed in a secure manner, using, for example, cryptographic techniques.

[0026] Referring to FIG. 2A, the accessory 200 may include an authentication device 208 that may be used to authenticate the accessory 200 to be used with the computing device 100. The computing device 100 may include an authentication manager 206 to authenticate the accessory 200 upon receiving information from the authentication device 208 of the accessory 200. The computing device 100 may receive the information from the authentication device 208 when the connector 204 of the accessory 200 is connected with the connector port 202 of the computing device 100, or via other I/O protocols including, but not limited to, I2C, USB, and resistor pull-ups.

[0027] In addition to transmitting information that may be used for authenticating the accessory 200 to be used with the computing device, the authentication device 208 of the accessory 200 may also transmit information relating to characteristics associated with the accessory 200 (e.g., thickness of the accessory and what the accessory 200 is made from). The computing device 100 may use this information to modify the strategy used to satisfy the SAR compliance criteria while the accessory 200 is coupled to the computing device 100, as will be further described.

[0028] FIG. 2B illustrates a side profile of the computing device 100 of FIG. 1B fitted or coupled within an external accessory 200b, according to an example. As described above, the accessory 200b (similar to accessory 200) may include peripherals, such as a physical keyboard (not illustrated), for expanding the use of the computing device 100. In addition, the accessory 200b may function as a protective cover, protecting portions of the computing device. As an example, the accessory 200b may protect at least the back surface 140 and sidewalls of the computing device 100, including at least the top sidewall 150, as illustrated. From the back surface 140 to the external surface 240 of the accessory 200b, the accessory may have a thickness 220c. From the top sidewall 150 to the external surface 240 of the accessory 200b, the accessory may have a thickness 220b, which may be similar to or different from thickness 220c. At least thicknesses 220b, 220c may provide additional clearance between the device 100 and an object (e.g., extremity of the human body) and may impact the RF radiation absorbed by the object. As a result, the strategy for satisfying SAR compliance criteria when the accessory 200b is coupled to the computing device 100 may differ from the strategy used when the device 100 is not fitted to the accessory 200b, as will be further described.

[0029] As described above, based on information received from the external accessory 200b when coupling to the computing device 100 (e.g., via authentication device 208), the computing device 100 may determine characteristics associated with the accessory 200b. Based on the characteristics of the accessory 200b, the computing device may determine whether to modify a threshold value (e.g., a first threshold value) used to determine whether the computing device 100, while it is fitted to the accessory 200b, is proximate to an object. Referring to FIG. 2B, the

computing device 100 may determine to modify distances 120a-c, based on the characteristics of the accessory 200b. As an example, the computing device may modify the threshold value of charge and discharge cycles of the capacitor including proximity sensor 104 when modifying one or more of distances 120a-c. Upon determining the computing device 100, while it is coupled to the accessory 200b, is proximate to an object (e.g., within one or more of distances 120a-c), the computing device 100 may adjust a transmitted power output of the antenna module 102 based on the characteristics associated with the external accessory.

[0030] As an example, a characteristic associated with the accessory 200b that may be used by the computing device 100 while modifying the strategy used to satisfy the SAR compliance criteria includes a thickness of the accessory 200b (e.g., thicknesses 220b, 220c). As an example, during authentication, the authentication manager 206 of the computing device 100 may search through a database for characteristics associated with the accessory 200, such as thickness. As an example, during authentication, the authentication device 208 of the accessory 208 may transmit information to the computing device 100, including characteristics such as thickness.

[0031] Referring to FIG. 2B, during authentication, the computing device 100 may receive information that accessory 200b has thicknesses 220b, 220c. As illustrated, thicknesses 220b, 220c are within predefined distances 120b, 120c, which are distances set when the computing device 100 is not coupled to an accessory (e.g., see FIG. 1B). As a result, accessory 200b may provide additional clearance between the device 100 and an extremity of the human body, and may impact the RF radiation absorbed by the human body. As an example, rather than adjusting the transmitted power output of the antenna module 102 based on a distance between the object and a surface of the device 100, the transmitted power output may be adjusted based on a distance between the object and the exterior surface 240 of the accessory 200b. Modifying the transmitted power output of the antenna module 102 according to the accessory fitted to the device 100 may allow for improved control of the transmitted power output of an antenna of the device, allowing the wireless device to achieve greater throughput and/or broader wireless coverage.

[0032] Referring to FIG. 2B, although thicknesses 220b, 220c are within predefined distances 120b, 120c, the predefined distances may be changed by the computing device 100 due to, for example, the capacitance detected by the capacitor including proximity sensor 104 when accessory 200b is coupled to the computing device 100. As an example, the type of materials used to make the accessory 200b (e.g., plastic) may be detected as additional capacitance. As a result, the capacitor including the proximity sensor 104 may not accurately detect the proximity of an object to the device 100. As an example, the computing device 100 may receive information concerning the type of materials used to make the accessory 200b (e.g., plastic). Based on this information and the thickness of accessory 200b (e.g., thicknesses 220b, 220c), the computing device 100 may determine the additional capacitance that may be detected by the capacitor including proximity sensor 104, and adjust predefined distances 120b, 120c accordingly. As an example, if the accessory 200b is made of plastic and has thicknesses 220b, 220c that are below a second threshold value (e.g., predefined distances 120b, 120c, respectively), the computing device 100 may determine to increase one or more of predefined distances 120b, 120c by increasing the threshold value of charge and discharge cycles of the capacitor including proximity sensor 104 that corresponds to the increased predefined distance.

[0033] FIG. 2C illustrated a side profile of the computing device 100 of FIG. 1B fitted or coupled within an external accessory 200c, according to an example. From the back surface 140 to the external surface 240 of the accessory 200b, the accessory may have a thickness 220c. From the top sidewall 150 to the external surface 240 of the accessory 200b, the accessory may have a thickness 220b, which may be similar to or different from thickness 220c. As illustrated in FIG. 2C, thicknesses 220b, 220c is greater than predefined distances 120b, 120c, which are distances set when the computing device 100 is not coupled to an accessory (e.g., see FIG. 1B). With the materials of the accessory 200c having thicknesses 220b, 220c greater than predefined distances 120b, 120c, respectively, accessory 200c may provide sufficient clearance to overcome any RF radiation exposure from the computing device 100, at least from the back surface 140 or top sidewall 150 of the device 100. As an example, if thicknesses 220b, 220c is above a second threshold value (e.g., predefined distances 120b, 120c, respectively), the computing device 100 may

determine not to modify predefined distances 120b, 120c. As the material of accessory 200c is thick enough to shield any extremity of the human body from RF radiation exposure, the computing device 100 may maintain or increase the transmitted power output of the antenna module 102, irrespective of the proximity of the extremities to the computing device 100.

[0034] Referring to FIG.3, a flow diagram is illustrated in accordance with various examples. The flow diagram illustrates processes for adjusting a transmitted power output of an antenna of a device (e.g., wireless capable device 100) in a particular order. The order of the processes is not meant to limit the disclosure. Rather, it is expressly intended that one or more of the processes may occur in other orders or simultaneously. The disclosure is not to be limited to any particular example.

[0035] A method 300 may begin and progress to 310, where the device may determine, based on information received from an external accessory coupled to the device, characteristics associated with the external accessory. Progressing to 320, the device may determine, based on the characteristics, whether to modify a first threshold value used to determine whether the device is proximate to an object.

[0036] As an example, the device may receive information concerning the thickness of the external accessory. If the thickness of the external accessory is above a second threshold value, the device may determine not to modify the first threshold value used to determine whether the device is proximate to the object. As an example, the device may maintain or increase the transmitted power output of the antenna if the thickness of the external accessory is above the second threshold value. However, if the thickness of the external accessory is below the second threshold value, the device may determine to increase the first threshold value used to determine whether the device is proximate to the object.

[0037] Upon determining to modify the first threshold value, the device may monitor a measurement from a proximity sensor coupled to the antenna of the device, and may determine whether the device is proximate to the object based upon whether the measurement is above the modified first threshold value.

[0038] Progressing to 330, upon determining the device is proximate to the object, the device may adjust a transmitted power output of the antenna of the computing device based on the characteristics associated with the external accessory. As an example, the device may adjust the transmitted power output based on a distance between the object and an exterior surface of the external accessory.

[0039] It is appreciated that examples described may include various components and features. It is also appreciated that numerous specific details are set forth to provide a thorough understanding of the examples. However, it is appreciated that the examples may be practiced without limitations to these specific details. In other instances, well known methods and structures may not be described in detail to avoid unnecessarily obscuring the description of the examples. Also, the examples may be used in combination with each other.

[0040] Reference in the specification to “an example” or similar language means that a particular feature, structure, or characteristic described in connection with the example is included in at least one example, but not necessarily in other examples. The various instances of the phrase “in one example” or similar phrases in various places in the specification are not necessarily all referring to the same example.

[0041] It is appreciated that the previous description of the disclosed examples is provided to enable any person skilled in the art to make or use the present disclosure. Various modifications to these examples will be readily apparent to those skilled in the art, and the generic principles defined herein may be applied to other examples without departing from the spirit or scope of the disclosure. Thus, the present disclosure is not intended to be limited to the examples shown herein but is to be accorded the widest scope consistent with the principles and novel features disclosed herein.

## CLAIMS

### WHAT IS CLAIMED IS:

1. A method of operation in a computing device, comprising:
  - determining, based on information received from an external accessory coupled to the computing device, characteristics associated with the external accessory;
  - determining, based on the characteristics, whether to modify a first threshold value used to determine whether the device is proximate to an object; and
  - upon determining the device is proximate to the object, adjusting a transmitted power output of an antenna of the computing device based on the characteristics associated with the external accessory.
2. The method of claim 1, comprising:
  - upon determining to modify the first threshold value:
    - monitoring a measurement from a proximity sensor coupled to the antenna of the computing device; and
    - determining whether the computing device is proximate to the object based upon whether the measurement is above the modified first threshold value.
3. The method of claim 1, wherein the characteristics associated with the external accessory comprise a thickness of the external accessory.
4. The method of claim 3, wherein if the thickness of the external accessory is above a second threshold value, determining not to modify the first threshold value used to determine whether the device is proximate to the object.
5. The method of claim 4, comprising maintaining or increasing the transmitted power output of the antenna if the thickness of the external accessory is above the second threshold value.

6. The method of claim 4, wherein if the thickness of the external accessory is below the second threshold value, determining to increase the first threshold value used to determine whether the device is proximate to the object.
7. The method of claim 1, wherein adjusting the transmitted power output of the antenna comprises reducing the transmitted power output based on a distance between the object and an exterior surface of the external accessory.
8. A computing device, comprising:
  - an antenna;
  - a proximity sensor coupled to the antenna to determine whether the device is proximate to an object; and
  - a controller to:
    - determine, based on information received from an external accessory coupled to the device, a thickness associated with the external accessory;
    - determine, based on the thickness, whether to modify a first threshold value used by the proximity sensor to determine whether the device is proximate to an object; and
    - upon the proximity sensor determining the device is proximate to the object, adjust a transmitted power output of the antenna based on the thickness associated with the external accessory.
9. The computing device of claim 8, wherein if the thickness of the external accessory is above a second threshold value, the controller is to determine not to modify the first threshold value used to determine whether the device is proximate to the object.
10. The computing device of claim 9, wherein the controller is to maintain or increase the transmitted power output of the antenna if the thickness of the external accessory is above the second threshold value.
11. The computing device of claim 9, wherein if the thickness of the external accessory is below the second threshold value, the controller is to determine to

increase the first threshold value used to determine whether the device is proximate to the object.

12. A device, comprising a non-transitory computer-readable storage medium and a plurality of programming instructions stored in the storage medium, in response to execution of the programming instructions by a processing resource, to cause the device to:

- determine, based on information received from an external accessory coupled to the device, characteristics associated with the external accessory;

- determine, based on the characteristics, whether to modify a first threshold value used to determine whether the device is proximate to an object; and

- upon determining the device is proximate to the object, adjust a transmitted power output of an antenna of the device based on the characteristics associated with the external accessory.

13. The device of claim 12, wherein the characteristics associated with the external accessory comprise a thickness of the external accessory.

14. The device of claim 13, wherein if the thickness of the external accessory is above a second threshold value, comprising instructions for determining not to modify the first threshold value used to determine whether the device is proximate to the object.

15. The device of claim 14, wherein if the thickness of the external accessory is below the second threshold value, comprising instructions for determining to increase the first threshold value used to determine whether the device is proximate to the object.

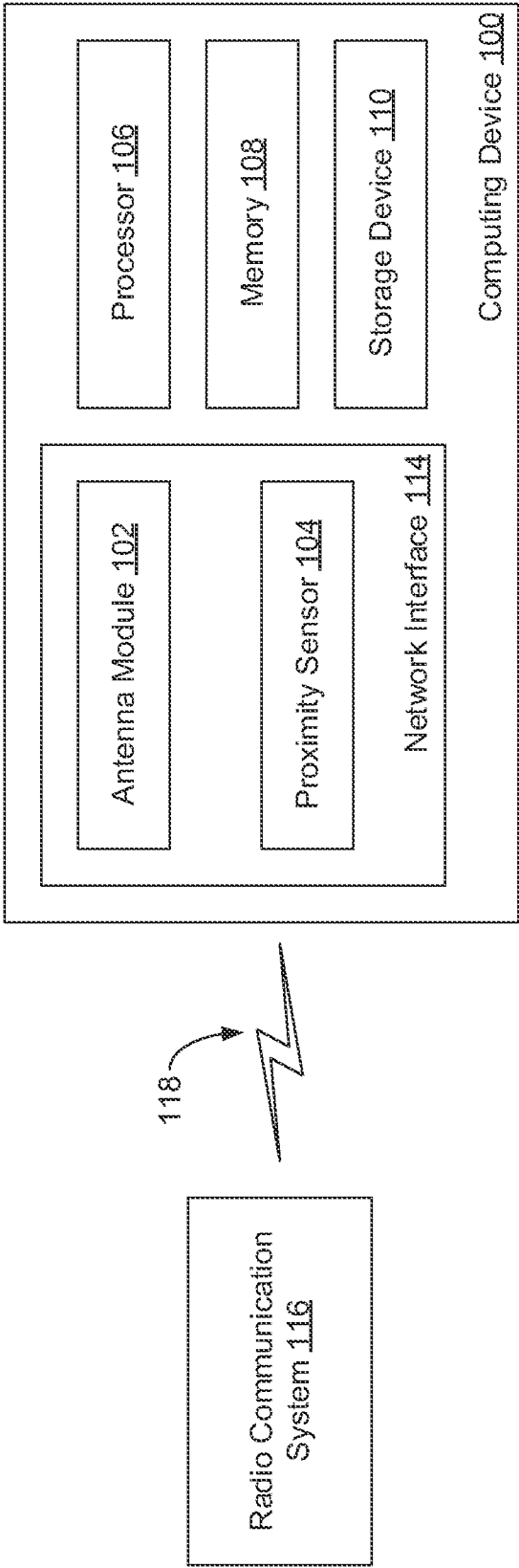


FIG. 1A

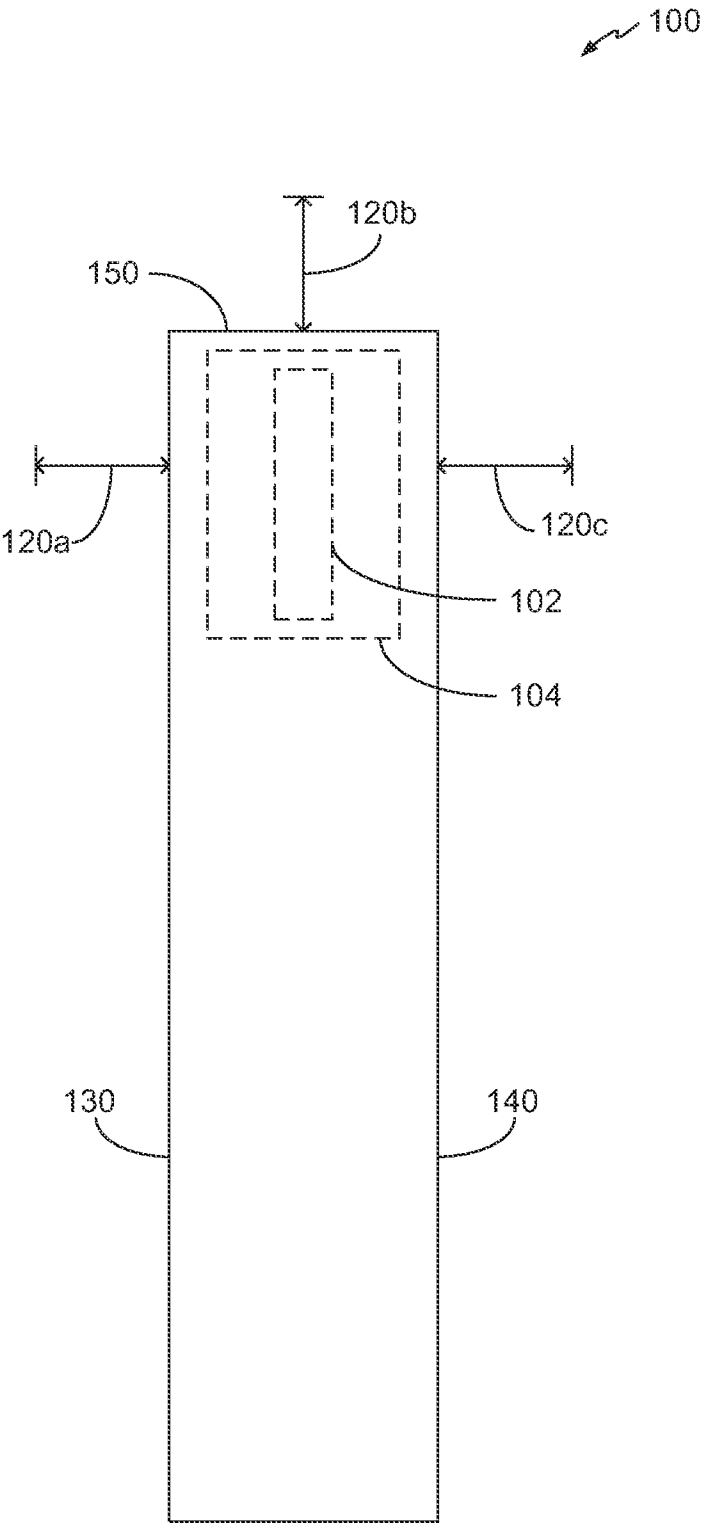


FIG. 1B

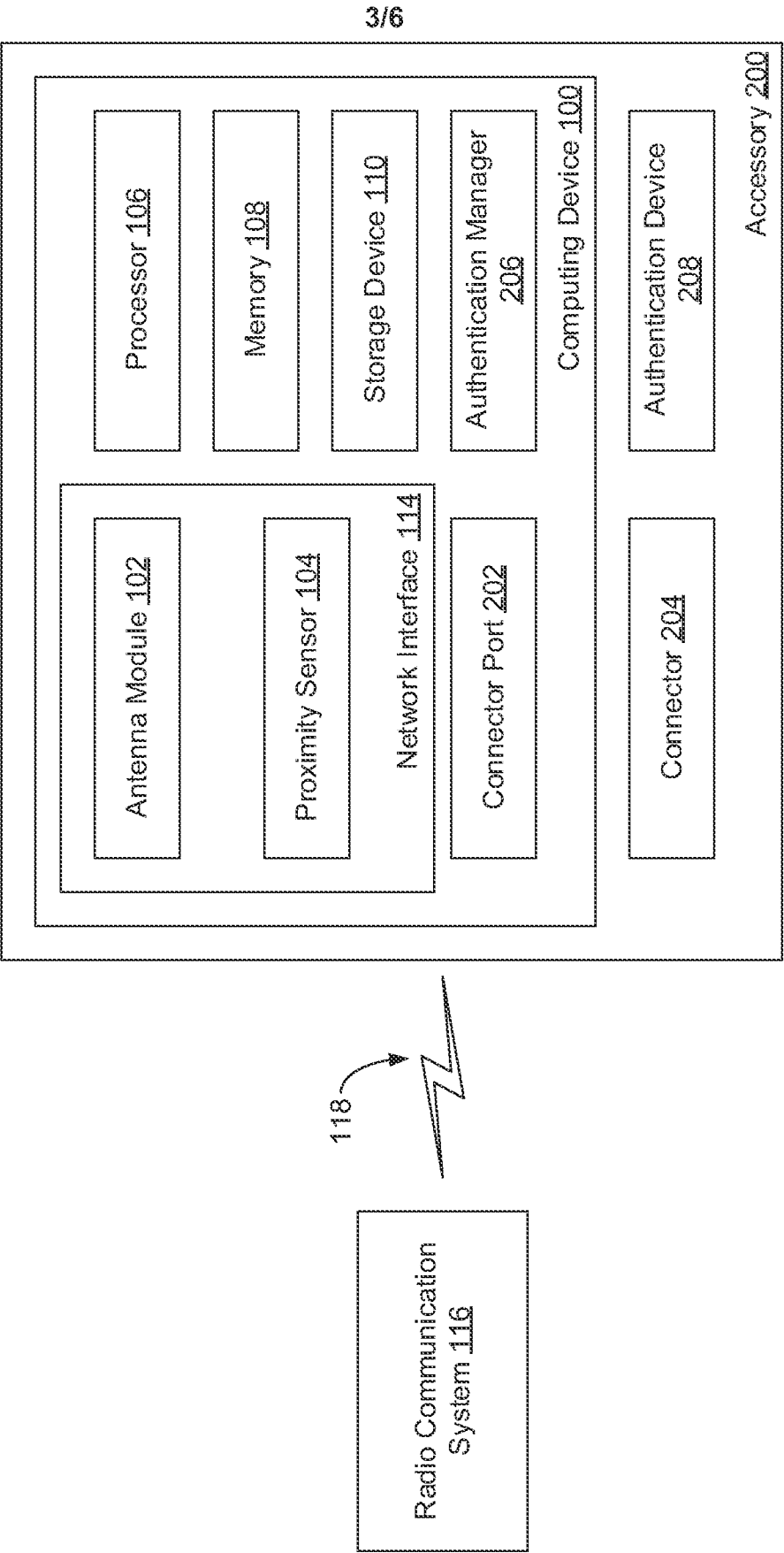
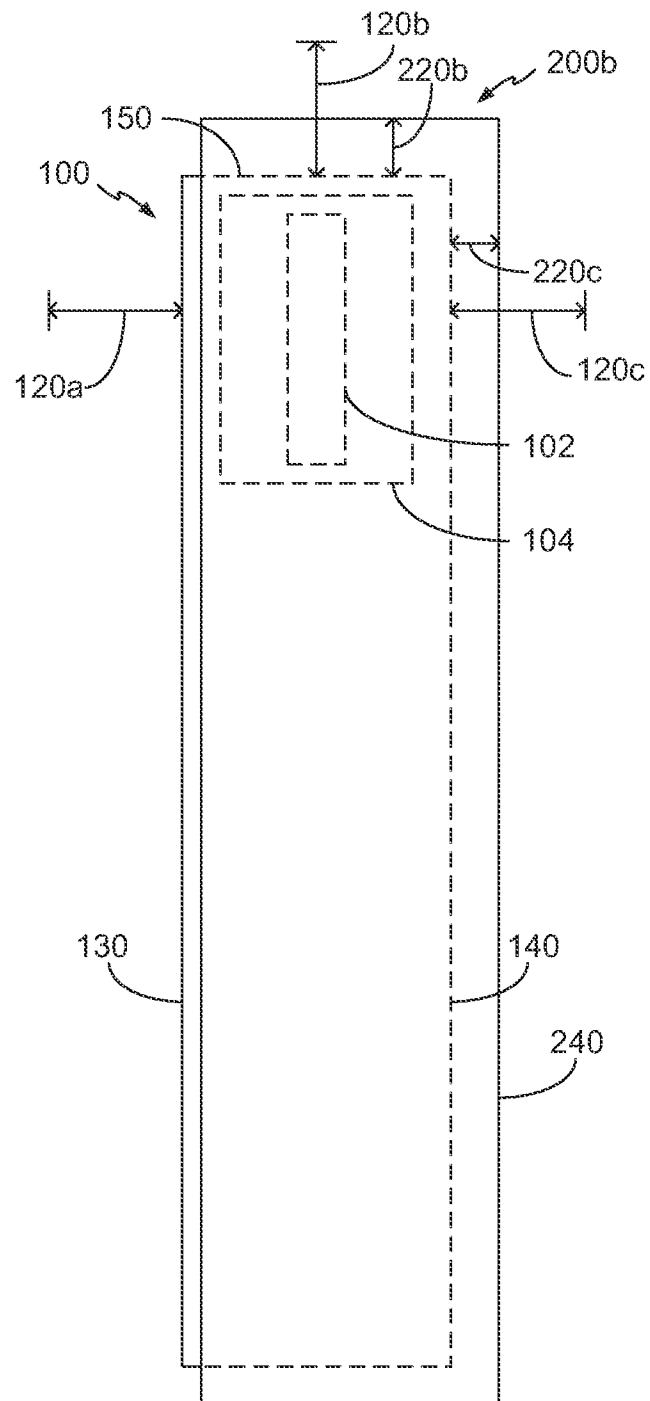


FIG. 2A

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**FIG. 2B**

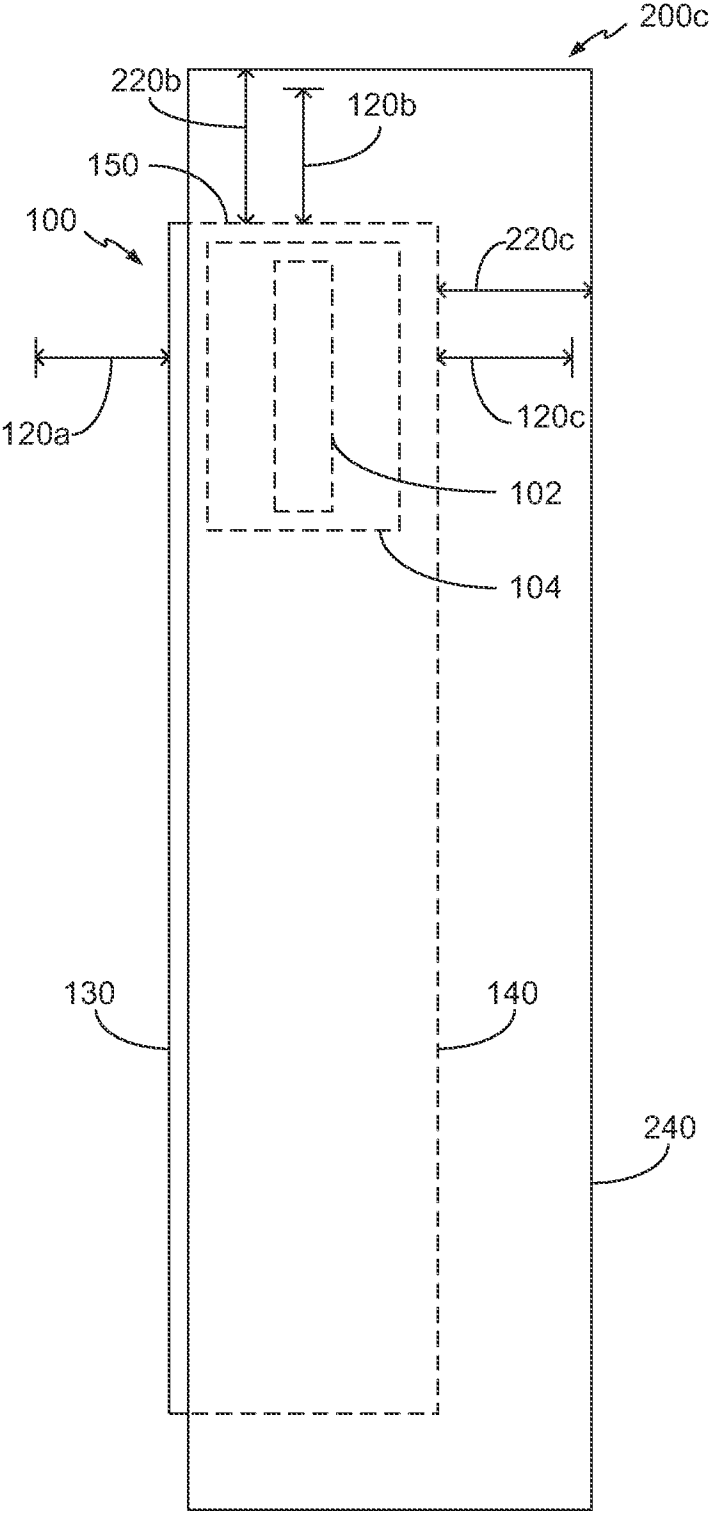
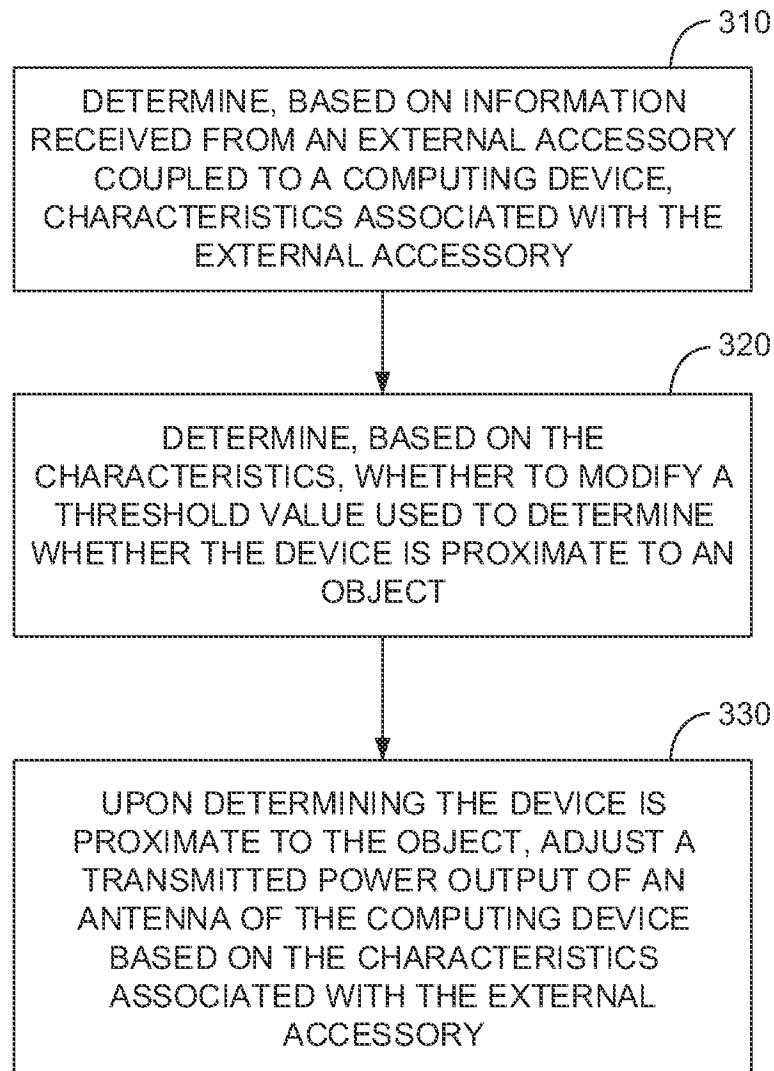


FIG. 2C

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300

**FIG. 3**

## INTERNATIONAL SEARCH REPORT

International application No.  
**PCT/US2014/032413****A. CLASSIFICATION OF SUBJECT MATTER****H04W 52/04(2009.01)i, H04W 88/02(2009.01)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)

H04W 52/04; H04W 88/02; G01R 29/08; H04B 17/00; H04B 1/04; H01Q 1/24

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

Japanese utility models and applications for utility models

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

eKOMPASS(KIPO internal) &amp; Keywords: external, device, antenna, couple, transmit, power, proximate, sensor

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

| Category* | Citation of document, with indication, where appropriate, of the relevant passages                                                           | Relevant to claim No. |
|-----------|----------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| X         | KR 10-2013-0010120 A (APPLE INC.) 25 January 2013<br>See abstract, descriptions [0078]-[0027], claims 8-12 and figure 1                      | 1-2, 12               |
| A         |                                                                                                                                              | 3-11, 13-15           |
| A         | US 2009-0096683 A1 (ROSENBLATT MICHAEL N. et al.) 16 April 2009<br>See abstract, descriptions [0095]-[0096], claims 16-20 and figure 15      | 1-15                  |
| A         | US 05956626 A (KASCHKE; KEVIN D. et al.) 21 September 1999<br>See abstract, column 12, line 63 - column 13, line 28 claims 1-20 and figure 6 | 1-15                  |
| A         | EP 1564896 A1 (SONY ERICSSON MOBILE COMMUNICATIONS AB) 17 August 2005<br>See abstract, descriptions [0028]-[0031], claims 1-7 and figure 4   | 1-15                  |



Further documents are listed in the continuation of Box C.



See patent family annex.

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"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

"&amp;" document member of the same patent family

Date of the actual completion of the international search

16 December 2014 (16.12.2014)

Date of mailing of the international search report

**19 December 2014 (19.12.2014)**

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**INTERNATIONAL SEARCH REPORT**

Information on patent family members

International application No.

**PCT/US2014/032413**

| Patent document<br>cited in search report | Publication<br>date | Patent family<br>member(s) | Publication<br>date |
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| US 05956626 A                             | 21/09/1999          | None                       |                     |
| EP 1564896 A1                             | 17/08/2005          | None                       |                     |