

US009270339B2

(12) **United States Patent**
Yao et al.

(10) **Patent No.:** **US 9,270,339 B2**
(45) **Date of Patent:** **Feb. 23, 2016**

(54) **METHOD, APPARATUS AND SYSTEM OF RECOVERING AN OPERATING SYSTEM ON A PORTABLE COMMUNICATION DEVICE**

(75) Inventors: **Jiewen Yao**, Shanghai (CN); **Chuan Song**, Shanghai (CN); **Haili Zhang**, Shanghai (CN); **Wenlong Yang**, Shanghai (CN)

(73) Assignee: **Intel Corporation**, Santa Clara, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 117 days.

(21) Appl. No.: **13/997,827**

(22) PCT Filed: **Aug. 29, 2012**

(86) PCT No.: **PCT/CN2012/080680**

§ 371 (c)(1),
(2), (4) Date: **Sep. 26, 2013**

(87) PCT Pub. No.: **WO2014/032230**

PCT Pub. Date: **Mar. 6, 2014**

(65) **Prior Publication Data**

US 2014/0065958 A1 Mar. 6, 2014

(51) **Int. Cl.**
H04B 5/00 (2006.01)
G06F 9/54 (2006.01)

(Continued)

(52) **U.S. Cl.**
CPC **H04B 5/0031** (2013.01); **G06F 9/544** (2013.01); **G06F 11/20** (2013.01); **H04M 1/7253** (2013.01); **H04M 1/72525** (2013.01)

(58) **Field of Classification Search**
USPC 455/456.1, 41.1, 465.3, 418, 411;
713/1, 2, 155

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

7,831,857 B2 * 11/2010 Muppirla G06F 11/0778
714/2
2002/0112198 A1 * 8/2002 Lim G06F 11/1417
714/6.12

(Continued)

FOREIGN PATENT DOCUMENTS

KR 20090118941 A 11/2009
KR 20100017105 A 2/2010

(Continued)

OTHER PUBLICATIONS

International Search Report and Written Opinion received for PCT Patent Application No. PCT/CN2012/080680, mailed on Jun. 6, 2013, 10 pages.

(Continued)

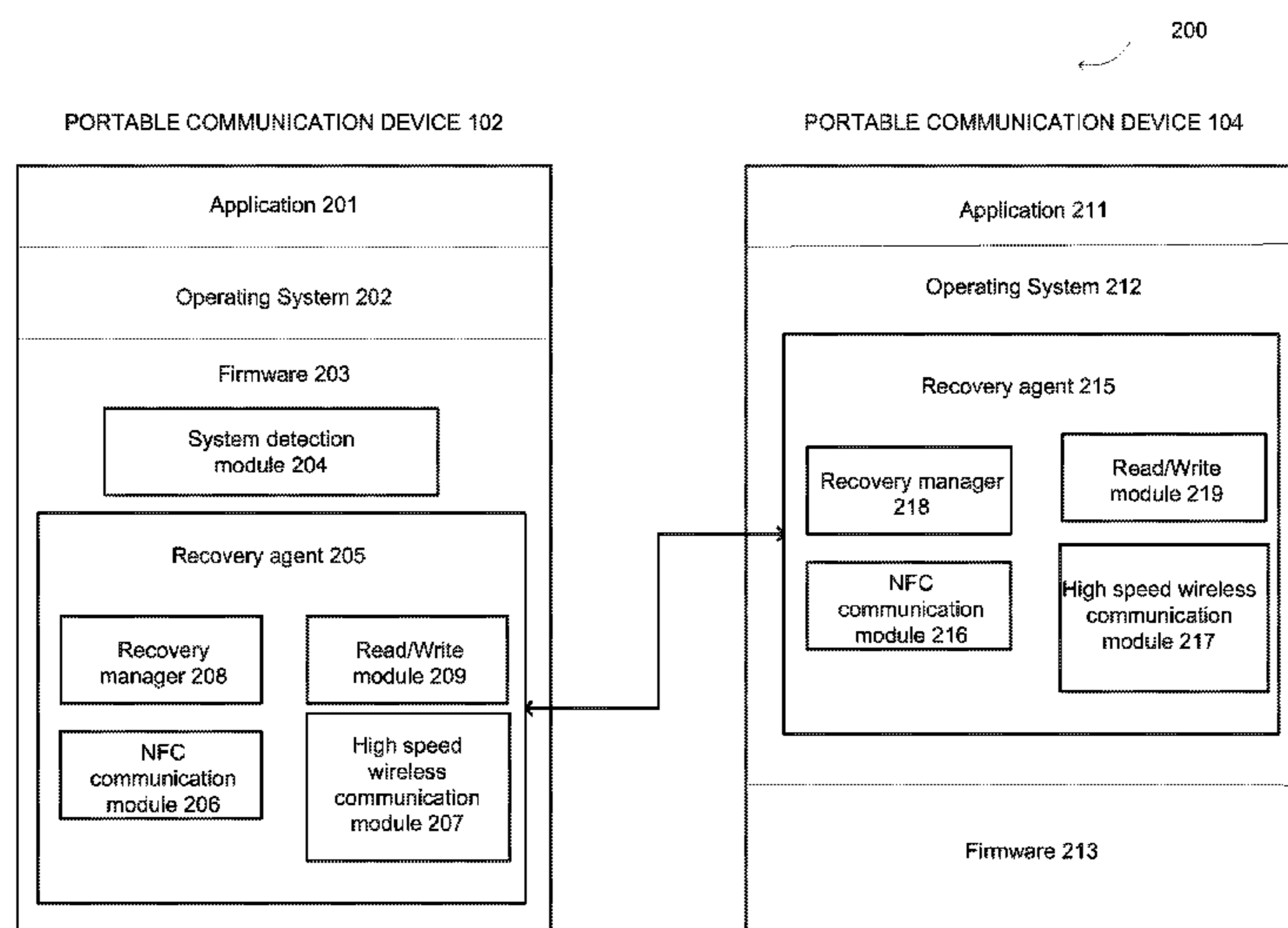
Primary Examiner — Ganiyu A Hanidu

(74) *Attorney, Agent, or Firm* — Barnes & Thornburg LLP

(57) **ABSTRACT**

A device, method and system for recovering an operating system may comprise a near field communication module; a high speed wireless communication module; and a recovery manager. In some embodiments, the recovery manager may initiate a session between a portable communication device and another portable communication device through a near field communication connection established by the near field communication module; continue the session to receive an operating system image from the another portable communication device through a high speed wireless connection established by the high speed wireless communication module; and recover the operating system of the portable communication device with use of the operating system image.

19 Claims, 3 Drawing Sheets



(51) **Int. Cl.** 2012/0329389 A1* 12/2012 Royston H04B 5/0062
G06F 11/20 (2006.01) 455/41.1
H04M 1/725 (2006.01)

(56) **References Cited**

FOREIGN PATENT DOCUMENTS

U.S. PATENT DOCUMENTS

WO 0155922 A2 8/2001
WO 2005093964 A1 10/2005
WO 2007121791 A1 11/2007

2005/0144431 A1* 6/2005 Lin G06F 9/4416
713/1
2006/0129614 A1* 6/2006 Kim G06F 11/1435
2008/0209199 A1* 8/2008 Sadovsky G06F 9/4401
713/2
2008/0291852 A1* 11/2008 Abel H04L 5/16
370/296
2011/0098056 A1* 4/2011 Rhoads G01C 21/20
455/456.1
2011/0289350 A1* 11/2011 Andrews G06F 11/1464
714/6.31

OTHER PUBLICATIONS

Notice of Preliminary Rejection issued Oct. 19, 2015 in connection with Korean Patent Application No. 10-2015-7000837, 9 pages.

* cited by examiner

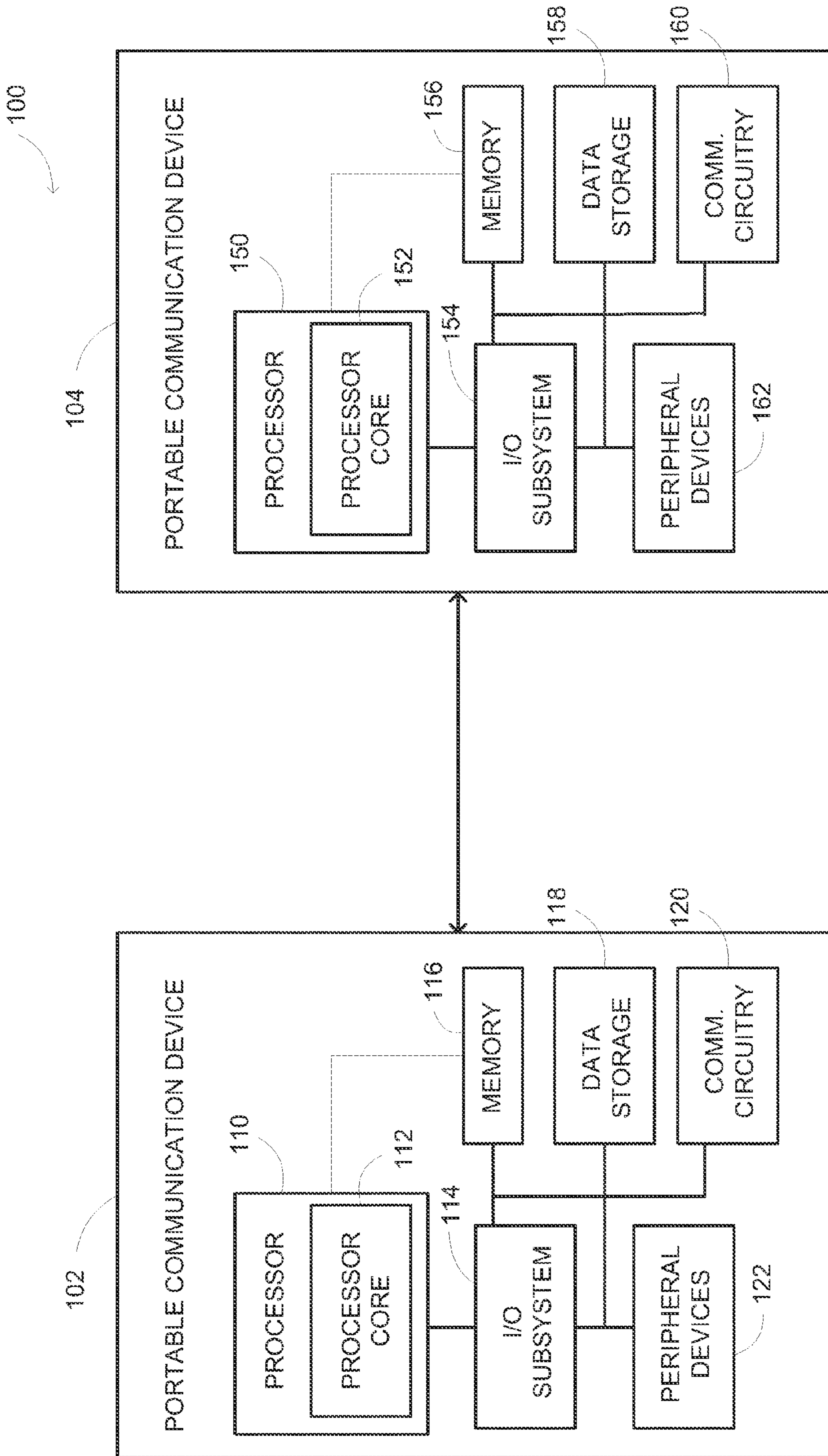


FIG. 1

200

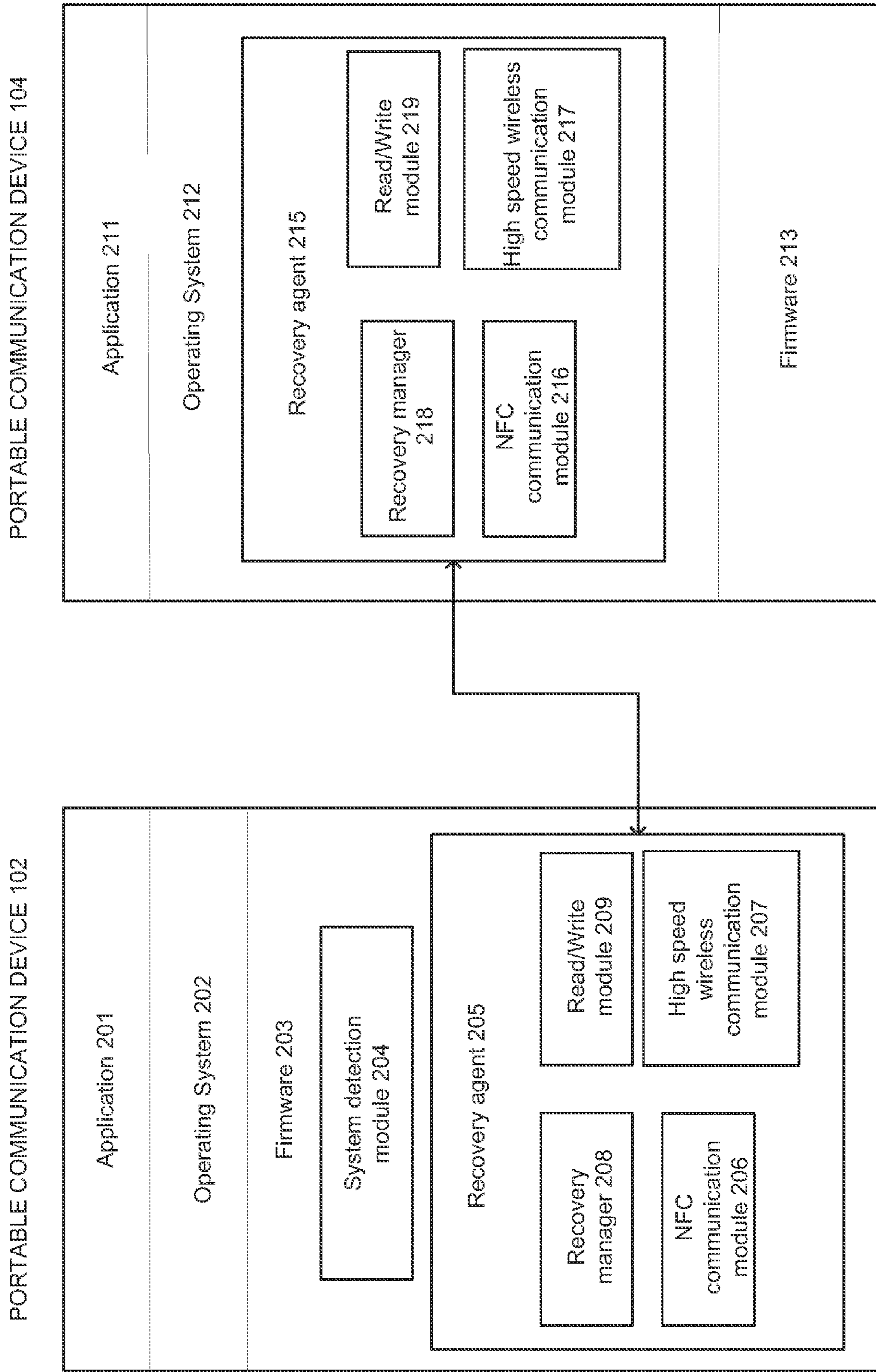


FIG. 2

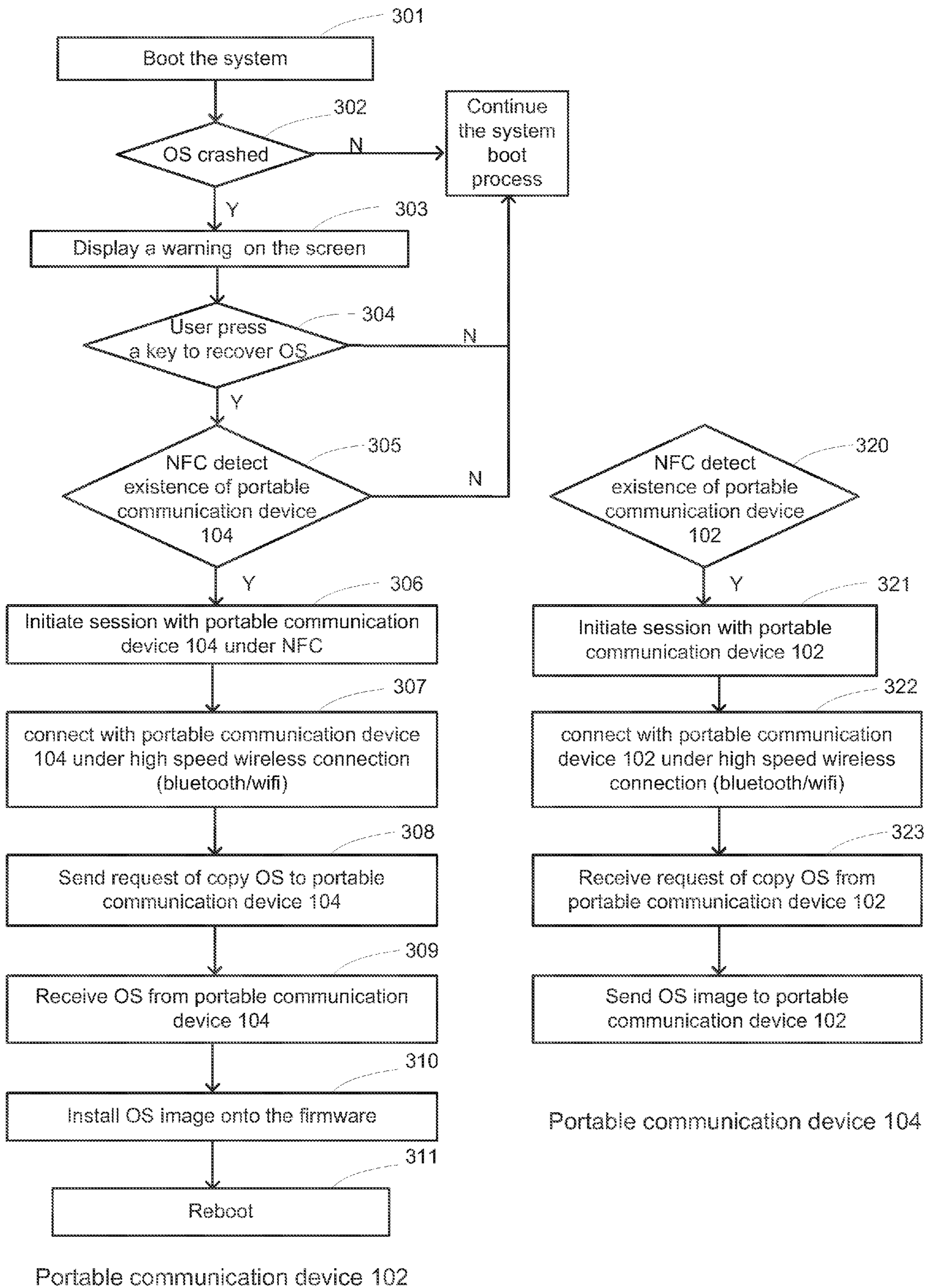


FIG. 3

1

METHOD, APPARATUS AND SYSTEM OF RECOVERING AN OPERATING SYSTEM ON A PORTABLE COMMUNICATION DEVICE

BACKGROUND

With prevailing of portable communication devices, such as smart phones and tablets, more and more people worry about security for operating systems of the portable communication devices. In current practices, when an operating system of a portable communication device is crashed, the portable communication device may be connected with a computer via a data line or a universal serial bus (USB) to copy an operating system image from the computer. Usually, before the copying, the computer may online search and download the operating system image suitable for the portable communication device,

BRIEF DESCRIPTION OF THE DRAWINGS

The invention described herein is illustrated by way of example and not by way of limitation in the accompanying figures. For simplicity and clarity of illustration, elements illustrated in the figures are not necessarily drawn to scale. For example, the dimensions of some elements may be exaggerated relative to other elements for clarity. Further, where considered appropriate, reference labels have been repeated among the figures to indicate corresponding or analogous elements.

FIG. 1 illustrates an embodiment of a system for recovering an operating system.

FIG. 2 illustrates an embodiment of an environment for recovering the operating system, which is established by the system of FIG. 1.

FIG. 3 illustrates an embodiment of a method of recovering the operating system.

DETAILED DESCRIPTION

While the concepts of the present disclosure are susceptible to various modifications and alternative forms, specific exemplary embodiments thereof have been shown by way of example in the drawings and will herein be described in detail. It should be understood, however, that there is no intent to limit the concepts of the present disclosure to the particular forms disclosed, but on the contrary, the intention is to cover all modifications, equivalents, and alternatives consistent with the present disclosure and the appended claims.

In the following description, numerous specific details such as logic implementations, opcodes, means to specify operands, resource partitioning/sharing/duplication implementations, types and interrelationships of system components, and logic partitioning/integration choices are set forth in order to provide a more thorough understanding of the present disclosure. It will be appreciated, however, by one skilled in the art that embodiments of the disclosure may be practiced without such specific details. In other instances, control structures, gate level circuits and full software instruction sequences have not been shown in detail in order not to obscure the invention. Those of ordinary skill in the art, with the included descriptions, will be able to implement appropriate functionality without undue experimentation.

References in the specification to “one embodiment,” “an embodiment,” “an example embodiment,” etc., indicate that the embodiment described may include a particular feature, structure, or characteristic, but every embodiment may not necessarily include the particular feature, structure, or char-

2

acteristic. Moreover, such phrases are not necessarily referring to the same embodiment. Further, when a particular feature, structure, or characteristic is described in connection with an embodiment, it is submitted that it is within the knowledge of one skilled in the art to effect such feature, structure, or characteristic in connection with other embodiments whether or not explicitly described.

Embodiments of the invention may be implemented in hardware, firmware, software, or any combination thereof. Embodiments of the invention implemented in a computer system may include one or more bus-based interconnects between components and/or one or more point-to-point interconnects between components. Embodiments of the invention may also be implemented as instructions carried by or stored on a transitory or non-transitory machine-readable (e.g., computer-readable) medium, which may be read and executed by one or more processors. A machine-readable medium may be embodied as any device, mechanism, or physical structure for storing or transmitting information in a form readable by a machine (e.g., a computing device). For example, a machine-readable medium may be embodied as read only memory (ROM); random access memory (RAM); magnetic disk storage media; optical storage media; flash memory devices; mini- or micro-SD cards, memory sticks, electrical signals, and others.

In the drawings, specific arrangements or orderings of schematic elements, such as those representing devices, modules, instruction blocks, and data elements, may be shown for ease of description. However, it should be understood by those skilled in the art that the specific ordering or arrangement of the schematic elements in the drawings is not meant to imply that a particular order or sequence of processing, or separation of processes, is required. Further, the inclusion of a schematic element in a drawing is not meant to imply that such element is required in all embodiments or that the features represented by such element may not be included in or combined with other elements in some embodiments.

In general, schematic elements used to represent instruction blocks may be implemented using any suitable form of machine-readable instruction, such as software or firmware applications, programs, functions, modules, routines, processes, procedures, plug-ins, applets, widgets, code fragments and/or others, and that each such instruction may be implemented using any suitable programming language, library, application programming interface (API), and/or other software development tools. For example, some embodiments may be implemented using Java, C++, and/or other programming languages. Similarly, schematic elements used to represent data or information may be implemented using any suitable electronic arrangement or structure, such as a register, data store, table, record, array, index, hash, map, tree, list, graph, file (of any file type), folder, directory, database, and/or others.

Further, in the drawings, where connecting elements, such as solid or dashed lines or arrows, are used to illustrate a connection, relationship or association between or among two or more other schematic elements, the absence of any such connecting elements is not meant to imply that no connection, relationship or association can exist. In other words, some connections, relationships or associations between elements may not be shown in the drawings so as not to obscure the disclosure. In addition, for ease of illustration, a single connecting element may be used to represent multiple connections, relationships or associations between elements. For example, where a connecting element represents a communication of signals, data or instructions, it should be understood by those skilled in the art that such element may repre-

sent one or multiple signal paths (e.g., a bus), as may be needed, to effect the communication.

FIG. 1 illustrates an embodiment of a system 100 for recovering an operating system of a portable communication device 102 using an operating system image copied from another portable communication device 104. Here, “recovering” may refer to reinstalling, refreshing, updating, or the similar. The portable communication device 102 may include a processor 110, an I/O subsystem 114, a memory 116, a data storage 118, a communication circuitry 120, and one or more peripheral devices 122. In some embodiments, several of the foregoing components may be incorporated on a motherboard or main board of the portable communication device 102, while other components may be communicatively coupled to the motherboard via, for example, a peripheral port. Furthermore, it should be appreciated that the portable communication device 102 may include other components, sub-components, and devices commonly found in a communication and/or computing device, which are not illustrated in FIG. 1 for clarity of the description.

The processor 110 of the portable communication device 102 may be embodied as any type of processor capable of executing software/firmware, such as a microprocessor, digital signal processor, microcontroller, or the like. The processor 110 is illustratively embodied as a single core processor having a processor core 112. However, in other embodiments, the processor 110 may be embodied as a multi-core processor having multiple processor cores 112. Additionally, the portable communication device 102 may include additional processors 110 having one or more processor cores 112.

The I/O subsystem 114 of the portable communication device 102 may be embodied as circuitry and/or components to facilitate input/output operations with the processor 110 and/or other components of the portable communication device 102. In some embodiments, the I/O subsystem 114 may be embodied as a memory controller hub (MCH or “northbridge”), an input/output controller hub (ICH or “southbridge”) or platform controller hub (PCH), and a firmware device. In such embodiments, the firmware device of the I/O subsystem 114 may be embodied as a memory device for storing Basic Input/Output System (BIOS) data and/or instructions and/or other information (e.g., a BIOS driver used during booting of the portable communication device 102). However, in other embodiments, I/O subsystems having other configurations may be used. For example, in some embodiments, the I/O subsystem 114 may be embodied as a platform controller hub (PCH). In such embodiments, the memory controller hub (MCH) may be incorporated in or otherwise associated with the processor 110, and the processor 110 may communicate directly with the memory 116 (as shown by the dashed line in FIG. 1). Additionally, in other embodiments, the I/O subsystem 114 may form a portion of a system-on-a-chip (SoC) and be incorporated, along with the processor 110 and other components of the portable communication device 102, on a single integrated circuit chip.

The processor 110 is communicatively coupled to the I/O subsystem 114 via a number of signal paths. These signal paths (and other signal paths illustrated in FIG. 1) may be embodied as any type of signal paths capable of facilitating communication between the components of the portable communication device 102. For example, the signal paths may be embodied as any number of point-to-point links, wires, cables, light guides, printed circuit board traces, vias, bus, intervening devices, and/or the like.

The memory 116 of the portable communication device 102 may be embodied as or otherwise include one or more memory devices or data storage locations including, for

example, dynamic random access memory devices (DRAM), synchronous dynamic random access memory devices (SDRAM), double-data rate synchronous dynamic random access memory device (DDR SDRAM), mask read-only memory (ROM) devices, erasable programmable ROM (EPROM), electrically erasable programmable ROM (EEPROM) devices, flash memory devices, and/or other volatile and/or non-volatile memory devices. The memory 116 is communicatively coupled to the I/O subsystem 114 via a number of signal paths. Although only a single memory device 116 is illustrated in FIG. 1, the portable communication device 102 may include additional memory devices in other embodiments. Various data and software may be stored in the memory 116. For example, one or more operating systems, applications, programs, libraries, and drivers that make up the software stack executed by the processor 110 may reside in memory 116 during execution.

The data storage 118 may be embodied as any type of device or devices configured for the short-term or long-term storage of data. For example, the data storage 118 may include any one or more memory devices and circuits, memory cards, hard disk drives, solid-state drives, or other data storage devices.

The communication circuitry 120 of the portable communication device 102 may include any number of devices and circuitry for enabling communications between the portable communication device 102 and one or more devices or networks as discussed in more detail below. The communication circuitry 120 may be configured to use any one or more, or combination thereof, communication protocols to communicate, such as, for example, a cellular communication protocol Wideband Code Division Multiple Access (W-CDMA)), a wireless network communication protocol (e.g., Wi-Fi®, WiMAX), a wireless personal area network communication protocol (e.g., Bluetooth®), a wired network communication protocol (e.g., TCP/IP), and/or other communication protocols.

In some embodiments, the portable communication device 102 may also include one or more peripheral devices 122. Such peripheral devices 122 may include any number of additional input/output devices, interface devices, and/or other peripheral devices. For example, in some embodiments, the peripheral devices 122 may include a display, touch screen, graphics circuitry, keyboard, speaker system, and/or other input/output devices, interface devices, and/or peripheral devices.

The portable communication device 104 may be substantially similar to the portable communication device 102 and include similar components, which have been identified in FIG. 1 with a common reference numbering scheme, including a processor 150, a processor core 152, a 110 subsystem 154, a memory 156, a data storage 158, a communication circuitry 160 and one or more peripheral devices 162. As such, the description provided above of the components of the portable communication device 102 is equally applicable to those similar components of the portable communication device 104 and is not repeated herein so as not to obscure the present disclosure. Of course, it should be appreciated that in some embodiments the portable communication devices 102, 104 of the system 100 may be dissimilar to each other. For example, the portable communication devices of the system 100 may be embodied as various types of communication devices different from each other (e.g., a tablet, a smart phone, or other communication device) and include components typically found in such corresponding communication devices.

Each of the portable communication devices **102**, **104** of the system **100** may be embodied as any type of communication device capable of performing the functions described herein. For example, each of the portable communication devices **102**, **104** may be embodied as, without limitation, a smart phone, a cellular telephone, a handset, a messaging device, a tablet, a consumer electronic device, and/or any other portable communication device configured to recovering the operating system.

FIG. 2 illustrates an embodiment of an environment **200** for recovering the operating system, which is established by the system of FIG. 1. In an embodiment, the environment **200** may comprise a recovery agent **205** residing in a firmware **203** of the portable communication device **102**, which may communicate with a recovery agent **215** residing in an operating system **212** of the portable communication device **104**, to recover an operating system **202** in the portable communication device **102**, in response that a system detection module **204** residing in the firmware **203** detects that the operating system **202** is crashed.

In an embodiment, the system detection module **204** may detect a system of the portable communication device **102** during a system boot process, including detecting whether the operating system **202** is crashed, e.g., because of a malicious attack to the portable communication device **102**. If the operating system **202** is crashed, the system detection module **204** may send a recovery request to the recovery agent **205**. However, it should be understood that other embodiments may implement other technologies for the recovery request. For example, the system detection module **204** may report to a user of the portable communication device **102**, who may request the recovery, e.g., through pressing a key.

In an embodiment, the recovery agent **205** may comprise a near field communication (NFC) module **206** a high speed wireless communication module **207**, a recovery manager **208** and a read/write module **209**. The recovery agent **215** may comprise a near field communication (NFC) module **216**, a high speed wireless communication module **217**, a recovery manager **218** and a read/write module **219**.

In an embodiment, the NFC module **206** may detect whether the portable communication device **104** exists, connect the portable communication device **102** with the portable communication device **104** and obtain a network address of the portable communication device **104**, based on NFC technologies. In response to detecting the existence of the portable communication device **104**, the recovery manager **208** may initiate a session with the recovery manager **218**. For example, the recovery manager **208** may coordinate the NFC module **206** to send a request of connection and receive a response to the request from/to the recovery manager **218** of the portable communication device **104**.

In an embodiment, after the session is initiated, the NFC module **206** may disconnect the NFC connection with the portable communication device **104**. The high speed wireless communication module **207** may then connect the portable communication device **102** with the portable communication device **104**, based on a high speed wireless communication technology, such as Bluetooth or WiFi. The high speed wireless communication module **207** may complete the connection using the network address obtained from the NFC module.

Through the high speed wireless connection, the recovery manager **208** may continue the session with the recovery manager **218** to copy an operating system image from the portable communication device **104** using the read/write module **209**. Examples of the operating system image may include the operating system **212** of the portable communi-

cation device **104**, except for any data or codes desired to keep secret from the portable communication device **102**, such as private data. In another embodiment, the operating system image may be obtained from a third party, e.g., an online source, and pre-stored in the portable communication device **104**. In yet another embodiment, the operating system image may be copied from the portable communication device **102** before the operating system **202** is crashed.

In an embodiment, the NFC module **216** may detect whether the portable communication device **102** exists, connect the portable communication device **104** with the portable communication device **102**, and obtain a network address of the portable communication device **102**, based on the NFC technology. In response to detecting the existence of the portable communication device **102**, the recovery manager **218** may initiate a session with the recovery manager **208** of the portable communication device **102**. For example, the recovery manager **218** may coordinate the NFC module **216** to receive a request of connection and send a response to the request from/to the recovery manager **208** of the portable communication device **104**.

In an embodiment, after the session is initiated, the NFC module **216** may disconnect the NFC link with the portable communication device **102**. The high speed wireless communication module **217** may then connect the portable communication device **104** with the portable communication device **102**, based on a high speed wireless communication technology, such as Bluetooth or WiFi. The high speed wireless communication module **217** may complete the connection using the network address obtained by the NFC module.

Through the high speed wireless connection, the recovery manager **218** may continue the session with the recovery manager **208** to obtain the operating system image using the read/write module **219** and send the operating system image to the portable communication device **102**.

As illustrated in FIG. 2, the portable communication device **102** may further install various applications running over the operating system **202**. Similarly, the portable communication device **104** may further install a firmware **213** running under the operating system **212** and various applications **211** running over the operating system **212**.

In some embodiments, the various modules of the environment **200** may be embodied as hardware, software, firmware or a combination thereof. For example, any of the above-stated modules may be embodied as software/firmware instructions stored in a machine-readable medium of the portable communication device **102** or the portable communication device **104**.

With the above solution, the portable communication device **102** may recover the operating system from another portable communication device without the need of a wired connection, such as a data line or a USB. On the contrary, a wireless connection can be used to recover the operating system from a reliable source, namely, the portable communication device **104**, which the user of the portable communication device **102** trusts and runs the operating system that may be suitable for the portable communication device **102** as well. In addition, since the portable communication devices **102** and **104** obtain each other's network address and initiate the session via the NFC connection, it avoids broadcasting under other wireless communication schemes to obtain the targeted network addresses, and thus enhances security for the later operating system image transmission.

FIG. 3 illustrates an embodiment of a method of recovering the operating system. The method on the left is implemented

by the portable communication device **102**, while the method on the right is implemented by the portable communication device **104**.

Referring to the method on the left, in block **301**, when booting the system of the portable communication device **102**, the system detection module **204** may check hardware and software of the system. If, in block **302**, the system detection module **204** detects that the operating system **202** is crashed before being loaded into a memory of the portable communication device **102**, then in blocks **303-304**, the portable communication device **102** may display the information about the operating system being crashed on its screen and detect whether the user presses a key to request the operating system recovery. If the user presses the key, then in block **305**, the NFC module **206** or other device may detect whether the portable communication device **104** having a good operating system image suitable for the portable communication device **102** exists within a NFC communication distance. In response to detecting the existence of the portable communication device **104**, the recovery manager **208** or other device may initiate a session with the recovery manager **218** or other device, in block **306**. For example, the recovery manager **208** may coordinate the NFC module **206** to connect with the portable communication device **104** and obtain the network address of the portable communication device **104**, based on the NFC technologies. In an embodiment, after the session is initiated, the NFC module **206** may disconnect the NFC connection with the portable communication device **104**.

Then, in block **307**, the recovery manager **208** or other device may coordinate the high speed wireless communication module **207** or other device to connect the portable communication device **102** with the portable communication device **104**, based on a high speed wireless communication technology, such as Bluetooth or WiFi. The high speed wireless communication module **207** may complete the connection using the network address obtained from the NFC module. In block **308**, the recovery manager **208** or other device may continue the session with the recovery manager **218** and send a request of copying the operating system image to the portable communication device **104**. Examples of the operating system image may include the operating system **212** of the portable communication device **104**, except for any data or codes desired to keep secret from the portable communication device **102**, e.g., private data. In an embodiment, the operating system image may be obtained from a third party, e.g., an online source, and pre-stored in the portable communication device **104**. In yet another embodiment, the operating system image may be copied from the portable communication device **102** before the operating system **202** is crashed.

In blocks **309-310**, the recovery manager **208** or other device may receive the operating system image from the portable communication device **104**, and install the operating system image onto the firmware **203** using the read/write module **209** or other device. In block **311**, the portable communication device **102** may reboot and load the operating system image to the memory.

Referring now to the method on the right, in block **320**, the NFC module **216** or other device may detect whether the portable communication device **102** exists within a NFC communication distance. In response to detecting the existence of the portable communication device **102**, the recovery manager **218** or other device may initiate a session with the recovery manager **208** or other device, in block **321**. For example, the recovery manager **208** may coordinate the NFC module **206** to connect with the portable communication device **102** and obtain the network address of the portable

communication device **102**, based on the NFC technologies. In an embodiment, after the session is initiated, the NFC module **216** may disconnect the NFC connection with the portable communication device **102**.

Then, in block **322**, the high speed wireless communication module **217** or other device may connect the portable communication device **104** with the portable communication device **102**, based on a high speed wireless communication technology, such as Bluetooth or WiFi. The high speed wireless communication module **217** may complete the connection using the network address obtained from the NFC module **216**. In block **323**, the recovery manager **18** or other device may continue the session with the recovery manager **208** and receive a request of copying the operating system image from the portable communication device **102**. Examples of the operating system image may include the operating system **212**, except for any data or codes desired to keep secret from the portable communication device **102**, e.g., the private data. In another embodiment, the operating system image may be obtained from a third party, e.g., an online source, and pre-stored in the portable communication device **104**. In yet another embodiment, the operating system image may be copied from the portable communication device **102** before the operating system **202** is crashed. In block **324**, the recovery manager **218** or other device may obtain the operating system image using the read/write module **219**, and send the operating system image to the portable communication device **102**.

It should be understood that other embodiments may implement other technologies for the system and method as discussed above. In an embodiment, the process of displaying the operating system being crashed on the screen and waiting for the user to press the key may be omitted. On the contrary, when the system detection module **204** detects that the operating system **202** is crashed, the system detection module **204** or other device may send the recovery agent **205** with the request of recovering the operating system, in response to which, the recovery agent **205** can start connecting with the portable communication device **104** and recover the operating system. In another embodiment, the portable communication device **102** may recover the operating system, even if the operating system **202** hasn't been crashed. For example, during the system boot process, the user may initiatively request the operating system recovery (e.g., through pressing a special key), rather than requesting the recovery after receiving the notification of the operating system being crashed.

While the disclosure has been illustrated and described in detail in the drawings and foregoing description, such an illustration and description is to be considered as exemplary and not restrictive in character, it being understood that only illustrative embodiments have been shown and described and that all changes and modifications consistent with the disclosure and recited claims are desired to be protected.

EXAMPLES

Illustrative examples of the devices, systems, and methods disclosed herein are provided below. An embodiment of the devices, systems, and methods may include any one or more, and any combination of, the examples described below.

In one example, a portable communication device may comprise a near field communication module; a high speed wireless communication module; and a recovery manager to initiate a session between the portable communication device and another portable communication device through a near field communication connection established by the near field

communication module, continue the session to receive an operating system image from the another portable communication device through a high speed wireless connection established by the high speed wireless communication module and recover an operating system of the portable communication device with use of the operating system image.

Additionally, in an example, the near field communication module, the high speed communication module and the recovery manager may be stored in a firmware of the portable communication device. Additionally, in any of the above examples, the near field communication module may be further to obtain an address of the another portable communication device during the session through the near field communication connection; and the high speed wireless communication module may be further to utilize the address to establish the high speed wireless connection with the another portable communication device.

Additionally, in any of the above examples, the recovery manager may be further to initiate the session in response that a user of the portable communication device presses a key to request recovering the operating system. Additionally, in any of the above examples, the recovery manager may be further to recover the operating system through storing the operating system image in the firmware and rebooting the portable communication device. Additionally, in any of the above examples, the high speed wireless connection may be Bluetooth or Wi-Fi connection. Additionally, in any of the above examples, the portable communication device and the another portable communication device may be smart phones.

In another example, a method operated by a portable communication device may comprise initiating, by a recovery manager, a session between the portable communication device and another portable communication device through a near field communication connection established by a near field communication module; and continuing, by the recovery manager, the session to receive an operating system image from the another portable communication device through a high speed wireless connection established by a high speed wireless communication module; and recovering, by the recovery manager, an operating system of the portable communication device with use of the operating system image, wherein the near field communication module, the high speed communication module and the recovery manager may be stored in a firmware of the portable communication device.

Additionally, in an example, the method may further comprise obtaining, by the near field communication module, an address of the another portable communication device during the session through the near field communication connection; and utilizing, by the high speed wireless communication module, the address to establishing the high speed wireless connection with the another portable communication device.

Additionally, in any of the above examples, the operating system image is received from another recovery manager stored in another operating system of the another portable communication device. Additionally, in any of the above examples, the initiating the session comprises initiating the session further in response that an user of the portable communication device presses a key to request recovering the operating system.

Additionally, in any of the above examples, the recovering the operating system further comprises storing the operating system image in the firmware; and rebooting the portable communication device. Additionally, in any of the above examples, the high speed wireless connection is Bluetooth or Wi-Fi communication. Additionally, in any of the above

examples, the portable communication device and the another portable communication device are smart phones.

In another example, a portable communication device may comprise a near field communication module; a high speed wireless communication module; and a recovery manager to initiate a session between the portable communication device with another portable communication device through a near field communication connection established by the near field communication module; and continue the session to send an operating system image to the another portable communication device through a high speed wireless connection established by the high speed wireless communication module, in response to a request from another recovery manager stored in a firmware of the another portable communication device

Additionally, in an example, the near field communication module, the high speed communication module and recovery manager may be stored in an operating system of the portable communication device. Additionally, in any of the above examples, the near field communication module may be further to obtain an address of the another portable communication device during the session through the near field communication connection, and the high speed wireless communication module may be further to utilize the address to establish the high speed wireless connection with the another portable communication device.

Additionally, in any of the above examples, the high speed wireless connection is Bluetooth or Wi-Fi communication. Additionally, in any of the above examples, the portable communication device and the another portable communication device are smart phones.

In another example, a method operated by a portable communication device may comprise initiating, by a recovery manager, a session between the portable communication device with another portable communication device through a near field communication connection established by a near field communication module; and continuing, by the recovery manager, the session to send an operating system image to the another portable communication device through a high speed wireless connection established by a high speed wireless communication module, in response to a request from another recovery manager stored in a firmware of the another portable communication device, wherein the near field communication module, the high speed communication module and the recovery manager may be stored in an operating system of the portable communication device.

Additionally, in any of the above examples, the method may further comprise obtaining, by the near field communication module, an address of the another portable communication device during the session through the near field communication connection; and utilizing, by the high speed wireless communication module, the address to establish the high speed wireless connection with the another portable communication device. Additionally, in any of the above examples, the high speed wireless connection is Bluetooth or communication. Additionally, in any of the above examples, the portable communication device and the another portable communication device are smart phones.

What is claimed is:

1. A portable communication device, comprising:
 - a near field communication module;
 - a high speed wireless communication module; and
 - a recovery manager configured to:
 - initiate, in response to a determination that an operating system of the portable communication device has crashed, a session between the portable communication device and another portable communication device

11

through a near field communication connection established by the near field communication module; obtain, via the near field communication module, an address of the another portable communication device during the session; establish, via the high-speed wireless communication module, a high speed wireless connection with the another portable communication device using the address; continue the session to receive an operating system image from the another portable communication device through the high speed wireless connection; and recover the operating system of the portable communication device with use of the operating system image.

2. The portable communication device of claim 1, wherein the near field communication module, the high speed communication module and the recovery manager are stored in a firmware of the portable communication device.

3. The portable communication device of claim 1, wherein the recovery manager is further to initiate the session in response that a user of the portable communication device presses a key to request recovering the operating system.

4. The portable communication device of claim 1, wherein the recovery manager is further to recover the operating system through storing the operating system image in the firmware and rebooting the portable communication device.

5. The portable communication device of claim 1, wherein the high speed wireless connection is Bluetooth or Wi-Fi connection.

6. The portable communication device of claim 1, wherein the portable communication device and the another portable communication device are smart phones.

7. One or more non-transitory, machine readable storage media comprising a plurality of instructions that in response to being executed cause a portable computing device to:

initiate, by a recovery manager and in response to a determination that an operating system of the portable communication device has crashed, a session between the portable communication device and another portable communication device through a near field communication connection established by a near field communication module;

obtain, through the near field communication connection, an address of the another portable communication device during the session;

establish, by a high speed wireless communication module, a high speed wireless connection with the another portable communication device using the address;

continue, by the recovery manager, the session to receive an operating system image from the another portable communication device through the high speed wireless connection; and

recover, by the recovery manager, the operating system of the portable communication device with use of the operating system image;

wherein the near field communication module, the high speed communication module and the recovery manager are stored in a firmware of the portable communication device.

8. The non-transitory, machine readable media of claim 7, wherein the operating system image is received from another recovery manager stored in another operating system of the another portable communication device.

9. The non-transitory, machine readable media of claim 7, wherein to initiate the session comprises to initiate the session

12

further in response that a user of the portable communication device presses a key to request recovering the operating system.

10. The non-transitory, machine readable media of claim 7, wherein to recover the operating system further comprises to: store the operating system image in the firmware; and reboot the portable communication device.

11. The non-transitory, machine readable media of claim 7, wherein the high speed wireless connection is Bluetooth or Wi-Fi communication.

12. The non-transitory, machine readable media of claim 7, wherein the portable communication device and the another portable communication device are smart phones.

13. A portable communication device, comprising:

a near field communication module; a high speed wireless communication module; and a recovery manager configured to:

initiate, in response to a determination that an operating system of the portable communication device has crashed, a session between the portable communication device with another portable communication device through a near field communication connection established by the near field communication module; and

obtain, via the near field communication module, an address of the another portable communication device during the session;

establish, via the high-speed wireless communication module, a high speed wireless connection with the another portable communication device using the address;

continue the session to send the operating system image to the another portable communication device through the high speed wireless connection, in response to a request from another recovery manager stored in a firmware of the another portable communication device.

14. The portable communication device of claim 13, wherein the near field communication module, the high speed communication module and recovery manager are stored in an operating system of the portable communication device.

15. The portable communication device of claim 13, wherein the high speed wireless connection is Bluetooth or Wi-Fi communication.

16. The portable communication device of claim 13, wherein the portable communication device and the another portable communication device are smart phones.

17. One or more non-transitory, machine readable storage media comprising a plurality of instructions that in response to being executed cause a portable computing device to:

initiate, by a recovery manager and in response to a determination that an operating system of the portable communication device has crashed, a session between the portable communication device with another portable communication device through a near field communication connection established by a near field communication module; and

obtain, through the near field communication connection, an address of the another portable communication device during the session;

establish, by a high speed wireless communication module, a high speed wireless connection with the another portable communication device using the address;

continue, by the recovery manager, the session to send the operating system image to the another portable communication device through the high speed wireless connection, in response to a request from another recovery manager stored in a firmware of the another portable communication device;

wherein the near field communication module, the high speed communication module and the recovery manager are stored in an operating system of the portable communication device.

18. The non-transitory, machine readable media of claim 5
17, wherein the high speed wireless connection is Bluetooth or Wi-Fi communication.

19. The non-transitory, machine readable media of claim 17, wherein the portable communication device and the another portable communication device are smart phones. 10

* * * * *