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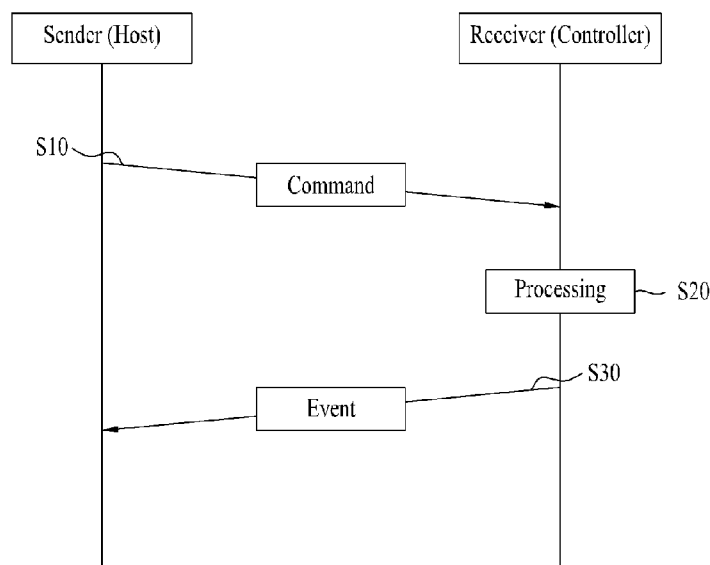
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[Continued on next page]

(54) Title: APPARATUS FOR CONTROLLING A POWER AND METHOD THEREOF

[Fig. 4]



(57) Abstract: An apparatus for controlling a power and a method thereof are disclosed. A method of controlling a power of a device including a device host and an NFC controller receives a command from an external source in the NFC controller, the command indicating whether to power on or off, transmits a power control command to the device host, the power control command indicating whether to power on or off, and receives an event being responded to the power control command from the device host, the event notifying achievement of the power control command.



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Description

APPARATUS FOR CONTROLLING A POWER AND METHOD THEREOF

Technical Field

- [1] The present invention relates to an interface between elements contained in a device, and more particularly to a power management process between elements contained in a device.

Background Art

- [2] Recently, a Near Field Communication (NFC) concept as a substitute for wired communication or infrared communication has been introduced to the market. As a result, high-speed data communication can be achieved among a plurality of electronic devices using a radio frequency instead of a physical cable. In addition, data communication is wirelessly achieved among a plurality of electronic appliances, such that there is no need to connect a cable to any devices (for example, a digital camera, a printer, and the like). Based on the above-mentioned radio frequency (RF) communication, not only text data but also voice data can be communicated among a plurality of electronic devices.

Disclosure of Invention

Technical Problem

- [3] Accordingly, the present invention is directed to an apparatus for controlling a power and a method thereof that substantially obviate one or more problems due to limitations and disadvantages of the related art.
- [4] An object of the present invention is to provide a power management method for implementing optimum communication between elements contained in a device using a minimum amount of power.

Technical Solution

- [5] The object of the present invention can be achieved by providing a method of controlling a power of a device 10 including a device host 100 and an NFC controller 200, the method including receiving a command from an external source 20 in the NFC controller 200, the command indicating whether to power on or off, transmitting a power control command to the device host 100, the power control command indicating whether to power on or off, and receiving an event being responded to the power control command from the device host 100, the event notifying achievement of the power control command.
- [6] In another aspect of the present invention, there is provided a method of controlling a power of an NFC controller 200 in a device host 100, the method including

transmitting a command indicating a control of the power of the NFC controller 200 to the NFC controller 200, the command including power mode information indicating a power mode of the NFC controller 200, and receiving an event being responded to the command from the NFC controller 200, the event notifying achievement of the command, wherein the power mode includes at least one of a normal mode to supply a power to an external source when to communicate with the external source 20, a sleep mode to be supplied to a power from the external source when to communicate with the external source 20, and a power-off mode.

- [7] In a further aspect of the present invention, there is provided a method of controlling a power of a device host 100 in an NFC controller 200, the method including transmitting a command indicating a control of the power of the device host 100 to the device host 100, the command including power mode information indicating a power mode of the device host 100, receiving an event being responded to the command from the device host 100, the event notifying achievement of the command, and re-transmitting the command to the device host 100 if the event is not received during a predetermined time, wherein the power mode includes at least one of a normal mode to transmit and receive data and a power-off mode.
- [8] In a further aspect of the present invention, there is provided an apparatus for controlling a power, the apparatus including a controller 200 configured to control to receive a command from an external source 20, the command indicating whether to power on or off, configured to control to transmit a power control command to a device host 100, the power control command indicating whether to power on or off, and configured to control to receive an event being responded to the power control command from the device host 100, the event notifying achievement of the power control command.
- [9] In a further aspect of the present invention, there is provided an apparatus for controlling a power, the apparatus including a controller configured to transmit a command indicating to control the power to a device host 100, the command including power mode information indicating power mode of the device host 100, configured to control to receive an event being responded to the command from the device host 100, the event notifying achievement of the command, and configured to control to re-transmit the command to the device host 100 if the event is not received during a predetermined time, wherein the power mode includes at least one of a normal mode to transmit and receive data and a power-off mode.

Advantageous Effects

- [10] The present invention can control a target element using a command and event communicated between elements contained in a device 10, thus guaranteeing effective

power management.

- [11] The present invention can immediately recognize the presence or absence of erroneous power management in a target element on the basis of an event, thus guaranteeing the accuracy of power management.

Brief Description of Drawings

- [12] The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constituted a part of this specification, illustrate embodiments of the invention and together with the description serve to explain the principles of the invention.
- [13] In the drawings:
- [14] FIG. 1 is a block diagram illustrating an overall system according to the present invention.
- [15] FIG. 2 is a block diagram illustrating a controller 200 contained in a system according to the present invention.
- [16] FIG. 3 is a flow chart of a command, an event, and a data message according to the present invention.
- [17] FIG. 4 is a flow chart illustrating a method for controlling power of a controller 200 by a host according to the present invention.
- [18] FIG. 5 is a flow chart illustrating a method for controlling power of a controller 200 by a host 100 according to the present invention.
- [19] FIG. 6 illustrates a format of parameters related to a command and an event according to the present invention.
- [20] FIG. 7 illustrates a format of parameters of "NCI_CORE_GET_POWER_LEVEL_CMD" and "NCI_CORE_GET_POWER_LEVEL_EVENT" according to the present invention.
- [21] FIG. 8 illustrates power status parameters according to the present invention.
- [22] FIG. 9 is a flow chart illustrating a method for controlling power of a controller 200 by a host 100 according to another embodiment of the present invention.

Best Mode for Carrying out the Invention

- [23] Reference will now be made in detail to the preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings.
- [24] The following detailed description includes specific details in order to provide a thorough understanding of the present invention. However, it will be apparent to those skilled in the art that the present invention may be practiced without such specific details. Prior to describing the present invention, it should be noted that most terms disclosed in the present invention correspond to general terms well known in the art, but some terms have been selected by the applicant as necessary and details thereof

will hereinafter be disclosed in the following description of the present invention.

Therefore, it is preferable that the terms defined by the applicant be understood on the basis of their meanings in the present invention.

[25] Also, wherever possible, the same reference numbers will be used throughout the drawings to refer to the same or like parts.

[26] Embodiments of the present invention will hereinafter be described with reference to the annexed drawings in order to provide those skilled in the art with a thorough understanding of the present invention.

[27] FIG. 1 is a block diagram illustrating an overall system according to the present invention.

[28] For convenience of description and better understanding of the present invention, although the present invention uses a Near Field Communication (NFC) environment, which is a short-range wireless connectivity technology that enables simple and safe two-way interactions between electronic devices, as an exemplary communication environment, the scope or spirit of the present invention is not limited thereto and the present invention can be applied to other communication environments as necessary.

[29] As shown in FIG. 1, an overall system for use in a Near Field Communication (NFC) environment may include an NFC device 10 and an external source 20.

[30] The NFC device 10 may include a host 100 for controlling a controller 200 and Secure Elements (SEs) 301, 302 and 303, and the controller 200 for controlling communication between the NFC device 10 and the external source 20 under the NFC environment. The external source 20 communicates with the NFC device 10 through the controller 200 contained in the NFC device 10 under the NFC environment, and may include a reader for a transportation card or an access control system, a tag of a smart poster, etc.

[31] FIG. 2 is a block diagram illustrating a controller 200 according to the present invention.

[32] Referring to FIG. 2, the controller 200 may include an interface 201, a message manager 202, a buffer 203, a processor 204, and an antenna 205.

[33] The interface 201 is defined as a logical and physical connection path among the host 100, the SEs 301, 302 and 303, and the controller 200. Particularly, according to the embodiment of the present invention, the interface 201 may be used as a connection path between the host 100 and the controller 200 under the NFC environment, and may be defined as an NFC Host Controller Interface (NCI).

[34] In the meantime, the interface 201 may be implemented in different ways according to whether one host 100 is connected to the controller 200 (i.e., a single-host architecture) or other constituent components including any secure element (SE) in addition to the host 100 are connected to the controller 200 (i.e., a multi-host ar-

chitecture). Although the NCI scope does not change, the NCI needs to support additional features in a multi-host architecture, compared to the single-host architecture. Therefore, the required NCI functionality is different in a single-host or multi-host environment. While the interface 201 is included in the controller 200 in the exemplary embodiment of the present invention, it may be incorporated into the host 100 or into both the controller 200 and the host 100.

- [35] The interface 201 sends signals received from the host 100 to individual constituent components of the controller 200, or sends signals processed by the constituent components to the host 100. In more detail, the interface 201 receives a command from the host 100, sends the command to the message manager 202, receives a response for the command from the message manager 202, and sends the response to the host 100. In the present invention, a concept including the command and the response is defined as a message. Specifically, the present invention will disclose a message flow in the scope of the NFC Host Controller Interface (NCI) used as the interface 201.
- [36] The message manager 202 receives a command from the interface 201 and generates a response message to the command. The response message may include an initial response indicating an acknowledgement message corresponding to the command originated from a host 100, and a subsequent response transmitted after the initial response such that it is used as one of a plurality of responses corresponding to the command. The controller 200 receives the command according to the embodiment of the present invention. In contrast, it is also obvious to those skilled in the art that the controller 200 generates a command and transmits the command to the host 100, and the host 100 generates a response to the command.
- [37] In addition, multiple responses corresponding to the command may be generated together with an identifier for identifying a transmission entity of such responses. The identifier generated from the message manager 202 may be equal to an identifier for identifying the command generated from the host 100.
- [38] Further, multiple responses corresponding to the command may be generated together with an identifier for identifying a transmission entity of such responses. The identifier generated from the message manager 202 may be equal to an identifier for identifying the command generated from the host 100.
- [39] Besides, upon receiving a get command and a set command from the host 100, the message manager 202 generates a get command response to the get command and a set command response to the set command. The get command response is generated in response to a get command including a parameter identifier for retrieving a parameter value of the controller 200, and the get command response has a retrieved value corresponding to the parameter. The set command response is generated in response to a set command including a parameter identifier for setting a parameter of the controller 200

to a target value.

- [40] The buffer 203 stores a command generated from the host 100 and a response generated from the message manager 202, and transmits the command and the response to the processor 204. The buffer 203 may be used as a temporary storage unit while the controller 200 performs a given process. In addition, the buffer 203 may also be used to disperse the work load of the processor 204.
- [41] The processor 204 executes the command received from the buffer 203. The message manager 202 monitors the execution status of the processor 204, and generates the aforementioned initial response or subsequent response (i.e., an event) according to the execution status.
- [42] The antenna 205 is used as an interface between the controller 200 and the external source 20 for Near Field Communication (NFC), and is used for transmission and/or reception of a radio frequency (RF) signal.
- [43] According to the present invention, a data flow between a sender and a receiver may be classified into a command flow, an event flow, and a data message flow. Hereinafter, types of the above-mentioned data flows for use in the system will be described with reference to FIG. 3.
- [44] FIG. 3 shows flows of a command, events, and data messages between the host 100 and the controller 200 according to the present invention.
- [45] It is obvious to those skilled in the art that the sender may be the host 100 and the controller 200, and the receiver may also be the host 100 and the controller 200. For convenience of description and better understanding of the present invention, the following description assumes that an entity of the command is the host 100.
- [46] A command generated from the sender may command the receiver to carry out a specific action instructed by the command itself. The command may be answered with at least one event. Referring to an upper part of FIG. 3, when the host 100 transmits the command to the controller 200, the controller 200 transmits a first event (Event 1) and a second event (Event 2) as responses to the command. The first event (Event 1) indicates acknowledgement of reception of the command, and the second event (Event 2) is a final response indicating the completion of an operation for processing the command in the direction from the controller 200 to the host 100. After the first event (Event 1) has occurred, the second event (Event 2) is generated as one of a plurality of subsequent responses corresponding to the command. In FIG. 3, Event 1 may be implemented as mandatory and Event 2 may be implemented as optional, however, it may be possible implementing Event 1 as optional and Event 2 as mandatory. In other words, the first event (Event 1) and the second event (Event 2) may be implemented as mandatory or optional responses to the command. In this case, it is necessary to define the relationship between the command and the Event 1 or 2 used as a response to this

command. This relationship is referred to as a transaction.

[47] The transaction is started with a command and is ended when this command is completed, and the concept of the transaction is applicable to commands and events having the parameter transaction identifier. At least one event corresponding to the response of a command may have the same transaction identifier in connection with the command to which the event belongs.

[48] The transaction identifier value may not be reused as long as the transaction is not complete. In other words, if the sender transmits a command, all events and commands associated with the transmitted command have the same transaction identifier value until the action based on the above-mentioned command is completed.

[49] Referring to a lower part of FIG. 3, a data message can be sent from the host 100 to the controller 200 or vice versa. The sender (i.e., the host 100 of a data message) may not require an acknowledgement from the receiver (i.e., the controller 200).

[50] Power control methods for elements contained in a device will hereinafter be described with reference to the annexed drawings. Although the following embodiments of the present invention will be described centering on the host 100 and the controller 200, it is obvious to those skilled in the art that the embodiments are applicable to other elements contained in the device.

[51] FIG. 4 is a flow chart illustrating a method for controlling power of a controller by a host according to the present invention.

[52] Referring to FIG. 4, the host 100 transmits a command for power control of the controller 200 to the controller 200 at step S10. The controller 200 controls the power of the controller 200 on the basis of the instruction of the received command at step S20. Thereafter, the controller 200 may send an event as a response to the command at step S30.

[53] Transmission of the event transmitted from the controller 200 may be optional, and the controller 200 may not send an event for a power-off command. The controller 200 may send a reception-associated event simultaneously while receiving the command. That is, the controller 200 may notify the host 100 of the completion of normal transmission of the command. Thereafter, the power control process for the controller 200 may be carried out by the instruction of the command.

[54] The host 100 may retransmit the command when it does not receive the event within a given time, such that it can expedite the power control process of the controller 200 and can effectively use the power of the device.

[55] FIG. 5 is a flow chart illustrating a method for controlling power of a controller by a host according to the present invention.

[56] Referring to FIG. 5, the controller 200 receives a command for power control of the host 100 from the external source at step S100. The controller 200 transmits the

command for power control to the host 100 on the basis of the instruction of the received command at step S200. The host 100 performs power control on the basis of the instruction of the received command at step S300. The host 100 may transmit an event as a response to the command at step S400.

[57] Transmission of the event transmitted from the controller 100 may be optional, and the controller 200 may not transmit an event for a power-off command. The controller 200 may transmit a reception-associated event simultaneously while receiving the command. That is, the host 100 may notify the controller 200 of the completion of normal transmission of the command. Thereafter, the power control process for the controller 100 may be carried out by the instruction of the command.

[58] The controller 200 may retransmit the command when it does not receive the event within a given time, such that it can expedite the power control process of the host 100 and can effectively use the power of the device.

[59] FIG. 6 illustrates a format of parameters for a command and an event according to the present invention.

[60] Referring to FIG. 6, the command may include parameters for a transaction identifier and a power status. The event may include parameters for a transaction identifier and a status. The parameter for the transaction identifier is the same as described above. The transaction identifier originated from one command has the same value until the command is completed. Therefore, the transaction identifier of the command has the same value as in the event replying to the command.

[61] The parameter of the power status may be established in a different manner depending on what the entity is, i.e., the host 100 or the controller 200. The difference in the power-status parameter may occur due to characteristics of individual elements included in the device. For example, the controller 200 may actively emit the electric field to the external source so as to RF-communicate with the external source. In addition, the controller 200 may passively receive the electric field from the external source, such that it may communicate with the external source. Due to the above-mentioned characteristics, the power status for the controller 200 may include three power modes. In more detail, the three power modes may be a normal mode, a sleep mode, and a power-off mode. The normal mode corresponds to a command for maintaining the normal power-on status of the controller 200. In this case, as previously stated above, active communication with the external source may be made available by the emission of the electric field. The power-off mode corresponds to a command for powering off the controller 200. In the sleep mode, the controller 200 receives the electric field (i.e., power) from the external source, such that it can passively communicate with the external source. In conclusion, during the sleep mode, the controller 200 may transmit or receive to/from the external source, depending on

power of the external source. In contrast, although the power status of the host 100 may include a power-on mode for powering on the host 100 and a power-off mode for powering off the host 100, the scope of the present invention is not limited thereto. The status parameter of the event indicates a current power status of a host 100 or controller 200 processed by the command. The status parameter may indicate the failure in power control of the host 100 and the controller 200.

- [62] FIG. 7 illustrates a format of parameters of "NCI_CORE_GET_POWER_LEVEL_CMD" and "NCI_CORE_GET_POWER_LEVEL_EVENT" according to the present invention.
- [63] "NCI_CORE_GET_POWER_LEVEL_CMD" and "NCI_CORE_GET_POWER_LEVEL_EVENT" are commands for checking a current power status of each associated element. For example, there may be a need for the host 100 to check the power status of the controller 200. Needless to say, there may also be a need for the controller 200 to check the power status of the host 100. In this case, each power status of associated elements can be confirmed by "NCI_CORE_GET_POWER_LEVEL_CMD" and "NCI_CORE_GET_POWER_LEVEL_EVENT". "NCI_CORE_GET_POWER_LEVEL_CMD" and "NCI_CORE_GET_POWER_LEVEL_EVENT" may include parameters for a transaction identifier, a power status, and a status, and individual parameters are the same as in FIG. 6. For example, if the host 100 transmits "NCI_CORE_GET_POWER_LEVEL_CMD" to the controller 200, the controller 200 may transmit "NCI_CORE_GET_POWER_LEVEL_EVENT" including a current power status of the controller 200 to the host 100. On the other hand, the status parameter may represent a specific status in which it is impossible to check the power status of a current element. That is, the status parameter may represent a specific status in which the instruction of the command has not been carried out.
- [64] FIGS. 8A and 8B illustrate power status parameters according to the present invention.
- [65] FIG. 8A is a configuration view of the power status associated with a command for controlling the power of the host 100. FIG. 8B is a configuration view of the power status associated with a command for controlling the power of the controller 200. The configurations of FIGS. 8A and 8B are disclosed only for illustrative purposes, however it is obvious to those skilled in the art that there are a variety of power statuses based on corresponding elements.
- [66] FIG. 9 is a flow chart illustrating a method for controlling power of a controller 200 by a host 100 according to another embodiment of the present invention.
- [67] Referring to FIG. 9, the host 100 changes a power mode of the controller 200 to a

normal mode, and adds a duration parameter to instruct a duration of the normal mode at step S50. The controller 200 changes a current power mode to a normal mode at step S55, and transmits an event as a response to the command at step S60. On the other hand, after the lapse of a predetermined time instructed by the duration parameter of the command, the controller 200 changes a current power mode to a previous power mode at step S63, and transmits an event corresponding to the changed power mode at step S65.

[68] Transmission of the event transmitted from the controller 200 may be optional, and the controller 200 may not transmit an event for a power-off command. The host 100 may transmit a reception-associated event simultaneously while receiving the command. That is, the host 100 may notify the controller 200 of the completion of normal transmission of the command. Thereafter, the power control process for the host 100 may be carried out by the instruction of the command.

[69] While the present invention has been described and illustrated herein with reference to the preferred embodiments thereof, it will be apparent to those skilled in the art that various modifications and variations can be made therein without departing from the spirit and scope of the invention. Thus, it is intended that the present invention covers the modifications and variations of this invention that come within the scope of the appended claims and their equivalents.

Mode for the Invention

[70] Various embodiments have been described in the best mode for carrying out the invention.

Industrial Applicability

[71] As apparent from the above description, the present invention can control a target element using a command and event communicated between elements contained in a device, thus guaranteeing effective power management.

[72] The present invention can immediately recognize the presence or absence of erroneous power management in a target element on the basis of an event, thus guaranteeing the accuracy of power management.

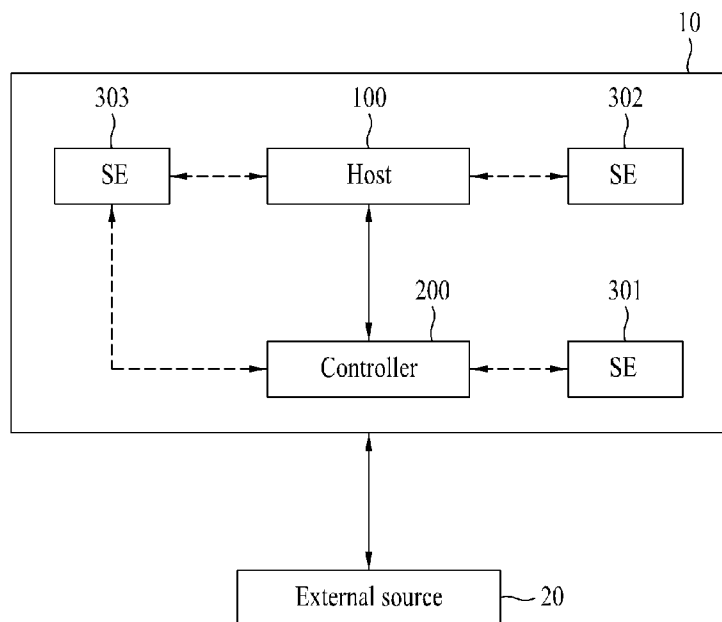
Claims

- [1] A method of controlling a power of a device including a device host and an NFC controller, the method comprising:
receiving a command from an external source in the NFC controller, the command indicating whether to power on or off;
transmitting a power control command to the device host, the power control command indicating whether to power on or off; and
receiving an event being responded to the power control command from the device host, the event notifying achievement of the power control command.
- [2] The method of claim 1, wherein the power control command further includes at least one of transaction identifier information, source address information and destination address information.
- [3] The method of claim 1, further comprising:
retransmitting the power control command to the device host if the event is not received during a predetermined time.
- [4] A method of controlling a power of an NFC controller in a device host, the method comprising:
transmitting a command indicating a control of the power of the NFC controller to the NFC controller, the command including power mode information indicating a power mode of the NFC controller; and
receiving an event being responded to the command from the NFC controller, the event notifying achievement of the command,
wherein the power mode includes at least one of a normal mode to supply a power to an external source when to communicate with the external source, a sleep mode to be supplied to a power from the external source when to communicate with the external source, and a power-off mode.
- [5] The method of claim 1, wherein the command further includes at least one of transaction identifier information, source address information and destination address information.
- [6] The method of claim 1, further comprising:
retransmitting the command to the NFC controller if the event is not received during a predetermined time.
- [7] A method of controlling a power of a device host in an NFC controller, the method comprising:
transmitting a command indicating a control of the power of the device host to the device host, the command including power mode information indicating a power mode of the device host;

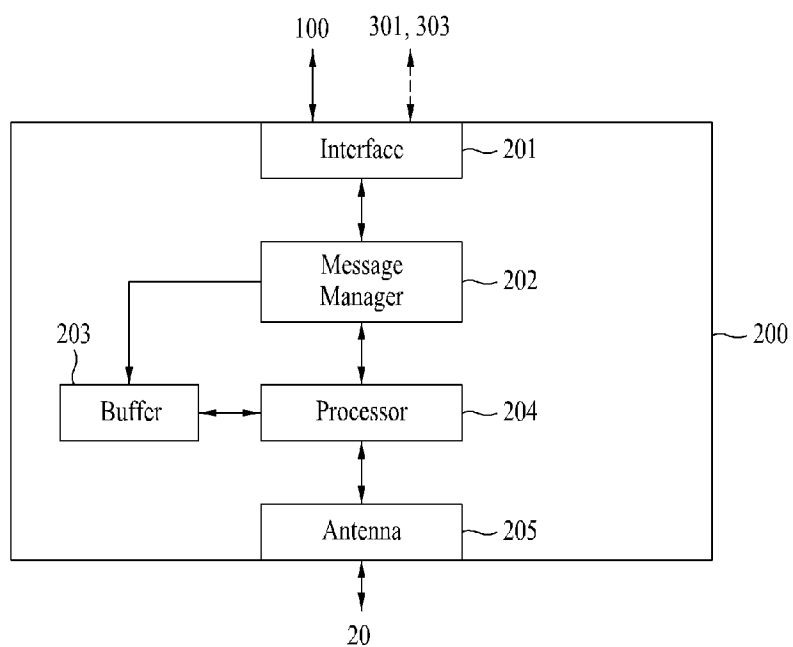
receiving an event being responded to the command from the device host, the event notifying achievement of the command; and
retransmitting the command to the device host if the event is not received during a predetermined time,
wherein the power mode includes at least one of a normal mode to transmit and receive, and a power-off mode.

- [8] An apparatus for controlling a power, the apparatus comprising:
a controller configured to control to receive a command from an external source, the command indicating whether to power on or off, configured to control to transmit a power control command to a device host, the power control command indicating whether to power on or off, and configured to control to receive an event being responded to the power control command from the device host, the event notifying achievement of the power control command.
- [9] The apparatus of claim 8, wherein the power control command further includes at least one of transaction identifier information, source address information and destination address information.
- [10] The apparatus of claim 8, wherein the controller is further configured to control to retransmit the power control command to the device host if the event is not received during a predetermined time.
- [11] An apparatus for controlling a power, the apparatus comprising:
a controller configured to transmit a command indicating a control of the power to a device host, the command including power mode information indicating a power mode of the device host, configured to control to receive an event being responded to the command from the device host, the event notifying achievement of the command, and configured to control to retransmit the command to the device host if the event is not received during a predetermined time,
wherein the power mode includes at least one of a normal mode to transmit and receive, and a power-off mode.

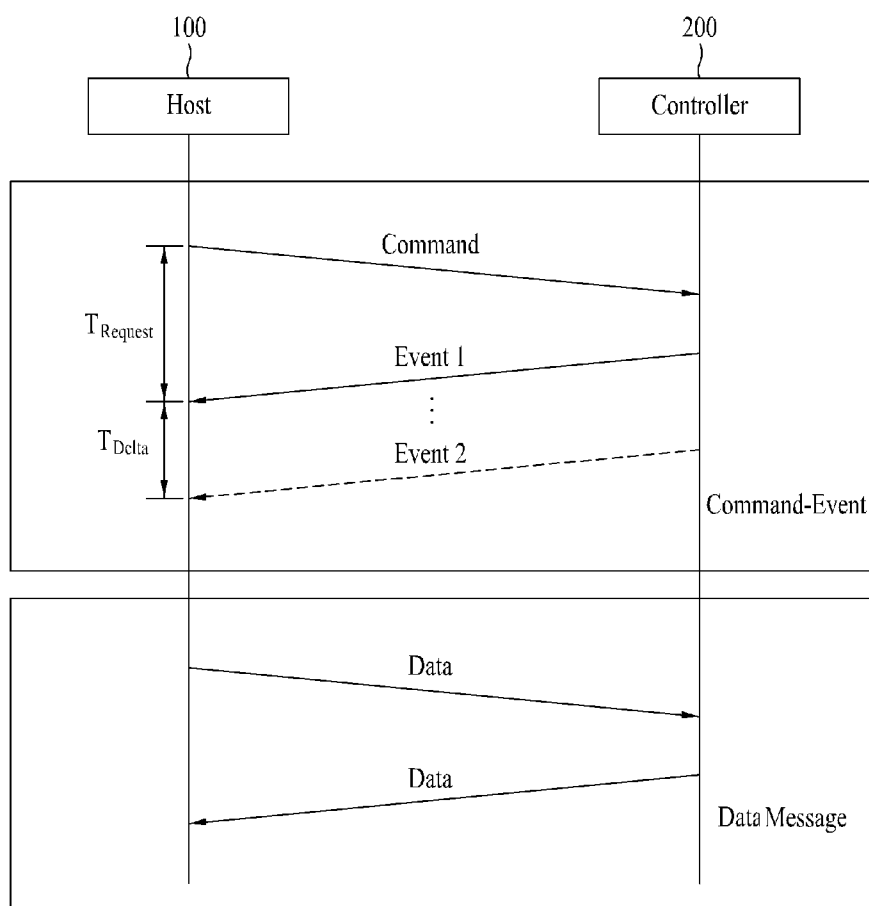
[Fig. 1]



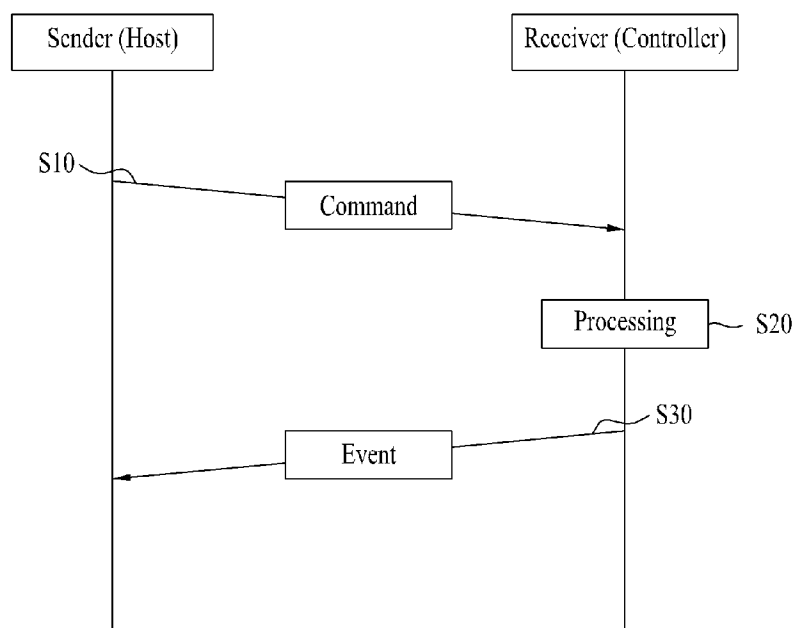
[Fig. 2]



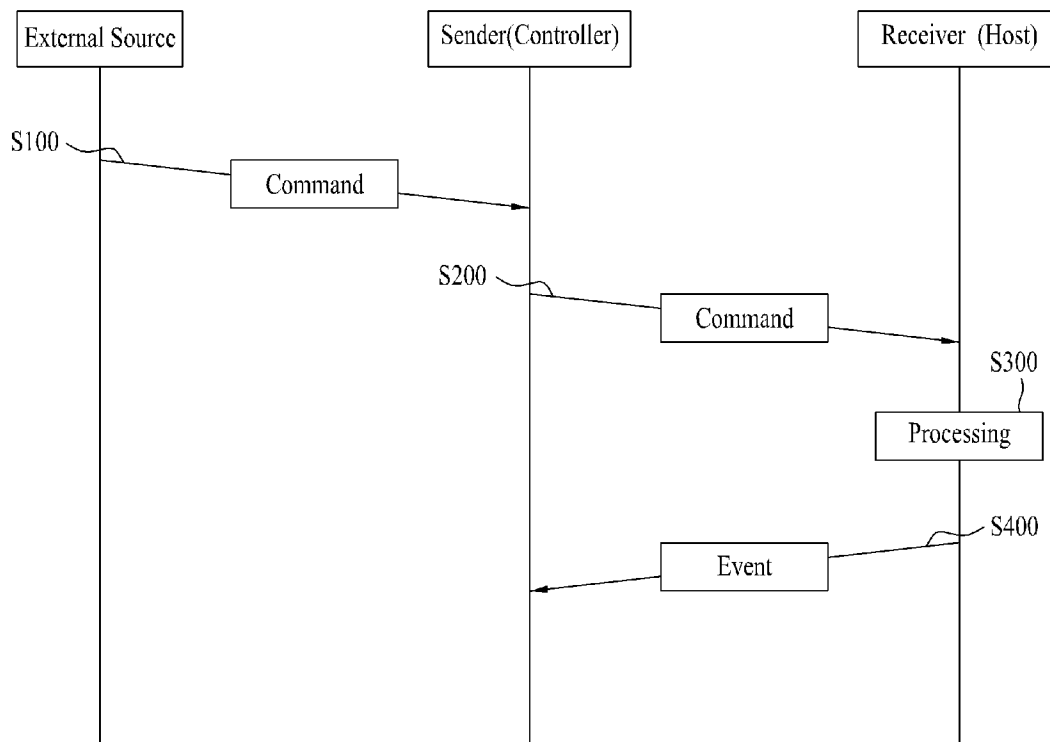
[Fig. 3]



[Fig. 4]



[Fig. 5]



[Fig. 6]

Command	Param length	Parameters
NCI_CORE_SET_POWER_LEVEL_CMD	0x02	Transaction Identifier (1 octet) Power Status (1 octet)

Event	Param length	Parameters
NCI_CORE_SET_POWER_LEVEL_EVENT	0x02	Transaction Identifier (1 octet) Status (1 octet)

[Fig. 7]

Command	Param length	Parameters
NCI_CORE_GET_POWER_LEVEL_CMD	0x01	Transaction Identifier (1 octet)

Event	Param length	Parameters
NCI_CORE_GET_POWER_LEVEL_EVENT	0x03	Transaction Identifier (1 octet) Power Status (1 octet) Status (1 octet)

[Fig. 8]

Power Status	Definition
0x00	Power-off mode
0x01	Normal mode
0x02-0xFF	Not used

(A)

Power Status	Definition
0x00	Power-off mode
0x01	Normal mode
0x02	Sleep mode
0x03-0xFF	Not used

(B)

[Fig. 9]

