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(54) COMMUNICATION WITHIN AN ELECTRONIC DEVICE

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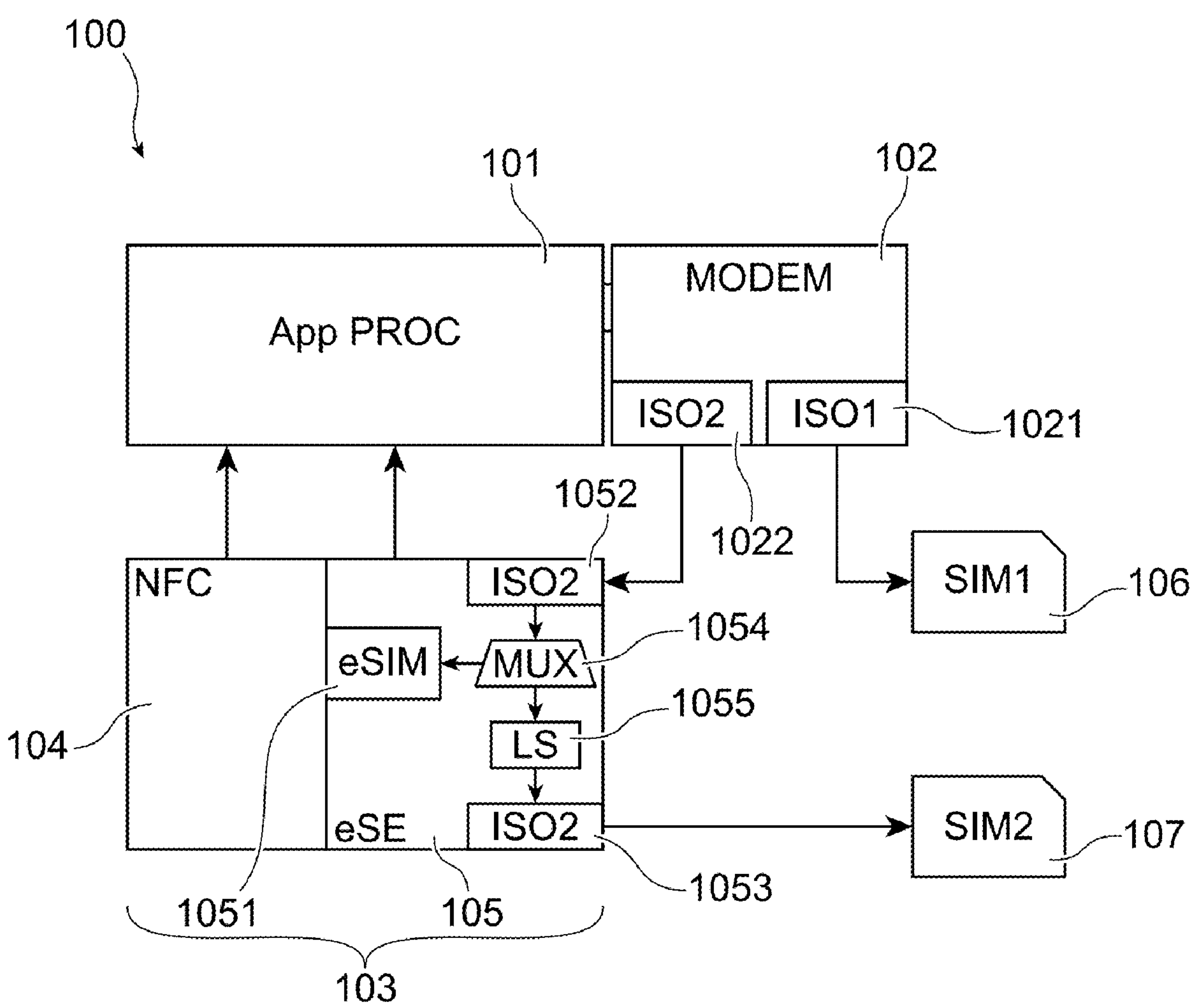
(57) **ABSTRACT**

An embedded secure element (eSE) includes an input configured to receive a first data signal and an output configured to deliver a second signal. The eSE further includes a circuit configured to implement an embedded SIM card. The output is intended to be coupled to an external SIM card. A selector within the eSE receives the first signal from the input is controlled in a first selection to deliver the first signal to the embedded SIM card. The selector is further controlled in a second selection to deliver the first signal to a voltage level converter which level shifts the first signal to generate the second signal at the output.



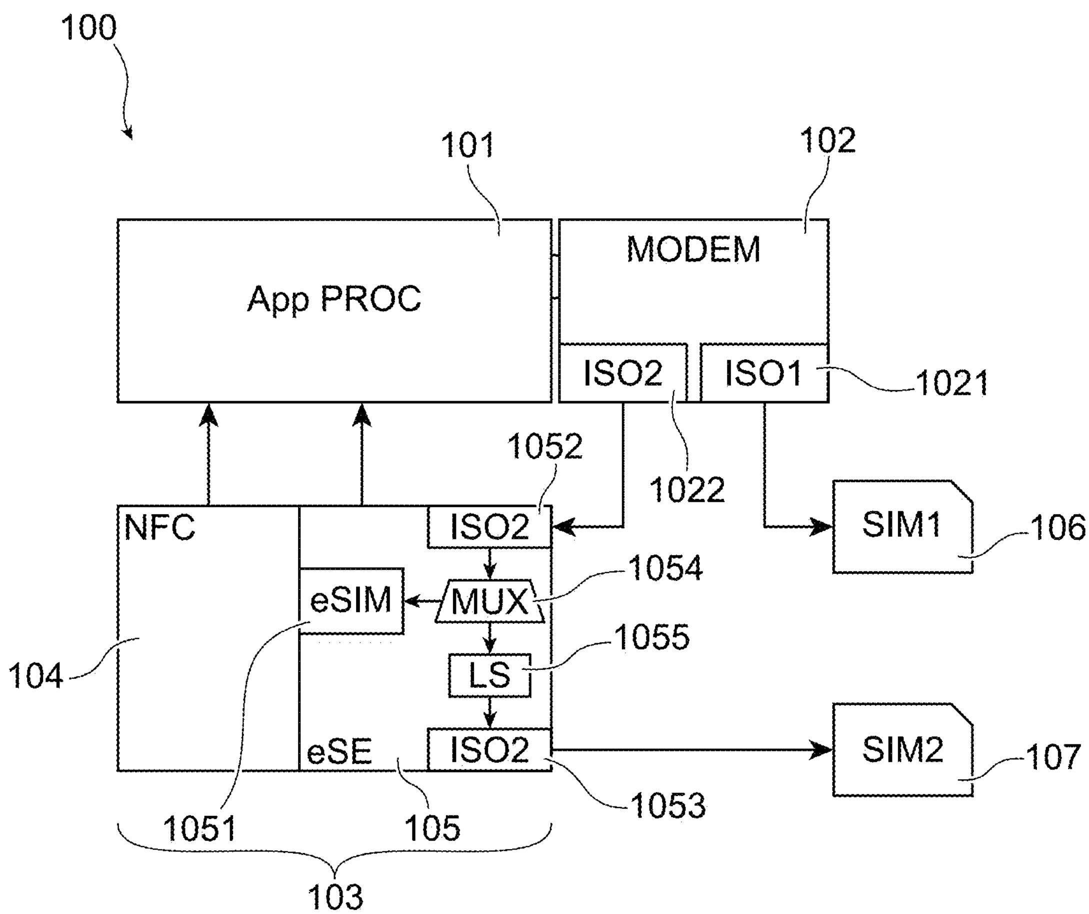
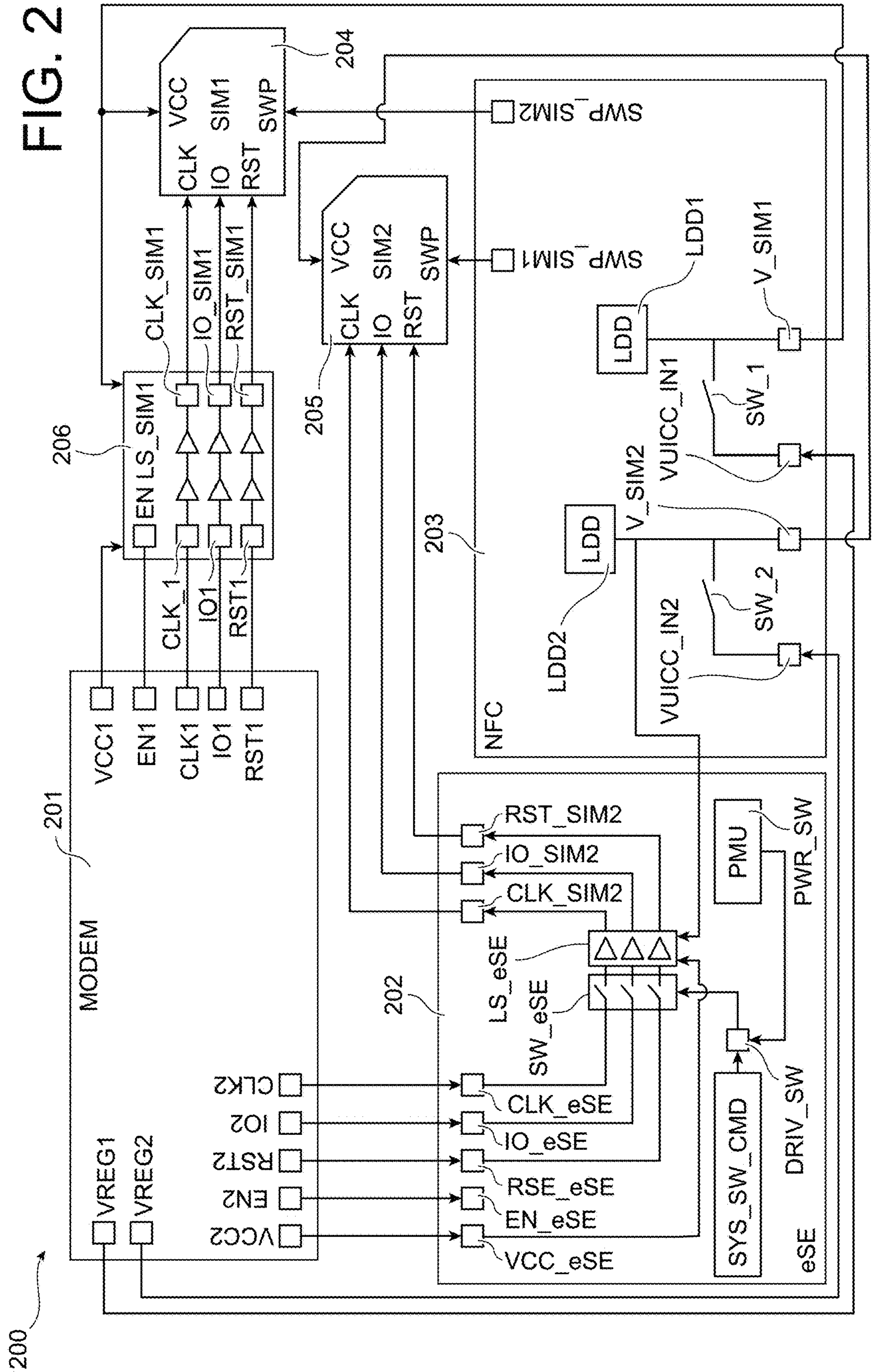

100
101
102
App PROC
MODEM
ISO2
ISO1
1021
1022
1052
NFC
ISO2
SIM1
106
1054
eSIM
MUX
1055
LS
104
eSE
ISO2
SIM2
107
1053
1051
105
103

FIG. 1

FIG. 2


200
201
MODEM
VCC1
EN1
CLK1
IO1
RST1
VREG1
VREG2
CLK2
IO2
RST2
EN2
VCC2
206
EN LS_SIM1
CLK_1
IO1
RST1
CLK_SIM1
IO_SIM1
RST_SIM1
204
VCC
CLK
IO
RST
SIM1
SWP
205
VCC
CLK
IO
RST
SIM2
SWP
203
NFC
SWP_SIM2
SWP_SIM1
LDD
LDD1
LDD
LDD2
V_SIM1
V_SIM2
SW_1
SW_2
VUICC_IN1
VUICC_IN2
202
eSE
RST_SIM2
IO_SIM2
CLK_SIM2
LS_eSE
SW_eSE
PMU
PWR_SW
SYS_SW_CMD
DRIV_SW
CLK_eSE
IO_eSE
RSE_eSE
EN_eSE
VCC_eSE

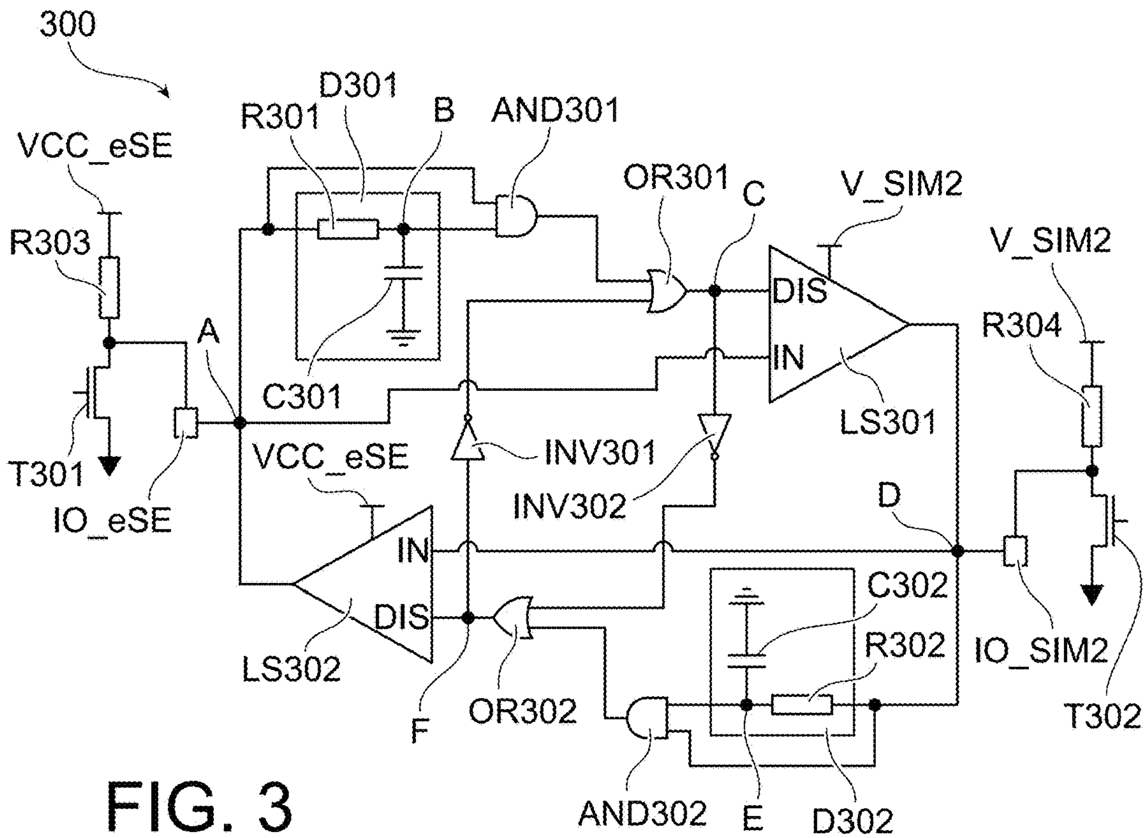

300
VCC_eSE
R303
T301
IO_eSE
A
R301
D301
B
AND301
C301
OR301
C
V_SIM2
DIS
IN
LS301
INV301
INV302
VCC_eSE
IN
DIS
LS302
F
OR302
D
C302
R302
AND302
E
D302
V_SIM2
R304
IO_SIM2
T302

FIG. 3

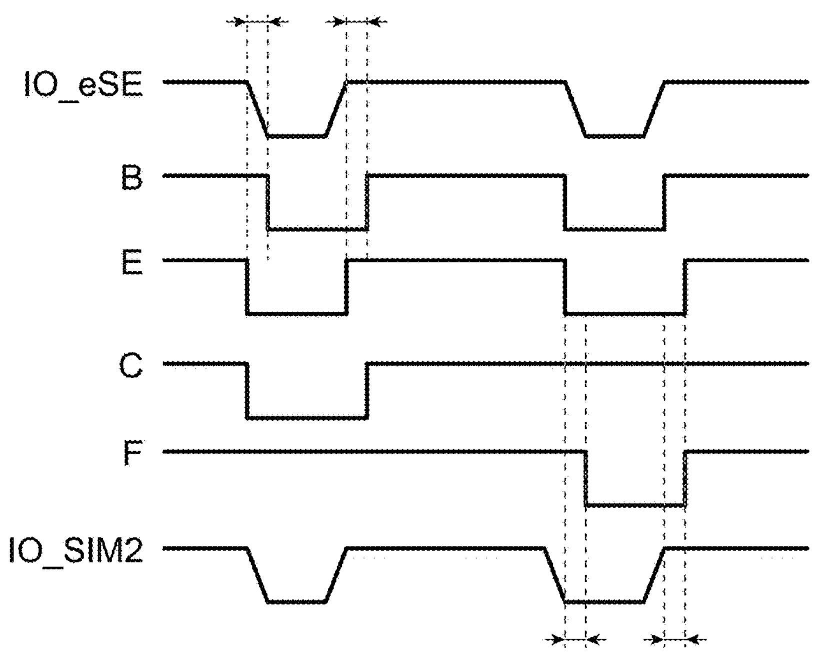

IO_eSE
B
E
C
F
IO_SIM2

FIG. 4

COMMUNICATION WITHIN AN ELECTRONIC DEVICE

PRIORITY CLAIM

[0001] This application claims the priority benefit of French Application for Patent No. 2401418, filed on Feb. 14, 2024, the content of which is hereby incorporated by reference in its entirety to the maximum extent allowable by law.

TECHNICAL FIELD

[0002] The present disclosure generally concerns electronic systems and devices and the power supply and the transmission of signals within these electronic systems and devices. The present disclosure more specifically concerns the adaptation of voltage levels within a complex electronic system or device.

BACKGROUND

[0003] Complex electronic systems and devices may be formed of a plurality of circuits, modules, or subsystems, using different voltage levels. The use of voltage level adaptation circuits is thus necessary for the correct operation of this type of electronic system or device.

[0004] It would be desirable to be able to improve, at least partly, certain aspects of the management of voltage levels within an electronic system or device.

[0005] There exists a need for electronic systems and devices having a better management of the voltage levels used by the circuits and modules forming them.

[0006] There exists a need for more compact electronic systems and devices.

[0007] There is a need in the art to overcome all or part of the disadvantages of known circuits and processes for management of different voltage levels within an electronic system or device.

SUMMARY

[0008] An embodiment provides an electronic system or device comprising an embedded secure element itself comprising a level converter circuit configured to adjust the voltage levels of signals intended for a SIM card.

[0009] An embodiment provides an embedded secure element comprising: at least one input configured to receive at least a first data signal; a circuit configured to implement an embedded SIM card; at least one output configured to deliver a second signal; a first voltage level converter configured to deliver said second signal to said output; and a selector configured to receive said first signal and to deliver it either to said circuit or to said output according to a control signal.

[0010] According to an embodiment, said output is configured to deliver said second signal to a first slot intended for a first SIM card.

[0011] According to an embodiment, said first voltage level converter is bidirectional.

[0012] According to an embodiment, said first voltage level converter comprises: an input node; an output node; a first branch, coupling said input node to said output node, comprising a first delay circuit and a first voltage level step-up circuit; and a second branch, coupling the output node to said input node, comprising a second delay circuit and a second voltage level step-up circuit.

[0013] Another embodiment provides a chip comprising a previously-described embedded secure element.

[0014] According to an embodiment, the chip further comprises a near-field communication controller.

[0015] Another embodiment provides an electronic device comprising a previously-described chip, a router, and said first slot.

[0016] According to an embodiment, the device further comprises a second slot intended for a second SIM card.

[0017] According to an embodiment, the device further comprises a second voltage level converter coupling said router and said second slot.

[0018] According to an embodiment, the device is a cell phone.

[0019] Another embodiment provides a method of communication within the previously-described device between said router and said first slot.

[0020] According to an embodiment, the method comprises the following successive steps: sending a control signal to said selector indicating that said first slot is selected; sending, by use of said router, said first voltage to the input of said embedded secure element; converting said first voltage, by use of said first voltage level converter, into said second voltage; and sending, by use of said embedded secure element, said second voltage to said first slot.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021] The foregoing features and advantages, as well as others, will be described in detail in the rest of the disclosure of specific embodiments given as an illustration and not limitation with reference to the accompanying drawings, in which:

[0022] FIG. **1** very schematically shows in the form of blocks an embodiment of an electronic device;

[0023] FIG. **2** shows in further detail the embodiment of FIG. **1**;

[0024] FIG. **3** shows a level converter circuit; and

[0025] FIG. **4** shows timing diagrams illustrating the operation of the circuit of FIG. **3**.

DETAILED DESCRIPTION

[0026] Like features have been designated by like references in the various figures. In particular, the structural and/or functional features that are common among the various embodiments may have the same references and may dispose identical structural, dimensional and material properties.

[0027] For clarity, only those steps and elements which are useful to the understanding of the described embodiments have been shown and are described in detail.

[0028] Unless indicated otherwise, when reference is made to two elements connected together, this signifies a direct connection without any intermediate elements other than conductors, and when reference is made to two elements coupled together, this signifies that these two elements can be connected or they can be coupled via one or more other elements.

[0029] In the following description, where reference is made to absolute position qualifiers, such as "front", "back", "top", "bottom", "left", "right", etc., or relative position qualifiers, such as "top", "bottom", "upper", "lower", etc., or orientation qualifiers, such as "horizontal", "vertical", etc., reference is made unless otherwise specified to the orientation of the drawings.

[0030] Unless specified otherwise, the expressions "about", "approximately", "substantially", and "in the order of" signify plus or minus 10%, preferably of plus or minus 5%.

[0031] The embodiments described hereafter concern complex electronic systems and devices, and more particularly the transmission of signals within such electronic systems and devices. The embodiments more particularly relate to the use of one or a plurality of subscriber identity/identification module (SIM) cards and of one or a plurality of SIM cards embedded in such electronic systems or devices. A SIM card is an electronic device, generally a chip equipped with at least one microprocessor and data storage circuit, carrying the identity of a user. An embedded SIM (eSIM) card, is a software device carrying the identity of a user, and can be implemented by a circuit comprising, for example, a processor and data storage circuit.

[0032] There exist electronic systems or devices capable of implementing a plurality of SIM cards and/or embedded SIM cards. Not all SIM cards and embedded SIM cards are configured to receive signals referenced to the same voltage levels. The embodiments described hereafter provide supplying a compact electronic device in which SIM cards and embedded SIM cards receive signals having adjusted voltage levels.

[0033] Further, the embodiments described hereafter are particularly applicable to electronic systems and devices using SIM cards and embedded SIM cards, such as cell phones or smart cell phones, connected tablets, or any other connected objects capable of using a SIM card.

[0034] FIG. **1** schematically shows in the form of blocks an embodiment of an electronic device **100**.

[0035] According to an example, electronic device **100** comprises a processor **101** (App Proc), for example a processor configured to implement application functions.

[0036] Device **100** further comprises a router **102** (Modem) configured to transmit signals within device **100**. According to an example, router **102** can exchange signals with processor **101**. According to an embodiment, router **102** comprises at least two terminals **1021** (ISO**1**) and **1022** (ISO**2**). The data signals supplied by router **102** are all referenced to a first voltage level Vdd**1**.

[0037] Device **100** further comprises a chip **103** configured to communicate with processor **101** and/or router **102**.

[0038] Chip **103** optionally comprises a circuit configured to implement a communication function **104** (NFC). According to a preferred example, circuit **104** is configured to implement a near field communication (NFC) circuit **104** and is, in this case, also referred to as an NFC controller **104**.

[0039] According to an embodiment, chip **103** comprises an embedded secure element (eSE) **105** configured to implement secure operations. Element **105** generally comprises its own processor(s), its own memory or memories, and/or its own circuit(s) implementing various functions. In the embodiment described herein, embedded secure element **104** comprises at least one circuit **1051** (eSIM) configured to implement an embedded SIM card. As previously mentioned, circuit **1051** may comprise a processor and a data storage circuit.

[0040] Embedded secure element **105** further comprises at least two communication terminals **1052** (ISO**2**) and **1053** (ISO**2**), a selector circuit **1054** (MUX or multiplexer), and a voltage level converter **1055** (LS or level shifting circuit), the uses of which are described hereafter. Selector **1054** comprises an input coupled, preferably connected, to terminal **1052**, a control terminal receiving a control signal, not shown in FIG. **1**, and at least two outputs, one being coupled to circuit **1051** (and selected by a first state of the control signal) and the other being coupled to an input of voltage level converter **1055** (and selected by a second state of the control signal). An output of converter **1055** is coupled, preferably connected, to terminal **1053**.

[0041] According to an embodiment, electronic device **100** comprises one or a plurality of slots intended to receive SIM cards. In particular, in FIG. **1**, device **100** comprises two slots **106** (SIM**1**) and **107** (SIM**2**). Slot **106** is coupled to terminal **1021** of router **102**. According to an embodiment, slot **107** is coupled to terminal **1053** of secure element **105**.

[0042] The operation of device **100** is the following. As previously described, device **100** is configured to implement two SIM cards and one embedded SIM card. Router **102**, however, only comprises two outputs enabling it to transmit data to these SIM and embedded SIM cards. During the use of device **100**, it is thus necessary to make a choice as to which SIM card and/or embedded SIM card are used. A SIM card inserted into slot **106** is always used, since it is directly coupled to the router. A SIM card inserted into slot **107** is not always used, since it is not directly coupled to router **102**. The user of device **100** thus has a choice between using an embedded SIM card implemented by circuit **1051** or a SIM card inserted into slot **107**.

[0043] When the user chooses to use an embedded SIM card, a method of communication between router **102** and circuit **1051** is the following. A control signal is sent to selector **1054** to indicate that circuit **1051** is selected. This step may be carried out prior to the implementation of a communication. When router **102** has a data signal to transmit to circuit **1051**, it transmits it by using its terminal **1022**, the connection between terminal **1022** and terminal **1052**, and then terminal **1052**. The data signal is then transmitted by selector **1054** to circuit **1051**. According to an embodiment, circuit **1051** is configured to receive data signals referenced to the first voltage level Vdd**1**.

[0044] When the user chooses to use a SIM card placed in slot **107**, a method of communication between router **102** and slot **107** is the following. A control signal is sent to selector **1054** to indicate that slot **107** is selected. This step may be carried out prior to the implementation of a communication. When router **102** has a data signal to transmit to slot **107**, it transmits it by using secure element **105**, that is, terminal **1022**, the connection between terminal **1022** and terminal **1052**, and then terminal **1052**. The data signal is then transmitted by selector **1054** to voltage level converter **1055**, which converts it into a data signal referenced to a second voltage level Vdd**2**, different from the first voltage level Vdd**1**. According to an embodiment, slot **107**, and a SIM card inserted therein, are configured to receive data signals referenced to the second voltage level Vdd**2**. The new data signal is then transmitted by using terminal **1053** and the link between terminal **1053** and the slot.

[0045] According to an example, the links between terminals **1022**, **1021**, **1052**, **1053** and slots **106** and **107** are links using communication protocols according to the ISO7816 standard.

[0046] According to an example, device **100** may further comprise a voltage level converter arranged between terminal **1021** of router **102** and slot **106**. This converter would enable to convert (for example, adjust or level shift) the voltage levels of a signal delivered by router **102** for slot **107**.

[0047] An advantage of this embodiment is that directly integrating to secure element **105** a selector and converter of the type of selector **1054** and of converter **1055** enables to make device **100** more compact.

[0048] FIG. **2** shows in further detail an embodiment of an electronic device **200** of the type of the electronic device **100** described in relation with FIG. **1**.

[0049] Like device **100**, electronic device **200** comprises: a router **201** (Modem) of the type of the router **101** of FIG. **1**; a chip comprising an embedded secure element **202** (eSE), of the type of the embedded secure element **105**, and an NFC controller **203** (NFC) of the type of the NFC controller **104** of FIG. **1**; two slots **204** (SIM**1**) and **205** (SIM**2**) configured to receive SIM cards, of the type of the slots **106** and **107** of FIG. **1**; and a voltage level converter **206** (LS_SIM**1**) coupling router **201** to slot **204**.

[0050] Router **201** comprises two series of communication terminals, each series of communication terminals being dedicated to delivering signals to a SIM card or an embedded SIM card, and two power terminals VREG**1** and VREG**2**. Each series of communication terminals comprises: a power supply terminal VCC**1**, VCC**2** delivering a power supply voltage enabling to reference the data signals; an enable terminal EN**1**, EN**2** delivering an enable signal; a reset terminal RST**1**, RST**2** delivering a reset signal; a communication terminal IO1, IO2 delivering a data communication signal; and a clock terminal CLK**1**, CLK**2** delivering a clock signal.

[0051] Embedded secure element **202** comprises a circuit configured to implement an embedded SIM card, not shown in FIG. **2**, a selector, a voltage level converter LS_eSE, and communication terminals.

[0052] The communication terminals of secure element **202** are the following: a power supply terminal VCC_eSE coupled, preferably connected, to the power supply terminal VCC**2** of router **101**; an enable terminal EN_eSE coupled, preferably connected, to the enable terminal EN**2** of router **101**; a reset terminal RST_eSE coupled, preferably connected, to the reset terminal RST**2** of router **101**; a communication terminal IO_eSE coupled, preferably connected, to the communication terminal IO2 of router **101**; a clock terminal CLK_eSE coupled, preferably connected, to the clock terminal CLK**2** of router **101**; a clock terminal CLK_SIM2 configured to deliver a clock signal to slot **205**; a communication terminal IO_SIM2 configured to deliver a data signal to slot **205**; and a reset terminal RST_SIM2 configured to deliver a reset signal to slot **205**.

[0053] The selector of secure element **202** comprises switches SW-eSE controlled by a driver circuit DRIV-eSE receiving a control signal DRIV_SW from a control circuit SYS_SW_CMD and powered by a power supply circuit PWR_SW (PMU). In the example of FIG. **2**, switches SW_eSE are three (3) in number, and each comprise an input coupled, preferably connected, respectively to terminals RST_eSE, IO_eSE, and CLK_eSE. The outputs of switches SW-eSE are coupled, preferably connected, to inputs of voltage level converter LS_eSE.

[0054] As previously described, the selector enables to direct the data signals received from router **201** and intended for a SIM card or an embedded SIM card, and to transmit them to the SIM card or to the embedded SIM card according to a control signal. In the case illustrated herein, control circuit SYS_SW_CMD may be a processor of element **202**.

[0055] According to an embodiment, voltage level converter LS_eSE comprises as many inputs as switch SW_eSE comprises outputs. Here, voltage level converter LS_eSE comprises three inputs and three outputs. Each output of converter LS_eSE is coupled, preferably connected, to one of the communication terminals CLK_SIM**2**, IO_SIM**2**, and RST_SIM**2** of secure element **202**. Converter LS_eSE further comprises two power supply terminals, one receiving the power supply voltage delivered by the power supply terminal VCC_eSE corresponding to a first voltage level, of the type of the first voltage level Vdd**1** described in relation with FIG. **1**, and the other receiving a second power supply voltage corresponding to a second voltage level, of the type of the second voltage level Vdd**2** described in relation with FIG. **1**. It should be noted that the portion of converter LS_eSE converting the voltage level of the data signal transmitted by terminal IO_eSE is bidirectional. A detailed example of converter LS_eSE and its operation are described in relation with FIGS. **3** and **4**.

[0056] As previously described, voltage level converter LS_eSE enables to convert the voltage levels of the data signals delivered by router **201** before transmitting them to slot **205**.

[0057] NFC controller **203** is here used to communicate with slots **204** and **205**, but also to convey the power supply voltages delivered by the terminals VREG**1** and VREG**2** of router **201**, or by NFC controller **203** as described hereafter. For this purpose, NFC controller **203** comprises two communication terminals SWP_SIM**1** and SWP_SIM**2** configured to deliver a communication signal to slots **204** and **205**.

[0058] To deliver the power supply voltages, NFC controller **203** comprises two power supply reception terminals VUICC_IN**1** and VUICC_IN**2**, two switches SW_**1** and SW_**2**, two voltage regulators LDO**1** (LDO) and LDO**2** (LDO), and two power supply transmission terminals V_SIM**1** and V_SIM**2**. Terminal VUICC_IN**1**, respectively VUICC_IN**2**, is coupled, preferably connected, to the terminal VREG**1**, respectively VREG**2**, of router **201**. Switch SW_**1**, respectively SW_**2**, comprises a first conduction terminal coupled, preferably connected, to terminal VUICC_IN**1**, respectively VUICC_IN**2**, and a second conduction terminal coupled, preferably connected, to terminal V_SIM**1**, respectively V_SIM**2**. An output of voltage regulator LDO**1**, respectively LDO**2**, is coupled, preferably connected, to terminal V_SIM**1**, respectively V_SIM**2**.

[0059] Slots **204** and **205** each comprise five terminals, among which: a terminal VCC configured to receive a power supply voltage; a terminal CLK configured to receive a clock signal; a terminal IO configured to receive a data signal and to delivering a data signal; a terminal RST configured to receive a reset signal; and a terminal SWP configured to receive a data signal and to delivering a data signal.

[0060] According to an embodiment, the terminals of slot **205** are coupled as follows: terminal VCC is coupled, preferably connected, to the terminal V_SIM**2** of NFC controller **203**; a terminal CLK is coupled, preferably connected, to the terminal CLK_SIM**2** of embedded secure element **202**; a terminal IO is coupled, preferably connected, to the terminal IO_SIM**2** of embedded secure element **202**; a terminal RST is coupled, preferably connected, to the terminal RST_SIM**2** of embedded secure element **202**; and a terminal SWP is coupled, preferably connected, to the terminal SWP_SIM**2** of NFC controller **203**.

[0061] Voltage level converter **206** is used to adapt or adjust the voltage levels of signals delivered by router **201** to slot **204**. For this purpose, converter **206** comprises the following terminals: an enable terminal EN coupled, preferably connected, to the terminal EN**1** of router **201**; an input clock terminal CLK**1** coupled, preferably connected to the terminal CLK**1** of router **201**; an input communication terminal IO**1** coupled, preferably connected to the terminal IO**1** of router **201**; an input reset terminal RST**1** coupled, preferably connected, to the terminal RST**1** of router **201**; an output clock terminal CLK-SIM**1** coupled, preferably connected, to the terminal CLK of slot **204**; an output communication terminal IO_SIM**1** coupled, preferably connected to the terminal IO of slot **204**; and an output reset terminal RST_SIM**1** coupled, preferably connected, to the terminal RST of slot **204**.

[0062] Converter **206** comprises a plurality of voltage step-up circuits coupling its input and output terminals.

[0063] According to an embodiment, the terminals of slot **204** are connected as follows: terminal VCC is coupled, preferably connected, to the terminal V_SIM**1** of NFC controller **203**; a terminal CLK is coupled, preferably connected, to the terminal CLK_SIM**1** of voltage level converter **206**; a terminal IO is coupled, preferably connected, to the terminal IO_SIM**1** of voltage level converter **206**; a terminal RST is coupled, preferably connected, to the terminal RST_SIM**1** of voltage level converter **206**; and a terminal SWP is coupled, preferably connected, to the terminal SWP_SIM**1** of NFC controller **203**.

[0064] The operation of device **200** is identical to the operation of the device **100** described in relation with FIG. **1**.

[0065] FIG. **3** is a circuit diagram of a portion of a voltage level converter **300** of the type of the voltage level converter LS_eSE described in relation with FIG. **2**. More particularly, FIG. **3** illustrates the portion of converter **300** enabling to convert the data signal delivered by terminal IO_eSE into the data signal delivered by the terminal IO_SIM**2** of embedded secure element **202**.

[0066] Converter **300** comprises two branches. A first branch enables to convert the voltage level of a first data signal received on terminal IO_eSE to deliver a second data signal on terminal IO_SIM**2**. A second branch enables to convert the voltage level of a third data signal received on terminal IO_SIM**2** to deliver a fourth data signal on terminal IO_eSE.

[0067] The first branch includes a delay element D**301** comprising a resistor R**301** and a capacitor C**301**. A first terminal of resistor R**301** is coupled, preferably connected, to a node A, itself coupled to terminal IO_eSE. A second terminal of resistor R**301** is coupled, preferably connected, to a node B. A first terminal of capacitor C**301** is coupled, preferably connected, to node B, and a second terminal of capacitor C**301** is coupled, preferably connected, to a node receiving the reference potential.

[0068] The first branch further comprises a logic gate AND**301** of "AND" type and a logic gate OR**301** of "OR" type. A first input of gate AND**301** is coupled, preferably connected, to node A, and a second input of gate AND**301** is coupled, preferably connected, to node B. An output of gate AND**301** is coupled, preferably connected, to a first input of gate OR**301**. An output of gate OR**301** is coupled, preferably connected, to a node C.

[0069] The first branch further comprises a voltage level step-up circuit LS**301**, or boost circuit. Boost circuit LS**301** comprises an input DIS coupled, preferably connected, to node C, and an input IN coupled, preferably connected, to node A. A power supply terminal of the step-up circuit is coupled, preferably connected, to the node receiving voltage V_SIM**2**. An output of step-up circuit LS**301** is coupled, preferably connected, to node D.

[0070] The second branch comprises a delay element D**302** comprising a resistor R**302** and a capacitor C**302**. A first terminal of resistor R**302** is coupled, preferably connected, to node D. A second terminal of resistor R**302** is coupled, preferably connected, to a node E. A first terminal of capacitor C**302** is connected, preferably connected, to node E, and a second terminal of capacitor C**302** is coupled, preferably connected, to the node receiving the reference potential.

[0071] The second branch further comprises a logic gate AND**302** of "AND" type and a logic gate OR**302** of "OR" type. A first input of gate AND**302** is coupled, preferably connected, to node D, and a second input of gate AND**302** is coupled, preferably connected, to node E. An output of gate AND**302** is coupled, preferably connected, to a first input of gate OR**302**. An output of gate OR**302** is coupled, preferably connected, to a node F.

[0072] The second branch further comprises a voltage level step-up circuit LS**302**, or boost circuit LS**302**. According to an embodiment, boost circuit LS**302** is identical to boost circuit LS**301**. Boost circuit LS**302** comprises an input DIS coupled, preferably connected, to node F, and an IN input coupled, preferably connected, to node D. A power supply terminal of the boost circuit is coupled, preferably connected, to the node receiving voltage V_SIM**2**. An output of boost circuit LS**302** is coupled, preferably connected, to a node A.

[0073] Converter **300** further comprises two logic gates INV**301** and INV**302** of inverting (NOT) type. An input of gate INV**301** is coupled, preferably connected, to the input DIS of boost circuit LS**302**, and an output of gate INV**301** is coupled, preferably connected, to a second input of gate OR**301**. An input of gate INV**302** is coupled, preferably connected, to the input DIS of boost circuit LS**301**, and an output of gate INV**302** is coupled, preferably connected, to a second input of gate OR**302**.

[0074] Converter **300** further comprises a pull-up resistor R**303** and a transistor T**301** enabling to set the voltage level of terminal IO_eSE. Resistor R**303** comprises a first terminal coupled, preferably connected, to power supply terminal VCC_eSE, and a second terminal coupled, preferably connected, to terminal IO_eSE. A first conduction terminal of transistor T**301** is coupled, preferably connected, to terminal IO_eSE, and a second conduction terminal of transistor T**302** is coupled, preferably connected, to a node receiving a reference potential, for example the ground. According to an example, a control terminal of transistor T**301** is left floating. According to an example, transistor T**301** is a metal-oxide-semiconductor field-effect transistor, or MOS-

FET transistor, or MOS transistor. Further, transistor T**301** is an N-channel MOS transistor, or N-type MOS transistor, or NMOS transistor.

[0075] Converter **300** further comprises a pull-up resistor R**304** and a transistor T**302** for setting the voltage level at the IO_SIM**2** terminal. Resistor R**304** comprises a first terminal coupled, preferably connected, to power supply terminal VCC_SIM**2**, and a second terminal coupled, preferably connected, to terminal IO_SIM**2**. A first conduction terminal of transistor T**302** is coupled, preferably connected, to terminal IO_SIM**2**, and a second conduction terminal of transistor T**302** is coupled, preferably connected, to a node receiving a reference potential, for example the ground. According to an example, a control terminal of transistor T**302** is left floating. According to an example, transistor T**302** is an NMOS transistor.

[0076] The operation of voltage level converter **300** is described in relation with FIG. **4**.

[0077] FIG. **4** comprises timing diagrams illustrating the operation of the voltage level converter **300** described in relation with FIG. **3**.

[0078] More particularly, FIG. **4** shows the time variation of the following data signals: a signal IO_eSE representing the variation of the data signal present at terminal IO_eSE; a signal B representing the variation of the data signal present at node B; a signal E representing the variation of the data signal present at node E; a signal C representing the variation of the data signal present at node C; a signal F representing the variation of the data signal present at node F; and a signal IO_SIM**2** representing the variation of the data signal present at terminal IO_SIM**2**.

[0079] As soon as signal IO_eSE exhibits a falling edge, signals E, C, and IO_SIM**2** all immediately exhibit a falling edge, and signal F if not modified. Signal B also exhibits a falling edge, delayed by delay element D**301**. However, when signal IO_eSE exhibits a rising edge, signals B, E, C, and IO_SIM**2** all exhibit a rising edge with a delay defined by delay element D**301**, and signal F is not modified.

[0080] Conversely, as soon as signal IO_SIM**2** exhibits a falling edge, signals B, E, and IO_eSE all immediately exhibit a falling edge, and signal C is not modified. Signal F also exhibits a falling edge, delayed by delay element D**301**. However, when signal IO_SIM**2** exhibits a rising edge, signals B, E, F, and IO_eSE all exhibit a rising edge with a delay defined by delay element D**301**, and signal C is not modified.

[0081] An advantage of voltage level converter **300** is that the presence of the delay elements D**301** and D**302** enable to obtain a bidirectional converter, that is, a converter capable of converting the voltage level of a signal arriving onto terminal IO_eSE and also of a signal arriving onto terminal IO_SIM**2**. Without the presence of delay elements D**301** and D**302**, no data would be transmitted.

[0082] Various embodiments and variants have been described. Those skilled in the art will understand that certain features of these various embodiments and variants may be combined, and other variants will occur to those skilled in the art.

[0083] Finally, the practical implementation of the described embodiments and variants is within the abilities of those skilled in the art based on the functional indications given hereabove.

1. An embedded secure element, comprising:
an input configured to receive at least a first data signal;
a circuit configured to implement an embedded SIM card;
an output configured to deliver a second signal;
a first voltage level converter configured to deliver said second signal to said output; and
a selector configured to receive said first signal and to deliver the received first signal to said circuit in response to a first state of a control signal and deliver the received first signal to the first voltage level converter to generate the second signal in response to a second state of the control signal.

2. The element according to claim **1**, wherein said output is configured to deliver said second signal to a first slot intended to receive a first SIM card.

3. The element according to claim **1**, wherein said first voltage level converter is bidirectional.

4. The element according to claim **3**, wherein said first voltage level converter comprises:
an input node;
an output node;
a first branch, coupling said input node to said output node, comprising a first delay circuit and a first voltage level step-up circuit; and
a second branch, coupling the output node to said input node, comprising a second delay circuit and a second voltage level step-up circuit.

5. A chip, comprising: the embedded secure element according to claim **1**.

6. The chip according to claim **5**, further comprising a near-field communication controller.

7. An electronic device, comprising:
the chip according to claim **5**; a router; and
said first slot.

8. The device according to claim **7**, further comprising a second slot intended for a second SIM card.

9. The device according to claim **8**, further comprising a second voltage level converter coupling said router and said second slot.

10. The device according to claim **7**, wherein the device is a cell phone.

11. The device according to claim **7**, further comprising a control circuit configured to control communication within the device between said router and said first slot.

12. The device according to claim **11**, wherein the control circuit is configured to control:
sending a control signal to said selector indicating that said first slot is selected;
sending, by use of said router, said first voltage to the input of said embedded secure element;
converting said first voltage, by use of said first voltage level converter, into said second voltage; and
sending, by use of said embedded secure element, said second voltage to said first slot.

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