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(54) **ELECTRONIC DEVICE FOR PROVIDING INFORMATION FOR REINFORCEMENT LEARNING AND METHOD FOR OPERATING THEREOF**

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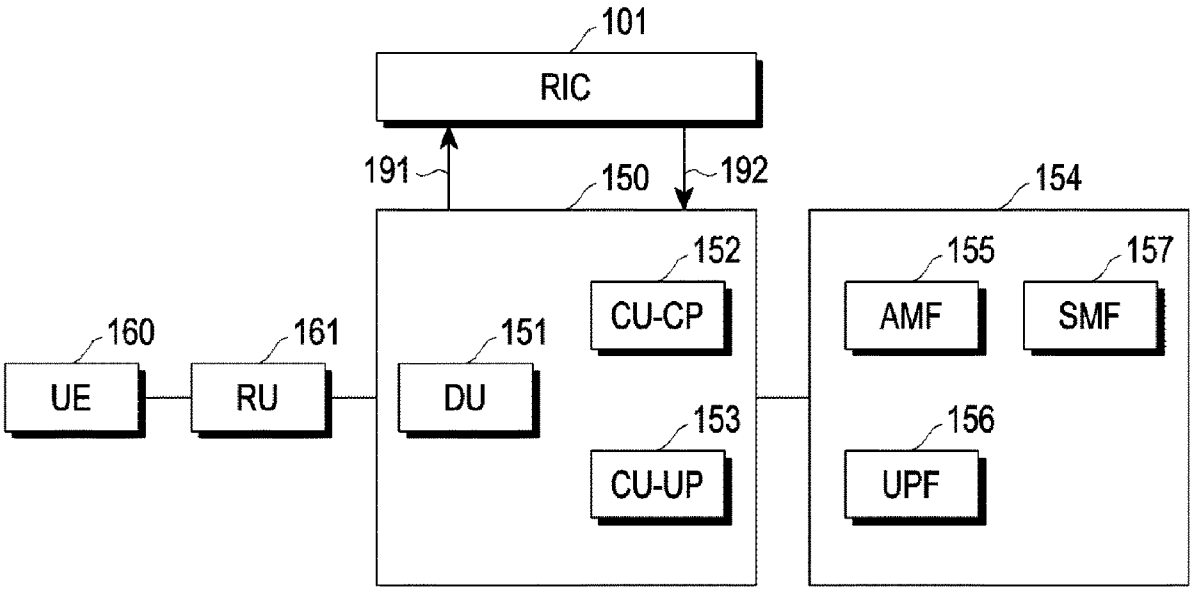
(57) **ABSTRACT**

According to various embodiments, a method of operating an electronic device may include: storing at least one value corresponding to each of at least one parameter associated with a radio access network (RAN), and information associated with an operation performed by the RAN. A value corresponding to at least some parameters among the at least one parameter may be used when at least one operation determination model executed by the electronic device determines at least a part of the information associated with the operation. The method of the electronic device may further include: identifying a request for experience information for learning a first operation determination model from a first learning learner for learning the first operation determination model among the at least one operation determination model, identifying, from the at least one value, a value corresponding to at least one first parameter corresponding to the first operation determination model and information associated with an operation corresponding to the at least one first parameter, in response to the request, and providing at least some among the value corresponding to the at least one first parameter, the information associated with the operation corresponding to the at least one first parameter, and a reward value identified based on at least a part of the value corresponding to the at least one first parameter, to the first learning learner as the experience information.



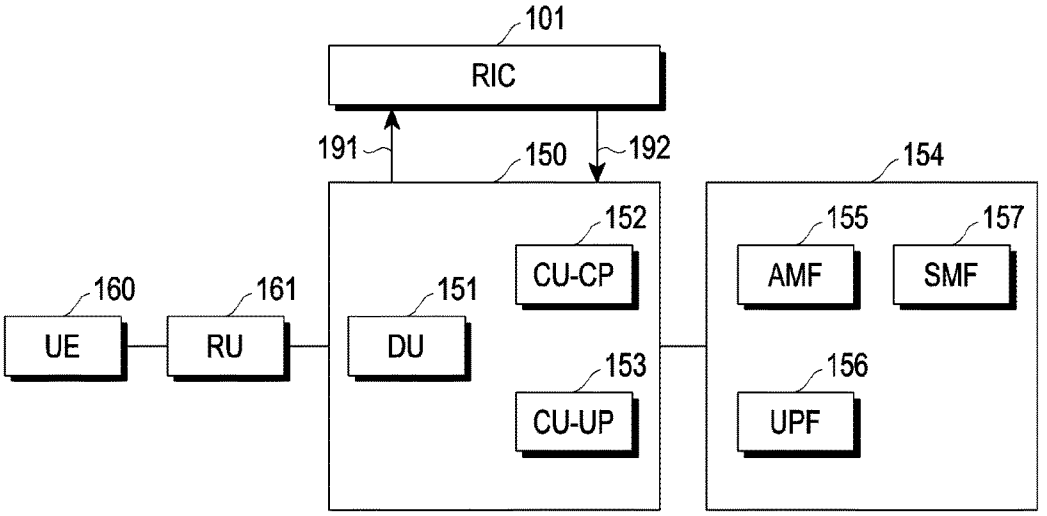

101
RIC
191
150
192
154
152
155
157
CU-CP
AMF
SMF
160
161
151
UE
RU
DU
153
156
CU-UP
UPF

FIG. 1A

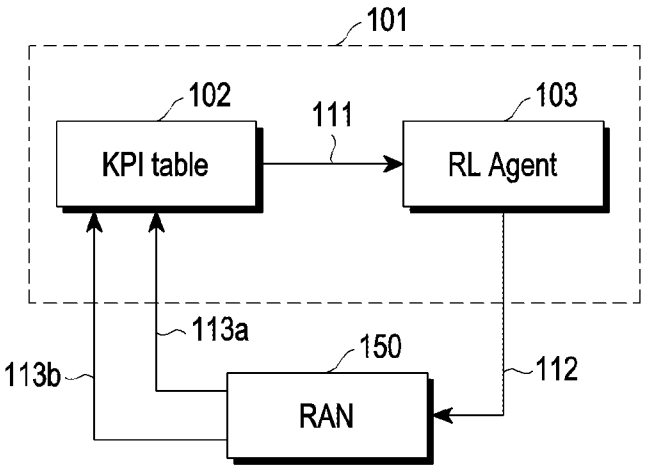

101
102
KPI table
111
103
RL Agent
113a
150
113b
112
RAN

FIG. 1B

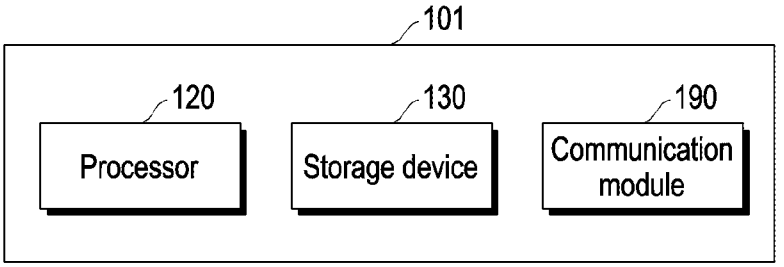

101
120
Processor
130
Storage device
190
Communication module

FIG. 1C

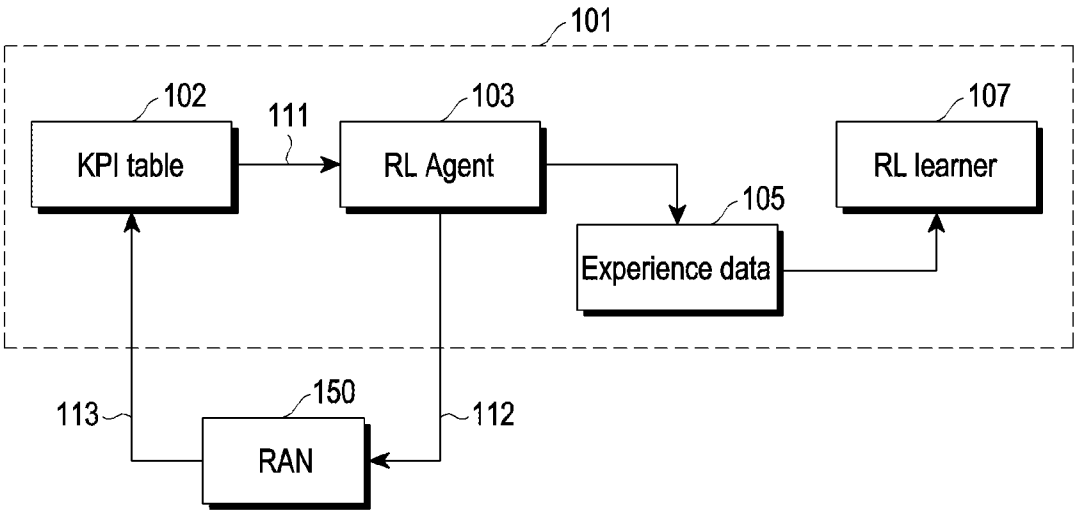

101
102
KPI table
111
103
RL Agent
107
RL learner
105
Experience data
113
150
RAN
112

FIG. 2A

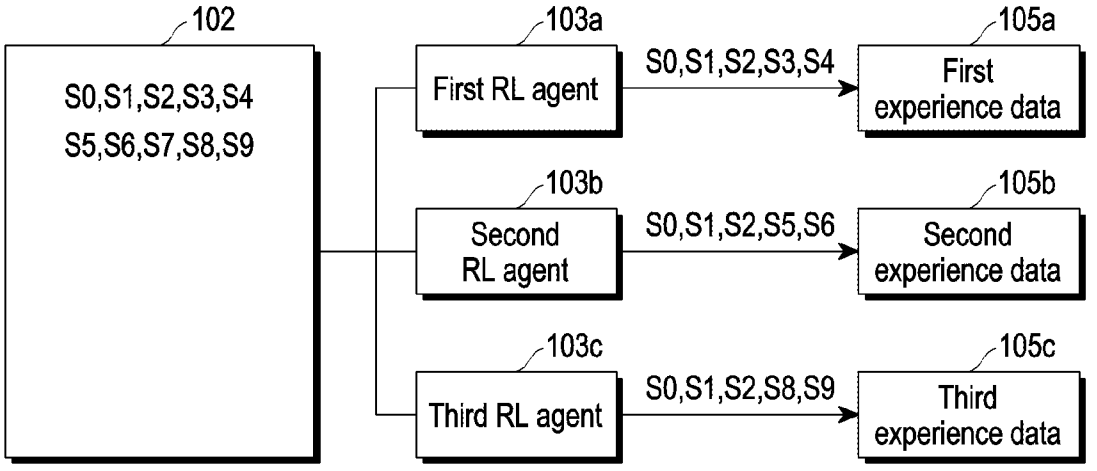

102
S0,S1,S2,S3,S4
S5,S6,S7,S8,S9
103a
First RL agent
S0,S1,S2,S3,S4
105a
First experience data
103b
Second RL agent
S0,S1,S2,S5,S6
105b
Second experience data
103c
Third RL agent
S0,S1,S2,S8,S9
105c
Third experience data

FIG. 2B

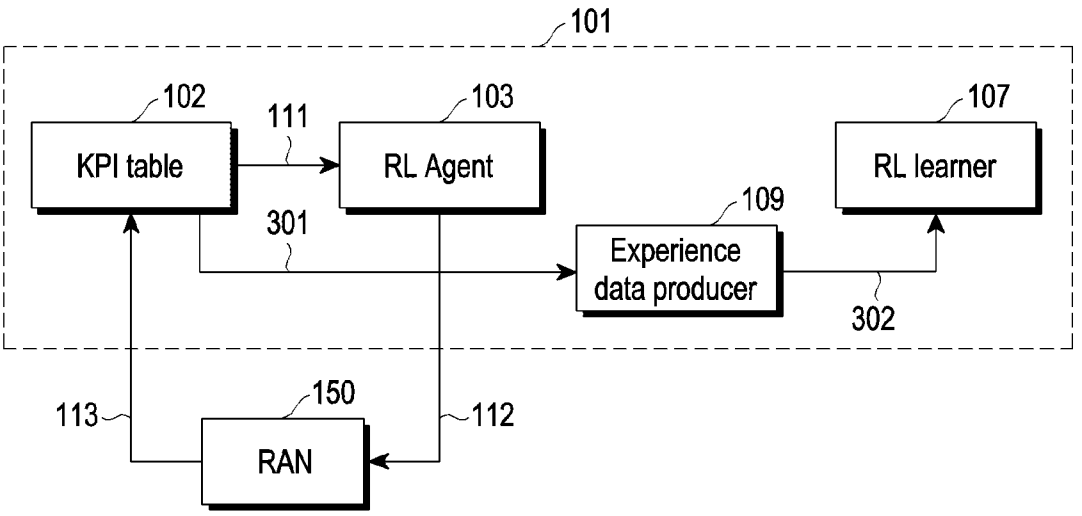

101
102
KPI table
111
103
RL Agent
107
RL learner
109
Experience data producer
301
302
113
150
RAN
112

FIG. 3

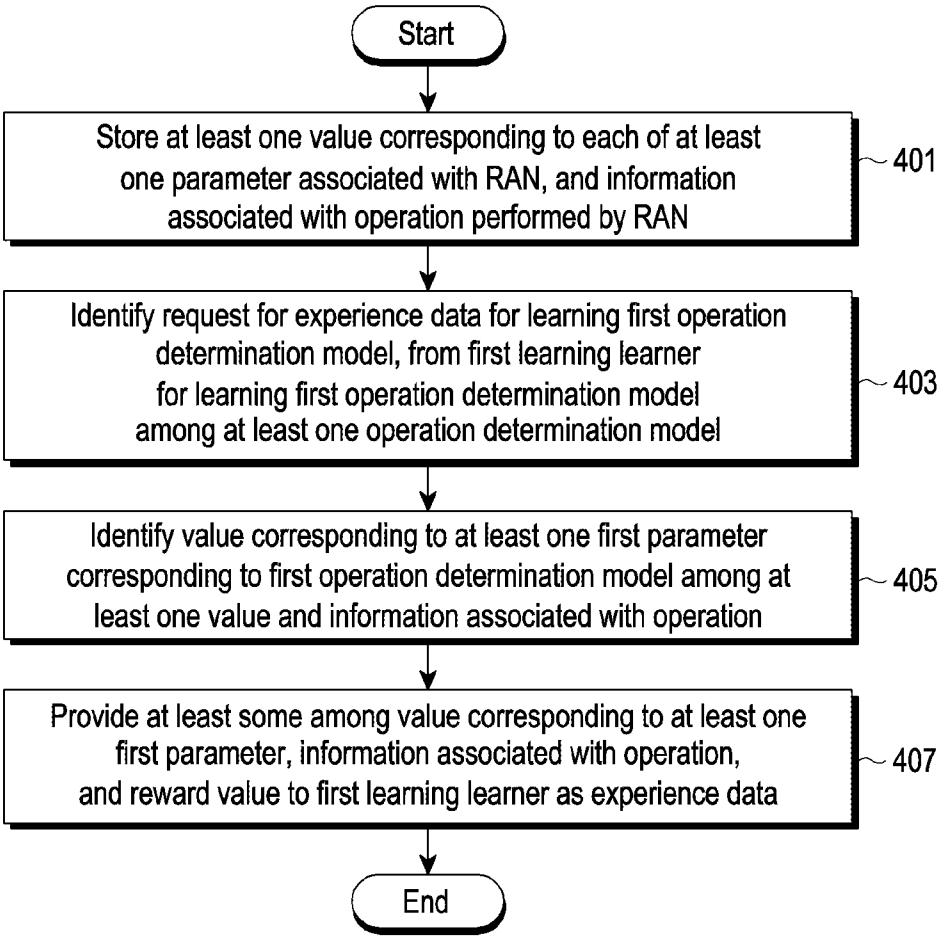

Start
Store at least one value corresponding to each of at least one parameter associated with RAN, and information associated with operation performed by RAN
401
Identify request for experience data for learning first operation determination model, from first learning learner for learning first operation determination model among at least one operation determination model
403
Identify value corresponding to at least one first parameter corresponding to first operation determination model among at least one value and information associated with operation
405
Provide at least some among value corresponding to at least one first parameter, information associated with operation, and reward value to first learning learner as experience data
407
End

FIG. 4

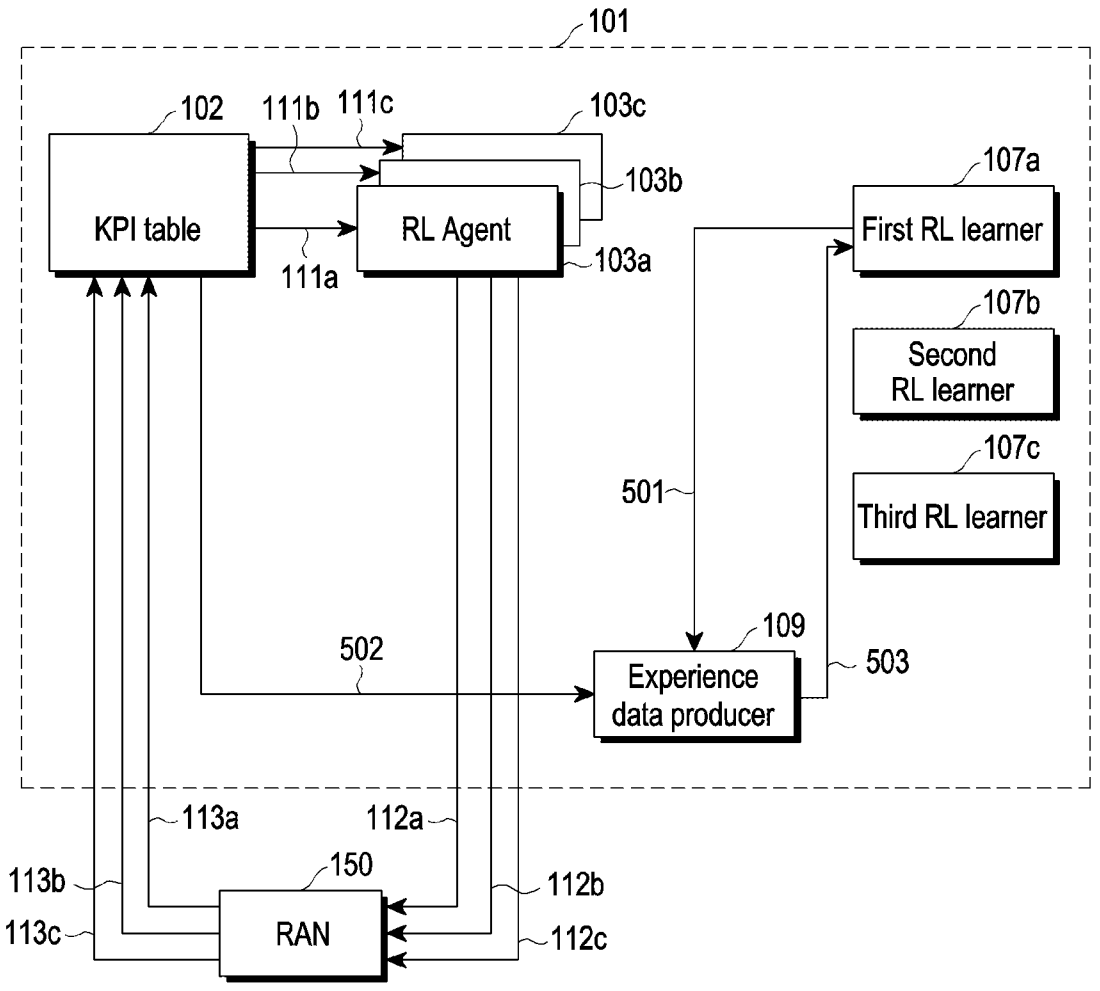

101
102
111b
111c
103c
103b
103a
111a
KPI table
RL Agent
107a
First RL learner
107b
Second RL learner
107c
Third RL learner
501
109
502
503
Experience data producer
113a
112a
150
113b
113c
RAN
112b
112c

FIG. 5

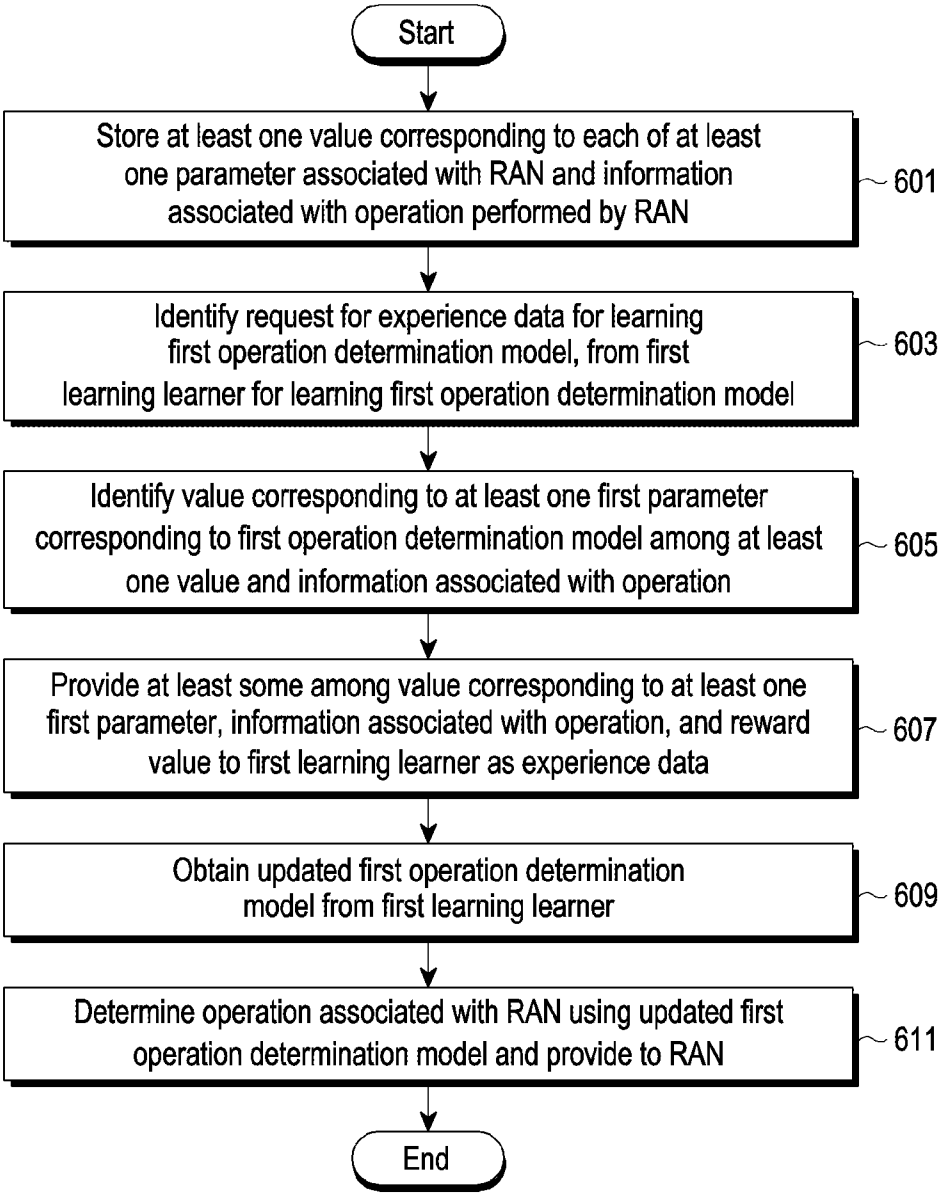

Start
Store at least one value corresponding to each of at least one parameter associated with RAN and information associated with operation performed by RAN
601
Identify request for experience data for learning first operation determination model, from first learning learner for learning first operation determination model
603
Identify value corresponding to at least one first parameter corresponding to first operation determination model among at least one value and information associated with operation
605
Provide at least some among value corresponding to at least one first parameter, information associated with operation, and reward value to first learning learner as experience data
607
Obtain updated first operation determination model from first learning learner
609
Determine operation associated with RAN using updated first operation determination model and provide to RAN
611
End

FIG. 6

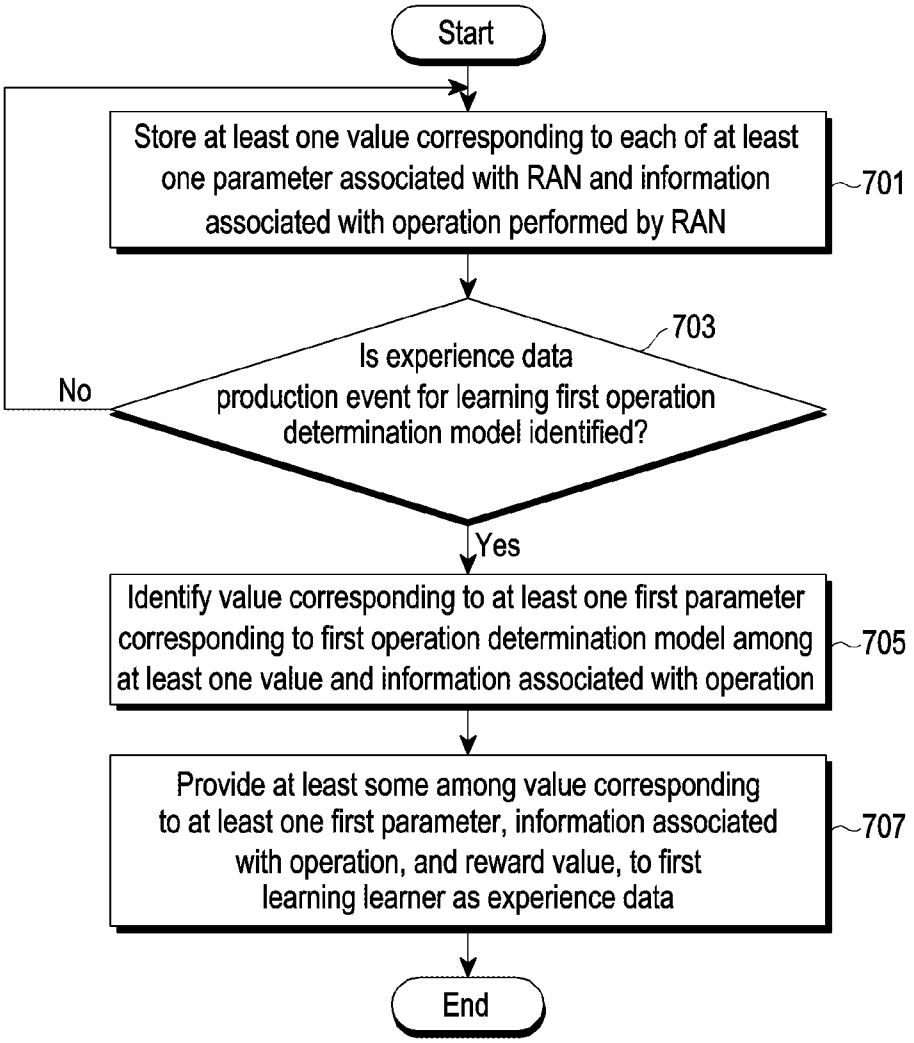

Start
Store at least one value corresponding to each of at least one parameter associated with RAN and information associated with operation performed by RAN
701
703
Is experience data production event for learning first operation determination model identified?
No
Yes
Identify value corresponding to at least one first parameter corresponding to first operation determination model among at least one value and information associated with operation
705
Provide at least some among value corresponding to at least one first parameter, information associated with operation, and reward value, to first learning learner as experience data
707
End

FIG. 7

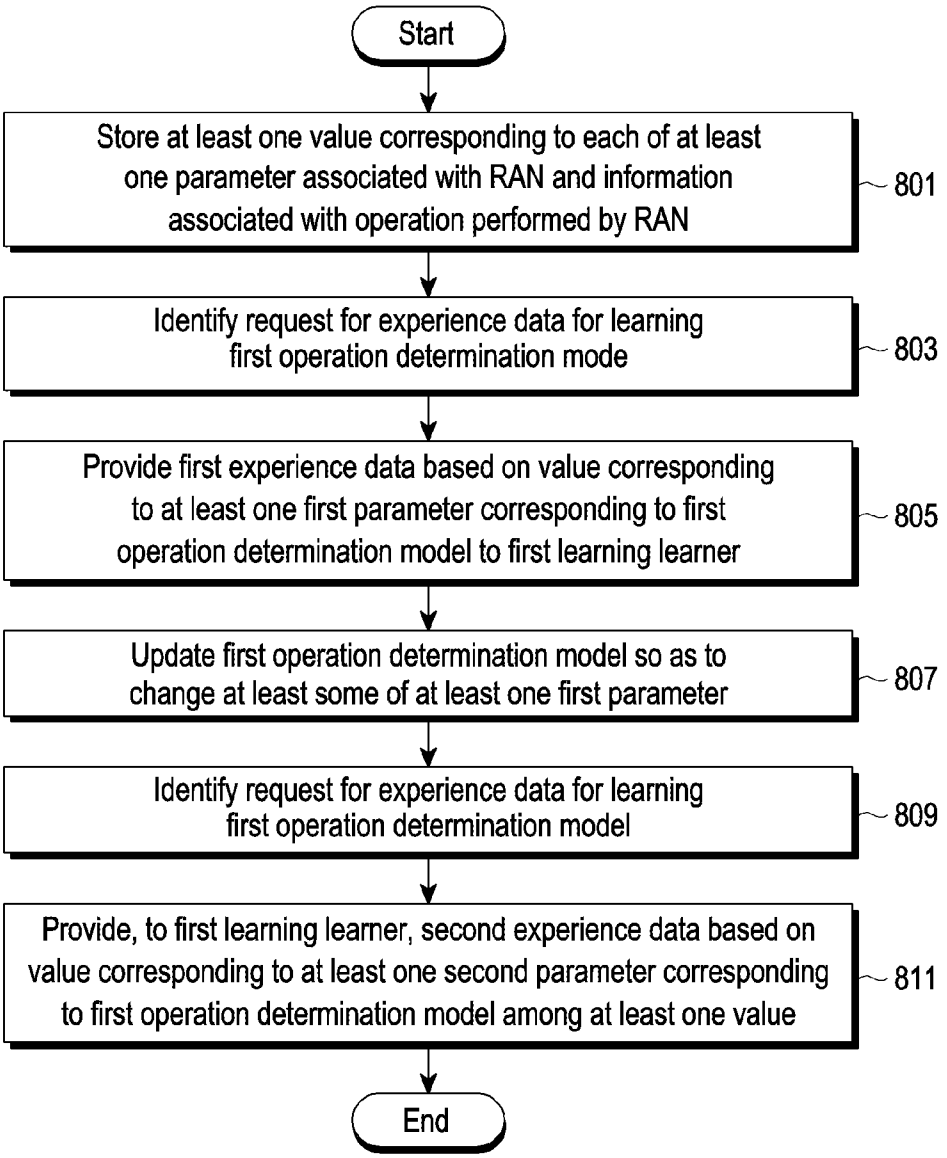

Start
Store at least one value corresponding to each of at least one parameter associated with RAN and information associated with operation performed by RAN
801
Identify request for experience data for learning first operation determination mode
803
Provide first experience data based on value corresponding to at least one first parameter corresponding to first operation determination model to first learning learner
805
Update first operation determination model so as to change at least some of at least one first parameter
807
Identify request for experience data for learning first operation determination model
809
Provide, to first learning learner, second experience data based on value corresponding to at least one second parameter corresponding to first operation determination model among at least one value
811
End

FIG. 8

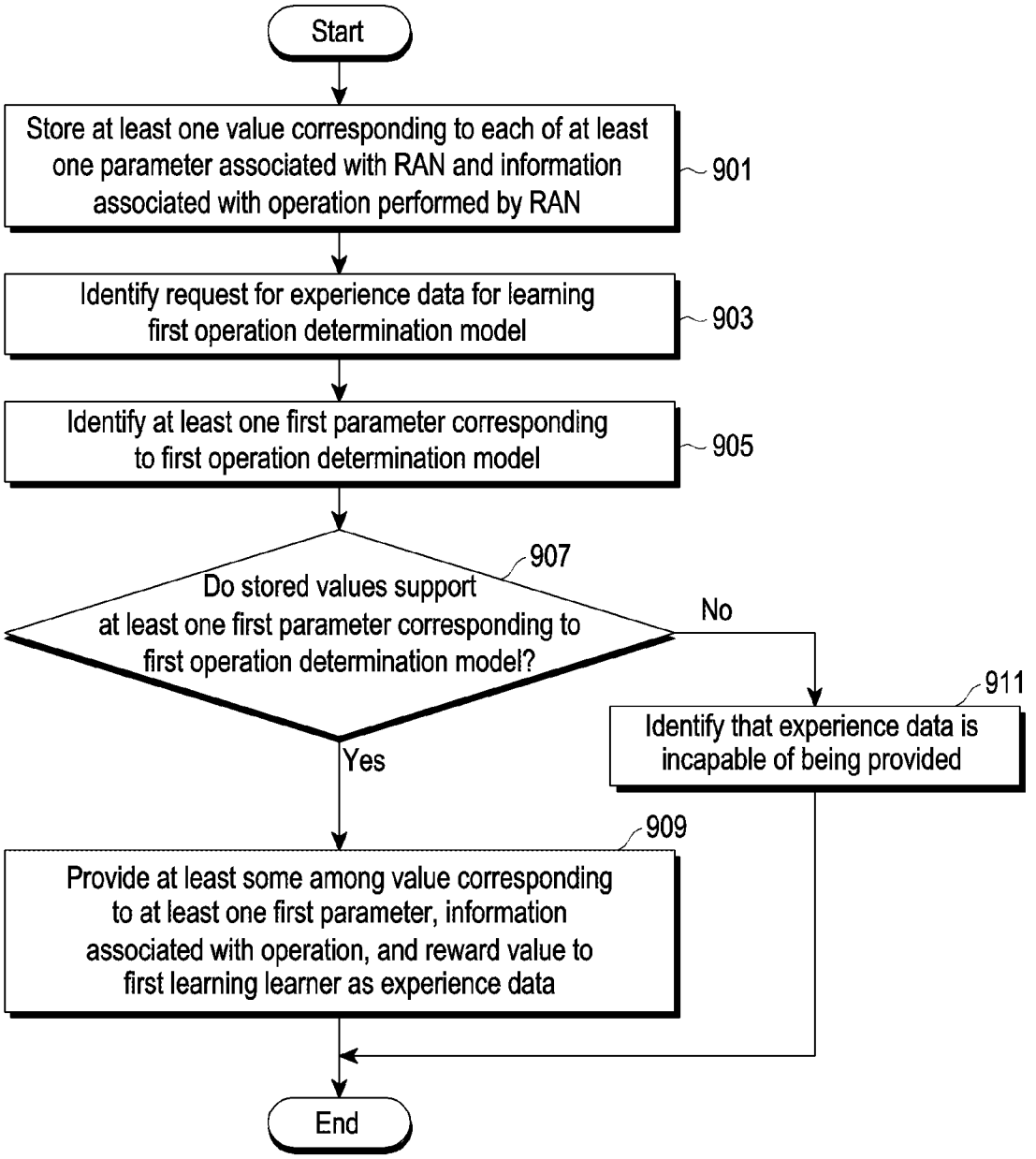

Start
Store at least one value corresponding to each of at least one parameter associated with RAN and information associated with operation performed by RAN
901
Identify request for experience data for learning first operation determination model
903
Identify at least one first parameter corresponding to first operation determination model
905
907
Do stored values support at least one first parameter corresponding to first operation determination model?
No
Yes
911
Identify that experience data is incapable of being provided
909
Provide at least some among value corresponding to at least one first parameter, information associated with operation, and reward value to first learning learner as experience data
End

FIG. 9

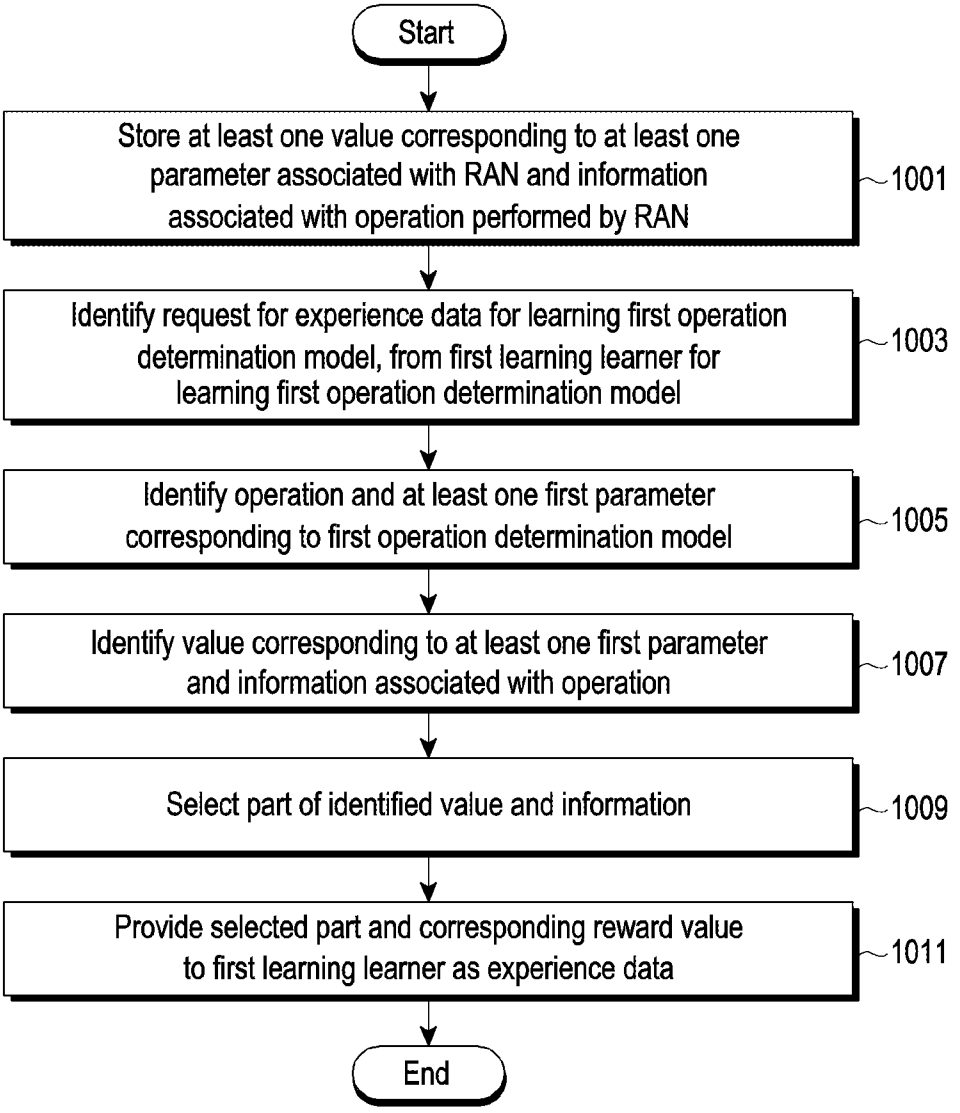

Start
Store at least one value corresponding to at least one parameter associated with RAN and information associated with operation performed by RAN
1001
Identify request for experience data for learning first operation determination model, from first learning learner for learning first operation determination model
1003
Identify operation and at least one first parameter corresponding to first operation determination model
1005
Identify value corresponding to at least one first parameter and information associated with operation
1007
Select part of identified value and information
1009
Provide selected part and corresponding reward value to first learning learner as experience data
1011
End

FIG. 10

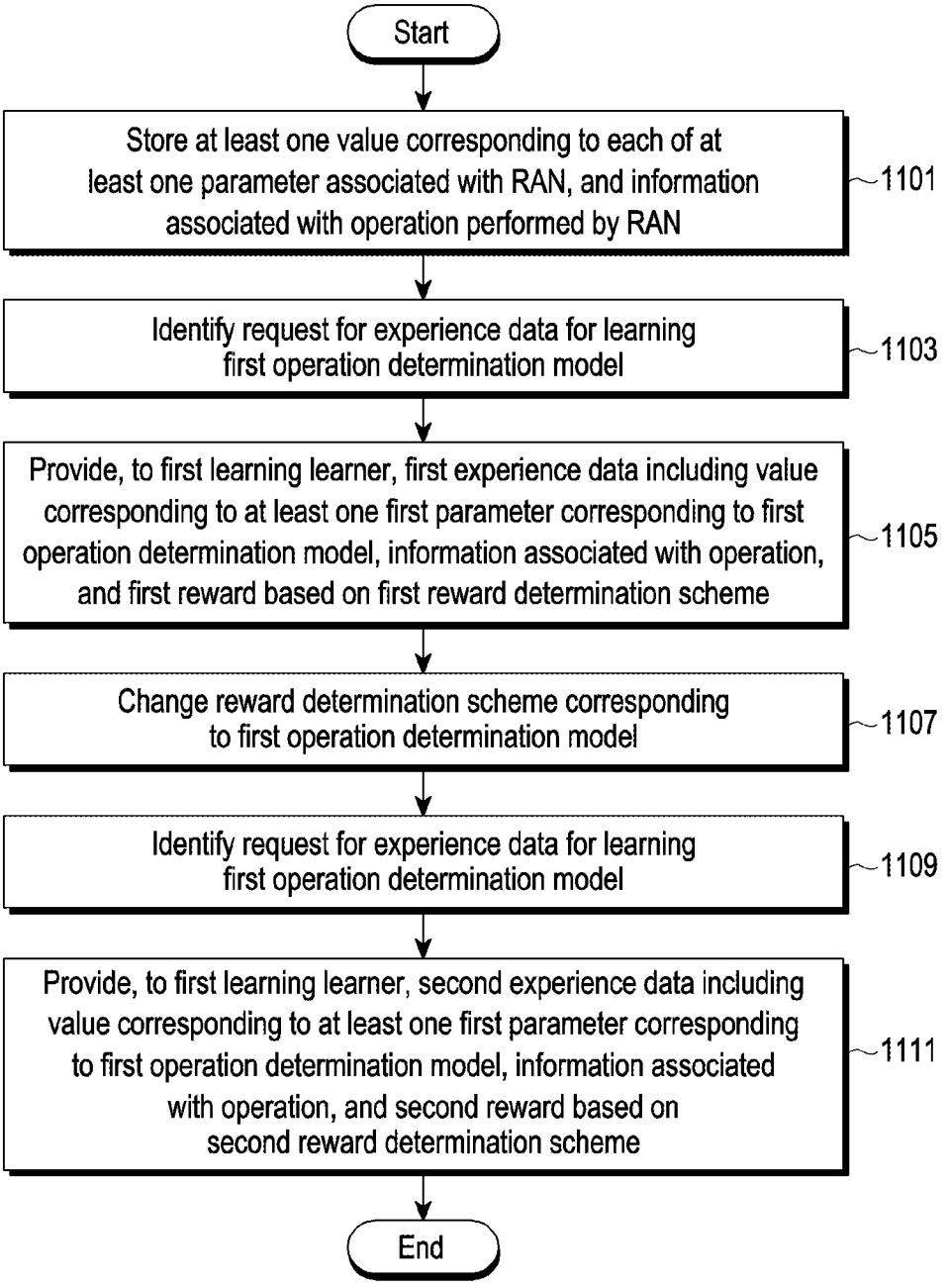

Start
Store at least one value corresponding to each of at least one parameter associated with RAN, and information associated with operation performed by RAN
1101
Identify request for experience data for learning first operation determination model
1103
Provide, to first learning learner, first experience data including value corresponding to at least one first parameter corresponding to first operation determination model, information associated with operation, and first reward based on first reward determination scheme
1105
Change reward determination scheme corresponding to first operation determination model
1107
Identify request for experience data for learning first operation determination model
1109
Provide, to first learning learner, second experience data including value corresponding to at least one first parameter corresponding to first operation determination model, information associated with operation, and second reward based on second reward determination scheme
1111
End

FIG. 11

ELECTRONIC DEVICE FOR PROVIDING INFORMATION FOR REINFORCEMENT LEARNING AND METHOD FOR OPERATING THEREOF

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation of International Application No. PCT/KR2022/011474 designating the United States, filed on Aug. 3, 2022, in the Korean Intellectual Property Receiving Office and claiming priority to Korean Patent Application No. 10-2021-0109360, filed on Aug. 19, 2021, the disclosures of which are incorporated by reference herein in their entireties.

BACKGROUND

Field

[0002] The disclosure relates to an electronic device for providing information for reinforcement learning and an operation method therefor, for example, the disclosure relates to an electronic device for providing experience data for reinforcement learning by an agent that controls a radio access network (RAN) and an operation method therefor.

Description of Related Art

[0003] An existing base station is embodied in the form in which a data processor (distributed unit (DU)) of the base station and a wireless transceiver (radio unit or remote unit (RU)) are installed together in a cell site. However, such integrated embodied form may have a physical limitation. For example, as the number of service subscribers or traffic increases, a business operator needs to establish a new base station in a cell site. To overcome the above-described drawback, a centralized radio access network (RAN) or cloud RAN (C-RAN) structure has been embodied. The C-RAN may have a structure in which a DU is disposed in a single physical place, and an RU is disposed in a cell site where transmission or reception of a radio signal is actually performed with a user equipment (UE). The DU and the RU may be connected via an optical cable or coaxial cable. Since the RU and the DU are separated, an interface standard for communication therebetween is needed, and the standard such as a common public radio interface (CPRI) or the like may be used between the RU and the DU. In 3^{rd} generation partnership project (3GPP), a base station structure has been standardized, and an open radio access network (O-RAN) which is an open network standard applicable to a 5G system has been discussed.

[0004] In the O-RAN, an RU, DU, central unit-control plane (CU-CP), and a central unit-user plane (CU-UP) which are existing 3GPP NEs are newly defined as an O-RU, O-DU, O-CU-CP, and O-CU-UP, respectively (they are commonly called an O-RAN base station). In addition, an RAN intelligent controller (RIC) and a non-real-time RAN intelligent controller (NRT-RIC) are additionally proposed. An RIC may include a reinforcement learning (RL) agent (RL agent). An RL agent may receive data input from an RAN via an E2 interface, and may output an operation associated with the RAN. An RAN may operate based on an output from an RL agent. The RL agent may be based on an reinforcement learning model, and the reinforcement learning model may be updated via reinforcement learning. The RL agent may produce a parameter associated with an RAN (e.g., key performance indicators (KPI)), a performed operation, and a reward value, as experience information for reinforcement learning.

[0005] When experience information is produced by an RL agent, experience information may be subordinate to the RL agent. For example, experience information associated with a KPI, excluding an KPI that the RL agent uses, is incapable of being produced. Accordingly, there may be the constraint on generation of experience information. In addition, if a plurality of RL agents exist, each of the plurality of RL agents may produce experience information. At least some of the KPIs used by the plurality of RL agents may be used in common. Accordingly, experience information produced by the plurality of RL agents may include duplicate data, which may constrain on resource operation.

SUMMARY

[0006] Embodiments of the disclosure provide an electronic device and an operation method therefor which may produce experience information with reference to a KPI table in response to a request from an RL learner.

[0007] According to various example embodiments, a method of operating an electronic device may include: storing at least one value corresponding to each of at least one parameter associated with a radio access network (RAN), and information associated with an operation performed by the RAN. A value corresponding to at least some parameters among the at least one parameter may be used when at least one operation determination model executed by the electronic device determines at least a part of the information associated with the operation. The method of operating the electronic device may include: identifying a request for experience information for learning a first operation determination model, from a first learning learner for learning the first operation determination model among the at least one operation determination model, identifying, from the at least one value, a value corresponding to at least one first parameter corresponding to the first operation determination model and information associated with an operation corresponding to the at least one first parameter, in response to the request, and providing at least some among the value corresponding to the at least one first parameter, the information associated with the operation corresponding to the at least one first parameter, and a reward value identified based on at least a part of the value corresponding to the at least one first parameter, to the first learning learner as the experience information.

[0008] According to various example embodiments, an electronic device may include: a storage device, at least one processor operatively connected to the storage device, wherein the at least one processor is configured to: store, in the storage device, at least one value corresponding to each of at least one parameter associated with a radio access network (RAN), and information associated with an operation performed by the RAN. A value corresponding to at least some parameters among the at least one parameter may be used when at least one operation determination model executed by the electronic device determines at least a part of the information associated with the operation. The at least one processor may be further configured to: identify a request for experience information for learning a first operation determination model from a first learning leaner for learning the first operation determination model among the

at least one operation determination model, identify a value corresponding to at least one first parameter corresponding to the first operation determination model among the at least one value and information associated with an operation corresponding to the at least one first parameter, in response to the request, and provide at least some among the value corresponding to the at least one first parameter, the information associated with the operation corresponding to the at least one first parameter, and a reward value identified based on at least a part of the value corresponding to the at least one first parameter, to the first learning learner as the experience information.

[0009] According to various example embodiments, a method of operating an electronic device may include: storing a key performance indicator (KPI) table in which at least one value corresponding to each of at least one parameter associated with a radio access network (RAN), and information associated with an operation performed by the RAN are classified for each of a plurality of points of time. A value corresponding to at least some parameters among the at least one parameter may be used when at least one operation determination model executed by the electronic device determines at least a part of the information associated with the operation. The method of operating the electronic device may further include: detecting an event for updating a first operation determination model among the at least one operation determination model, identifying a value corresponding to at least one first parameter corresponding to the first operation determination model and information associated with an operation corresponding to the at least one first parameter, by referring to the KPI, in response to the event detection, and providing at least some among the value corresponding to the at least one first parameter, the information associated with the operation corresponding to the at least one first parameter, and a reward value identified based on at least a part of the value corresponding to the at least one first parameter, to a first learning leaner for learning the first operation determination model as the experience information.

[0010] According to various example embodiments, an electronic device may include: a storage device, and at least one processor operatively connected to the storage device, wherein the at least one processor is configured to: store, in the storage device, a key performance indicator (KPI) table in which at least one value corresponding to each of at least one parameter associated with a radio access network (RAN), and information associated with an operation performed by the RAN are classified for each of a plurality of points in time. A value corresponding to at least some parameters among the at least one parameter may be used when at least one operation determination model executed by the electronic device determines at least a part of the information associated with the operation. The at least one processor may be configured to: detect an event for updating a first operation determination model among the at least one operation determination model, identify a value corresponding to at least one first parameter corresponding to the first operation determination model and information associated with an operation corresponding to the at least one first parameter by referring to the KPI in response to the event detection, and provide at least some among the value corresponding to the at least one first parameter, the information associated with the operation corresponding to the at least one first parameter, and a reward value identified based on at least a part of the value corresponding to the at least one first parameter, to a first learning leaner for learning the first operation determination model as the experience information.

[0011] According to various example embodiments, there may be provided an electronic device for producing experience information with reference to a KPI table in response to a request from a reinforcement learning (RL) learner, and an operation method therefor. Accordingly, experience information may be freely configured. In addition, the possibility of occurrence of duplicate data in experience information may be low.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] The above and other aspects, features and advantages of certain embodiments of the present disclosure will be more apparent from the following detailed description, taken in conjunction with the accompanying drawings, in which:

[0013] FIG. **1**A is a block diagram illustrating an example configuration of a radio access network intelligent controller (RIC), a radio access network (RAN), and a core network (CN) according to various embodiments;

[0014] FIG. **1**B is a block diagram illustrating an example configuration of an RIC according to various embodiments;

[0015] FIG. **1**C is a block diagram illustrating an example hardware configuration of an RIC according to various embodiments;

[0016] FIG. **2**A is a block diagram illustrating an example configuration of an RIC according to a comparative example for comparison with various embodiments;

[0017] FIG. **2**B is a block diagram illustrating an example production of experience data by a plurality of RL agents according to a comparative example for comparison with various embodiments;

[0018] FIG. **3** is a block diagram illustrating an example configuration of an RIC according to various embodiments;

[0019] FIG. **4** is a flowchart illustrating an example method of operating an electronic device according to various embodiments;

[0020] FIG. **5** is a block diagram illustrating an example configuration of an RIC according to various embodiments;

[0021] FIG. **6** is a flowchart illustrating an example method of operating an electronic device according to various embodiments;

[0022] FIG. **7** is a flowchart illustrating an example method of operating an electronic device according to various embodiments;

[0023] FIG. **8** is a flowchart illustrating an example method of operating an electronic device according to various embodiments;

[0024] FIG. **9** is a flowchart illustrating an example method of operating an electronic device according to various embodiments;

[0025] FIG. **10** is a flowchart illustrating an example method of operating an electronic device according to various embodiments; and

[0026] FIG. **11** is a flowchart illustrating an example method of operating an electronic device according to various embodiments.

DETAILED DESCRIPTION

[0027] FIG. **1**A is a block diagram illustrating a radio access network intelligent controller (RIC), an RAN, and a core network (CN) according to various embodiments.

[0028] According to various embodiments, an RAN **150** may include at least one among at least one distributed unit (DU) **151**, at least one central unit-control plane (CU-CP) **152**, or at least one central unit-user plane (CU-UP) **153**. Although it is illustrated that the RAN **150** is connected to at least one remote unit (RU) (or radio unit) **161**, this is merely an example. At least one RU **161** may be connected to the RAN **150** or may be included in the RAN **150**. The RAN **150** may be an O-RAN. In this instance, the DU **151** may be an O-DU, the CU-CP **152** may be an O-CU-CP, the CU-UP **153** may be an O-CU-UP, and the RU **161** may be an O-RU.

[0029] According to various embodiments, the RU **161** may perform communication with a user equipment (UE) **160**. The RU **161** may be a logical node that provides a low physical layer (low-PHY) function and RF processing. The DU **151** may be a logical node that provides functions of an RLC, an MAC, and a high-physical layer (high-PHY), and may be connected to, for example, the RU **161**. The CU **152** and **153** may be logical nodes that provides functions of a radio resource control (RRC), a service data adaptation protocol (SDAP), and a packet data convergence protocol (PDCP). The CU-CP **152** may be a logical node that provides a function of a control plane part of an RRC and a PDCP. The CU-UP **153** may be a logical node that provides a function of a user plane part of an SDAP and a PDCP.

[0030] According to various embodiments, a core network (e.g., 5GC 5^{th} generation core) **154** may include at least one of an access and mobility management function (AMF) **155**, a user plane function (UPF) **156**, or a session management function (SMF) **157**. The AMF **155** may provide a function for accessing in a unit of the UE **160**, and mobility management. The SMF **156** may provide a session management function. The UPF **156** may transfer downlink data received from a data network to the UE **160**, or may transfer uplink data received from the UE **160** to a data network. For example, the CU-CP **152** may be connected to the AMF **155** and an N2 interface (or NGAP interface). The AMF **155** may be connected to the SMF **157** via an N11 interface. The CU-UP **153** may be connected to the UPF **153** via an N3 interface.

[0031] According to various embodiments, an RAN intelligent controller (RIC) **101** may customize RAN functionality for service or regional resource optimization. The RIC **101** may provide at least one function among network intelligence (e.g., policy enforcement, handover optimization), resource assurance (e.g., radio-link management, advanced self-organized-network (advanced SON)), resource control (e.g., load balancing or slicing policy), and a function (or a performed operation) associated with the RAN **150** that the RIC **101** is capable of providing is not limited.

[0032] According to various embodiments, the RIC **101** may perform transmission and/or reception of E2 message **191** and **192** with RAN **150**. For example, the RIC **101** may be connected to the DU **151** via an E2-DU interface. For example, the RIC **101** may be connected to the CU-CP **152** via an E2-CP interface. For example, the RIC **101** may be connected to the CU-UP **153** via an E2-UP interface. At least one interface between the RIC **101** and the RAN **150** may be referred to as an E2 interface. Although the RIC **101** is illustrated as a device separate from the RAN **150**, this is merely an example, and the RIC **101** may be embodied as a device separate from the RAN **150** or may be embodied as a single device.

[0033] According to various embodiments, the RIC **101** may perform transmission and/or reception of the E2 message **191** and **192** with an E2 node (e.g., at least one of the DU **151**, the CU-CP **152**, or the CU-UP **153**). The E2 node may include (or provide) an E2 node function. The E2 node function may be configured based on predetermined xApp (application S/W) installed in the RIC **101**. If a KPI monitor function is provided, KPI monitor collecting S/W may be installed in the RIC **101**. The E2 node may produce KPI parameters, and may include an E2 node function that transfers the E2 message **191** including a KPI parameter to an E2 termination function located in the RIC **101**. As the termination of the RIC **101** for an E2 message, the E2 termination function located in the RIC **101** may interpret the E2 message transferred from the E2 node, and may transfer the same to xApp. The RIC **101** may provide the information associated with an operation of the RAN **150** to the RAN **150** as the E2 message **192**. The RL agent of the RIC **101** may obtain at least some of the KPI parameters as an input, and may provide an output value corresponding thereto, which will be described later. An output from the RL agent may be an operation (or an action or an RAN policy) of at least one entity of the RAN **150**, and the at least one entity of the RAN **150** may operate based on received information.

[0034] FIG. **1**B is a block diagram illustrating an example configuration of an RIC according to various embodiments.

[0035] According to various embodiments, at least one of a KPI table **102** or an RL agent **103** may be defined (or stored) in the RIC **101**. The RIC **101** may refer to the KPI table **102** and/or may execute the RL agent **103**, and the KPI table **102** and/or RL agent **103** may not be necessarily stored in the RIC **101**.

[0036] According to various embodiments, the KPI table may include information associated with an operation (or action) and a parameter associated with an RAN for each of a plurality of points in time. A parameter may be referred to as, for example, performance information. For example, an action may be referred to as configuration information. Table 1 is an example of a KPI table.

TABLE 1

Point in time	First parameter	Second parameter	Third parameter	Action
First point in time	1.2	230	0.2	Config#1
Second point in time	1.3	242	0.19	Config#1
Third point in time	1.4	236	0.18	Config#2
Fourth point in time	1.5	209	0.17	Config#2
Fifth point in time	1.6	220	0.16	Config#1

[0037] In Table 1, parameters (a first parameter, a second parameter, a third parameter) may be, for example, parameters for indicating the state (or environment) of an RAN. For example, the parameters included in the KPI table may include at least one among a packet data rate, cell traffic, information associated with a UL signal reception strength (at least one of a reference signals received power (RSRP), a reference signal received quality (RSRQ), or a reference signal strength indicator (RSSI)), a channel quality indicator

(CQI), channel state information (CSI), the number of connected UEs, a PDCP throughput, PRB usage, UE mobility statics, physical resource block (PRB) utilization, control channel elements (CCE) utilization, or a PDCP buffer state, a downlink latency, or the number of PDU sessions, and if it is information indicating the state (or environment) of an RAN, there is no limitation. Action may be an operation that at least one entity included in an RAN needs to perform. For example, the action may include at least one piece of information among information associated with UE scheduling (e.g., UE scheduling priority), bearer reselection decision, UE mobility (e.g., a handover), a carrier aggregation (CA) associated information, or dual connectivity (DC) related information, and if it is an operation that an entity included in an RAN is capable of performing, there is no limitation. Table 1 shows an example in which a parameter and an action are separately managed. However, this is merely an example, a KPI table may manage a parameter and an action without distinguishing from each other, but may manage both as state factors. The form of the KPI table is not limited. In addition, the number of parameters (3 parameters) and the number of actions (one action) in Table 1 are merely an example, and the number of parameters is not limited.

[0038] According to various embodiments, the RL agent **103** may obtain, as an input value, a parameter **111** (e.g., at least some of the first, second, third parameters of Table 1) indicating the state (or environment) of an RAN at a predetermined (e.g., specified) point in time, by referring to the KPI table **102**. At least a part of the KPI table **102** may be updated based on, for example, existing information **113***a* associated with the state of an RAN obtained from the RIC **101**. For example, referring to the example of Table 1, the electronic device **101** may obtain a first parameter of "1.2", a second parameter of "230", and a third parameter of "0.2", as the information **113***a* associated with the state of the RAN at a first point in time. Accordingly, the RIC **101** may update the first parameter, the second parameter, and the third parameter at the first point in time in the KPI table **102**, respectively with "1.2", "230", and "0.2".

[0039] For example, the RL agent **103** may be for the assurance of service level agreements, and may output a UE scheduling priority as an action. The RL agent **103** may be for an SLS DU actor action, and may output a UE scheduling priority as an action. The RL agent **103** may be for a traffic steering DU actor action, and may output bearer reselection determination (or a division ratio for each RAT (e.g., E-UTRA:NR is 0.6:0.4) as an action. The RL agent **103** may be applied to only a single cell, or may be applied to a plurality of cells.

[0040] According to various embodiments, the RL agent **103** may include (or execute) at least one model produced via reinforcement learning. The RL agent **103** may process the parameter **111** indicating the state of an RAN at a predetermined point in time at which it is obtained as an input value, and may output an action **112**. For example, the RL agent **103** may obtain, as an input value, "1.2", "230", and "0.2" which are the respective values of the first parameter, the second parameter, and the third parameter that are predetermined parameters corresponding to the RL agent **103** at a first point in time. A model included in (or executed in) the RL agent **103** may process an input value, and may provide the action **112** which is an output value. For example, the action **112** may be "Config#1", and may be updated at a second point in time in the KPI table **102**. The action **112** may be transferred to the RAN **150**, and at least one entity included in the RAN **150** may operate according to the action **112** received at the second point in time. After an operation is performed according to the action **112**, the state of the RAN **150** may be changed. The RIC **101** may obtain information **113***b* associated with the changed state of the RAN **150**, and may update the KPI table for a next point in time. For example, referring to the example of Table 1, the electronic device **101** may obtain a first parameter of "1.3", a second parameter of "242", and a third parameter of "0.19", as the information **113***b* associated with the state of the RAN at the second point in time. Accordingly, the RIC **101** may update the first parameter, the second parameter, and the third parameter at the second point in time in the KPI table **102**, respectively with "1.3", "242", and "0.19". At least some of the parameter values at the second point in time may be used by the RL agent **103**, an action (e.g., Config #1) may be provided to the RAN **150**, and the entity of the RAN **150** may operate according to the corresponding action. Alternatively, the RIC **101** may be configured to receive values of "1.3", "242", and "0.19" respectively corresponding to the first parameter, the second parameter, and the third parameter at the second point in time from the RAN **150**, and may receive an action of "Config#1" from the RAN **150**. By repeating the above-described processes, the KPI table **102** may be updated in a time series manner (e.g., the order of a first point in time, a second point in time, a third point in time, a fourth point in time, and a fifth point in time). The RL agent **103** (or a model included in or executed in the RL agent **103**) may be updated, which will be described later.

[0041] FIG. **1**C is a block diagram illustrating an example hardware configuration of an RIC according to various embodiments.

[0042] According to various embodiments, the RIC **101** (or an electronic device configured to perform the function of the RIC **101**) may include at least one among the processor (e.g., including processing circuitry) **120**, the storage device **130**, and/or the communication module (e.g., including communication circuitry) **190**.

[0043] According to various embodiments, the processor **120** may include various processing circuitry and control at least one other element (e.g., hardware or software element) of the RIC **101** (or an electronic device configured to perform the function of the RIC **101**) connected to the processor **120** by operating, for example, software (e.g., a program), and may perform various data processing and operations. Software may include at least some among, for example, the RL agent **103** (or a program of executing or accessing the RL agent **103**) and the experience data producer **109** (or a program of executing or accessing the experience data producer **109**), (or if an RL learner **107** is included in the RIC **101**), the RL learner **107** (or a program of executing or accessing the RL learner **107**), but it is not limited thereto. According to an embodiment, as at least a part of data processing or operation performing, the processor **120** may store a command or data received from another element in the storage device **130**, may process the command or data stored in the storage device **130**, and may store resultant data in the storage device **130**. According to an embodiment, the processor **120** may include at least some among a central processing unit, an application processor, a neural processing unit (NPU), or a communication proces-

sor, but the type of processor **120** is not limited. A neural network processing device may include a hardware structure specialized for processing an artificial intelligence model. An artificial intelligence model (e.g., the RL agent **103**) (or a model included in or executed in the RL agent **103**) may include machine learning (e.g., reinforcement learning, supervised learning, unsupervised learning, or semi-supervised learning), but it is not limited thereto. The artificial intelligence model may include a plurality of artificial neural network layers. The artificial neural network may be a deep neural network (DNN), a convolutional neural network (CNN), a recurrent neural network (RNN), a restricted Boltzmann machine (RBM), a deep belief network (DBN), a bidirectional recurrent deep neural network (BRDNN), deep Q-networks, or a combination of at least two of them, but may not be limited thereto. The artificial intelligence model may additionally or alternatively include a software structure, in addition to a hardware structure. If the storage device **130** is a device for storing data, such as a disc (e.g., HDD), those skilled in the art would understand that there is no limitation. According to various embodiments, the operation of at least one of the RL agent **103**, the RL learner **107**, or the experience data producer **109** may be understood as an operation by the processor **120**, or an operation by another piece of hardware (e.g., at least one of the storage device **130** or the communication module **190**) controlled by the processor **120**. An instruction for operating at least one of the RL agent **103**, the RL learner **107**, or the experience data producer **109** may be stored in the storage device **130**.

[0044] According to various embodiments, the storage device **130** may store various data used by at least one element (e.g., the processor **120** or the communication module **190**) of the RIC **101** (or an electronic device configured to perform a function of the RIC **101**). Data may include, for example, software, and input data or output data associated with a command related to the software. The storage device **130** may store the above-described KPI table **101**.

[0045] According to various embodiments, the communication module **190** may include various communication circuitry and establish a direct (e.g., wired) communication channel or a wireless communication channel between the RIC **101** (or an electronic device configured to perform the function of the RIC **101**) and an external electronic device (e.g., an E2 node), and may support communication via the established communication channel. If the communication module **190** is capable of supporting, for example, an E2 interface, the type of the communication module **190** is not limited. If the RIC **101** and the RAN **150** are embodied as a single device, the communication module **190** may be an interface for both entities. If the RL learner **107** is embodied outside the RIC **101**, the RIC **101** may perform data transmission and/or reception with the RL learner **107** via the communication module **190**, which will be described later.

[0046] FIG. **2**A is a block diagram illustrating an example configuration of an RIC according to a comparative example for comparison with various embodiments. At least some of the operations performed by the RIC **101** according to the comparative example may be performed according to various embodiments.

[0047] The RL agent **103** of the RIC **101** may produce experience data **105**. Table 2 is an example of the experience data **105**.

TABLE 2

Experience data	State before performing action	Action	State after performing action	Reward
1	{1.2, 230, 0.2}	Config#1	{1.3, 242, 0.19}	1.3 * 0.19
2	{1.3, 242, 0.19}	Config#2	{1.4, 236, 0.18}	1.4 * 0.18
3	{1.4, 236, 0.18}	Config#2	{1.5, 209, 0.17}	1.5 * 0.17
4	{1.5, 209, 0.17}	Config#1	{1.6, 220, 0.16}	1.6 * 0.16

[0048] According to the reinforcement learning, obtaining state information, determining a corresponding action, obtaining subsequent state information as a result of performing the action, and obtaining a reward may be repeated, reinforcement learning may be performed to maximize reward. Accordingly, the experience data **105** for reinforcement learning may include information associated with "state before performing action", "action", "state after performing action", and "reward". For example, in Table 2, the state before performing action of {1.2, 230, 0.2} in the experience data of "1" may be the values of a first parameter, a second parameter, and a third parameter, respectively, at a first point in time in Table 1. Based thereon, Config#1 which is an action (e.g., an action in a second point in time in Table 1) determined by the RL agent **103** may be included as an action in the experience data of "1". The state after performing action of {1.3, 242, 0.19} in the experience data of 1" may be the values of the first parameter, the second parameter, and the third parameter, respectively, at the second point in time in Table 1. A reward may be determined by, for example, the product of the value of the first parameter and the value of the third parameter at the second point in time, and a method of determining a reward is not limited and may be changeable. Although not illustrated, reinforcement learning may use a penalty factor as well as a reward, and those skilled in the art will understand that the corresponding factor may be further included in the experience data **105**.

[0049] As described above, the RL agent **103** may update time series data (e.g., "1","2","3", and "4" in Table 2) of the experience data **105** (or experience table) as time series data in the KPI table **102** is updated. The RL learner **107** may update (or produce) the RL agent **103** (or a model included in or executed in the RL agent) using information associated with the experience data **105**. The RL agent **103** updated (or produced) by the RL learner **107** may be a model capable of maximizing a reward value more than before, or may include (or execute) the model.

[0050] According to a comparative example, a table for storing the experience data **105** needs to be defined in the storage device **130** at all times, and thus, it may be burden to resources. In addition, the experience data **105** is produced based on an input value and an output value of the RL agent **103**, and parameters included in the experience data **105** may be subordinate to the RL agent **103** and are not changeable. Furthermore, if the plurality of RL agents produce experience data, respectively, the same value may be duplicated and thus, this may be burden to the resources of the experience data **105**, which will be described with reference to FIG. **2**B.

[0051] FIG. **2**B is a block diagram illustrating example production of experience data by a plurality of RL agents according to a comparative example for comparison with various embodiments. At least some of the operations performed by the RIC **101** according to the comparative example may be performed according to various embodiments.

[0052] Referring to FIG. **2**B, the RIC **101** may produce the KPI table **102** associated with a plurality of states S0, S1, S2, S3, S4, S5, S6, S7, S8, and S9, and may update them in a time series manner. In Table 1, a KPI table including 4 states based on first to third parameters and an action has been described. Referring to the example of FIG. **2**B, the KPI table **102** associated with 10 states S0, S1, S2, S3, S4, S5, S6, S7, S8, and S9 may be produced and/or managed. At least some of the ten states S0, S1, S2, S3, S4, S5, S6, S7, S8, and S9 may be parameters for indicating the states of the RAN **150**, and at least some of the remaining may be actions performed by at least one entity of the RAN **150**, but the disclosure is not limited thereto. For example, the first RL agent **103***a* may obtain at least some of the S0, 51, S2, S3, and S4 states as an input value, and may provide at least some actions of the remaining as an output value. For example, the second RL agent **103***b* may obtain at least some of the S0, S1, S2, S5, and S6 states as an input value, and may provide at least some actions of the remaining as an output value. For example, the third RL agent **103***c* may obtain at least some of the S0, S1, S2, S8, and S9 states as an input value, and may provide at least some actions of the remaining as an output value. Information associated with input values and output values of a plurality of RL agents **103***a*, **103***b*, and **103***c* is included in the KPI table **102**, and thus, the KPI table **102** may include values associated with 10 S0, S1, S2, S3, S4, S5, S6, S7, S8, and S9 states.

[0053] The first RL agent **103***a* may produce a first experience data **105***a* associated with S0, S1, S2, S3, and S4 states, the second RL agent **103***b* may produce second experience data **105***b* associated with S0, S1, S2, S5, and S6 states, and the third RL agent **103***c* may produce third experience data **105***c* associated with S0, S1, S2, S8, and S9 states. The form of the experience data **105***a*, **105***b*, and **105***c* may be, for example, similar to those listed in Table 2. For example, it is assumed that Si is an action, and the remaining S0, S2, S3, S4, S5, S6, S7, S8, and S9 are parameters. In this instance, the examples of the first experience data **105***a* to third experience data **105***c* may be as shown in Table 3.

TABLE 3

Experience data	State before performing action	Action	State after performing action	Reward
First experience data 105a	{S0(t1), S2(t1), S3(t1), S4(t1)}	S1(t2)	{S0(t2), S2(t2), S3(t2), S4(t2)}	S0(t2) * S3(t2)
Second experience data 105b	{S0(t1), S2(t1), S5(t1), S6(t1)}	S1(t2)	{S0(t2), S2(t2), S5(t2), S6(t2)}	S0(t2) * S5(t2)
Third experience data 105c	{S0(t1), S2(t1), S8(t1), S9(t1)}	S1(t2)	{S0(t2), S2(t2), S8(t2), S9(t2)}	S0(t2) * S8(t2)

[0054] In Table 3, actions of the RL agents **103***a*, **103***b*, and **103***c* are all "S1" state, but this is merely an example, and the actions of the RL agents **103***a*, **103***b*, and **103***c* may be different from each other. For example, S0(t1) may denote the value of parameter S0 at t1, and S0(t2) may denote the value of parameter S0 at t2, and others may be understood in this manner. For example, as shown in Table 3, it is identified that duplicate values of S0, S1, and S2 states which the RL agents use in common are present in the KPI table. Accordingly, there may be a waste of resources.

[0055] FIG. **3** is a block diagram illustrating an example configuration of an RIC according to various embodiments.

[0056] According to various embodiments, the RIC **101** may further include an experience data producer (e.g., including various processing circuitry and/or executable program instructions) **109** (or may perform the function of the experience data producer **109**) when compared to FIG. **2**A. The fact that the RIC **101** includes the experience data producer **109** may describe, for example, that the function of the experience data producer **109** is executed by the processor **120** of an electronic device including the RIC **101** (or an electronic device that provides the function of the RIC **101**), or may describe that at least one instruction for executing the function of the experience data producer **109** is stored in the storage device **130**.

[0057] According to various embodiments, the experience data producer **109** may obtain data **301** from the KPI table **102**. The experience data producer **109** may produce experience data **302** using the obtained data **301**, and may provide the same to the RL learner **109**. The RL learner **109** may update the RL agent **103** or may produce a new RL agent using the experience data **302**. The updated or newly produced RL agent **103** may replace the existing RL agent.

[0058] According to various embodiments, the experience data producer **109** may obtain the data **301** and produce the experience data **302** in response to a request for producing experience data from the RL learner **107** (or another entity). The experience data **302** may be at least temporarily produced in the RIC **101** in response to the request for producing experience data, and may be deleted after being provided to the RL learner **107**. Accordingly, when compared to the comparative example of FIG. **2**A in which experience data produced by the RL agent **103** is stored all the time, the RIC **101** according to various embodiments may use relatively a small amount of resources to produce experience data. In addition, a parameter and/or an action included in the experience data **302** may be adjustable. According to the comparative example of FIG. **2**A, experience data may be produced based on a parameter and an action used by the RL agent **103**, the parameter and/or action in the experience data is not adjustable. According to the disclosure, the experience data **302** may be produced based on a parameter and an action declared by the RL agent **103**, or may be produced based on a parameter and an action selected by a user. In addition, a method of determining a reward included in the experience data **302** may be adjustable.

[0059] FIG. **4** is a flowchart illustrating an example method of operating an electronic device according to various embodiments. The embodiments of FIG. **4** will be described with reference to FIG. **5**. FIG. **5** is a block diagram illustrating an example configuration of an RIC according to various embodiments.

[0060] According to various embodiments, in operation **401**, the RIC **101** may store at least one value corresponding to each of at least one parameter associated with an RAN, and information associated with an operation performed by the RAN. The RIC **101** may store at least one value corresponding to each of at least one parameter associated with an RAN, and information associated with an operation performed by the RAN, for each of a plurality of points in

time. Referring to FIG. **5**, the RIC **101** may store the KPI table **102** as shown in Table 1. As described with reference to Table 1, the RIC **101** may store at least one value (e.g., "1.2", "230", and "0.2" at the first point in time in Table 1) corresponding to at least one parameter (e.g., the first parameter to third parameter in Table 1) for each of a plurality of points in time (e.g. the first point in time to the fifth point in time in Table 1), and information (e.g., "Config#1" at the first point in time in Table 1) associated with an operation (e.g., an action in Table 1) performed by the RAN. The RIC **101** may store value associated with a single RL agent and value associated with a plurality of RL agents. For example, as described with reference to FIG. **2**B, the KPI table **102** based on a plurality of states (e.g., S0 to S9) may be stored by the RIC **101**. Referring to FIG. **5**, the plurality of RL agents **103***a*, **103***b*, and **103***c* stored in (or executed in) the RIC **101** may obtain a value **111***a*, **111***b*, and **111***c* corresponding to at least one parameter from the KPI table **102**, and may provide information (e.g., action) **112***a*, **112***b*, and **112***c* associated with an operation corresponding thereto. The information **112***a*, **112***b*, and **112***c* associated with the operation may be provided to the RAN **150**. At least one entity of the RAN **150** may operate based on the information **112***a*, **112***b*, and **112***c* associated with the operation. As an operation is performed, the state of the RAN **150** may be changed. The information **113***a*, **113***b*, and **113***c* associated with the state of the RAN **150** may be provided to the RIC **101**. The RIC **101** may update the KPI table **102** using the information **113***a*, **113***b*, and **113***c* associated with the state of the RAN **150**. For example, the RIC **101** may write, based on the information **113***a*, **113***b*, and **113***c* associated with the state of the RAN **150**, a value corresponding to each of at least one parameter for a next point in time in the KPI table **102**.

[0061] According to various embodiments, in operation **403**, the RIC **101** may identify a request for experience data for learning a first operation determination model, from a first learning learner (e.g., the RL learner **107***a* of FIG. **5**) for learning the first operation determination model among at least one operation determination model (e.g., the RL agents **103***a*, **103***b*, and **103***c* of FIG. **5**). For example, referring to FIG. **5**, the RIC **101** may include RL learners **107***a*, **107***b*, and **107***c* for learning the RL agents **103***a*, **103***b*, and **103***c* (or models included in the RL agents **103***a*, **103***b*, and **103***c*). As described above, according to another embodiment, the RL learners **107***a*, **107***b*, and **107***c* may be executed in an entity different from the RIC **101**. In this instance, the RL learners **107***a*, **107***b*, and **107***c* may not be included in (or may not be executed in) the RIC **101**. The first learner **107***a* may be a learning learner for learning the first RL agent **103***a*. As illustrated in FIG. **5**, the experience data producer **109** may obtain a request **501** for experience data from the first RL learner **107***a*.

[0062] According to various embodiments, in operation **405**, the RIC **101** may identify a value corresponding to at least one first parameter corresponding to the first operation determination model (e.g., the first RL agent **103***a*) among the at least one value (e.g., the values included in the KPI table **102**), and information associated with an operation. As an example, the RIC **101** may identify a value corresponding to at least one first parameter declared in advance by the first RL agent **103**, and information associated with an operation. For example, the RIC **101** may store the correspondence relationship between the first RL learner **107***a* and the first RL agent **103***a* in advance, or may identify, based on the identification information of the first RL agent **103***a* included in the request **501**, a value corresponding to at least one first parameter declared in advance and information associated with an operation. As another example, based on an external input (e.g., an input by a user), the RIC **101** may identify a value corresponding to the at least one first parameter and information associated with an operation. The RIC **101** may be configured so as to configure a parameter and/or action for producing experience data. Based on a parameter and/or action configured according to an external input, the RIC **101** may identify a value corresponding to at least one first parameter and information associated with an operation for producing experience data.

[0063] According to various embodiments, in operation **407**, the RIC **101** may provide the value corresponding to the at least one first parameter and information associated with an operation, and a reward value identified based on at least a part of the value corresponding to the at least one first parameter to the first learning learner as the experience data **503**. The experience data producer **109** may produce the experience data **503** based on the value corresponding to the at least one first parameter and the information associated with the operation identified in operation **405**. For example, the experience data producer **109** may produce the experience data **503** provided in the form of Table 2. Based on the KPI table **102** produced based on values associated with the plurality of RL agents **103***a*, **103***b*, and **103***c*, the experience data producer **109** may obtain values corresponding to at least one first parameter (e.g., the first parameter, the second parameter, and the third parameter in Table 1) and values of information associated with an operation (e.g., an action in Table 1). The experience data producer **109** may produce, as the experience data **503**, information associated with each of the state before performing an action, an action, the state after performing an action, and a reward as shown in Table 2. The experience data producer **109** may produce the experience data **503**, and may at least temporarily store the same. That may be provided to the first RL learner **107***a*. For example, the experience data producer **109** may provide the experience data **503** to the first RL learner **107***a*, and may delete the experience data **503** that has been stored.

[0064] As described above, unlike the comparative example, the RIC **101** may not store and manage the experience data **503** all times, but the RIC **101** may produce and provide the experience data **503** by request from a learning leaner, and thus, a waste of resources of the RIC **101** may be prevented and/or reduced. In addition, the RIC **101** may decrease a probability of data duplication, unlike the comparative example in which experience data is produced by each of the plurality of RL agents **103***a*, **103***b*, and **103***c*. Furthermore, user settings associated with a parameter and an action of experience data may be available. Experience data may be flexibly produced in association with learning of an existing RL agent and learning of an updated RL agent.

[0065] FIG. **6** is a flowchart illustrating an example method of operating an electronic device according to various embodiments.

[0066] According to various embodiments, in operation **601**, the RIC **101** may store at least one value corresponding to each of at least one parameter associated with the RAN **105**, and information associated with an operation performed by the RAN **105**. For example, the RIC **101** may

store the KPI table **102**. In operation **603**, the RIC **101** may identify a request for experience data for learning a first operation determination model, from a first learning learner (e.g., a first RL leaner) for learning the first operation determination model (e.g., the first RL agent (or a model included in or executed in the first RL agent)). In operation **605**, the RIC **101** may identify a value corresponding to at least one first parameter corresponding to the first operation determination model among the at least one value, and information associated with an operation. For example, the RIC **101** may identify the values of parameters corresponding to the first operation determination model in the KPI table **102**, and information associated with an operation (e.g., an action). In operation **607**, the RIC **101** may provide the value corresponding to the at least one first parameter, the information associated the operation, and a reward value identified based on the value corresponding to the at least one first parameter to the first learning learner as the experience data. The RIC **101** may produce experience data, for example, in the form of Table 2. The RIC **101** may obtain values corresponding to the at least one first parameter and values of information associated with an operation from the KPI table **102**. The RIC **101** may produce information associated with each of the state before performing an action, an action, the state after performing an action, and a reward, as experience data, as shown in Table 2, and may provide the produced experience data to the first learning learner.

[0067] According to various embodiments, the RIC **101** may obtain an updated first operation determination model from the first learning learner in operation **609**. For example, an RL learner may update the first operation determination model using the provided experience data. Those skilled in the art will understand that an RL learner's learning method for updating a model (or for producing a new model) is not limited. In operation **611**, the RIC **101** may determine an operation associated with the RAN using the updated first operation determination model, and may provide the same to the RAN. The RIC **101** may provide at least one parameter associated with the state of the RAN to the updated first operation determination model. The updated first operation determination model may be configured to obtain, as an input value, a parameter which is the same as or similar to a parameter used before updating. However, depending on implementation, the updated first operation determination model may be configured to obtain, as an input value, a parameter different from a parameter used before updating.

[0068] FIG. **7** is a flowchart illustrating an example method of operating an electronic device according to various embodiments.

[0069] According to various embodiments, in operation **701**, the RIC **101** may store at least one value corresponding to each of at least one parameter associated with an RAN, and information associated with an operation performed by the RAN. For example, the RIC **101** may store the KPI table **102**. In operation **703**, the RIC **101** may determine whether an experience data production event for learning the first operation determination model is identified. For example, the RIC **101** may identify a request from a first learning learner as described above, as an experience data production event. For example, if it is identified that a reward satisfies a condition for a designated updating, the RIC **101** may identify that an experience data production event occurs. According to a change in a wireless environment, there is the probability that a reward associated with the action of the first operation determination model may be decreased. For example, if a reward having a value less than or equal to a designated value is detected (or the number of times that a value less than or equal to a designated value is detected is greater than or equal to a predetermined threshold number of times, or a period in which a value less than or equal to a designated value continues is greater than or equal to a designated threshold period), the RIC **101** may produce and provide experience data to the learning learner. In this instance, the RIC **101** may request learning from a learning leaner. For example, the RIC **101** may evaluate the quality of the RAN **150**, in addition to performing reward for experience data. If it is determined that the result of the evaluation of the quality is poor, the RIC **101** may produce experience data and provide the same to the learning learner. For example, if a designated period (e.g., one week) elapses from the last updating point, it is identified that an experience data production event occurs. The type of an event for producing experience data is not limited. In addition, those skilled in the art would understand that a request from a learning learner according to various embodiments of the disclosure may be replaced with an experience data production event according to the above-described embodiment and other embodiments. Based on the detection of the event (Yes in **703**), in operation **705**, the RIC **101** may identify a value corresponding to at least one first parameter corresponding to the first operation determination model among the at least one value, and information associated with an operation. In operation **707**, the RIC **101** may provide the value corresponding to the at least one first parameter, the information associated with the operation, and a reward value identified based on the value corresponding to the at least one first parameter to the first learning learner as the experience data.

[0070] FIG. **8** is a flowchart illustrating an example method of operating an electronic device according to various embodiments.

[0071] According to various embodiments, in operation **801**, the RIC **101** may store at least one value corresponding to each of at least one parameter associated with the RAN **150**, and information associated with an operation performed by the RAN **150**. For example, the RIC **101** may store the KPI table **102**. In operation **803**, the RIC **101** may identify a request for experience data for learning a first operation determination model. In operation **805**, the RIC **101** may provide, to a first learning learner, first experience data based on a value corresponding to at least one first parameter corresponding to the first operation determination model. For example, the RIC **101** may produce, as the first experience data, information associated with each of the state before performing an action, an action, the state after performing an action, and a reward as shown in Table 2. The state before performing an action and the state after performing an action in the first experience data may include a value corresponding to the at least one first parameter.

[0072] According to various embodiments, the RIC **101** may update the first operation determination model to change at least some of the at least one first parameter in operation **807**. As described above, the first operation determination model may be updated to use a parameter different from a parameter used before updating. Alternatively, a learning learner may change the existing first operation determination model to a new first operation determination

model. In this instance, at at least one point in time among the point in time of downloading the first operation determination model, the point in time of starting updating, the point in time of proceeding with updating, or the point in time of completion of updating, a parameter that the first operation determination model uses may be declared and the RIC **101** may identify the declared parameter. If a new operation determination model is obtained, at at least one point in time among the point in time of downloading the new operation determination model, the point in time of starting installation, the point in time of proceeding with installation, or the point in time of completion of installation, a parameter that the new operation determination model uses may be declared and the RIC **101** may identify the declared parameter. The RIC **101** may input a newly defined parameter in the KPI table **102** to the first operation determination model. In addition, when the first learning learner requests production of experience data for learning the first operation determination model, experience data may be produced using a newly defined parameter and action. In operation **809**, the RIC **101** may identify a request for experience data for learning the first operation determination model. In operation **811**, the RIC **101** may provide, to the first learning learner, second experience data based on a value corresponding to at least one second parameter corresponding to the first operation determination model among the at least one value. For example, the RIC **101** may produce, as second experience data, information associated with each of the state before performing an action, an action, the state after performing an action, and a reward as shown in Table 2. The state before performing an action and the state after performing an action in the second experience data may include a value corresponding to the at least one second parameter.

[0073] FIG. **9** is a flowchart illustrating an example method of operating an electronic device according to various embodiments.

[0074] According to various embodiments, the RIC **101** may store at least one value corresponding to each of at least one parameter associated with the RAN **150**, and information associated with an operation performed by the RAN in operation **901**. For example, the RIC **101** may store the KPI table **102**. In operation **903**, the RIC **101** may identify a request for experience data for learning a first operation determination model. In operation **905**, the RIC **101** may identify at least one first parameter corresponding to the first operation determination model. The method in which the RIC **101** identifies the at least one first parameter corresponding to the first operation determination model has been described, and thus, the detailed description thereof may not be repeated.

[0075] According to various embodiments, in operation **907**, the RIC **101** may determine whether the stored values support the at least one first parameter corresponding to the first operation determination model. The RIC **101** may determine whether the at least one first parameter is supported in the KPI table **102**. If the stored values support the at least one first parameter (Yes in operation **907**), in operation **909**, the RIC **101** may provide a value corresponding to the at least one first parameter, information associated with an operation, and a reward value identified based on the value corresponding to the at least one first parameter, to the first learning learner as experience data. If the stored values do not support at least some of the at least one first parameter (No in operation **907**), the RIC **101** may identify that experience data is incapable of being provided in operation **911**. The RIC **101** may output a message indicating that experience data is incapable of being provided. For example, it is assumed that the KPI table **102** such as Table 1 is stored. The RIC **101** may identify that a parameter for producing experience data is a first parameter and a second parameter. In this instance, the RIC **101** may produce experience data based on the first parameter and the second parameter. The RIC **101** may identify that a parameter for producing experience data is a first parameter and a fourth parameter. In this instance, the RIC **101** may identify that the fourth parameter is not supported in the KPI table **102**, and experience data is incapable of being produced.

[0076] FIG. **10** is a flowchart illustrating an example method of operating an electronic device according to various embodiments.

[0077] According to various embodiments, the RIC **101** may store at least one value corresponding to each of at least one parameter associated with the RAN **150**, and information associated with an operation performed by the RAN in operation **1001**. For example, the RIC **101** may store the KPI table **102**. In operation **1003**, the RIC **101** may identify a request for experience data for learning a first operation determination model. In operation **1005**, the RIC **101** may identify an operation and at least one first parameter corresponding to the first operation determination model. In operation **1007**, the RIC **101** may identify a value corresponding to the at least one first parameter and information associated with the operation. For example, the RIC **101** may identify (or read) the entirety of a value corresponding to the at least one first parameter and the entirety of information associated with the operation among the values stored in the KPI table **102**.

[0078] According to various embodiments, the RIC **101** may select some of the identified values and information in operation **1009**. In operation **1011**, the RIC **101** may provide the selected some values and information and a corresponding reward value as experience data to the first learning learner. The RIC **101** may not provide, to the first learning learner, experience data based on all the information obtained from the KPI table **102**, but may provide experience data based on some of the obtained information to the first learning learner. As an example, the RIC **101** may select some of the obtained information according to priority. It is assumed that information such as table 4 is identified (or read) as information corresponding to the first operation determination model.

TABLE 4

point in time	First parameter	Second parameter	Third parameter	Action
first point in time	1.2	230	0.2	Config#1
second point in time	1.3	242	0.19	Config#1
third point in time	1.4	236	0.18	Config#2
fourth point in time	1.5	209	0.17	Config#2
fifth point in time	1.6	220	0.16	Config#1
sixth point in time	1.3	209	0.17	Config#2
seventh point in time	1.4	220	0.14	Config#2
eighth point in time	1.2	211	0.17	Config#2
ninth point in time	1.6	217	0.15	Config#1
tenth point in time	1.4	233	0.15	Config#1

[0079] For example, if a second parameter has the highest priority, the RIC **101** may select values corresponding to the

second parameter in descending order up to a predetermined number (or a predetermined ratio). If it is the case of determining 40% of the all values corresponding to the second parameter according to priority, the RIC **101** may select information associated with "a second point in time", "a third point in time", "a tenth point in time", and "a first point in time" among the values corresponding to the second parameter in descending order. The RIC **101** may produce experience data based on the selected information. In order to produce experience data, a parameter before performing an action and a parameter after performing an action may be required. The RIC **101** may produce experience data further using information associated with a point in time before or after the information associated with the "second point in time", "the third point in time", "the tenth point in time", and "the first point in time". The process of performing selection according to priority is merely an example, the priority order for parameters is not limited, and if some of all data are selected in predetermined priority order, a selecting method is not limited.

[0080] As an example, the RIC **101** may randomly select some of the obtained information. A selection ratio (or a predetermined number) may be determined in advance. The RIC **101** may perform random extraction until the number of pieces of data corresponding to a previously selected ratio or the predetermined number of pieces of data is satisfied. As an example, the RIC **101** may sequentially extract some of the obtained information. For example, the RIC **101** may select a predetermined number of pieces of data from the point in time at which the KPI table **102** is updated. Alternatively, the RIC **101** may select a predetermined number of pieces of data from the latest point in time, and a sequential extracting method is not limited. The above-described various extraction methods are merely examples, and those skilled in the art would understand that there is no limitation if an extraction method is a method of selecting some of all data.

[0081] FIG. **11** is a flowchart illustrating an example method of operating an electronic device according to various embodiments.

[0082] According to various embodiments, the RIC **101** may store at least one value corresponding to each of at least one parameter associated with the RAN **150**, and information associated with an operation performed by the RAN **150** in operation **1101**. For example, the RIC **101** may store the KPI table **102**. In operation **1103**, the RIC **101** may identify a request for experience data for learning a first operation determination model. In operation **1105**, the RIC **101** may provide, to a first learning learner, first experience data including a value corresponding to at least one first parameter corresponding to the first operation determination model, information associated with an operation, and a first reward based on a first reward determination scheme. For example, it is assumed that the KPI table **102** is Table 1. In addition, the first reward determination scheme may be the product of a value corresponding to a first parameter and a value corresponding to a third parameter. In this instance, the RIC **101** may produce first experience data including, for example, the state before performing an action, an action, the state after performing an action, and a reward identified according to the first reward determination scheme, as shown in Table 2.

[0083] According to various embodiments, the RIC **101** may change the reward determination scheme corresponding to the first operation determination model in operation **1107**. For example, the RIC **101** may receive a new reward determination scheme, and a method of changing a reward determination scheme is not limited. For example, it is assumed that the reward determination scheme is changed from the first reward determination scheme corresponding to the product of the value of the first parameter and the value of the third parameter to a second reward determination scheme corresponding to the product of the value of the second parameter and the value of the third parameter. In operation **1109**, the RIC **101** may identify a request for experience data for learning the first operation determination model.

[0084] According to various embodiments, in operation **1111**, the RIC **101** may provide, to the first learning learner, second experience data including a value corresponding to the at least one first parameter corresponding to the first operation determination model, information associated with an operation, and a second reward based on the second reward determination scheme. For example, for the same KPI table (e.g., the KPI table of Table 1), the RIC **101** may produce experience data as shown in Table 5 according to the changed reward determination scheme.

TABLE 5

Experience data	State before performing action	Action	State after performing action	Reward
1	{1.2, 230, 0.2}	Config#1	{1.3, 242, 0.19}	1.3 * 242
2	{1.3, 242, 0.19}	Config#2	{1.4, 236, 0.18}	1.4 * 236
3	{1.4, 236, 0.18}	Config#2	{1.5, 209, 0.17}	1.5 * 209
4	{1.5, 209, 0.17}	Config#1	{1.6, 220, 0.16}	1.6 * 220

[0085] As described above, the RIC **101** may more flexibly change a reward determination scheme, compared to a comparative example. According to the comparative example, a reward determination scheme is stored in an RL agent, and thus, the reward determination scheme is not changeable without changing the RL agent. However, according to various embodiments, a reward determination scheme may be changeable and thus, experience data according to the changed reward determination scheme may be obtained.

[0086] According to various example embodiments, an example method of operating an electronic device may include: storing at least one value corresponding to each of at least one parameter associated with a radio access network (RAN), and information associated with an operation performed by the RAN. A value corresponding to at least some parameters among the at least one parameter may be used when at least one operation determination model executed by the electronic device determines at least a part of the information associated with the operation. The method of the electronic device may further include: identifying a request for experience information for learning a first operation determination model from a first learning learner for learning the first operation determination model among the at least one operation determination model, identifying, among the at least one value, a value corresponding to at least one first parameter corresponding to the

first operation determination model and information associated with an operation corresponding to the at least one first parameter, in response to the request, and providing at least some among the value corresponding to the at least one first parameter, the information associated with the operation corresponding to the at least one first parameter, and a reward value identified based on at least a part of the value corresponding to the at least one first parameter, to the first learning learner as the experience information.

[0087] According to various example embodiments, the operation of storing the at least one value corresponding to each of the at least one parameter associated with the RAN, and the information associated with the operation performed by the RAN may classify and store, for each of a plurality of points in time, the at least one value corresponding to each of the at least one parameter and the information associated with the operation performed by the RAN.

[0088] According to various example embodiments, the example method of operating the electronic device may further include: obtaining, from the first learning learner, a first operation determination model updated based on the provided experience information, obtaining a new value corresponding to the at least one first parameter from the RAN, obtaining information associated with a new operation which is a result obtained by applying the new value corresponding to the at least one first parameter to the updated first operation determination model, and providing the information associated with the new operation to the RAN.

[0089] According to various example embodiments, the example method of operating the electronic device may further include: obtaining, from the first learning learner, the first operation determination model updated based on the provided experience information, identifying a parameter used by the updated first operation determination model as at least one second parameter which is at least partially different from the at least one first parameter, obtaining a value corresponding to the at least one second parameter from the RAN, obtaining information associated with a new operation which is a result obtained by applying the value corresponding to the at least one second parameter to the updated first operation determination model, and providing the information associated with the new operation to the RAN.

[0090] According to various example embodiments, the example method of operating the electronic device may further include: identifying a new request for experience information for learning the first operation determination model, identifying a value corresponding to the at least one second parameter and information associated with an operation corresponding to the at least one second parameter, in response to the new request, and providing, as new experience information, at least some among the value corresponding to the at least one second parameter, the information associated with the operation corresponding to the at least one second parameter, and a reward value identified based on at least a part of the value corresponding to the at least one second parameter.

[0091] According to various example embodiments, in response to the request, the operation of identifying the value corresponding to the at least one first parameter corresponding to the first operation determination model among the at least one value and the information associated with the operation corresponding to the at least one first parameter may include: identifying whether at least one value corresponding to each of the at least one parameter supports the at least one first parameter, and based on the at least one first parameter being supported, identifying the value corresponding to the at least one first parameter corresponding to the first operation determination model and the information associated with the operation corresponding to the at least one first parameter.

[0092] According to various example embodiments, the operation of providing at least some among the value corresponding to the at least one first parameter, the information associated with the operation corresponding to the at least one first parameter, and the reward value identified based on at least a part of the value corresponding to the at least one first parameter to the first learning learner as the experience information may provide the value corresponding to the at least one first parameter, the information associated with the operation corresponding to the at least one first parameter, and the entirety of the value corresponding to the at least one first parameter, and the entirety of a reward value identified based on the entirety to the first learning learner as the experience information.

[0093] According to various example embodiments, the operation of providing at least some among the value corresponding to the at least one first parameter, the information associated with the operation corresponding to the at least one first parameter, and the reward value identified based on at least a part of the value corresponding to the at least one first parameter to the first learning learner as the experience information may include: selecting a part among the value corresponding to the at least one first parameter, the information associated with the operation corresponding to the at least one first parameter, and the value corresponding to the at least one first parameter, and providing the selected part and a reward value identified based on the selected part to the first learning learner as the experience information.

[0094] According to various example embodiments, the operation of selecting the part among the value corresponding to the at least one first parameter, the information associated with the operation corresponding to the at least one first parameter, and the value corresponding to the at least one first parameter may select the value corresponding to the at least one first parameter, the information associated with the operation corresponding to the at least one first parameter, and the part of the value corresponding to the at least one first parameter based on at least one operation among selecting the part based on priority of each of the at least one first parameter, selecting the part based on a point in time at which each value corresponding to the at least one first parameter is obtained, or selecting the part in a random manner.

[0095] According to various example embodiments, the example method of operating the electronic device may further include: identifying the reward value based on a reward determination scheme and at least a part of the value corresponding to the at least one first parameter, and the reward determination scheme may be stored in advance in the electronic device or may be received by the electronic device.

[0096] According to various example embodiments, in response to the request, the operation of identifying the value corresponding to the at least one first parameter corresponding to the first operation determination model

among the at least one value, and information associated with the operation corresponding to the at least one first parameter may include: identifying the at least one first parameter declared by the first operation determination model.

[0097] According to various example embodiments, in response to the request, the operation of identifying the value corresponding to the at least one first parameter corresponding to the first operation determination model among the at least one value, and the information associated with the operation corresponding to the at least one first parameter may include: identifying the at least one first parameter based on an external input.

[0098] According to various example embodiments, the experience information may include a value corresponding to the at least one first parameter at a first point in time, a first operation performed by the RAN at the first point in time, a value corresponding to the at least one first parameter at a second point in time after the first point in time according to a result of performing the first operation, and a reward value at the first point in time.

[0099] According to various example embodiments, an electronic device (e.g., the electronic device **101**) may include: a storage device (e.g., the storage device **130**), and at least one processor (e.g., the processor **120**) operatively connected to the storage device, and the at least one processor is configured to: store, in the storage device, at least one value corresponding to each of at least one parameter associated with a radio access network (RAN), and information associated with an operation performed by the RAN. A value corresponding to at least some parameters among the at least one parameter may be used based on at least one operation determination model executed by the electronic device determining at least a part of the information associated with the operation. The at least one processor may be further configured to: identify a request for experience information for learning a first operation determination model from a first learning leaner for learning the first operation determination model among the at least one operation determination model, identify a value corresponding to at least one first parameter corresponding to the first operation determination model among the at least one value and information associated with an operation corresponding to the at least one first parameter in response to the request, and provide at least some among the value corresponding to the at least one first parameter, the information associated with the operation corresponding to the at least one first parameter, and a reward value identified based on at least a part of the value corresponding to the at least one first parameter, to the first learning learner as the experience information.

[0100] According to various example embodiments, as at least a part of the operation of storing the at least one value corresponding to each of the at least one parameter associated with the RAN, and the information associated with the operation performed by the RAN, the at least one processor may be configured to: classify and store, for each of a plurality of points in time, the at least one value corresponding to each of the at least one parameter and the information associated with the operation performed by the RAN.

[0101] According to various example embodiments, the at least one processor may be configured to: obtain, from the first learning learner, a first operation determination model updated based on the provided experience information, obtain a new value corresponding to the at least one first parameter from the RAN, obtain information associated with a new operation which is a result obtained by applying the new value corresponding to the at least one first parameter to the updated first operation determination model, and provide the information associated with the new operation to the RAN.

[0102] According to various example embodiments, the at least one processor may be configured to: obtain from the first learning learner, the first operation determination model updated based on the provided experience information, identify a parameter used by the updated first operation determination model as at least one second parameter which is at least partially different from the at least one first parameter, obtain a value corresponding to the at least one second parameter from the RAN, obtain information associated with a new operation which is a result obtained by applying the value corresponding to the at least one second parameter to the updated first operation determination model, and provide the information associated with the new operation to the RAN.

[0103] According to various example embodiments, the at least one processor may be further configured to: identify a new request for experience information for learning the first operation determination model, identify a value corresponding to the at least one second parameter and information associated with an operation corresponding to the at least one second parameter in response to the new request, and provide, as new experience information, at least some among the value corresponding to the at least one second parameter, information associated with the operation corresponding to the at least one second parameter, and a reward value identified based on at least a part of the value corresponding to the at least one second parameter.

[0104] According to various example embodiments, in response to the request, the at least one processor may be further configured to: identify the value corresponding to the at least one first parameter corresponding to the first operation determination model among the at least one value and information associated with the operation corresponding to the at least one first parameter, identify whether at least one value corresponding to each of the at least one parameter supports the at least one first parameter, and based on the at least one first parameter being supported, and identify the value corresponding to the at least one first parameter corresponding to the first operation determination model and the information associated with the operation corresponding to the at least one first parameter.

[0105] According to various example embodiments, as at least a part of the operation of providing at least some among the value corresponding to the at least one first parameter, the information associated with the operation corresponding to the at least one first parameter, and the reward value identified based on at least a part of the value corresponding to the at least one first parameter to the first learning learner as the experience information, the at least one processor may be configured to: provide the value corresponding to the at least one first parameter, the information associated with the operation corresponding to the at least one first parameter, and the entirety of the value corresponding to the at least one first parameter, and the entirety of a reward value identified based on the entirety to the first learning learner as the experience information.

[0106] According to various example embodiments, as at least a part of the operation of providing at least some among

the value corresponding to the at least one first parameter, the information associated with the operation corresponding to the at least one first parameter, and the reward value identified based on at least a part of the value corresponding to the at least one first parameter to the first learning learner as the experience information, the at least one processor may be configured to: select a part among the value corresponding to the at least one first parameter, the information associated with the operation corresponding to the at least one first parameter, and the value corresponding to the at least one first parameter, and provide the selected part and a reward value identified based on the selected part to the first learning learner as the experience information.

[0107] According to various example embodiments, as at least a part of the operation of selecting the value corresponding to the at least one first parameter, the information associated with the operation corresponding to the at least one first parameter, and the part of the value corresponding to the at least one first parameter, the at least one processor may be configured to: select the value corresponding to the at least one first parameter, the information associated with the operation corresponding to the at least one first parameter, and the part of the value corresponding to the at least one first parameter based on at least one operation among an operation of: selecting the part based on priority of each of the at least one first parameter, selecting the part based on the point in time at which each value corresponding to the at least one first parameter is obtained, or selecting the part in a random manner.

[0108] According to various example embodiments, the at least one processor may be further configured to: identify the reward value based on a reward determination scheme and at least a part of the value corresponding to the at least one first parameter, and the reward determination scheme may be stored in advance in the electronic device or is received by the electronic device.

[0109] According to various example embodiments, in response to the request, as at least a part of the operation of identifying the value corresponding to the at least one first parameter corresponding to the first operation determination model among the at least one value, and information associated with the operation corresponding to the at least one first parameter, the at least one processor may be configured to identify the at least one first parameter declared by the first operation determination model.

[0110] According to various example embodiments, in response to the request, as at least a part of the operation of identifying the value corresponding to the at least one first parameter corresponding to the first operation determination model among the at least one value, and information associated with the operation corresponding to the at least one first parameter, the at least one processor may be configured to identify the at least one first parameter based on an external input.

[0111] According to various example embodiments, the experience information may include a value corresponding to the at least one first parameter at a first point in time, a first operation performed by the RAN at the first point in time, a value corresponding to the at least one first parameter at a second point in time after the first point in time according to a result of performing the first operation, and a reward value at the first point in time.

[0112] According to various example embodiments, an example method of operating an electronic device may include: storing a key performance indicator (KPI) table in which at least one value corresponding to each of at least one parameter associated with a radio access network (RAN), and information associated with an operation performed by the RAN are classified for each of a plurality of points of time. A value corresponding to at least some parameters among the at least one parameter may be used when at least one operation determination model executed by the electronic device determines at least a part of the information associated with the operation. The method of the electronic device may further include: detecting an event for updating a first operation determination model among the at least one operation determination model, identifying the value corresponding to at least one first parameter corresponding to the first operation determination model and information associated with an operation corresponding to the at least one first parameter by referring to the KPI in response to the event detection; and providing at least some among the value corresponding to the at least one first parameter, the information associated with the operation corresponding to the at least one first parameter, and a reward value identified based on at least a part of the value corresponding to the at least one first parameter, to a first learning leaner for learning the first operation determination model as the experience information.

[0113] According to various example embodiments, the detecting the event for updating the first operation determination model may detect the event based on the fact that a threshold period elapses from a point in time at which another experience information produced by the electronic device is provided, before the experience information.

[0114] According to various example embodiments, the detecting the event for updating the first operation determination model may detect the event based on the fact that at least a part of the value corresponding to the at least one first parameter satisfies a designated condition.

[0115] According to various example embodiments, the detecting the event for updating the first operation determination model may detect the event based on a request from the first learning learner and/or an external input.

[0116] According to various example embodiments, an electronic device (e.g., the electronic device **101**) may include: a storage device (e.g., the storage device **130**), and at least one processor (e.g., the processor **120**) operatively connected to the storage device, and the at least one processor may be configured to: store, in the storage device, a key performance indicator (KPI) table in which at least one value corresponding to each of at least one parameter associated with a radio access network (RAN), and information associated with an operation performed by the RAN are classified for each of a plurality of points in time. A value corresponding to at least some parameters among the at least one parameter may be used when at least one operation determination model executed by the electronic device determines at least a part of the information associated with the operation. The at least one processor may be configured to: detect an event for updating a first operation determination model among the at least one operation determination model, identify the value corresponding to at least one first parameter corresponding to the first operation determination model and information associated with an operation corresponding to the at least one first parameter by referring to the KPI in response to the event detection, and provide at least some among the value corresponding to the at least one first

parameter, the information associated with the operation corresponding to the at least one first parameter, and a reward value identified based on at least a part of the value corresponding to the at least one first parameter, to a first learning leaner for learning the first operation determination model as the experience information.

[0117] According to various example embodiments, as at least a part of the detecting the event for updating the first operation determination model, the at least one processor may be configured to detect the event based on a threshold period elapsing from the point in time at which another experience information produced by the electronic device is provided, before the experience information.

[0118] According to various example embodiments, as at least a part of the detecting the event for updating the first operation determination model, the at least one processor may be configured to detect the event based on at least a part of the value corresponding to the at least one first parameter satisfying a designated condition.

[0119] According to various example embodiments, as at least a part of the detecting the event for updating the first operation determination model, the at least one processor may be configured to detect the event in response to a request from the first learning learner and/or based on an external input.

[0120] The electronic device according to various embodiments may be one of various types of electronic devices. The electronic devices may include, for example, a portable communication device (e.g., a smartphone), a computer device, a portable multimedia device, a portable medical device, a camera, a wearable device, a home appliance, or the like. According to an embodiment of the disclosure, the electronic devices are not limited to those described above.

[0121] It should be appreciated that various embodiments of the disclosure and the terms used therein are not intended to limit the technological features set forth herein to particular embodiments and include various changes, equivalents, or replacements for a corresponding embodiment. With regard to the description of the drawings, similar reference numerals may be used to refer to similar or related elements. It is to be understood that a singular form of a noun corresponding to an item may include one or more of the things, unless the relevant context clearly indicates otherwise. As used herein, each of such phrases as "A or B", "at least one of A and B", "at least one of A or B", "A, B, or C", "at least one of A, B, and C", and "at least one of A, B, or C", may include any one of, or all possible combinations of the items enumerated together in a corresponding one of the phrases. As used herein, such terms as "1st" and "2nd", or "first" and "second" may be used to simply distinguish a corresponding component from another, and does not limit the components in other aspect (e.g., importance or order). It is to be understood that if an element (e.g., a first element) is referred to, with or without the term "operatively" or "communicatively", as "coupled with", "coupled to", "connected with", or "connected to" another element (e.g., a second element), the element may be coupled with the other element directly (e.g., wiredly), wirelessly, or via a third element.

[0122] As used in connection with various embodiments of the disclosure, the term "module" may include a unit implemented in hardware, software, or firmware, or any combination thereof, and may interchangeably be used with other terms, for example, "logic", "logic block", "part", or "circuitry". A module may be a single integral component, or a minimum unit or part thereof, adapted to perform one or more functions. For example, according to an embodiment, the module may be implemented in a form of an application-specific integrated circuit (ASIC).

[0123] Various embodiments as set forth herein may be implemented as software (e.g., the program **140**) including one or more instructions that are stored in a storage medium that is readable by a machine (e.g., the electronic device **101**). For example, a processor (e.g., the processor **120**) of the machine (e.g., the electronic device **101**) may invoke at least one of the one or more instructions stored in the storage medium, and execute it. This allows the machine to be operated to perform at least one function according to the at least one instruction invoked. The one or more instructions may include a code generated by a complier or a code executable by an interpreter. The machine-readable storage medium may be provided in the form of a non-transitory storage medium. Wherein, the "non-transitory" storage medium is a tangible device, and may not include a signal (e.g., an electromagnetic wave), but this term does not differentiate between where data is semi-permanently stored in the storage medium and where the data is temporarily stored in the storage medium.

[0124] According to an embodiment, a method according to various embodiments of the disclosure may be included and provided in a computer program product. The computer program product may be traded as a product between a seller and a buyer. The computer program product may be distributed in the form of a machine-readable storage medium (e.g., compact disc read only memory (CD-ROM)), or be distributed (e.g., downloaded or uploaded) online via an application store (e.g., PlayStore™), or between two user devices (e.g., smart phones) directly. If distributed online, at least part of the computer program product may be temporarily generated or at least temporarily stored in the machine-readable storage medium, such as memory of the manufacturer's server, a server of the application store, or a relay server.

[0125] According to various embodiments, each component (e.g., a module or a program) of the above-described components may include a single entity or multiple entities, and some of the multiple entities may be separately disposed in different components. According to various embodiments, one or more of the above-described components or operations may be omitted, or one or more other components or operations may be added. Alternatively or additionally, a plurality of components (e.g., modules or programs) may be integrated into a single component. In such a case, the integrated component may still perform one or more functions of each of the plurality of components in the same or similar manner as they are performed by a corresponding one of the plurality of components before the integration. According to various embodiments, operations performed by the module, the program, or another component may be carried out sequentially, in parallel, repeatedly, or heuristically, or one or more of the operations may be executed in a different order or omitted, or one or more other operations may be added.

[0126] While the disclosure has been illustrated and described with reference to various example embodiments, it will be understood that the various example embodiments are intended to be illustrative, not limiting. It will be further understood by those skilled in the art that various changes in

form and detail may be made without departing from the true spirit and full scope of the disclosure, including the appended claims and their equivalents. It will also be understood that any of the embodiment(s) described herein may be used in conjunction with any other embodiment(s) described herein.

What is claimed is:

1. A method of operating an electronic device, the method comprising:

storing at least one value corresponding to each of at least one parameter associated with a radio access network (RAN), and information associated with an operation performed by the RAN, wherein, a value corresponding to at least some parameters among the at least one parameter is used based on at least one operation determination model executed by the electronic device determining at least a part of the information associated with the operation;

identifying a request for experience information for learning a first operation determination model from a first learning learner for learning the first operation determination model among the at least one operation determination model;

in response to the request, identifying, among the at least one value, a value corresponding to at least one first parameter corresponding to the first operation determination model and information associated with an operation corresponding to the at least one first parameter; and

providing at least some among the value corresponding to the at least one first parameter, the information associated with the operation corresponding to the at least one first parameter, and a reward value identified based on at least a part of the value corresponding to the at least one first parameter, to the first learning learner as the experience information.

2. The method of claim **1**, wherein the storing of the at least one value corresponding to each of the at least one parameter associated with the RAN, and the information associated with the operation performed by the RAN comprises:

classifying and storing, for each of a plurality of points in time, the at least one value corresponding to each of the at least one parameter and the information associated with the operation performed by the RAN.

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

obtaining, from the first learning learner, a first operation determination model updated based on the provided experience information;

obtaining a new value corresponding to the at least one first parameter from the RAN;

obtaining information associated with a new operation which is a result obtained by applying the new value corresponding to the at least one first parameter to the updated first operation determination model; and

providing the information associated with the new operation to the RAN.

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

obtaining, from the first learning learner, the first operation determination model updated based on the provided experience information;

identifying a parameter used by the updated first operation determination model as at least one second parameter which is at least partially different from the at least one first parameter;

obtaining a value corresponding to the at least one second parameter from the RAN;

obtaining information associated with a new operation which is a result obtained by applying the value corresponding to the at least one second parameter to the updated first operation determination model; and

providing the information associated with the new operation to the RAN.

5. The method of claim **4**, further comprising:

identifying a new request for experience information for learning the first operation determination model;

in response to the new request, identifying a value corresponding to the at least one second parameter and information associated with an operation corresponding to the at least one second parameter; and

providing, as new experience information, at least some among the value corresponding to the at least one second parameter, the information associated with the operation corresponding to the at least one second parameter, and a reward value identified based on at least a part of the value corresponding to the at least one second parameter.

6. The method of claim **1**, wherein, in response to the request, the identifying of the value corresponding to the at least one first parameter corresponding to the first operation determination model among the at least one value and the information associated with the operation corresponding to the at least one first parameter comprises:

identifying whether at least one value corresponding to each of the at least one parameter supports the at least one first parameter, and based on the at least one first parameter being supported, identifying the value corresponding to the at least one first parameter corresponding to the first operation determination model and the information associated with the operation corresponding to the at least one first parameter.

7. The method of claim **1**, wherein the providing of at least some among the value corresponding to the at least one first parameter, the information associated with the operation corresponding to the at least one first parameter, and the reward value identified based on at least a part of the value corresponding to the at least one first parameter to the first learning learner as the experience information comprises:

providing the value corresponding to the at least one first parameter, the information associated with the operation corresponding to the at least one first parameter, and an entirety of the value corresponding to the at least one first parameter, and an entirety of a reward value identified based on the entirety to the first learning learner as the experience information.

8. The method of claim **1**, wherein the providing of at least some among the value corresponding to the at least one first parameter, the information associated with the operation corresponding to the at least one first parameter, and the reward value identified based on at least a part of the value corresponding to the at least one first parameter to the first learning learner as the experience information comprises:

selecting a part among the value corresponding to the at least one first parameter, the information associated with the operation corresponding to the at least one first

parameter, and the value corresponding to the at least one first parameter, and providing the selected part and a reward value identified based on the selected part to the first learning learner as the experience information.

9. The method of claim **8**, wherein the selecting of the value corresponding to the at least one first parameter, the information associated with the operation corresponding to the at least one first parameter, and the part of the value corresponding to the at least one first parameter comprises;

selecting the part among the value corresponding to the at least one first parameter, the information associated with the operation corresponding to the at least one first parameter, and the value corresponding to the at least one first parameter based on at least one operation among: selecting the part based on priority of each of the at least one first parameter, selecting the part based on a point in time at which each value corresponding to the at least one first parameter is obtained, or selecting the part in a random manner

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

identifying the reward value based on a reward determination scheme and at least a part of the value corresponding to the at least one first parameter,

wherein the reward determination scheme is stored in advance in the electronic device or is received by the electronic device.

11. The method of claim **1**, wherein, in response to the request, the identifying of the value corresponding to the at least one first parameter corresponding to the first operation determination model among the at least one value, and the information associated with the operation corresponding to the at least one first parameter comprises;

identifying the at least one first parameter declared by the first operation determination model.

12. The method of claim **1**, wherein, in response to the request, the identifying of the value corresponding to the at least one first parameter corresponding to the first operation determination model among the at least one value, and the information associated with the operation corresponding to the at least one first parameter comprises;

identifying the at least one first parameter based on an external input.

13. The method of claim **1**, wherein the experience information comprises: a value corresponding to the at least one first parameter at a first point in time, a first operation performed by the RAN at the first point in time, a value corresponding to the at least one first parameter at a second point in time after the first point in time according to a result of performing the first operation, and a reward value at the first point in time.

14. An electronic device, comprising:

a storage device; and

at least one processor operatively connected to the storage device,

wherein the at least one processor is configured to:

store, in the storage device, at least one value corresponding to each of at least one parameter associated with a radio access network (RAN), and information associated with an operation performed by the RAN, wherein, a value corresponding to at least some parameters among the at least one parameter is used based on at least one operation determination model executed by the electronic device determining at least a part of the information associated with the operation,

identify a request for experience information for learning a first operation determination model from a first learning leaner for learning the first operation determination model among the at least one operation determination model;

in response to the request, identify a value corresponding to at least one first parameter corresponding to the first operation determination model among the at least one value and information associated with an operation corresponding to the at least one first parameter; and

provide at least some among the value corresponding to the at least one first parameter, the information associated with the operation corresponding to the at least one first parameter, and a reward value identified based on at least a part of the value corresponding to the at least one first parameter, to the first learning learner as the experience information.

15. The electronic device of claim **14**, wherein, in response to the request, as at least a part of the identifying of the value corresponding to the at least one first parameter corresponding to the first operation determination model among the at least one value and the information associated with the operation corresponding to the at least one first parameter,

the at least one processor is configured to: identify whether at least one value corresponding to each of the at least one parameter supports the at least one first parameter, and

based on the at least one first parameter being supported, identify the value corresponding to the at least one first parameter corresponding to the first operation determination model and the information associated with the operation corresponding to the at least one first parameter.

16. The electronic device of claim **14**, wherein, as at least a part of the providing of at least some among the value corresponding to the at least one first parameter, the information associated with the operation corresponding to the at least one first parameter, and the reward value identified based on at least a part of the value corresponding to the at least one first parameter to the first learning learner as the experience information,

the at least one processor is configured to: select a part among the value corresponding to the at least one first parameter, the information associated with the operation corresponding to the at least one first parameter, and the value corresponding to the at least one first parameter, and

provide the selected part and a reward value identified based on the selected part to the first learning leaner as the experience information.

17. A method of operating an electronic device, the method comprising:

storing a key performance indicator (KPI) table in which at least one value corresponding to each of at least one parameter associated with a radio access network (RAN), and information associated with an operation performed by the RAN are classified for each of a plurality of points in time, wherein, a value corresponding to at least some parameters among the at least one parameter is used when at least one operation determination model executed by the electronic device determines at least a part of the information associated with the operation;

detecting an event for updating a first operation determination model among the at least one operation determination model;

in response to the event detection, identifying a value corresponding to at least one first parameter corresponding to the first operation determination model and information associated with an operation corresponding to the at least one first parameter, by referring to the KPI; and

providing at least some among the value corresponding to the at least one first parameter, the information associated with the operation corresponding to the at least one first parameter, and a reward value identified based on at least a part of the value corresponding to the at least one first parameter, to a first learning leaner for learning the first operation determination model as the experience information.

18. The method of claim **17**, wherein the detecting of the event for updating the first operation determination model comprises;

detecting the event based on a threshold period elapsing from a point in time at which another experience information produced by the electronic device is provided, before the experience information.

19. The method of claim **17**, wherein the detecting of the event for updating the first operation determination model comprises;

detecting the event based on at least a part of the value corresponding to the at least one first parameter satisfying a designated condition.

20. The method of claim **17**, wherein the detecting of the event for updating the first operation determination model comprises;

detecting the event based on a request from the first learning learner and/or an external input.

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