

METHODS, APPARATUSES, DEVICES AND STORAGE MEDIA FOR PROCESSING INTERACTIVE INFORMATION

TECHNICAL FIELD

[0001] The present invention relates to the field of Internet of Things communication technology, and in particular, to methods, apparatuses, devices and storage media for processing interactive information.

BACKGROUND

[0002] In a distributed system under the Internet of Things scenario, a large number of devices are to be managed in a unified manner from cloud, and therefore, interactive information is to be transferred between the cloud and the devices. However, the devices may not always be connected to the cloud, and the connection quality also fluctuates, so the interaction between the cloud and the devices is not satisfactory.

SUMMARY

[0003] The present invention provides a method, apparatus, device and storage medium for processing interactive information, to solve deficiencies in the related art.

[0004] According to a first aspect of examples of the present invention, there is provided a method of processing interactive information, being applicable to a proxy server, including: receiving interactive information issued by a first device in a predetermined topic, wherein the first device indicates one of a cloud server and a terminal device; storing the interactive information to a storage path corresponding to the predetermined topic; in response to that a second device which subscribes to the predetermined topic is online, wherein the second device indicates the other one of the cloud server and the terminal device, reading the interactive information from the storage path corresponding to

the predetermined topic, and sending the read interactive information to the second device.

[0005] According to a second aspect of the examples of the present invention, there is provided a method of processing interactive information, being applicable to a cloud server, including: issuing expected configuration information in a predetermined topic to a proxy server, wherein the expected configuration information is stored to a storage path corresponding to the predetermined topic by the proxy server, and is to be sent by the proxy server to a terminal device which subscribes to the predetermined topic when the terminal device is online; and receiving first response information which is sent by the proxy server after that the proxy server has stored the expected configuration information to the storage path corresponding to the predetermined topic, wherein the first response information indicates that the expected configuration information is successfully delivered.

[0006] According to a third aspect of the examples of the present invention, there is provided a method of processing interactive information, being applicable to a terminal device, including: in a case that the terminal device subscribes to a first topic, receiving expected configuration information sent by a proxy server, wherein the first topic includes an identifier of the terminal device, the expected configuration information is issued by a cloud server in the first topic, and the expected configuration information is stored to a storage path corresponding to the first topic by the proxy server; issuing second response information in a second topic to the proxy server, wherein the second topic includes an identifier of the terminal device or a wildcarded identifier, the wildcarded identifier indicates two or more terminal devices, the second response information characterizes a response to the received expected configuration information, and the second response information is stored to a storage path corresponding to the second topic by the proxy server, and is to be sent by the proxy server to a cloud server which subscribes to the

second topic when the cloud server is online.

[0007] According to a fourth aspect of the examples of the present invention, there is provided an apparatus of processing interactive information, being applicable to a proxy server, including: a first receiving unit configured to receive interactive information issued by a first device in a predetermined topic, wherein the first device indicates one of a cloud server and a terminal device; a storing unit configured to store the interactive information to a storage path corresponding to the predetermined topic; a sending unit configured to, in response to that a second device which subscribes to the predetermined topic is online, wherein the second device indicates the other one of the cloud server and the terminal device, reading the interactive information from the storage path corresponding to the predetermined topic, and sending the read interactive information to the second device.

[0008] According to a fifth aspect of the examples of the present invention, there is provided an apparatus of processing interactive information, being applicable to a cloud server, including: a first issuing unit configured to issue expected configuration information in a predetermined topic to a proxy server, wherein the expected configuration information is stored to a storage path corresponding to the predetermined topic by the proxy server, and is to be sent by the proxy server to a terminal device which subscribes to the predetermined topic when the terminal device is online; and a second receiving unit configured to receive first response information which is sent by the proxy server after that the proxy server has stored the expected configuration information to the storage path corresponding to the predetermined topic, wherein the first response information characterizes that the expected configuration information is successfully delivered.

[0009] According to a sixth aspect of the examples of the present invention, there is provided an apparatus of processing interactive information, being applicable to a terminal server, including: a third receiving unit configured to, in a case that the terminal device

subscribes to a first topic, receive expected configuration information sent by a proxy server, wherein the first topic includes an identifier of the terminal device, the expected configuration information is issued by a cloud server in the first topic, and the expected configuration information is stored to a storage path corresponding to the first topic by the proxy server; a second issuing unit configured to issue second response information in a second topic to the proxy server, wherein the second topic includes an identifier of the terminal device or a wildcarded identifier, the wildcarded identifier indicates two or more terminal devices, the second response information characterizes a response to the received expected configuration information, and the second response information is stored by the proxy server to a storage path corresponding to the second topic, and is to be sent by the proxy server to a cloud server which subscribes to the second topic when the cloud server is online.

[0010] According to a seventh aspect of the examples of the present invention, there is provided a system of processing interactive information, including: a proxy server configured to receive interactive information issued by a first device in a predetermined topic, store the interactive information to a storage path corresponding to the predetermined topic, and in response to that a second device which subscribes to the predetermined topic is online, read the interactive information from the storage path corresponding to the predetermined topic, and send the read interactive information to the second device, wherein the first device indicates one of a cloud server and a terminal device, the second device indicates the other one of the cloud server and the terminal device; the cloud server configured to issue expected configuration information in the predetermined topic to the proxy server, and receive first response information which is sent by the proxy server after that the proxy server has stored the expected configuration information to the storage path corresponding to the predetermined topic; the terminal

device configured to receive expected configuration information sent by the proxy server, and issue second response information in a second topic to the proxy server, wherein the second response information characterizes a response to the received expected configuration information.

[0011] According to an eighth aspect of the examples of the present invention, there is provided an electronic device, including: a memory; and a processor, wherein the memory is configured to store computer instructions runnable on the processor, and the processor is configured to execute the computer instructions to implement the method according to the first aspect, the second aspect or the third aspect.

[0012] According to a ninth aspect of the examples of the present invention, there is provided a computer readable storage medium having computer programs stored thereon, wherein the programs are executed by a processor to implement the method according to the first aspect, the second aspect or the third aspect.

[0013] As can be known from the above examples, interactive information issued by one of a cloud server and a terminal device in a predetermined topic is received and stored to a storage path corresponding to the predetermined topic, and thus when the other one of the cloud server and the terminal device that subscribes to the predetermined topic is online, the interactive information can be read from the storage path corresponding to the predetermined topic and sent to the other one of the cloud server and the terminal device. In this way, the interactive information may be stored using the storage path corresponding to the predetermined topic, and may be acquired by the other one of the cloud server and the terminal device when it is online, which reduces the dependence of information interaction between the terminal device and the cloud server on network connection quality. As a result, the information interaction between the cloud server and the terminal device does not need to be retried due to the network connection problem between them,

which improves interaction efficiency. In addition, by combining the predetermined topic with an issuing and subscribing mechanism to realize the transmission of the interactive information, the accuracy of the transmission of the interactive information may be effectively improved.

[0014] It should be understood that the above general description and the following detailed description are only exemplary and explanatory and are not restrictive of the present disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate examples consistent with the present disclosure and, together with the description, serve to explain the principles of the disclosure.

[0016] FIG. 1 is a flowchart illustrating a method of processing interactive information according to an example of the present invention.

[0017] FIG. 2 is a flowchart illustrating another method of processing interactive information according to an example of the present invention.

[0018] FIG. 3 is a flowchart illustrating still another method of processing interactive information according to an example of the present invention.

[0019] FIG. 4A is a schematic view illustrating a configuration delivery process according to an example of the present invention.

[0020] FIG. 4B is a schematic view illustrating a state report process according to an example of the present invention.

[0021] FIG. 5 is a schematic structural diagram illustrating an apparatus for processing interactive information according to an example of the present invention.

[0022] FIG. 6 is a schematic structural diagram illustrating another apparatus for processing interactive information according to an example of the present invention.

[0023] FIG. 7 is a schematic structural diagram illustrating still another apparatus for processing interactive information according to an example of the present invention.

[0024] FIG. 8 is a schematic structural diagram illustrating an electronic device according to an example of the present invention.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0025] Examples will be described in detail herein, with the illustrations thereof represented in the drawings. When the following descriptions involve the drawings, like numerals in different drawings refer to like or similar elements unless otherwise indicated. The embodiments described in the following examples do not represent all embodiments consistent with the present disclosure. Rather, they are merely examples of apparatuses and methods consistent with some aspects of the present disclosure as detailed in the appended claims.

[0026] The terms used in the present disclosure are for the purpose of describing particular examples only, and are not intended to limit the present disclosure. Terms determined by “a”, “the” and “said” in their singular forms in the present disclosure and the appended claims are also intended to include plurality, unless clearly indicated otherwise in the context. It should also be understood that the term “and/or” as used herein refers to and includes any and all possible combinations of one or more of the associated listed items.

[0027] It is to be understood that, although terms “first,” “second,” “third,” and the like may be used in the present disclosure to describe various information, such information should not be limited to these terms. These terms are only used to distinguish one category of information from another. For example, without departing from the scope of the present disclosure, first information may be referred as second information; and similarly, second information may also be referred as first information. Depending on the context, the word

“if” as used herein may be interpreted as “when” or “upon” or “in response to determining”.

[0028] At least one example of the present invention provides a method of processing interactive information. Reference may be made to FIG. 1, which shows the procedure of the method, including step S101 to step S103.

[0029] The processing method may be applied to a distributed system under an Internet of Things scenario. Therefore, the interactive information processed by the method may be interactive information in the distributed system. The distributed system may include a cloud server, a proxy server, and a plurality of terminal devices. The proxy server and the cloud server may be disposed separately or combined into a whole persistently. The interactive information may be, for example, expected configuration information sent by the cloud server to a terminal device, or actual configuration state information sent by a terminal device to the cloud server. When the method of processing interactive information is described below in the present disclosure, information interaction between a terminal device and the cloud server is taken as an example for illustration, but the present disclosure is not intended to limit the number of terminal devices.

[0030] In addition, the method of processing interactive information shown in FIG. 1 may be applied to the proxy server in the distributed system.

[0031] At step S101, interactive information issued by one of a cloud server and a terminal device (hereinafter can be referred to as a first device, and “the other one of the cloud server and the terminal device” can be referred to as a second device) in a predetermined topic is received. The interactive information may include expected configuration information issued by the cloud server for the terminal device, a response of the terminal device to received expected configuration information, or actual configuration state information of the terminal device.

[0032] The cloud server and the proxy server may realize network connection in a wired or wireless manner. The terminal device and the proxy server may also realize network connection in a wired or wireless manner. The first device may be the cloud server, correspondingly, the second device may be the terminal device. Or, the first device may be the terminal device, correspondingly, the second device may be the cloud server. The cloud server may issue the expected configuration information of the terminal device to the proxy server, so that the proxy server may receive the expected configuration information of the terminal device sent by the cloud server. The terminal device may issue the actual configuration state information of the terminal device to the proxy server, so that the proxy server may receive the actual configuration state information issued by the terminal device.

[0033] The expected configuration information and the actual configuration state information may correspond to different topics. Therefore, for interactive information to be issued by the proxy server or the terminal device, a corresponding topic is selected according to the content or type of the to-be-issued interactive information, so to issue the to-be-issued interactive information in the selected topic. The proxy server may define a plurality of topics corresponding to the content or type of the interactive information in advance.

[0034] At step S102, the interactive information is stored to a storage path corresponding to the predetermined topic.

[0035] The interactive information issued in a predetermined topic may have an identifier of the predetermined topic. The proxy server may pre-store a mapping relationship between each predetermined topic and its identifier, and after receiving the interactive information, by identifying the identifier of topic in the interactive information, a topic corresponding to the interactive information may be selected out from the mapping

relationship. In addition, the interactive information may have a unified information format, for example, a fixed character bit of the information is used to store the identifier of corresponding topic, which may facilitate the identification by the proxy server.

[0036] Different storage paths may indicate different storage partitions, different storage disks or different folders in the proxy server. It is possible to set a storage path and assign corresponding storage address for each predetermined topic. For storing interactive information, by comparing a topic of the interactive information with respective topics of all preset storage paths, a storage path corresponding to the topic of the interactive information may be found. Alternatively, it is possible to establish corresponding storage path when interactive information is to be stored. That is, each time a piece of interactive information of a new topic is occurred, a new corresponding storage path may be established. Specifically, when storing interactive information, it is possible to traverse respective topics of all storage paths in the proxy server firstly based on a topic of the interactive information. If there is a storage path matched with the topic of the interactive information, the interactive information is directly stored to the matched storage path. If there is no storage path matched with the topic of the interactive information, a new storage path is established and is marked with a topic that is the same as the topic of the interactive information, and the interactive information is stored to the newly established storage path.

[0037] At step S103, in response to that other one of the cloud server and the terminal device (hereinafter can be referred to as a second device) which subscribes to the predetermined topic is online, the interactive information is read from the storage path corresponding to the predetermined topic, and the read interactive information is sent to the second device.

[0038] If the interactive information received at the step S101 comes from the cloud

server, the interactive information may be sent to the terminal device at this step. If the interactive information received at the step S101 comes from the terminal device, the interactive information may be sent to the cloud server.

[0039] Being online may mean that there is an effective network connection with the proxy server, and being offline may mean that there is no effective network connection with the proxy server.

[0040] The cloud server being online may mean that there is an effective network connection between the cloud server and the proxy server. In this case, data transmission may be performed between the cloud server and the proxy server. The cloud server being offline may mean that there is no effective network connection between the cloud server and the proxy server, for example, a complete disconnection or a poor quality connection. The proxy server, when determining whether the cloud server is online, may send a detection signal to the cloud server, for example, send a heartbeat signal according to a predetermined period of time, and determine whether a response signal to the detection signal is received within a certain period of time after sending the detection signal. If the response signal to the detection signal is received, it may be determined that the cloud server is online.

[0041] Similarly, the terminal device being online may mean that there is an effective network connection between the terminal device and the proxy server. In this case, data transmission may be performed between the terminal device and the proxy server. The terminal device being offline may mean that there is no effective network connection between the terminal device and the proxy server, for example, a complete disconnection or a poor quality connection. The proxy server, when determining whether the terminal device is online, may send a detection signal to the terminal device, for example, send a heartbeat signal according to a predetermined period of time, and determine whether a

response signal to the detection signal is received within a certain period of time after sending the detection signal. If the response signal to the detection signal is received, it may be determined that the terminal device is online. There may be a plurality of terminal devices. It is possible to determine whether the terminal devices are online one by one, according to the above determining manner. It is also possible to send a detection signal to a plurality of terminal devices in a unified manner by broadcasting, detect whether a response signal to the detection signal is received within a certain period of time, and determine that a terminal device corresponding to ID information carried in the detected response signal is online.

[0042] In addition, the interactive information at the step S101 is issued in a case where the cloud server or the terminal device is online.

[0043] The cloud server and/or the terminal device may subscribe to a specific topic from the proxy server, and the topic subscribed to may characterize information demands of the cloud server and/or the terminal device. Therefore, the cloud server and/or the terminal device may purposefully monitor the interactive information in the proxy server, that is, the interactive information of a topic subscribed to by itself, according to the information demands. The monitoring may be performed in real time, or at a specific time point according to a certain frequency. The cloud server and/or the terminal device may monitor whether there is new information in a storage path corresponding to the topic subscribed to by itself. If it is found that there is new information in the path, the proxy server is requested for obtaining the information. The proxy server may deliver the information to the cloud server and/or the terminal device which request(s) for obtaining the information.

[0044] As can be known from the above analysis, the proxy server, after storing the interactive information to the storage path corresponding to the predetermined topic

according to the step S102, may verify, according to the request of the cloud server and/or the terminal device for obtaining the interactive information, whether the requestor(s) (i.e., the cloud server and/or the terminal device which send(s) the obtaining request) is/are online and subscribe(s) to the topic of the interactive information. If the verification result indicates that the requestor(s) is/are online and subscribe(s) to the topic of the interactive information, the interactive information is delivered to the requestor(s).

[0045] As can be known from the above example, interactive information issued by one of a cloud server and a terminal device in a predetermined topic is received; the interactive information is stored to a storage path corresponding to the predetermined topic; and in response to that the other one of the cloud server and the terminal device which subscribes to the predetermined topic is online the interactive information is read from the storage path corresponding to the predetermined topic, and the read interactive information is sent to the other one of the cloud server and the terminal device. In this way, the interactive information may be stored using the storage path corresponding to the predetermined topic, and when the other one of the cloud server and the terminal device is online, the interactive information may be obtained, which reduces the dependence of information interaction between the terminal device and the cloud server on network connection quality. Therefore, the information interaction between the cloud server and the terminal device does not need to be retried due to their network connection problem, which improves interaction efficiency. In addition, combination of the predetermined topic with an issuing and subscribing mechanism is used to realize the transmission of the interactive information, which improves the transmission accuracy of the interactive information.

[0046] In some examples of the present disclosure, the proxy server may process the interactive information in the following manner: firstly, receiving first expected configuration information issued by the cloud server in a first topic; next, storing the first

expected configuration information to a storage path corresponding to the first topic; finally, in response to that the terminal device which subscribes to the first topic is online, reading the first expected configuration information from the storage path corresponding to the first topic, and sending the read first expected configuration information to the terminal device.

[0047] The interactive information starts from the cloud server, and reaches the terminal device through the proxy server. That is, the interactive information is transmitted in a direction from the cloud server to the proxy server and then to the terminal device. The cloud server is a sender of the interactive information, and the terminal device is a receiver of the interactive information. The content of the interactive information is the first expected configuration information. That is, this process is a process in which the cloud server delivers configuration to the terminal device.

[0048] After the first expected configuration information is sent to the proxy server, the proxy server stores the first expected configuration information, and after the terminal device that subscribes to the first topic, that is, a device targeted by the first expected configuration information, is online, the first expected configuration information will be automatically delivered to the terminal device. Therefore, although the cloud server does not directly send the first expected configuration information to the terminal device, the first expected configuration information being sent to the proxy server may already be regarded as being successfully sent to the terminal device. Therefore, the proxy server, after storing the first expected configuration information to the storage path corresponding to the first topic, may return first response information to the cloud server. The first response information characterizes that the first expected configuration information is successfully delivered. The storing by the proxy server enables the cloud server to deliver configuration information to the terminal device without depending on a constantly online

terminal device and network connection quality. Therefore, the cloud server may deliver configuration information at any time, which reduces the difficulty in configuration information delivery.

[0049] The first expected configuration information may characterize a target expected state for a configuration item of the terminal device. That is, the first expected configuration information may indicate a configuration state expected by the cloud server to the terminal device which is to receive the information. It is possible to obtain configuration change information and real-time configuration information of the terminal device. The configuration change information and the real-time configuration information may be combined to obtain the first expected configuration information, i.e., the configuration state obtained by applying the configuration change information to the real-time configuration information. The target expected state is a kind of declarative configuration information. That is, the target expected state declares a state expected by the cloud server. The terminal device, after receiving the declarative configuration information, may check the difference from its actual configuration state, and perform corresponding configuration adjustment according to difference items, which avoids various specific adjustment items from being listed in interactive configuration information in detail, realizes interactive information simplification, saves interactive information transmission traffic, and improves interactive information transmission efficiency.

[0050] The first topic may include an identifier of the terminal device, and the terminal device may subscribe to a topic including the identifier of the terminal device. For example, the first topic may include an identifier of corresponding storage path such as `/device/{device_id}/ config`, wherein the `device_id` is a wildcarded identifier which indicates two or more terminal devices. For a particular terminal device, the “id” is

adaptively modified to an identifier of the particular terminal device. That is, the first topic includes the identifier of the terminal device targeted by the first expected configuration information. The proxy server may determine the receiver of the interactive information according to the identifier of the terminal device included in the first topic. That is, it is determined that the terminal device indicated by the identifier of the terminal device included in the first topic is the receiver of the interactive information. Therefore, the first expected configuration information is sent to the terminal device as the receiver. By setting, in the first topic, the identifier of the terminal device that subscribes to the first topic, the pertinence of the first expected configuration information may be improved. Thereby, the first expected configuration information is accurately sent to a to-be-configured terminal device, improving accuracy for configuration delivery of the terminal device. At the same time, by setting the identifier of the terminal device in the first topic, various terminal devices are allowed to subscribe to different first topics, which may help to isolate respective communication channels of different terminal devices and managing the authority in a unit of a terminal device.

[0051] In some examples of the present disclosure, after storing the interactive information to the storage path corresponding to the predetermined topic, the method further includes: marking the first expected configuration information with a reserved information mark to indicate the first expected configuration information is reserved information of the first topic. Based on the marking operation, the interactive information may be sent in the following manner: in response to that the terminal device which subscribes to the first topic is online, reading expected configuration information with the reserved information mark from the storage path corresponding to the first topic, and sending the read expected configuration information with the reserved information mark to the terminal device.

[0052] The reserved information may be effective information of corresponding topic, that is, information with the highest importance or priority. When delivering interactive information of a topic, interactive information of the topic with a reserved information mark may be delivered. When new interactive information is stored in a storage path corresponding to the topic, the new interactive information may be marked as reserved information, and the reserved information mark of original interactive information in the storage path corresponding to the topic may be deleted. That is, only one piece of the latest interactive information under the same topic is marked as reserved information, i.e., effective information, and other information is expired ineffective information. In this way, the terminal device, when reading information from a storage path corresponding to a topic to which the terminal device subscribes, may successfully read the latest interactive information. Moreover, for a terminal device which is being offline currently, as the interactive information is to be send to the terminal device by the proxy server when the terminal device is online, while the cloud server may deliver expected configuration information of the terminal device to the proxy server many times, by marking only the delivered latest expected configuration information as reserved information. In this way, the terminal device, after being online, receives the latest expected configuration information sent by the proxy server without receiving multiple pieces of interactive information. Further, the interaction information may be delivered in a declarative manner. For example, in the first expected configuration information, the target expected state of the configuration item of the terminal device is declared. According to the method in this example, the terminal device, after being online, receives only the latest first expected configuration information, so that the configuration item of the terminal device may be updated to the latest state based on the first expected configuration information, which simplifying the configuration update of the terminal device.

[0053] In addition, the unique expected configuration information for delivery may be determined by the reserved information. Thereby, the delivery accuracy of the expected configuration information may be improved.

[0054] For multiple pieces of expected configuration information stored in the first topic, one of them needs to be marked as reserved information of the first topic. It is possible to firstly rank the importance or priority of the multiple pieces of expected configuration information, and finally take the highest rank to be marked as reserved information of the first topic. Optionally, a timestamp of newly received expected configuration information may be compared with a timestamp of original expected configuration information with a reserved information mark, and when the timestamp of the newly received expected configuration information is larger, that is, the time of generating the newly received expected configuration information is later, the original reserved information mark is deleted, and the newly received expected configuration information is marked as reserved information.

[0055] After storing the first expected configuration information to the storage path corresponding to the first topic, the method further includes: firstly, in response to receiving second expected configuration information issued by the cloud server in the first topic, storing the second expected configuration information to the storage path corresponding to the first topic; next, marking the second expected configuration information with the reserved information mark to indicate that the second expected configuration information is the reserved information of the first topic, and deleting the reserved information mark of the first expected configuration information.

[0056] The second expected configuration information is expected configuration information received after the first expected configuration information. For the second expected configuration information, in addition to storing it to the storage path

corresponding to the first topic, it is marked as the reserved information of the first topic instead of the first expected configuration information. That is, after the second expected configuration information is stored to the storage path corresponding to the first topic, the reserved information mark of the first topic is transferred from the first expected configuration information to the second expected configuration information.

[0057] In an application scenario of examples of the present disclosure, the cloud server may uniformly manage the configuration of a plurality of terminal devices. The cloud server may update the configuration of the plurality of terminal devices regularly or as required, generate expected configuration information, and deliver, to the proxy server, the expected configuration information as a topic subscribed to by a terminal device with to-be-updated configuration. When the cloud server delivers new expected configuration information, the proxy server transfers a reserved information mark of a topic subscribed to by each terminal device to the new expected configuration information, and each terminal device, after being online, may successfully obtain the latest expected configuration information.

[0058] It is understandable that the process of transferring the reserved information mark of the first topic mentioned above is only an example. The proxy server, after receiving the second expected configuration information, will continue to receive other expected configuration information such as third expected configuration information, and fourth expected configuration information. As a result, every time new expected configuration information is received, the reserved information mark of the first topic is transferred once, that is, from other expected configuration information to the received new expected configuration information.

[0059] In addition, every time the reserved information mark of the first topic is transferred, it may be re-determined that whether the terminal device which subscribes to

the first topic is online. If the terminal device which subscribes to the first topic is online, new expected configuration information with a reserved information mark of the first topic is re-delivered to the terminal device. If in the process of determining that whether the terminal device which subscribes to the first topic is online, the reserved information mark of the first topic is transferred, after it is determined that the terminal device which subscribes to the first topic is online, the latest expected configuration information with a reserved information mark is directly sent to the terminal device.

[0060] In some examples of the present disclosure, after sending the first expected configuration information or the second expected configuration information, the proxy server may process the interactive information in the following manner: firstly, receiving second response information issued by the terminal device in a second topic, wherein the second response information characterizes a response of the terminal device to received expected configuration information; next, storing the second response information to a storage path corresponding to the second topic; finally, in response to the cloud server which subscribes to the second topic is online, reading the second response information from the storage path corresponding to the second topic, and sending the read second response information to the cloud server.

[0061] The second response information characterizes the response of the terminal device to the received expected configuration information, that is, a response of the terminal device after receiving the first expected configuration information or the second expected configuration information. The content of the second response information may include information indicating a delivery state of expected configuration information such as “the expected configuration information is successfully received”, or a configuration update state such as “the configuration update has been completed”. Optionally, the second response information may be sent from different nodes of processing the received

expected configuration information by the terminal device. For example, the terminal device, after receiving the first expected configuration information, reports the second response information once. The state indicated by the second response information is “the configuration has been received”. Next, the terminal device determines whether the configuration information is legal, and after the determination ends, reports a determination result as response content. Then, the terminal device performs configuration update according to the configuration information, and reports a configuration update progress such as “the configuration has taken effect” as a response content. By setting the proxy server, the cloud server may view the response information of the terminal device at any time without having to rely on the online state of the terminal device and the network connection quality.

[0062] In addition, the second response information is sent for the latest expected configuration information received by the terminal device. That is to say, the terminal device, after receiving the first expected configuration information, starts to report the second response information to the first expected configuration information. Optionally, the cloud server and/or the proxy server may select whether to deliver new configuration information, for example, the second expected configuration information, according to actual needs. Moreover, the terminal device, after receiving new expected configuration information, for example, the second expected configuration information, starts to report second response information to the new expected configuration information, for example, the second expected configuration information.

[0063] The second topic includes an identifier of the terminal device. That is, the second topic includes the identifier of the terminal device that reports a response. For example, the form of the second topic may be /device/{device_id}/config_ack, wherein device_id is a wildcarded identifier which indicates two or more terminal devices. For a particular

terminal device, the “id” may be adaptively modified to an identifier of the particular terminal device. After the cloud server receives the second response information in the second topic, the second response information may be determined as from the terminal device, which improving the accuracy and pertinence of the cloud server obtaining respective responses from terminal devices. The cloud server, in a scenario of performing unified configuration management on a plurality of terminal devices, may receive second response information reported by a plurality of terminal devices, and subscribe to a plurality of second topics including the identifier of the terminal device through a wildcarded identifier, realizing the monitoring of a configuration delivery state or a configuration update state of a plurality of terminal devices.

[0064] In some examples of the present disclosure, interactive information may be sent by a terminal device, and a target receiver of the interactive information is a cloud server. The interactive information may be actual configuration state information reported by the terminal device. The proxy server may process the interactive information in the following manner: receiving the actual configuration state information issued by the terminal device in a third topic; storing the actual configuration state information to a storage path corresponding to the third topic; in response to the cloud server which subscribes to the third topic is online, reading the actual configuration state information from the storage path corresponding to the third topic, and sending the read actual configuration state information to the cloud server.

[0065] The interactive information is triggered from the terminal device, and reaches the cloud server through the proxy server. That is, the interactive information is transmitted in a direction from the terminal device to the proxy server and then to the cloud server. The terminal device is a sender of the interactive information, and the cloud server is a receiver of the interactive information. The content of the interactive information is the actual

configuration state information of the terminal device. This process is a process in which the terminal device reports a configuration state to the cloud server. The terminal device may report the configuration state at a certain time interval, or be triggered by a particular event, for example, configuration changes or a cloud terminal initiates a configuration state query request, to report the configuration state. Relaying the actual configuration state information of the terminal device by the proxy server enables the cloud server to view the state information of the terminal device at any time without relying on the online state of the terminal device and the network connection quality.

[0066] The third topic includes an identifier of the terminal device that reports the actual configuration state information. For example, the third topic may be “/device/{device_id}/state”, which corresponds to the storage path of the third topic, wherein “device_id” is a wildcarded identifier which indicates two or more terminal devices. For a particular terminal device, the “id” may be adaptively modified to an id of the particular terminal device. The cloud server, after receiving the actual configuration state information issued in the third topic, may determine, according to the third topic, the terminal device that sends the actual configuration state information so as to accurately synchronize the actual configuration state information of the terminal device to a cloud database. In a scenario where a cloud terminal manages configuration states of a plurality of terminal devices, a cloud server may obtain actual configuration state information reported by a plurality of terminal devices, and subscribe to a plurality of third topics through a wildcarded identifier, realizing the monitoring and management of states of a plurality of terminal devices.

[0067] It should be noted that the cloud server, after receiving the actual configuration state information, may store the actual configuration state information to the cloud database, and in response to an instruction from a call object to query a configuration state

of the terminal device, send the actual configuration state information of the queried terminal device to the call object.

[0068] The call object may be a user, or other devices connected to the cloud server that need to call or read the configuration state of the terminal device. The call object may issue a call instruction to the cloud server to obtain the actual configuration state information of the terminal device. Since the actual configuration state information of the terminal device has been persistently stored to the cloud database, the call object may obtain actual state information of the terminal device in real time, without relying on whether the terminal device is online, which improves the flexibility of querying actual configuration state information of the terminal device.

[0069] In some examples of the present disclosure, before in response to that the second device which subscribes to the predetermined topic is online, reading the interactive information from the storage path corresponding to the predetermined topic, and sending the read interactive information to the second device, it is also possible to receive subscription information to the predetermined topic from the second device.

[0070] In this example, the cloud server or the terminal device, before receiving the interactive information issued in the predetermined topic for the first time, may send subscription information to the predetermined topic to the proxy server so as to subscribe to the predetermined topic from the proxy server. After that, the cloud server or the terminal device may not repeatedly subscribe to the predetermined topic, even before receiving subsequent interactive information issued in the predetermined topic.

[0071] The cloud server or the terminal device may subscribe to corresponding predetermined topic in advance according to information needs. For example, the terminal device may send subscription information to the first topic to the proxy server in advance so as to subscribe to the interactive information in the first topic from the proxy server.

Further, the terminal device may subscribe to, from the proxy server, the interactive information in the first topic including an identifier of the terminal device, so that configuration may be delivered accurately and purposefully. For another example, the cloud server may send subscription information to the second topic to the proxy server in advance so as to subscribe to the interactive information in the second topic from the proxy server. Further, the cloud server may subscribe to, from the proxy server, the interactive information in the second topic including an identifier of any terminal device, that is, the second response information reported by all terminal devices. Optionally, the cloud server may subscribe to, from the proxy server through a wildcarded identifier, the interactive information in the second topic including the identifier of any terminal device. For another example, the cloud server may send subscription information to the third topic to the proxy server in advance so as to subscribe to the interactive information in the third topic from the proxy server. The cloud server may subscribe to, from the proxy server, the interactive information in the third topic including an identifier of any terminal device, that is, actual configuration state information reported by all terminal devices. For example, the cloud server may subscribe to, from the proxy server through a wildcarded identifier, the interactive information in the third topic including the identifier of any terminal device.

[0072] In the second aspect, at least one example of the present disclosure provides a method of processing interactive information. Reference may be made to FIG. 2, which shows the procedure of the method, including step S201 to step S202.

[0073] The application scenario of the processing method has been described in detail in the first aspect, and will not be repeated here. It should be noted that the method of processing interactive information shown in FIG. 2 may be applied to the cloud server in the distributed system.

[0074] At step S201, expected configuration information is issued in a predetermined topic to a proxy server. The expected configuration information is stored by the proxy server to a storage path corresponding to the predetermined topic, and in a case where a terminal device subscribing to the predetermined topic is online, is to be sent to the terminal device.

[0075] This step is a process in which the cloud server delivers configuration to the terminal device. Reference may be made to the description of related contents in the first aspect.

[0076] At step S202, first response information sent by the proxy server after that the proxy server has stored the expected configuration information to the storage path corresponding to the predetermined topic is received. The first response information characterizes that the expected configuration information is successfully delivered.

[0077] This step is a process in which the proxy server sends the first response information to the cloud server. Reference may be made to the description of related contents in the first aspect.

[0078] In some examples of the present disclosure, the expected configuration information may be issued in the predetermined topic to the proxy server in the following manners: issuing, to the proxy server, first expected configuration information in a first topic subscribed to by a to-be-configured terminal device. The first topic may include an identifier of the terminal device which subscribes to the first topic.

[0079] The above contents have been described in detail in the first aspect, and will not be repeated here. Reference may be made to the description of related contents in the first aspect.

[0080] In some examples of the present disclosure, after issuing, to the proxy server, the first expected configuration information in the first topic subscribed to by the

to-be-configured terminal device, it is also possible to issue second expected configuration information in the first topic to the proxy server. The second expected configuration information is stored by the proxy server to the storage path corresponding to the first topic and marked as reserved information of the first topic, and in a case where the terminal device subscribing to the predetermined topic is online, the second expected configuration information is sent to the terminal device.

[0081] The above contents describe a process in which expected configuration information is continuously delivered. Reference may be made to the description of related contents in the first aspect.

[0082] It should be noted that the first expected configuration information and the second expected configuration information may be generated according to configuration instructions. The configuration instructions may be directly or indirectly input by a user for the cloud server. For example, the first expected configuration information may be generated according to a first configuration instruction, and the second expected configuration information may be generated according to a second configuration instruction. In addition, since there may exist a situation where multiple users input configuration instructions at the same time, a concurrent protection mechanism may be set, so that expected configuration information is generated according to a configuration instruction under the concurrent protection mechanism. The concurrent protection mechanism may be formed by an optimistic lock.

[0083] In some examples of the present disclosure, after issuing the expected configuration information to the proxy server, it is also possible to receive second response information sent by the proxy server to the cloud server subscribing to the second topic through a wildcarded identifier. The second response information characterizes a response of the terminal device to received expected configuration information, and the second

response information is issued in the second topic by the terminal device to the proxy server, and stored by the proxy server to the storage path corresponding to the second topic.

[0084] The above contents describe a process in which the terminal device reports the second response information. Reference may be made to the description of related contents in the first aspect.

[0085] In some examples of the present disclosure, after issuing the expected configuration information to the proxy server, it is also possible to receive actual configuration state information sent by the proxy server to the cloud server subscribing to the third topic through a wildcarded identifier. The actual configuration state information is issued in the third topic by the terminal device to the proxy server, and stored to the storage path corresponding to the third topic.

[0086] The above contents describe a process in which the terminal device reports the actual configuration state information. Reference may be made to the description of related contents in the first aspect.

[0087] It should be noted that the cloud server, after receiving the actual configuration state information, may store the actual configuration state information to the cloud database, and in response to an instruction from a call object to query a configuration state of the terminal device, send the actual configuration state information of the queried terminal device to the call object.

[0088] In some examples of the present disclosure, the cloud server may send subscription information to the second topic to the proxy server in advance so as to subscribe to the interactive information in the second topic from the proxy server. The cloud server may send subscription information to the third topic to the proxy server in advance so as to subscribe to the interactive information in the third topic from the proxy

server. The above process of subscribing to a topic has been described in detail in the first aspect, and will not be repeated here. Reference may be made to the description of related contents in the first aspect.

[0089] For other details in each process of the method shown in FIG. 2, reference may be made to the description of related contents in the first aspect.

[0090] In the third aspect, at least one example of the present disclosure provides a method of processing interactive information. Reference may be made to FIG. 3, which shows the procedure of the method, including step S301 to step S302.

[0091] The application scenario of this processing method has been described in detail in the first aspect, and will not be repeated here. It should be noted that the method of processing interactive information shown in FIG. 3 may be applied to the terminal device in the distributed system.

[0092] At step S301, expected configuration information sent by a proxy server is received. The expected configuration information is issued in a first topic by a cloud server, and the expected configuration information is stored by the proxy server to a storage path corresponding to the first topic, and is to be sent in response to a terminal device subscribing to the first topic is online.

[0093] This step is a process in which the cloud server delivers configuration to the terminal device. Reference may be made to the description of related contents in the first aspect.

[0094] At step S302, second response information is issued in a second topic to the proxy server. The second response information characterizes a response to the received expected configuration information, and the second response information is stored by the proxy server to a storage path corresponding to the second topic, and is to be sent to the cloud server in response to the cloud server subscribing to the second topic is online.

[0095] This step is a process in which the terminal device reports the second response information. Reference may be made to the description of related contents in the first aspect.

[0096] In some examples of the present disclosure, the terminal device may issue actual configuration state information in the third topic to the proxy server, where the actual configuration state information is stored by the proxy server to the storage path corresponding to the third topic, and in a case where the cloud server subscribing to the third topic is online, is sent to the cloud server.

[0097] The above contents describe a process in which the terminal device reports a state. Reference may be made to the description of related contents in the first aspect.

[0098] For other details in each process of the method shown in FIG. 3, reference may be made to the description of related contents in the first aspect.

[0099] In the fourth aspect, at least one example of the present disclosure provides a method of processing interactive information. The processing method is applied to the distributed system mentioned in the first aspect. The processing method is described below in detail with reference to FIGS. 4A and 4B.

[0100] Reference may be made to FIG. 4A, which shows a process in which a cloud server delivers configuration information to a terminal device through a proxy server. To begin with, at S411: first expected configuration information is generated, that is, a user inputs a first configuration instruction to a cloud server to generate the first expected configuration information according to the first configuration instruction. Next, at S412: the cloud server issues the first expected configuration information in a first topic to a proxy server, and the proxy server stores the first expected configuration information and marks it as reserved information of the first topic. At this time, a terminal device may be offline, so that the first expected configuration information is not actually delivered, but it

can be deemed to be successfully delivered, and at S413, first response information is returned to indicate that the first expected configuration information is successfully delivered. In a case where the terminal device is online, S414 is performed to subscribe to the first topic. Then, when new information under the first topic is monitored by the terminal device, S415 is performed, i.e., the proxy server delivers the first expected configuration information to the terminal device. When the user desires to update a configuration state of the terminal device, S416 is performed to generate second expected configuration information. For example, the user inputs a second configuration instruction to the cloud server to generate the second expected configuration information according to the second configuration instruction. The cloud server may perform S417 to use an optimistic lock to verify the legality of the second expected configuration information. In a case where a verification result shows that the second expected configuration information is legal configuration information, S418 is performed, i.e., the cloud server issues the second expected configuration information in the first topic to the proxy server, and the proxy server stores the second expected configuration information and marks it as the reserved information of the first topic while deleting a reserved information mark of the first expected configuration information. Thereafter, at S419, the cloud server returns the first response information to indicate that the second expected configuration information is successfully delivered. In a case where the terminal device is online, the proxy server performs S410 to deliver the second expected configuration information to the terminal device.

[0101] In addition, as shown in FIG. 4A, the cloud server may subscribe to a second topic from the proxy server in advance at S431, for example, the cloud server may subscribe to all second topics including an identifier of the terminal device through a wildcarded identifier. Accordingly, when the terminal device is online, the terminal device

may issue second response information in a second topic to the proxy server at S432, so that the proxy server may store the second response information. The second response information indicates a response of the terminal device to received expected configuration information. Then, at S433, the proxy server report the second response information to the cloud server being online.

[0102] Reference may be made to FIG. 4B, which shows a process in which a terminal device reports state information to a cloud server through a proxy server. At S421, the cloud server subscribes to a third topic from the proxy server in advance, and may subscribe to all third topics including an identifier of the terminal device through a wildcarded identifier. The terminal device may, at S422, issue actual configuration state information in a third topic to the proxy server, and the proxy server stores the actual configuration state information. Next, at S423, the proxy server reports the actual configuration state information to the cloud server being online. Thereafter, at S424, the cloud server updates state information of the terminal device to received latest actual configuration state information. At S425, a call object such as a user inputs a call instruction to the cloud server. At S426, based on the call instruction at the S425, the cloud server returns the actual configuration state information to the call object such as the user.

[0103] It can be understood that both of the configuration delivery process shown in FIG. 4A and the state report process shown in FIG. 4B are examples of the method of processing interactive information provided by the present disclosure, and are not intended to limit the specific embodiments, application scenarios and step orders of the method of processing interactive information in the present disclosure.

[0104] With reference to FIG. 5, according to the fourth aspect of the examples of the present invention, there is provided an apparatus for processing interactive information, being applicable to a proxy server, including: a first receiving unit 501 configured to

receive interactive information issued by a first device in a predetermined topic, wherein the first device indicates one of a cloud server and a terminal device; a storing unit 502 configured to store the interactive information to a storage path corresponding to the predetermined topic; a sending unit 503 configured to, in response to that a second device which subscribes to the predetermined topic is online, wherein the second device indicates the other one of the cloud server and the terminal device, reading the interactive information from the storage path corresponding to the predetermined topic, and sending the read interactive information to the second device.

[0105] With reference to any of the examples provided in the present disclosure, where in a case that the first device indicates a cloud server and the second device indicates a terminal device, the interactive information includes first expected configuration information issued by the cloud server in a first topic, the first topic includes an identifier of the terminal device, the first expected configuration information indicates a target expected state for a configuration item of the terminal device; the storing unit, when storing the interactive information to the storage path corresponding to the predetermined topic, is specifically configured to: store the first expected configuration information to a storage path corresponding to the first topic; the sending unit, when in response to that the second device which subscribes to the predetermined topic is online, reading the interactive information from the storage path corresponding to the predetermined topic, and sending the read interactive information to the second device, is specifically configured to: in response to the terminal device which subscribes to the first topic is online, read the first expected configuration information from the storage path corresponding to the first topic, and send the read first expected configuration information to the terminal device.

[0106] With reference to any of the examples provided in the present disclosure, the

apparatus further includes a first response unit configured to, after storing the first expected configuration information to the storage path corresponding to the first topic, return first response information to the cloud server, where the first response information characterizes that the first expected configuration information is successfully delivered.

[0107] With reference to any of the examples provided in the present disclosure, the apparatus further includes a marking unit configured to, after storing the first expected configuration information to the storage path corresponding to the first topic, mark the first expected configuration information with a reserved information mark to indicate the first expected configuration information is reserved information of the first topic; the sending unit, when in response to that the second device which subscribes to the predetermined topic is online, reading the interactive information from the storage path corresponding to the predetermined topic, and sending the read interactive information to the second device, is specifically configured to: in response to that the terminal device which subscribes to the first topic is online, read expected configuration information with the reserved information mark from the storage path corresponding to the first topic, and send the read expected configuration information with the reserved information mark to the terminal device.

[0108] With reference to any of the examples provided in the present disclosure, the apparatus further includes a replacement unit configured to, after storing the first expected configuration information to the storage path corresponding to the first topic, in response to that second expected configuration information issued by the cloud server in the first topic is received, store the second expected configuration information to the storage path corresponding to the first topic; mark the second expected configuration information with the reserved information mark to indicate that the second expected configuration information is the reserved information of the first topic, and delete the reserved

information mark of the first expected configuration information.

[0109] With reference to any of the examples provided in the present disclosure, where, in a case that the first device indicates a terminal device and the second device indicates a cloud server, the interactive information includes second response information issued by the terminal device in a second topic, the second response information indicates a response of the terminal device to received expected configuration information, the second topic includes an identifier of the terminal device or a wildcarded identifier, the wildcarded identifier indicates two or more terminal devices; the apparatus further includes a second response unit configured to: store the second response information to a storage path corresponding to the second topic; in response to the cloud server which subscribes to the second topic is online, read the second response information from the storage path corresponding to the second topic, and send the read second response information to the cloud server.

[0110] With reference to any of the examples provided in the present disclosure, in a case that the first device indicates a terminal device and the second device indicates a cloud server, the interactive information includes actual configuration state information issued by the terminal device in a third topic, the third topic includes an identifier of the terminal device or a wildcarded identifier, the wildcarded identifier indicates two or more terminal devices; the storing unit, when storing the interactive information to the storage path corresponding to the predetermined topic, is specifically configured to: store the actual configuration state information to a storage path corresponding to the third topic; the sending unit, when in response to that the second device which subscribes to the predetermined topic is online, reading the interactive information from the storage path corresponding to the predetermined topic, and sending the read interactive information to the second device, is specifically configured to: in response to the cloud server which

subscribes to the third topic is online, read the actual configuration state information from the storage path corresponding to the third topic, and send the read actual configuration state information to the cloud server.

[0111] With reference to any of the examples provided in the present disclosure, the apparatus further includes a subscribing unit configured to: before, in response to that the second device which subscribes to the predetermined topic is online, reading the interactive information from the storage path corresponding to the predetermined topic, and sending the read interactive information to the second device, receive subscription information to the predetermined topic from the second device.

[0112] With reference to FIG. 6, according to the fifth aspect of the examples of the present invention, there is provided an apparatus of processing interactive information, being applicable to a cloud server, including: a first issuing unit 601 configured to issue expected configuration information in a predetermined topic to a proxy server, wherein the expected configuration information is stored by the proxy server to a storage path corresponding to the predetermined topic and is to be sent by the proxy server to a terminal device which subscribes to the predetermined topic when the terminal device is online; and a second receiving unit 602 configured to receive first response information which is returned by the proxy server after that the proxy server has stored the expected configuration information to the storage path corresponding to the predetermined topic, wherein the first response information characterizes that the expected configuration information is successfully delivered.

[0113] With reference to any of the examples provided in the present disclosure, the first issuing unit is specifically configured to: issue, to the proxy server, first expected configuration information in a first topic wherein the first topic includes an identifier of a to-be-configured terminal device.

[0114] With reference to any of the examples provided in the present disclosure, the apparatus further includes a third response unit configured to: in a case that the cloud server subscribes to a second topic, receive second response information sent by the proxy server, wherein the second topic includes an identifier of the terminal device or a wildcarded identifier, the wildcarded identifier indicates two or more terminal devices, the second response information characterizes a response of the terminal device to received expected configuration information, and the second response information is issued by the terminal device in the second topic to the proxy server, and is stored to a storage path corresponding to the second topic by the proxy server.

[0115] With reference to any of the examples provided in the present disclosure, the apparatus further includes a first state unit configured to: in a case that the cloud server subscribes to a third topic, receive actual configuration state information sent by the proxy server, where the third topic includes an identifier of the terminal device or a wildcarded identifier, the wildcarded identifier indicates two or more terminal devices, the actual configuration state information is issued by the terminal device in the third topic to the proxy server, and is stored to a storage path corresponding to the third topic by the proxy server; store the actual configuration state information to a cloud database.

[0116] With reference to any of the examples provided in the present disclosure, the apparatus further includes a calling unit configured to: after storing the actual configuration state information to the cloud database, in response to an instruction from a call object to query a configuration state of the terminal device, send the actual configuration state information of the queried terminal device to the call object.

[0117] With reference to FIG. 7, according to the sixth aspect of the examples of the present invention, there is provided an apparatus of processing interactive information, being applicable to a terminal device, including: a third receiving unit 701 configured

to, in a case that the terminal device subscribes to a first topic, receive expected configuration information sent by a proxy server, wherein the first topic includes an identifier of the terminal device, the expected configuration information is issued by a cloud server in the first topic, and the expected configuration information is stored to a storage path corresponding to the first topic by the proxy server; a second issuing unit 702 configured to issue second response information in a second topic to the proxy server, wherein the second topic includes an identifier of the terminal device or a wildcarded identifier, the wildcarded identifier indicates two or more terminal devices, the second response information indicates a response to the received expected configuration information, and the second response information is stored to a storage path corresponding to the second topic by the proxy server and is to be sent by the proxy server to a cloud server which subscribes to the second topic when the cloud server is online.

[0118] According to the seventh aspect of the examples of the present invention, there is provided a system of processing interactive information, including: a proxy server configured to receive interactive information issued by a first device in a predetermined topic, store the interactive information to a storage path corresponding to the predetermined topic, and in response to that a second device which subscribes to the predetermined topic is online, read the interactive information from the storage path corresponding to the predetermined topic, and send the read interactive information to the second device, wherein the first device indicates one of a cloud server and a terminal device, the second device indicates the other one of the cloud server and the terminal device; the cloud server configured to issue expected configuration information in the predetermined topic to the proxy server, and receive first response information which is sent by the proxy server after that the proxy server has stored the expected configuration information to the storage path corresponding to the predetermined topic; the terminal

device configured to receive expected configuration information sent by the proxy server, and issue second response information in a second topic to the proxy server, wherein the second response information indicates a response to the received expected configuration information.

[0119] Regarding the apparatuses and system in the above examples, the specific manner in which each unit performs operations has been described in detail in the method examples in the third aspect, which will not be elaborated here.

[0120] With reference to FIG. 8, according to the eighth aspect of the examples of the present invention, there is provided an electronic device, including: a memory; and a processor, wherein the memory is configured to store computer instructions runnable on the processor, and the processor is configured to execute the computer instructions to implement the method according to the first aspect, the second aspect or the third aspect.

[0121] According to the ninth aspect of the examples of the present invention, there is provided a computer readable storage medium having computer programs stored thereon, wherein the programs are executed by a processor to implement the method according to the first aspect, the second aspect or the third aspect.

[0122] In the present invention, the terms “first” and “second” are used only for descriptive purposes, and cannot be understood as indicating or implying relative importance. The term “plurality” refers to two or more, unless specifically defined otherwise.

[0123] Other embodiments of the present disclosure will be readily apparent to those skilled in the art after considering the specification and practicing the contents disclosed herein. The present application is intended to cover any variations, uses, or adaptations of the present disclosure, which follow the general principle of the present disclosure and include common knowledge or conventional technical means in the art that are not

disclosed in the present disclosure. The specification and examples are to be regarded as illustrative only. The true scope and spirit of the present disclosure are pointed out by the following claims.

CLAIMS

1. A method of processing interactive information, being applicable to a proxy server, comprising:

receiving interactive information issued by a first device in a predetermined topic, wherein the first device indicates one of a cloud server and a terminal device;

storing the interactive information to a storage path corresponding to the predetermined topic;

in response to that a second device which subscribes to the predetermined topic is online, wherein the second device indicates other one of the cloud server and the terminal device, reading the interactive information from the storage path corresponding to the predetermined topic, and sending the read interactive information to the second device.

2. The method according to claim 1, wherein, in a case that the first device indicates a cloud server and the second device indicates a terminal device, the interactive information comprises first expected configuration information issued by the cloud server in a first topic, the first topic comprises an identifier of the terminal device, the first expected configuration information indicates a target expected state for a configuration item of the terminal device;

storing the interactive information to the storage path corresponding to the predetermined topic, comprises:

storing the first expected configuration information to a storage path corresponding to the first topic;

in response to that the second device which subscribes to the predetermined topic is online, reading the interactive information from the storage path corresponding to the predetermined topic, and sending the read interactive information to the second device,

comprises:

in response to the terminal device which subscribes to the first topic is online, reading the first expected configuration information from the storage path corresponding to the first topic, and sending the read first expected configuration information to the terminal device.

3. The method according to claim 2, wherein after storing the first expected configuration information to the storage path corresponding to the first topic, the method further comprises:

sending first response information to the cloud server, wherein the first response information indicates that the first expected configuration information is successfully delivered.

4. The method according to claim 2 or 3, wherein

after storing the first expected configuration information to the storage path corresponding to the first topic, the method further comprises:

marking the first expected configuration information with a reserved information mark to indicate the first expected configuration information is reserved information of the first topic;

in response to that the second device which subscribes to the predetermined topic is online, reading the interactive information from the storage path corresponding to the predetermined topic, and sending the read interactive information to the second device, comprises:

in response to that the terminal device which subscribes to the first topic is online, reading expected configuration information with the reserved information mark

from the storage path corresponding to the first topic, and sending the read expected configuration information with the reserved information mark to the terminal device.

5. The method according to claim 4, wherein after storing the first expected configuration information to the storage path corresponding to the first topic, the method further comprises:

in response to that second expected configuration information issued by the cloud server in the first topic is received,

storing the second expected configuration information to the storage path corresponding to the first topic;

marking the second expected configuration information with the reserved information mark to indicate that the second expected configuration information is the reserved information of the first topic, and

deleting the reserved information mark of the first expected configuration information.

6. The method according to any of claims 1 to 5, wherein, in a case that the first device indicates a terminal device and the second device indicates a cloud server, the interactive information comprises second response information issued by the terminal device in a second topic, the second response information indicates a response of the terminal device to received expected configuration information, the second topic comprises an identifier of the terminal device or a wildcarded identifier, the wildcarded identifier indicates two or more terminal devices;

storing the interactive information to the storage path corresponding to the predetermined topic, comprises:

storing the second response information to a storage path corresponding to the second topic;

in response to that the second device which subscribes to the predetermined topic is online, reading the interactive information from the storage path corresponding to the predetermined topic, and sending the read interactive information to the second device, comprises,

in response to the cloud server which subscribes to the second topic is online, reading the second response information from the storage path corresponding to the second topic, and sending the read second response information to the cloud server.

7. The method according to any of claims 1 to 6, wherein, in a case that the first device indicates a terminal device and the second device indicates a cloud server, the interactive information comprises actual configuration state information issued by the terminal device in a third topic, the third topic comprises an identifier of the terminal device or a wildcarded identifier, the wildcarded identifier indicates two or more terminal devices;

storing the interactive information to the storage path corresponding to the predetermined topic comprises:

storing the actual configuration state information to a storage path corresponding to the third topic;

in response to that the second device which subscribes to the predetermined topic is online, reading the interactive information from the storage path corresponding to the predetermined topic, and sending the read interactive information to the second device, comprises:

in response to the cloud server which subscribes to the third topic is online,

reading the actual configuration state information from the storage path corresponding to the third topic, and sending the read actual configuration state information to the cloud server.

8. The method according to any of claims 1 to 7, wherein before, in response to that the second device which subscribes to the predetermined topic is online, reading the interactive information from the storage path corresponding to the predetermined topic, and sending the read interactive information to the second device, the method further comprises:

receiving subscription information to the predetermined topic from the second device.

9. A method of processing interactive information, being applicable to a cloud server, comprising:

issuing expected configuration information in a predetermined topic to a proxy server, wherein the expected configuration information is stored to a storage path corresponding to the predetermined topic by the proxy server and is to be sent by the proxy server to a terminal device which subscribes to the predetermined topic when the terminal device is online; and

receiving first response information which is sent by the proxy server after that the proxy server has stored the expected configuration information to the storage path corresponding to the predetermined topic, wherein the first response information indicates that the expected configuration information is successfully delivered.

10. The method according to claim 9, wherein issuing the expected configuration

information in the predetermined topic to the proxy server comprises:

issuing first expected configuration information in a first topic to the proxy server, wherein the first topic comprises an identifier of a to-be-configured terminal device.

11. The method according to claim 9 or 10, further comprising:

in a case that the cloud server subscribes to a second topic, receiving second response information sent by the proxy server, wherein

the second topic comprises an identifier of the terminal device or a wildcarded identifier, the wildcarded identifier indicates two or more terminal devices,

the second response information indicates a response of the terminal device to received expected configuration information, and

the second response information is issued by the terminal device in the second topic to the proxy server and is stored to a storage path corresponding to the second topic by the proxy server.

12. The method according to any of claims 9 to 11, further comprising:

in a case that the cloud server subscribes to a third topic, receiving actual configuration state information sent by the proxy server, wherein

the third topic comprises an identifier of the terminal device or a wildcarded identifier, the wildcarded identifier indicates two or more terminal devices,

the actual configuration state information is issued by the terminal device in the third topic to the proxy server and is stored to a storage path corresponding to the third topic by the proxy server;

storing the actual configuration state information to a cloud database.

13. The method according to claim 12, wherein after storing the actual configuration state information to the cloud database, the method further comprises:

in response to an instruction from a call object to query a configuration state of the terminal device, sending the actual configuration state information of the queried terminal device to the call object.

14. A method of processing interactive information, being applicable to a terminal device, comprising:

in a case that the terminal device subscribes to a first topic, receiving expected configuration information sent by a proxy server, wherein

the first topic comprises an identifier of the terminal device,

the expected configuration information is issued by a cloud server in the first topic, and the expected configuration information is stored to a storage path corresponding to the first topic by the proxy server;

issuing second response information in a second topic to the proxy server, wherein

the second topic comprises an identifier of the terminal device or a wildcarded identifier, the wildcarded identifier indicates two or more terminal devices,

the second response information indicates a response to the received expected configuration information, and

the second response information is stored to a storage path corresponding to the second topic by the proxy server and is to be sent by the proxy server to a cloud server which subscribes to the second topic when the cloud server is online.

15. The method according to claim 14, further comprises:

issuing actual configuration state information in a third topic to the proxy server,

wherein

the third topic comprises the identifier of the terminal device or the wildcarded identifier,

the actual configuration state information is stored to a storage path corresponding to the third topic by the proxy server and is to be sent by the proxy server to a cloud server which subscribes to the third topic when the cloud server is online.

16. An apparatus for processing interactive information, being applicable to a proxy server, comprising:

a first receiving unit configured to receive interactive information issued by a first device in a predetermined topic, wherein the first device indicates one of a cloud server and a terminal device;

a storing unit configured to store the interactive information to a storage path corresponding to the predetermined topic;

a sending unit configured to, in response to that a second device which subscribes to the predetermined topic is online, wherein the second device indicates other one of the cloud server and the terminal device, reading the interactive information from the storage path corresponding to the predetermined topic, and sending the read interactive information to the second device.

17. An apparatus for processing interactive information, being applicable to a cloud server, comprising:

a first issuing unit configured to issue expected configuration information in a predetermined topic to a proxy server, wherein the expected configuration information is stored to a storage path corresponding to the predetermined topic by the proxy server and

is to be sent by the proxy server to a terminal device which subscribes to the predetermined topic when the terminal device is online; and

a second receiving unit configured to receive first response information which is sent by the proxy server after that the proxy server has stored the expected configuration information to the storage path corresponding to the predetermined topic, wherein the first response information indicates that the expected configuration information is successfully delivered.

18. An apparatus for processing interactive information, being applicable to a terminal device, comprising:

a third receiving unit configured to, in a case that the terminal device subscribes to a first topic, receive expected configuration information sent by a proxy server, wherein the first topic comprises an identifier of the terminal device, the expected configuration information is issued by a cloud server in the first topic, and the expected configuration information is stored to a storage path corresponding to the first topic by the proxy server;

a second issuing unit configured to issue second response information in a second topic to the proxy server, wherein the second topic comprises an identifier of the terminal device or a wildcarded identifier, the wildcarded identifier indicates two or more terminal devices, the second response information indicates a response to the received expected configuration information, and the second response information is stored to a storage path corresponding to the second topic by the proxy server and is to be sent by the proxy server to a cloud server which subscribes to the second topic when the cloud server is online.

19. A system for processing interactive information, comprising:

a proxy server configured to receive interactive information issued by a first device

in a predetermined topic, store the interactive information to a storage path corresponding to the predetermined topic, and in response to that a second device which subscribes to the predetermined topic is online, read the interactive information from the storage path corresponding to the predetermined topic, and send the read interactive information to the second device, wherein the first device indicates one of a cloud server and a terminal device, the second device indicates other one of the cloud server and the terminal device;

the cloud server configured to issue expected configuration information in the predetermined topic to the proxy server, and receive first response information which is sent by the proxy server after that the proxy server has stored the expected configuration information to the storage path corresponding to the predetermined topic;

the terminal device configured to receive expected configuration information sent by the proxy server, and issue second response information in a second topic to the proxy server, wherein the second response information indicates a response to the received expected configuration information.

20. An electronic device, comprising: a memory; and a processor, wherein the memory is configured to store computer instructions, and the processor is configured to execute the computer instructions to implement a method according to any of claims 1 to 8, 9 to 13, 14 to 15.