

PRIVATE-NETWORK LOADING CONFIGURATION METHOD, APPARATUS AND DEVICE, COMPUTER STORAGE MEDIUM, AND COMPUTER PROGRAM PRODUCT

CROSS-REFERENCE TO RELATED APPLICATION

5 [0001] Embodiments of the disclosure are based on and claim priority of Chinese patent application No. 202211175257.1, filed on September 26, 2022, with a title of “method, apparatus, and device for configuring private network rack, and computer storage medium”, the entire content of which is hereby introduced into this application as a reference.

10 TECHNICAL FIELD

[0002] Embodiments of the disclosure relate to but are not limited to the field of network communication technology, and in particular to a method for rack installation and configuration in a private network, an apparatus for rack installation and configuration in a private network, a device for rack installation and configuration in a private network, a computer storage medium and
15 a computer program product.

BACKGROUND

[0003] Currently, there is only a design for rack installation and configuration in a cloud resource pool, which relates to servers, storage, networking and security devices.

20 [0004] The related art for private network rack installation and configuration involves a small number of device types, cannot be widely applied to installation and configuration of private network devices in different scenarios and cannot be quickly replicated to service requirement scenarios for private network users in different industries, which leads to a low working efficiency of the related art for installation and configuration of a private network system.

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SUMMARY

[0005] A method for rack installation and configuration in a private network, an apparatus for rack installation and configuration in a private network, a device for rack installation and configuration in a private network, a computer storage medium and a computer program product
30 are provided in embodiments of the present disclosure.

[0006] According to a first aspect of the embodiments of the present disclosure, there is provided a method for rack installation and configuration in a private network, including:

[0007] determining private network deployment requirement information according to a private network service requirement, deploying device hardware characteristics, and an environmental resource situation of a machine room, in which the private network deployment requirement information includes at least one of a device security requirement, a device hardware requirement, or a device environment requirement;

[0008] obtaining a deployed rack by deploying a plurality of devices to be deployed on corresponding target racks according to the private network deployment requirement information;

and

[0009] obtaining the rack installation and configuration in the private network by adjusting installation and configuration of the deployed rack according to device hardware characteristics of the devices to be deployed and a specification requirement of user rack installation and configuration.

[0010] According to another aspect of embodiments of the present disclosure, there is provided an apparatus for rack installation and configuration in a private network, including:

[0011] a determination module, configured to determine private network deployment requirement information according to a private network service requirement, deploying device hardware characteristics, and an environmental resource situation of a machine room, wherein the private network deployment requirement information comprises at least one of a device security requirement, a device hardware requirement, or a device environment requirement;

[0012] a deployment module, configured to obtain a deployed rack by deploying a plurality of devices to be deployed on corresponding target racks according to the private network deployment requirement information;

[0013] an adjustment module, configured to obtain the rack installation and configuration in the private network by adjusting installation and configuration of the deployed rack according to device hardware characteristics of the device to be deployed and a specification requirement of user rack installation and configuration.

[0014] According to another aspect of embodiments of the present disclosure, there is provided a device for rack installation and configuration in a private network, including:

[0015] a processor, a memory, a communication interface and a communication bus, in which the processor, the memory and the communication interface communicate with each other via the communication bus;

[0016] the memory is configured to store at least one executable instruction, in which the executable instruction causes the processor to perform operations of the method for rack installation and configuration in a private network as described in any one aspect of the disclosure.

[0017] According to another aspect of embodiments of the present disclosure, there is provided a computer readable storage medium for storing at least one executable instruction, in which the executable instruction causes the device for rack installation and configuration in a private network to perform the operations of the method for rack installation and configuration in a private network as described in any one aspect of the disclosure.

[0018] According to another aspect of embodiments of the present disclosure, there is provided a computer program product including computer instructions which when executed by a computer device, cause the computer device to perform operations of the method for rack installation and configuration in a private network as described in any one aspect of the disclosure.

[0019] In the embodiments of the disclosure, the private network deployment requirement information is determined according to the private network service requirement, the deploying device hardware characteristics and the environmental resource situation of the machine room, in which the private network deployment requirement information includes at least one of the device security requirement, the device hardware requirement and the device environment requirement; the deployed rack is obtained by deploying the plurality of devices to be deployed on the corresponding target racks according to the private network deployment requirement information; the rack installation and configuration in the private network is obtained by adjusting installation and configuration of the deployed rack according to the device hardware characteristics of the devices to be deployed and the specification requirement of user rack installation and configuration. The above solution is different from the related art that is only a design for a cloud resource pool rack, only relates to servers, storage, networking and security devices with fewer device types involved, does not consider devices in other private network systems such as a wireless device, an access device, and a transmission device, and does not consider impacts on a rack installation arrangement of a disaster recovery mode, an air supply mode, etc. This leads to a low efficiency of rack installation and configuration in the existing private network and poor

private network usage experiences of the users. In the embodiments of the present disclosure, rack installation and configuration for each device to be deployed may be performed in a private network integrated apparatus according to device configuration situations of private network users in different scenarios and deployment requirements in a plurality of dimensions corresponding to the device, thereby improving the efficiency and accuracy of rack installation and configuration in the private network, and enhancing private network usage experiences of the users.

[0020] The above description is only an overview of the technical solution of the embodiments of the disclosure. In order to better understand the technical means of the embodiments of the disclosure, it may be implemented in accordance with the contents of the disclosure, and in order to make the above and other purposes, features and advantages of the embodiments of the disclosure more clearly understood, specific implementations of the disclosure are listed below.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021] The drawings are intended to illustrate the embodiments but are not construed to limit the present disclosure. In the attached drawings, the same components are represented by the same reference numbers.

[0022] FIG. 1 is a flowchart of a method for rack installation and configuration in a private network according to a first embodiment of the disclosure.

[0023] FIG. 2 is a diagram of a private network integrated apparatus according to the first embodiment of the disclosure.

[0024] FIG. 3 is a flowchart of a method for rack installation and configuration in a private network according to a second embodiment of the disclosure.

[0025] FIG. 4 is a flowchart of a method for rack installation and configuration in a private network according to a third embodiment of the disclosure.

[0026] FIG. 5 is a table of device configuration information for the private network integrated apparatus according to the third embodiment of the disclosure.

[0027] FIG. 6 is a structure diagram of an apparatus for rack installation and configuration in a private network according to the first embodiment of the disclosure.

[0028] FIG. 7 is a structure diagram of a device for rack installation and configuration in a private network according to the first embodiment of the disclosure.

DETAILED DESCRIPTION

[0029] The exemplary embodiments of the disclosure are described in detail below with reference to the attached drawings. Although the exemplary embodiments of the disclosure are shown in the attached drawings, it should be understood that the disclosure may be implemented in various forms and should not be limited by the embodiments set forth herein.

[0030] Before describing the embodiments of the present disclosure, the related art and its existing problems are described.

[0031] The deployment in the private network faces various challenges such as a weak infrastructure and a long implementation period. The application requirements in different scenarios have differences for communication device configuration and differences for installation and configuration. For different private network devices in different industries, automatic rack installation and configuration is conducive to the rapid deployment of the private network.

[0032] Currently, the existing solutions are only designed for rack installation and configuration in a cloud resource pool, which relates to servers, storage, networking and security devices, do not consider other system devices such as a wireless device, an access device, and a transmission device, and do not consider impacts on a rack installation layout of a disaster recovery mode, an air supply mode, etc. Since fewer device types are involved, it cannot be widely applied to the rack installation arrangement of private network devices in different scenarios, and cannot achieve the rapid replication.

[0033] FIG. 1 is a flowchart of a method for rack installation and configuration in a private network according to a first embodiment of the disclosure. The method is executed by a computer processing device. The computer processing device may include a mobile phone, a laptop computer, etc. As shown in FIG. 1, the method includes the following steps 10 to 30.

[0034] At step 10, private network deployment requirement information is determined according to a private network service requirement, deploying device hardware characteristics, and an environmental resource situation of a machine room, in which the private network deployment requirement information includes at least one of a device security requirement, a device hardware requirement, or a device environment requirement.

[0035] In one embodiment of the present disclosure, the private network service requirement is configured to represent a private network service capability that needs to be met, which may

include service scenarios, terminal types, access modes, coverage, access restrictions, slicing requirements, user service types and application requirements, network performance, security requirements, disaster recovery requirement, etc. The deploying device hardware characteristics are configured to represent hardware feature information of a device to be deployed corresponding to the private network service requirement, such as device hardware configuration, port configuration, device quantity, power configuration, power consumption, a device size, a weight, an air supply type and other information corresponding to each configuration function module device in a private network integrated apparatus. The environment resource situation of the machine room is configured to represent a current environment of the machine room and a current resource situation in the machine room, such as a machine room space, a power, refrigeration, fire fighting, monitoring, transmission facilities, private network device situations, etc. The device to be deployed in the private network integrated apparatus and its configuration information under a private network user service requirement may be determined according to the private network user service requirement and the environment resource situation of the machine room.

[0036] In another embodiment of the present disclosure, a private network integrated apparatus as shown in FIG. 2 is configured to provide services for private network users, and the target private network integrated apparatus includes a plurality of function modules and a plurality of devices corresponding to each function module. The function modules may be divided into service modules and infrastructure modules. The service modules may include at least one of: an access module, a transmission module, a switching module, a computing application module, a management module and a networking module. The infrastructure modules may include at least one of a refrigeration module, a fire fighting module, a monitoring module, a power module and a connector module.

[0037] The power module is configured to obtain a power input of the private network integrated apparatus through power supply introduction or a power supply device in the machine room to power the apparatus. When the apparatus is configured with a plurality of racks, the power module may provide a plurality of outputs as needed to power each rack of the private network integrated apparatus.

[0038] When the power module configures power supply for each device, the configuration may be performed according to a power connection mode and power consumption requirements of all function module devices in the present rack, and certain power consumption requirements and

power connection terminal requirements may be reserved according to reservation suggestions for a remaining space of the apparatus and configuration situations of each function module device (for example, a maximum configuration of each function module device has not been reached). According to power supply conditions of the machine room in the private network, the power module may support introduction of mains power, access of uninterruptible power supply (UPS) or direct current (DC) as needed. When the function module devices in the private network integrated apparatus require different power supply modes, the power module may meet a rectification function of alternate current (AC) to DC and an inversion function of DC to AC. If reliability requirements of the private network service are high, the power module may be configured with batteries as needed, and when the mains power access to the machine room is cut off, the power module may need to meet a power output for a certain backup time.

[0039] The connector module is configured to provide a standard connection for an interconnection between the function module devices in the apparatus and a standard connection for an external connection of the apparatus, including a power connector module and a signal connector module. The power connector module is configured as needed in a rack dimension, its input is a voltage and current output provided by the power module, and its output is a power input required by each function module device in the present rack. The power connector module may be configured as needed to provide miniature circuit breakers, power distribution unit (PDU) sockets, or the like according to the power connection mode and the power consumption requirements of each function module device in the present rack, and to be redundant with a certain proportion of power miniature circuit breakers, fuses or sockets and a certain power consumption requirement according to reservation suggestions for the remaining space of the present rack and configuration situations of each function module device (for example, the maximum configuration of each function module device has not been reached). The signal connector module is configured as needed in the rack dimension, to provide interfaces such as interfaces of a standard optical fiber, a network cable, a 2M cable, which thus realizes a data communication connection between the function module devices in the present rack, a cross-rack data communication connection of the function module devices in the present rack and an external data communication connection of the function module devices in the present rack. The signal connector module is configured as needed according to an external bandwidth and an interface type of each function module device in the present rack, and may be redundant with a certain proportion of interfaces of the optical fiber, the

network cable, the 2M cable and the like according to the reservation suggestions for the remaining space of the present rack and the configuration situations of each function module device (for example, the maximum configuration of each function module device has not been reached). According to a number of power terminals and a number of signal interfaces of each function module device, a width of a rack, and a size of interfaces such as interfaces of the power miniature circuit breaker/fuse, the PDU socket, the optical fiber, the network cable, the 2M cable, several configuration templates for the connector module may be defined based on different types and quantity/number combinations. Then, an appropriate configuration template for the connector module may be matched and selected by each rack according to its own device situations.

[0040] The monitoring module is configured for monitoring a machine room environment and a infrastructure function module, which includes but is not limited to a dynamic environment monitoring (also known as environmental and power supervision, EPC), and a video monitoring. The dynamic environment monitoring includes smoke detection, water leak detection, temperature and humidity detection, detections of battery clips, door magnets, smart power supplies, a smart UPS and smart air conditioners, pressure detection for fire extinguisher cylinders, etc.

[0041] The refrigeration module is implemented by a configured air conditioning system and hot and cold air channels in racks of the private network integrated apparatus. The refrigeration module is configured to provide refrigeration for the private network integrated apparatus and its surrounding environment, and to realize temperature controllability. The refrigeration module is configured as needed according to refrigeration requirements of all function module devices in the present rack, and may be redundant with refrigerating capacity requirements according to the reservation suggestions for the remaining space of the present rack and the configuration situations of each function module device (for example, the maximum configuration of each function module device has not been reached). The hot and cold air channels of each rack in the apparatus and their ventilation modes needs to be determined by ventilation modes of each function module device in the present rack. The devices of the same air supply type are deployed on a same rack or in a certain area of the same rack.

[0042] The fire fighting module is implemented by configuration of a gas extinguisher. The fire fighting module is configured to provide gas extinguishing for the private network integrated apparatus and its surrounding environment. For a filling volume of the fire extinguisher cylinder and selection of a pipeline, a volume of a protection area needs to be considered. The fire fighting

module performs fire extinguishing according to an abnormal smoke detection monitored by the monitoring module or fire fighting instructions issued by the management module.

[0043] The access module is configured to provide a network access for users in the private network and provide a wireless or wired access according to service requirements, including a 2G /4G /5G, a wireless local area network (WLAN), a network cable, an optical fiber access, including but not limited to a baseband unit (BBU), a WLAN access controller (AC), an access switch, an optical fiber access device.

[0044] The transmission module is configured to realize external long-distance data transmission of the apparatus, including but not limited to a slicing packet network (SPN), a packet transport network (PTN), and a synchronous digital hierarchy (SDH) device.

[0045] The switching module is configured to realize service control and forwarding for private network users, including but not limited to control and forwarding of a data service and a voice service, including but not limited to a user plane function (UPF) and a core network device in the private network.

[0046] The computing application module is configured to provide application deployment capacities of private network services, such as an MEC Platform (MEP), including but not limited to a server and a magnetic array device.

[0047] The networking module is configured to realize internal data connection, external data connection and corresponding security isolation of each module, including but not limited to a switch, a router, and a firewall.

[0048] The management module is configured to collect and count basic data of each function module device, provides service data display (including but not limited to a visual display based on dimensions of a function module device, a service process, a user, an operating state, and a location), and manages operation controls of all function module devices and racks in the apparatus, including but not limited to: an abnormal alarm, an operation control of each function module device, an operation control of each rack (e.g., opening and closing of a rack door). The operation control of the module includes but is not limited to judging an operating state of each function module device according to statistical data of each function module device or monitoring data of the monitoring module, and performing optimization control, such as shutting down an appropriate number of devices when the service is idle.

[0049] In one embodiment of the disclosure, the device security requirement is configured to represent a security level requirement for normal operations of devices after installed in a rack, for example, disaster recovery requirement of the devices (i.e., the requirements to ensure the normal operations of at least part of the devices when a disaster occurs in one or more rack areas in the machine room), or security requirements related to a rack environment in which the devices are located, such as air supply security requirements or electromagnetic security requirements.

[0050] The device hardware requirement is configured to but not limited to represent an energy supply requirement of hardware of the device itself, which may include, for example, requirements of types supported by power supplies and power consumption requirements. When the device hardware requirement is met, hardware functions of the device deployed on the rack may be supported.

[0051] The device environment requirement is configured to represent a requirement of a device for a space environment of the rack where the device is deployed, which may be, for example, a rack size limit and a machine room load-bearing limit. Meeting the space environment may be that a space of the rack is sufficient to accommodate or bear all the device deployed on the rack.

[0052] Therefore, in one embodiment of the present disclosure, the device security requirement may be determined according to the private network service requirement.

[0053] The step 10 also includes the following steps at 101 to 103. At step 101, the device security requirement is determined according to the private network service requirement, in which the device security requirement includes at least one of a disaster recovery requirement, an air supply mode security requirement or an electromagnetic security requirement.

[0054] In one embodiment of the present disclosure, the disaster recovery requirement is configured to ensure a certain level of device security when a disaster occurs, which may ensure, for example, normal operations of some devices. The disaster may be an event in the machine room environment that will affect the normal operations of the devices, such as fires, floods, power outage, network disconnection, or electromagnetic wave impacts. The air supply security requirement is configured to ensure temperature requirements of the devices for their safe operations such as by adjusting the air supply mode, for example, it is ensured that the device in each air supply area is in a safe and stable state by adjusting cooling or heating temperatures. The electromagnetic security requirement is configured to ensure that there is no electromagnetic interference between the devices in the rack. Optionally, the device security requirement may also

include requirements for no interference on heat dissipation, wiring, etc. between various devices deployed on the same rack.

[0055] In one embodiment of the present disclosure, a device to be configured and configuration parameter information corresponding to the device to be configured are determined according to the private network service requirement. The device security requirement of each device to be configured is determined according to the configuration parameter information. For example, the air supply mode security requirement may be determined according to the private network service requirement, an operating temperature and an air supply mode in the device configuration parameter information, and the electromagnetic security requirement may be determined according to the private network service requirement and a communication type in the configuration parameter information. A disaster recovery ratio is determined according to the disaster recovery requirement in the private network service requirement.

[0056] At step 102, the device hardware requirement is determined according to the deploying device hardware characteristics, in which the device hardware requirement includes at least one of: a power consumption requirement or a power type requirement of the devices to be deployed.

[0057] In one embodiment of the present disclosure, parameters related to energy supply requirements of the device to be deployed, such as a rated operating voltage, a rated operating current, power consumption, environmental requirements, etc., are determined according to the deploying device hardware characteristics, and the device hardware requirement is determined according to the above parameters related to the energy supply requirements.

[0058] At step 103, the device environment requirement is determined according to the environmental resource situation of the machine room, in which the device environment requirement includes at least one of a rack size limit or a machine room load-bearing limit.

[0059] In one embodiment of the present disclosure, a space available for arranging racks in the existing machine room and a weight of a device that may be bore are determined according to the environmental resource situation of the machine room. For example, the rack size limit and the machine room load-bearing limit are determined according to a size, a free space, and load-bearing information of the machine room. It is easy to understand that the size of the rack should be within a size of the existing free space in the machine room, and a weight sum of the configured single rack should not exceed the machine room load-bearing limit.

[0060] At step 20, a deployed rack is obtained by deploying a plurality of devices to be deployed on corresponding target racks according to the private network deployment requirement information.

[0061] In one embodiment of the present disclosure, the private network deployment requirement information includes the device security requirement, the device hardware requirement, and the device environment requirement. When rack installation and deployment are performed on the device to be deployed according to the device security requirement, since the rack environment in the same area is relatively fixed and other requirements directly related to the rack environment (such as the electromagnetic security requirement and the air supply mode security requirement) that may be met are also relatively fixed, the device security requirement deployed to one rack should be the same. That is, if the electromagnetic security requirement and/or the air supply mode security requirement of the device to be deployed are different from those of other deployed device in the currently selected rack, when the private network service requirement indicates that the same electromagnetic environment and/or the same air supply mode security requirement are used in the same rack, the device to be deployed needs to be deployed on a new rack. At the same time, when considering the disaster recovery requirement, in order to disperse risks, it is necessary to deploy devices to be deployed that have the disaster recovery requirement and are of a same device type on different racks respectively.

[0062] When rack installation and deployment are performed according to the device hardware requirement, it is necessary to consider a hardware power supply mode supported by the rack and whether the provided energy may meet a hardware power supply requirement of a device. For example, the device to be deployed first needs to be deployed on a rack that supports a power supply type of the device, and a sum of a post-deployment power consumption requirement and a reserved power consumption requirement of the currently selected target rack needs to not be greater than a rack power consumption setting value after the device to be deployed is deployed on the currently selected target rack. If it is greater than the rack power consumption setting value, the device to be deployed is deployed on a new target rack, thereby avoiding problems such as local overheating caused by excessive overall rack power consumption after rack installation and deployment.

[0063] When rack installation and deployment are performed according to the device environment requirement, it is necessary to consider whether the overall environment of the

currently selected rack after the device to be deployed is deployed on this rack may meet the needs of all the devices deployed on this rack, such as a occupied space of this rack and whether the weight of the deployed devices on this rack exceeds a total load-bearing capacity of this rack, etc. If the above conditions cannot be met, the devices to be deployed will be deployed on a new rack.

5 **[0064]** Therefore, in one embodiment of the present disclosure, the step at 20 includes at least one of the following steps at 2011 to 2013.

[0065] At step 2011, devices to be deployed that have the disaster recovery requirement and are of a same device type are deployed on different target racks respectively, in which a number of devices of each device type deployed on each target rack is less than or equal to a disaster recovery
10 ratio of a total number of devices of each device type.

[0066] In one embodiment of the present disclosure, considering that if devices of the same type are deployed in a relatively concentrated manner, when a disaster occurs in one or more specific racks, the devices of the same type deployed thereon are also affected, which causes most or even all of the devices of the same type to stop working, and causes the functions achieved by the
15 devices of the same type are affected or even paralyzed, directly affecting private network usage experiences of the users. Therefore, for devices to be deployed of various types that have the disaster recovery requirement, the devices to be deployed of the same type are dispersedly deployed on different racks, so that a disaster resistance capability of the devices of the same type in the system after deployment is stronger.

20 **[0067]** Exemplarily, for a device to be deployed currently, a disaster recovery requirement corresponding to its device type is determined, and a preset disaster recovery ratio may be 0, 50% or other values between 0 and 1. If the preset disaster recovery ratio is set to 0, that is, there is no disaster recovery requirement, the same type of devices may be deployed on the same rack from the rack bottom to the rack top. When the same type of devices have the disaster recovery
25 requirement, such as the preset disaster recovery ratio being set to 50%, the same type of devices may be deployed from the rack bottom to the rack top for each of a plurality of racks, and a number of the same type of devices in a single rack is not more than half of a total number of the same type of devices.

[0068] At step 2012, devices to be deployed that have the air supply mode security requirement
30 and different air supply modes are deployed on different target racks respectively, in which each of different target racks achieves the air supply mode security requirement.

[0069] In one embodiment of the present disclosure, the air supply security requirement is determined according to an air supply mode of a device to be deployed. The air supply mode requirement is configured to represent a requirement of a device for air inlet and outlet physical modes, such as front air intake and rear air exhaust, bottom air intake and top air exhaust, left air intake and right air exhaust. Different air supply modes have different airflow organizations inside the rack. When devices with a same air supply mode are deployed on the same rack or a certain area of the rack, an airflow group for hot and cold channels within the rack may be effectively formed, the heat dissipation efficiency of the rack may be improved and the refrigerating capacity requirement of the refrigeration module may be reduced, thereby ensuring the high availability of the configured private network integrated apparatus.

[0070] At step 2013, devices to be deployed that have the electromagnetic security requirement and different electromagnetic types are deployed on different target racks respectively, in which each of different target racks achieves the electromagnetic security requirement.

[0071] In one embodiment of the present disclosure, the electromagnetic security requirement is determined according to a communication type of the device to be deployed. By deploying the devices to be deployed with different electromagnetic types that have the electromagnetic security requirement on different racks or different areas within the rack, an electromagnetic interference between the devices may be effectively reduced, and the normal operations of the devices within the rack may be prevented from being affected by the electromagnetic interference, thereby ensuring the high availability of the configured private network integrated apparatus.

[0072] In yet another embodiment of the present disclosure, the step at 20 further includes at least one of the following steps at 2021 to 2022.

[0073] At step 2021, in response to determining that the device to be deployed is deployed on a currently selected target rack, and a sum of a post-deployment power consumption requirement and a reserved power consumption requirement of the currently selected target rack is greater than a rack power consumption setting value, the device to be deployed is deployed on a new target rack.

[0074] In one embodiment of the present disclosure, after the device to be deployed is deployed on the currently selected target rack, power consumption requirements of all the deployed devices on the currently selected target rack are summed to obtain the post-deployment power consumption requirement of this rack. If the sum of the post-deployment power consumption

requirement and the reserved power consumption requirement is greater than a preset rack power consumption value, it means that the power consumption of the currently selected target rack is too large, which may easily cause local overheating in the machine room. Therefore, the device to be deployed needs to be redeployed on another new target rack.

5 **[0075]** At step 2022, devices to be deployed that have the power type requirement and different power types are deployed on different target racks or different areas of a same target rack respectively, in which each of different target racks achieves the power type requirement.

[0076] In one embodiment of the present disclosure, the power type requirement is determined according to the power type of the device to be deployed. The power type requirement is
10 configured to represent a physical parameter requirement of the device for its power input mode, which may be, for example, -48V DC power supply, 220V AC power supply, etc. By deploying the devices to be deployed with different power types that have the power type requirement on different racks (such as deploying them to different target racks that achieve the power type requirement) or different areas within the rack (such as deploying them to different areas of the
15 same target rack), the security of the device and wiring may be effectively improved, thereby ensuring the high availability of the configured private network integrated apparatus. It is easy to understand that for a device installed in a certain rack, the rack on which the device is installed needs to have the capability to support its hardware requirements. Therefore, the target rack needs to be able to meet the power type requirement corresponding to the device to be deployed, etc.

20 **[0077]** Therefore, in one embodiment of the present disclosure, the step at 20 further includes at least one of the following steps at 2031 to 2032.

[0078] At step 2031, in response to determining that the device to be deployed is deployed on a currently selected target rack, and a sum of an occupied space and a reserved space of the currently selected target rack is greater than a rack size limit, the device to be deployed is deployed on a new
25 target rack.

[0079] In one embodiment of the present disclosure, the occupied space is obtained by summing size information of all the deployed devices on the currently selected target rack. The reserved space is configured to represent that the devices within the rack are in a normal use and have no interference with each other, which may include but is not limited to an interval space reserved
30 between the deployed devices on the rack. The rack size limit may be at least one of a limited height, length or width of the rack.

[0080] At step 2032, in response to determining that the device to be deployed has been deployed on the currently selected target rack, and a sum of a post-deployment weight and a reserved weight of the currently selected target rack exceeds a preset load-bearing limit of the machine room, the device to be deployed is deployed on a new target rack.

5 **[0081]** In one embodiment of the present disclosure, the post-deployment weight of the currently selected target rack may be obtained by summing weight information of all the deployed devices on the currently selected target rack and a rack weight when this rack is empty. The reserved weight may be obtained by summing a weight of a connector module corresponding to each deployed device, a weight of a monitoring module corresponding to this rack, and a weight
10 difference between the rack not fully equipped with devices and the rack fully equipped with devices.

[0082] In one embodiment of the present disclosure, considering that different deployment priorities may be configured for different private network users in the private network deployment requirement information, when the private network deployment requirement information includes
15 the three items (i.e., the device security requirement, the device hardware requirement, the device environment requirement) at the same time, the step 20 may also include the following steps at 2040 to 2042.

[0083] At step 2040, each of the devices to be deployed is deployed on one of a plurality of target racks in sequence according to the private network deployment requirement information and
20 a deployment priority.

[0084] In one embodiment of the present disclosure, taking into account that function modules to which the devices to be deployed are different, and different function modules have different weights for rack deployment (such as the service module device has more requirements and is more important to the private network experiences of the users compared to the infrastructure
25 module device), the deployment priority of the device to be deployed may be determined according to the function module to which the device to be deployed belongs. For example, the service module device is in preference to the infrastructure module device, and the refrigeration module, the power module, the fire fighting module, the monitoring module, and the connector module included in the infrastructure module are sorted in order.

30 **[0085]** In one embodiment of the present disclosure, it is considered that there is also a priority between private network deployment requirement information of different dimensions. That is, the

private network deployment requirement information of certain dimensions is more important and fundamental to the normal operation and usage experiences of the private network, and there is a need to consider and ensure the priority. For private network users who pursue service security, they give priority to the device security requirement for deployment of the device to be deployed.

5 For private network users with limited device environment, they give priority to the device environment requirement for deployment of the device to be deployed, and consider as appropriate whether it is necessary to meet the device security requirement and the device hardware requirement when the service deployment requirement is met. Therefore, when the device to be deployed is deployed according to the private network deployment requirement information, the
10 device to be deployed may be iteratively installed and deployed in sequence according to the priority in the private network deployment requirement information.

[0086] In one embodiment of the present disclosure, a plurality of devices to be deployed are deployed in descending order of deployment priorities.

[0087] At step 2041, for each of the devices to be deployed, the device to be deployed is
15 deployed on a first target rack according to the device security requirement.

[0088] In one embodiment of the present disclosure, the process of determining the first target rack according to the device security requirement may refer to the aforementioned steps at 2011 to 2013, which will not be described in detail.

[0089] In another embodiment of the present disclosure, the device to be deployed may also be
20 deployed by first considering the device hardware requirement or the device environment requirement.

[0090] At step 2042, in response to determining that there is a device to be deployed on the first target rack that does not meet the device hardware requirement and the device environment requirement, the device to be deployed is deployed on a second target rack.

25 **[0091]** In one embodiment of the present disclosure, on the basis of ensuring that the device security requirement of the deployed devices on the first target rack may be met, further consideration is given to whether the device hardware requirement and the device environment requirement of these deployed devices may also be met. If the device hardware requirement and the device environment requirement of these deployed devices are not met, adjustments are made
30 to obtain an adjusted second target rack. The process of determining the second target rack may refer to the aforementioned steps at 2021 to 2032, which will not be repeated here.

[0092] In another embodiment of the present disclosure, on the basis of ensuring that the device hardware requirement of the deployed devices on the first target rack may be met, further consideration is given to whether the device security requirement and the device environment requirements of these deployed devices may also be met. If the device security requirement and the device environment requirements of these deployed devices are not met, adjustments are made to obtain an adjusted second target rack.

[0093] In another embodiment of the present disclosure, on the basis of ensuring that the device environment requirement of the deployed devices on the first target rack may be met, further consideration is given to whether the device security requirement and the device hardware requirement of these deployed devices may also be met. If the device security requirement and the device hardware requirement of these deployed devices are not met, adjustments are made to obtain an adjusted second target rack.

[0094] At step 30, the rack installation and configuration in the private network is obtained by adjusting installation and configuration of the deployed rack according to device hardware characteristics of the devices to be deployed and a specification requirement of user rack installation and configuration.

[0095] In one embodiment of the present disclosure, after determining that a single target rack may meet the device security requirement, the device hardware requirement, and the device environment requirement corresponding to the device deployed on this rack, installation and configuration of the deployed rack may be further adjusted within the same rack according to the device hardware characteristics of the deployed device.

[0096] In one possible manner, for a plurality of racks included in the private network integrated apparatus, the adjusted rack installation and configuration may be adjusted for the second time according to the specification requirement of user rack installation and configuration. That is, the installation and configuration of the deployed rack are adjusted for the second time to obtain the rack installation and configuration in the private network.

[0097] Therefore, in one embodiment of the present disclosure, the step at 30 further includes the following steps at 301 to 302.

[0098] At step 301, an adjusted configuration is obtained by adjusting installation and configuration of the deployed rack within a same rack according to the device hardware

characteristics of the device to be deployed, in which the device hardware characteristics includes at least one of a power supply mode, an air supply mode, or a device weight.

[0099] Exemplarily, the device hardware characteristics are configured to represent hardware characteristics of the device, such as a size, a weight, power consumption, a power supply mode, an air supply mode, an interface type, etc. of the device to be deployed. A rack installation and configuration position of each deployed device within a single deployed rack is adjusted so that hardware characteristics of each deployed device will not affect each other or affect each other as little as possible after being deployed on the same rack. If there are a plurality of different air supply modes in a single rack, an order of the rack air supply modes is considered, and a deployment position of a device in the present rack is adjusted to meet the requirement that devices of the same air supply type are deployed in the same air supply area of the same rack.

[00100] In one possible manner, devices of the same power supply mode may be preferentially deployed in the same air supply area of the same rack according to device deployment requirements. The positions of the connector module and the monitoring module may be reserved at the top of each rack. The rack installation and arrangement may be planned according to a number of devices required for future service development, to reserve corresponding installation positions of the future devices.

[00101] In a possible manner, the device deployment position within the present rack may also be adjusted according to the weight of the deployed device. For example, a device with a heavy weight is preferentially deployed at the rack bottom.

[00102] At step 302, the rack installation and configuration in the private network is obtained by adjusting the installation and configuration adjusted again according to the specification requirement of user rack installation and configuration.

[00103] In one embodiment of the present disclosure, the specification requirement of user rack installation and configuration includes a specification or guideline of rack installation and configuration and user device operation and maintenance habits, etc. formulated by the private network users. Through second adjustments, the finally obtained the rack installation and configuration in the private network meets the specification requirement of user rack installation and configuration.

[00104] In the second embodiment of the present disclosure, the process of performing the rack installation and configuration in the private network may also refer to FIG. 3.

[00105] As shown in FIG. 3, at S1, a rack height of a private network integrated apparatus is determined according to a basic resource situation of a machine room, and a rack width and depth of the private network integrated apparatus are determined according to a size of each function module device selected and determined by the private network integrated apparatus. The basic resource situation of the machine room includes a height of the machine room, a height of an existing wiring rack (if any), a fire fighting sprayer in the machine room (if any), etc.

[00106] At S2, for each function module device selected and determined by the private network integrated apparatus, a disaster recovery requirement and an air supply requirement of each device, a rack power consumption setting, a rack size limit, and a load-bearing limit of the machine room are considered in sequence, and a device deployment situation of all racks of the apparatus is obtained by determining whether to deploy the device on a new target rack or a target rack where the device has been deployed.

[00107] At S3, rack installation and arrangement per rack is determined by rearranging each rack in sequence in consideration of the air supply mode, the power supply mode and the device weight of each device, according to the device deployment situation of all racks of the apparatus determined at S2 as well as the air supply mode, the power supply mode and the device weight of each device deployed on each rack, in which the determined rack installation and arrangement may be adjusted according to a specification requirement of user rack installation and configuration, such as a vertical misalignment adjustment, an order adjustment when placing racks, etc.

[00108] According to the private network deployment requirement information, devices of the same air supply type are deployed on the same rack or the same air supply area of the same rack, devices of the same power supply mode are deployed on the same rack or the same area of the same rack, and devices with strong disaster recovery and mutual exclusion are deployed on different racks. The weight of each rack (including planned and reserved module devices) cannot exceed the load-bearing limit of the machine room. The positions in each rack need to be reserved for the connector module and the monitoring module. The rack installation and arrangement may be planned according to a number of devices required for future service development, to reserve corresponding installation positions of the future devices.

[00109] In the third embodiment of the present disclosure, the method for rack installation and configuration in a private network is based on the following rules.

[00110] At r1, according to the disaster recovery requirement of the device, when the device has no disaster recovery requirement, devices of the same type are deployed on the same rack from the bottom to the top of the rack; when the device has the disaster recovery requirement, the devices are deployed on a plurality of racks from the bottom to the top of each rack, and a number of
5 devices of the same type in a single rack is not greater than a disaster recovery ratio of a total number of devices of the same type.

[00111] At r2, each rack is used upwards from 2U below the rack.

[00112] At r3, for service racks, hm U is reserved for installing a monitoring device, and 1U-5U is reserved for installing a connector module, in which a height of the connector module depends on
10 a number of power terminal types and a number of signal type ports of the devices deployed on this rack; a plurality of templates for the connector module are defined according to a size of the power terminals, a size of communication interfaces and a width of the rack; a weight of a single rack with the monitoring module and the connector module is wx, and a weight of an empty rack is wc.

[00113] At r4, a rack height “hc” of the apparatus and a load-bearing requirement “wh” of a machine room are determined according to a space environment of the machine room.

[00114] At r5, a height of an interval space between adjacent devices is equal to a larger value between requirements of the two devices for the height of the interval space; a height of an interval space between the monitoring module and the connector module is hx; the height of the interval
20 space needs to take into account electromagnetic interference, air supply, wiring and other requirements.

[00115] In the third embodiment of the present disclosure, the process of performing the rack installation and configuration in the private network may also refer to FIG. 4.

[00116] As shown in FIG. 4, at P0, a rack height of a private network integrated apparatus is
25 determined according to a height of a machine room or a height of an existing wiring rack or a height of an existing fire fighting sprayer in the machine room; a rack width and a rack depth of the private network integrated apparatus are determined according to a maximum size of function module devices selected and determined by the private network integrated apparatus.

[00117] At P1, a device configuration information table summarizing the function module devices
30 selected by the apparatus is shown in FIG. 5 (please be noted that the table in figure 5 is split into two tables due to the figure size limit), and it is sorted according to function modules and device

type information, and the devices are numbered with “1, 2, 3...m” based on the sorting in the device configuration information table. The device configuration information includes a device model number, a configuration situation, a port, a size, a power consumption, a weight, an air supply mode, a disaster recovery mode, etc. of each function module device selected by the apparatus. In addition, the service module device is in preference to the infrastructure module device, and the refrigeration module, the power module, the fire fighting module, the monitoring module, and the connector module included in the infrastructure module are sorted in order; different types of devices in the same function module may be sorted according to their device type information, for example, a device with a heavy weight is preferentially sorted.

[00118] At P2, initialization is performed; according to a device sequence in the device configuration information table of the private network integrated apparatus determined at P1, the 1st device is selected from devices of the 1st type and is pre-deployed on a rack with the rack number being 1. That is, the jth device (j=1) with the serial number i (i=1) is selected according to the device sequence determined in FIG. 5, a current rack t (t=1) is recorded, a current total number “nc_temp=1” of racks is recorded, a number “n[t=1][i=1]=0” of devices with the serial number i on the current rack “t=1” is recorded, a number “n[t=1]=0” of devices on the current rack “t=1” is recorded, an air supply type (v[t]=“”) of the current rack t is recorded, and then the step at P3a is performed.

[00119] At P3, the disaster recovery requirement is considered, the disaster recovery requirement of a device currently selected for deploying is judged, and it is considered whether a pre-deployed rack meets a backup mode requirement of the device currently selected for deploying after the device currently selected for deploying is deployed on the pre-deployed rack (that is, a number of the same type of devices in the rack needs to not be greater than a disaster recovery ratio of a total number of the same type of devices in the apparatus, and if it is in a 1+1 backup mode or a POOL mode, the disaster recovery ratio is equal to 0.5): if the existing rack cannot meet the backup mode requirement, the device is pre-deployed on a new rack. The step as P3 is implemented by the following 3 steps at P3a to P3c.

[00120] At P3a, it is judged whether there is a disaster recovery requirement of the device with the device No. i: if no, the step at P4a is performed; if yes, the number “qb” of the pre-deployed rack is equal to t, and the step at P3b is performed.

[00121] At P3b, it is judged whether the number “qb” of the pre-deployed rack is less than or equal to the current total number “nc_temp” of racks: if yes, the step at P3c is performed; if no, the current total number “nc_temp” of racks is equal to “nc_temp + 1”, a number “n[qb][i]” of devices with the serial number i in the pre-deployed rack qb is equal to 0, a number “n[qb]” of devices in the pre-deployed rack qb is equal to 0 and the step at P3c is performed.

[00122] At P3c, it is judged whether the number “n[qb][i]” of devices with the serial number i in the pre-deployed rack qb is less than a disaster recovery ratio j^* of the current deploying device with the serial number $i=1$: if yes, the current rack number t is equal to qb, and the step at P4a is performed; if no, the number qb of the pre-deployed rack is equal to “qb+1” and the step at P3b is performed.

[00123] At P4, the air supply requirement is considered, and the air supply requirement of the device currently selected for deploying is judged. If the device currently selected for deploying may not be deployed on the same rack with devices of different air supply types, it is considered whether all the devices deployed on the rack are of the same air supply type after the device currently selected for deploying is deployed on the pre-deployed rack. The step as P4 is implemented by the following 3 steps at P4a to P4c.

[00124] At P4a, an air supply requirement of the device with the device No. i is judged: if the device with the device No. i may be deployed on the same rack with devices of different air supply types, the step at P5a is performed; if the device with the device No. i may not be deployed on the same rack with devices of different air supply types, a pre-deployed rack number “qv” is equal to t, the step at P4b is performed.

[00125] At P4b, it is judged whether the pre-deployed rack number “qv” is less than or equal to the current total number “nc_temp” of racks: if yes, the step at P4c is performed; if no, the current total number “nc_temp” of racks is equal to “nc_temp + 1”, a number “n[qv][i]” of devices with the serial number i in the pre-deployed rack “qv” is equal to 0, a number “n[qv]” of devices in the pre-deployed rack “qv” is equal to 0 and the step at P4c is performed.

[00126] At P4c, it is judged whether an existing air supply type “v[qv]” of the pre-deployed rack “qv” is the same as that of the device with the serial number $i=1$ or whether the number “n[qv]” of devices in the current rack is 0: if they are the same or n[qv] is equal to 0, the current rack number t is equal to qv, and the step at P5a is performed; if they are not the same or n[qv] is not equal to 0, the pre-deployed rack number “qv” is not equal to “qv+1”, and the step at P4b is performed.

[00127] At P5, a rack height limit is considered, and a deployment space for the monitoring module and connector module is considered and reserved after the device currently selected for deploying is deployed on the rack. The occupied space of the pre-deployed rack does not exceed the rack height limit. The step as P5 is implemented by the following 3 steps at P5a to P5c.

5 **[00128]** At P5a, the j^{th} device with the currently selected serial number i is deployed on the current rack t , and the occupied space “ h_{temp} ” of the rack is calculated in a formula of $h_{\text{temp}} = (1U \text{ reserved below the rack}) + (\text{a sum of the heights of all deployed devices on the current rack}) + (\text{a sum of interval height requirements of all the deployed devices on the current rack}) + (\text{a requirement of an interval height between the device currently selected for deploying and the adjacent deployed device}) + (\text{a height of the device currently selected for deploying}) + (\text{a requirement of an interval height between the device currently selected for deploying and the connector module}) + (\text{a height reserved for the connector module}) + (\text{a requirement of an interval height “}hx\text{” between the connector module and the monitoring module}) + (\text{a height “}hm\text{” reserved for the monitoring module})$, where the reserved connector module currently selected needs to meet
10 the number of power terminals and the number of signal ports of the devices currently deployed on the rack.

[00129] At P5b, it is judged whether the rack space “ h_{temp} ” is greater than the rack size “ hc ”: if yes, the current rack number t is equal to $t+1$, and the step at P3a is performed; if no, the step at P6a is performed.

20 **[00130]** At P6, the load-bearing limit of the machine room is considered, weights of the monitoring module, the connector module and the empty rack are considered after the device currently selected for deploying is deployed on the rack, a weight of the pre-deployed rack after the devices are deployed does not exceed the load-bearing limit of the machine room. The step as P6 is implemented by the following 2 steps at P6a to P6b.

25 **[00131]** At P6a, a deployment weight “ w_{temp} ” of the rack is calculated in a formula of $w_{\text{temp}} = \text{a weight of all deployed devices in the current rack} + \text{a weight of the device currently selected for deploying} + \text{a weight “}wx\text{” of a single rack with the monitoring module and the connector module} + \text{a weight “}wc\text{” of the empty rack}$.

[00132] At P6b, it is judged whether the deployment weight “ w_{temp} ” of the rack is greater than
30 the load-bearing requirement “ wh ” of the machine room: if yes, the current rack number t is equal to $t+1$, the step at P3a is performed; if no, the step at P7 is performed.

[00133] At P7, it is considered whether the pre-deployed rack meets requirements of the device currently selected for deploying (i.e., meeting the disaster recovery requirement, the air supply requirement, the rack height limit, and the load-bearing limit of the machine room at the same time), and if yes, the device currently selected for deploying is deployed on the pre-deployed rack.

5 That is, a rack number t and a rack position " $p[t]$ " of the j^{th} device with the currently selected serial number i are recorded, where the $p[t]$ [(1U reserved below the rack) + (a sum of the heights of all deployed devices on the current rack) + (a sum of interval height requirements of all the deployed devices on the current rack) + (a requirement of an interval height between the device currently selected for deploying and the adjacent deployed device) + 1] = $p[t]$ [(1U reserved below the rack) + (a sum of the heights of all deployed devices on the current rack) + (a sum of interval height requirements of all the deployed devices on the current rack) + (a requirement of an interval height between the device currently selected for deploying and the adjacent deployed device) + 2] = ... = $p[t]$ [(1U reserved below the rack) + (a sum of the heights of all deployed devices on the current rack) + (a sum of interval height requirements of all the deployed devices on the current rack) + (a requirement of an interval height between the device currently selected for deploying and the adjacent deployed device) + (a height of the device currently selected for deploying)] = the j^{th} device of the device with the serial number i . The number " $n[t][i] = n[t][i]+1$ " of devices with the serial number i in the current rack t is recorded, the number of devices " $n[t] = n[t]+1$ " in the current rack t is recorded, and it is recorded that the air supply type of the current rack t " $v[t]$ is equal to the air supply type of the device with the serial number i when $n[t] = 1$, or $v[t] = v[t] \& \& \text{"&"}$ & the air supply type of the device with the serial number I when $n[t] > 1$. Then, the step at P8 is performed.

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[00134] At P8, it is judged whether all devices with the serial number i are deployed and racked. That is, it is judged whether $j+1$ is greater than a number of devices with the currently selected serial number i : if yes, then $i=i+1$, and the step at P9 is performed; if no, $j=j+1$, and the step at P3a is performed.

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[00135] At P9, it is judged whether devices of all types are fully deployed and racked. That is, it is judged whether i is greater than a maximum serial number of the apparatus: if yes, the step at P10 is performed; if no, $n[1][i] = n[2][i] = \dots = n[t][i] = 0$, $j = 1$, $t = 1$, and the step at P3a is performed.

30 **[00136]** At P10, an air supply area of each rack is adjusted. If a single rack has a plurality of different air supply modes and power supply modes, it is considered that the racks are rearranged

according to their air supply modes and power supply modes respectively, and device deployment positions are adjusted on the rack, to ensure that devices of the same air supply mode are deployed in the same air supply area of the same rack, and devices of the same power supply mode are deployed in the same area of the same rack.

5 **[00137]** The embodiments of the present disclosure may realize rapid and automatic rack installation and configuration of the private network integrated apparatus according to service requirements in different scenarios, guide rapid installation of the device after it arrives on site, provide a basis for accurate estimation of a cable length required for the function module devices in the apparatus, and comprehensively consider factors such as the disaster recovery requirement,
10 the air supply requirement, the rack size limit, the load-bearing requirement of the machine room, the power supply mode, etc., during the rack installation and configuration, which thus improves the rationality of the rack installation and configuration.

[00138] In the method for rack installation and configuration in a private network according to the embodiments of the disclosure, the private network deployment requirement information is
15 determined according to the private network service requirement, the deploying device hardware characteristics and the environmental resource situation of the machine room, in which the private network deployment requirement information includes at least one of the device security requirement, the device hardware requirement and the device environment requirement; the deployed rack is obtained by deploying the plurality of devices to be deployed on the
20 corresponding target racks according to the private network deployment requirement information; the rack installation and configuration in the private network is obtained by adjusting installation and configuration of the deployed rack according to the device hardware characteristics of the devices to be deployed and the specification requirement of user rack installation and configuration. The above solution is different from the related art that is only a design for a cloud
25 resource pool rack, only relates to servers, storage, networking and security devices with fewer device types involved, does not consider devices in other private network systems such as a wireless device, an access device, and a transmission device, and does not consider impacts on a rack installation arrangement of a disaster recovery mode, an air supply mode, etc. This leads to a low efficiency of rack installation and configuration in the existing private network. In the method
30 for rack installation and configuration in a private network according to the embodiments of the disclosure, rack installation and configuration for each device to be deployed may be performed in

a private network integrated apparatus according to device configuration situations of private network users in different scenarios and deployment requirements in a plurality of dimensions corresponding to the device, thereby improving the efficiency of rack installation and configuration in the private network, and enhancing private network usage experiences of the users.

[00139] FIG. 6 is a structure diagram of an apparatus for rack installation and configuration in a private network according to the first embodiment of the disclosure. As shown in FIG. 6, the apparatus 30 includes a determination module 301, a deployment module 302 and an adjustment module 303.

[00140] The determination module 301 is configured to determine private network deployment requirement information according to a private network service requirement, deploying device hardware characteristics, and an environmental resource situation of a machine room, in which the private network deployment requirement information includes at least one of a device security requirement, a device hardware requirement, or a device environment requirement.

[00141] The deployment module 302 is configured to obtain a deployed rack by deploying a plurality of devices to be deployed on corresponding target racks according to the private network deployment requirement information.

[00142] The adjustment module 303 is configured to obtain the rack installation and configuration in the private network by adjusting installation and configuration of the deployed rack according to device hardware characteristics of the device to be deployed and a specification requirement of user rack installation and configuration.

[00143] The operation process of the apparatus for rack installation and configuration in a private network according to the embodiments of the present disclosure is roughly the same as the operation process of the aforementioned method embodiments, which will not be repeated here.

[00144] In the apparatus for rack installation and configuration in a private network according to the embodiments of the disclosure, the private network deployment requirement information is determined according to the private network service requirement, the deploying device hardware characteristics and the environmental resource situation of the machine room, in which the private network deployment requirement information includes at least one of the device security requirement, the device hardware requirement and the device environment requirement; the deployed rack is obtained by deploying the plurality of devices to be deployed on the

corresponding target racks according to the private network deployment requirement information; the rack installation and configuration in the private network is obtained by adjusting installation and configuration of the deployed rack according to the device hardware characteristics of the devices to be deployed and the specification requirement of user rack installation and configuration. The above solution is different from the related art that is only a design for a cloud resource pool rack, only relates to servers, storage, networking and security devices with fewer device types involved, does not consider devices in other private network systems such as a wireless device, an access device, and a transmission device, and does not consider impacts on a rack installation arrangement of a disaster recovery mode, an air supply mode, etc. This leads to a low efficiency of rack installation and configuration in the existing private network and poor private network usage experiences of the users. In the apparatus for rack installation and configuration in a private network according to the embodiments of the disclosure, rack installation and configuration for each device to be deployed may be performed in a private network integrated apparatus according to device configuration situations of private network users in different scenarios and deployment requirements in a plurality of dimensions corresponding to the device, thereby improving the efficiency of rack installation and configuration in the private network, and enhancing private network usage experiences of the users.

[00145] FIG. 7 is a structural diagram of a device for rack installation and configuration in a private network according to embodiments of the disclosure. The embodiments of the disclosure do not limit the specific implementation of the device for rack installation and configuration in a private network.

[00146] As illustrated in FIG. 7, the computing device includes a processor 402, a communication interface 404, a memory 406, and a communication bus 408.

[00147] The processor 402, the communication interface 404, and the memory 406 communicate with each other via the communication bus 408. The communication interface 404 is configured for a network element communication with other devices such as user terminals or other servers. The processor 402 is configured to execute a program 410, which may specifically perform the steps related to the method for rack installation and configuration in a private network in the above embodiments.

[00148] In some embodiments, the program 410 may include a program code including computer executable instructions.

[00149] The processor 402 may be a central processing unit (CPU), an application specific integrated circuit (ASIC), or one or more integrated circuits configured to implement the embodiments of the disclosure. One or more processors included in the device for rack installation and configuration in a private network may be the same type of processors, such as one or more CPUs; or may be different types of processors, such as one or more CPUs and one or more ASICs.

[00150] The memory 406 is configured to store the program 410. The memory 406 may include a high-speed random access memory (RAM), or it may also include a non-volatile memory, such as a plurality of disk memories.

[00151] The program 410 may be called by the processor 402 to cause the device for rack installation and configuration in a private network to perform the following operations:

[00152] determining private network deployment requirement information according to a private network service requirement, deploying device hardware characteristics, and an environmental resource situation of a machine room, in which the private network deployment requirement information includes at least one of a device security requirement, a device hardware requirement, or a device environment requirement;

[00153] obtaining a deployed rack by deploying a plurality of devices to be deployed on corresponding target racks according to the private network deployment requirement information; and

[00154] obtaining the rack installation and configuration in the private network by adjusting installation and configuration of the deployed rack according to device hardware characteristics of the devices to be deployed and a specification requirement of user rack installation and configuration.

[00155] The operation process of the device for rack installation and configuration in a private network according to the embodiments of the present disclosure is roughly the same as the operation process of the aforementioned method embodiments, which will not be repeated here.

[00156] In the device for rack installation and configuration in a private network according to the embodiments of the disclosure, the private network deployment requirement information is determined according to the private network service requirement, the deploying device hardware characteristics and the environmental resource situation of the machine room, in which the private network deployment requirement information includes at least one of the device security requirement, the device hardware requirement and the device environment requirement; the

deployed rack is obtained by deploying the plurality of devices to be deployed on the corresponding target racks according to the private network deployment requirement information; the rack installation and configuration in the private network is obtained by adjusting installation and configuration of the deployed rack according to the device hardware characteristics of the devices to be deployed and the specification requirement of user rack installation and configuration. The above solution is different from the related art that is only a design for a cloud resource pool rack, only relates to servers, storage, networking and security devices with fewer device types involved, does not consider devices in other private network systems such as a wireless device, an access device, and a transmission device, and does not consider impacts on a rack installation arrangement of a disaster recovery mode, an air supply mode, etc. This leads to a low efficiency of rack installation and configuration in the existing private network and poor private network usage experiences of the users. In the device for rack installation and configuration in a private network according to the embodiments of the disclosure, rack installation and configuration for each device to be deployed may be performed in a private network integrated apparatus according to device configuration situations of private network users in different scenarios and deployment requirements in a plurality of dimensions corresponding to the device, thereby improving the efficiency of rack installation and configuration in the private network, and enhancing private network usage experiences of the users.

[00157] The embodiments of the disclosure provide a computer readable storage medium for storing at least one executable instruction which, when executed by the device for rack installation and configuration in a private network, cause the device for rack installation and configuration in a private network to perform the method for rack installation and configuration in a private network in any one of the above method embodiments.

[00158] For example, the executable instruction may cause the device for rack installation and configuration in a private network to perform the following operations:

[00159] determining private network deployment requirement information according to a private network service requirement, deploying device hardware characteristics, and an environmental resource situation of a machine room, in which the private network deployment requirement information includes at least one of a device security requirement, a device hardware requirement, or a device environment requirement;

[00160] obtaining a deployed rack by deploying a plurality of devices to be deployed on

corresponding target racks according to the private network deployment requirement information;
and

[00161] obtaining the rack installation and configuration in the private network by adjusting installation and configuration of the deployed rack according to device hardware characteristics of the devices to be deployed and a specification requirement of user rack installation and configuration.

[00162] The operation process of the executable instructions stored in the computer storage medium according to the embodiments of the present disclosure is roughly the same as the operation process of the aforementioned method embodiments, which will not be repeated here.

[00163] In the executable instructions stored in the computer storage medium according to the embodiments of the disclosure, the private network deployment requirement information is determined according to the private network service requirement, the deploying device hardware characteristics and the environmental resource situation of the machine room, in which the private network deployment requirement information includes at least one of the device security requirement, the device hardware requirement and the device environment requirement; the deployed rack is obtained by deploying the plurality of devices to be deployed on the corresponding target racks according to the private network deployment requirement information; the rack installation and configuration in the private network is obtained by adjusting installation and configuration of the deployed rack according to the device hardware characteristics of the devices to be deployed and the specification requirement of user rack installation and configuration. The above solution is different from the related art that is only a design for a cloud resource pool rack, only relates to servers, storage, networking and security devices with fewer device types involved, does not consider devices in other private network systems such as a wireless device, an access device, and a transmission device, and does not consider impacts on a rack installation arrangement of a disaster recovery mode, an air supply mode, etc. This leads to a low efficiency of rack installation and configuration in the existing private network and poor private network usage experiences of the users. In the executable instructions stored in the computer storage medium according to the embodiments of the disclosure, rack installation and configuration for each device to be deployed may be performed in a private network integrated apparatus according to device configuration situations of private network users in different scenarios and deployment requirements in a plurality of dimensions corresponding to the device,

thereby improving the efficiency of rack installation and configuration in the private network, and enhancing private network usage experiences of the users.

[00164] The embodiments of the disclosure provide a device for rack installation and configuration in a private network to perform the above-mentioned method for rack installation and configuration in a private network.

[00165] The embodiments of the disclosure provide a computer program, which may be called by a processor to enable a device for rack installation and configuration in a private network to execute the method for rack installation and configuration in a private network in any of the above method embodiments.

[00166] The embodiments of the disclosure provide a computer program product, which includes a computer program stored on a computer readable storage medium, and the computer program includes program instructions. When the program instructions are running on a computer, the computer is caused to perform the method for rack installation and configuration in a private network in any of the above method embodiments.

[00167] An algorithm or display herein is not inherently associated with any particular computer, any virtual system, or other device. Various general systems may also be used in conjunction with the teachings herein. From the above descriptions, the structure required to construct such a system is obvious. In addition, the embodiments of the disclosure are not specific to any particular programming language. It should be understood that the content of the disclosure described herein may be implemented in a variety of programming languages, and the above descriptions for specific languages are intended to disclose the preferred implementation of the disclosure.

[00168] A lot of details are given in the description provided herein. However, it should be understood that the embodiments of the disclosure may be practiced without these specific details. In some examples, well-known methods, structures and techniques are not shown in detail so as not to obscure the understanding of the disclosure.

[00169] Similarly, it should be understood that, in the above description of exemplary embodiments of the disclosure, various features in the embodiments of the disclosure are sometimes grouped together into a single embodiment, drawing, or description thereof, in order to streamline the disclosure and to assist in understanding one or more of various aspects of the disclosure. However, the disclosed method should not be interpreted as reflecting the intention that

the claims in the disclosure that need to be protected have more features than features described in each claim.

[00170] It may be understood by those skilled in the art that modules in the apparatus in the embodiment may be adaptively altered and be set in one or more apparatuses different from that in the present embodiment. A module or unit or component in the embodiment may be combined into a single module or unit or component, and they may also be divided into more submodules or subunits or subcomponents. Except that at least some of such features and/or processes or units are mutually exclusive, all features disclosed in the disclosure (including accompanying claims, abstract and attached drawings) and all processes or units of any method or device disclosed herein may be combined in any combination. Unless otherwise explicitly stated, each feature disclosed in the disclosure (including accompanying claims, abstract, and attached drawings) may be replaced by an alternative feature providing the same, equivalent, or similar purpose.

[00171] It should be noted that the above embodiments are just explanatory rather than to limit the present disclosure, and that those skilled in the art may design alternative embodiments without departing from the scope of the attached claims. In the claims, any reference number located in parentheses should not be constructed as a limitation of the claims. The word “comprise/include” does not exclude the existence of an element or a step not listed in the claims. The word “a/an” or “one” before a component does not exclude the existence of a plurality of such components. The disclosure may be implemented by means of hardware including a number of different components and by means of a properly programmed computer. In the claims that lists units of several apparatuses, several of these apparatuses may be embodied by the same hardware item. The use of the words first, second, and third does not indicate any sequence. These words may be interpreted as names. The steps in the above embodiments shall not be construed as a limitation of the execution sequence unless otherwise specified.

WHAT IS CLAIMED IS:

1. A method for rack installation and configuration in a private network, the method comprising:

determining private network deployment requirement information according to a private network service requirement, deploying device hardware characteristics, and an environmental resource situation of a machine room, wherein the private network deployment requirement information comprises at least one of a device security requirement, a device hardware requirement, or a device environment requirement;

obtaining a deployed rack by deploying a plurality of devices to be deployed on corresponding target racks according to the private network deployment requirement information; and

obtaining the rack installation and configuration in the private network by adjusting installation and configuration of the deployed rack according to device hardware characteristics of the devices to be deployed and a specification requirement of user rack installation and configuration.

2. The method of claim 1, wherein the private network deployment requirement information comprises at least one of the device security requirement, the device hardware requirement, or the device environment requirement;

wherein determining the private network deployment requirement information according to the private network service requirement, the deploying device hardware characteristics, and the environmental resource situation of the machine room comprises:

determining the device security requirement according to the private network service requirement, wherein the device security requirement comprises at least one of a disaster recovery requirement, an air supply mode security requirement, or an electromagnetic security requirement;

determining the device hardware requirement according to the deploying device hardware characteristics, wherein the device hardware requirement comprises at least one of: a power consumption requirement or a power type requirement of the devices to be deployed; and

determining the device environment requirement according to the environmental resource situation of the machine room, wherein the device environment requirement comprises at least one of a rack size limit or a machine room load-bearing limit.

3. The method of claim 2, wherein obtaining the deployed rack by deploying the plurality of devices to be deployed on the corresponding target racks according to the private network deployment requirement information comprises:

deploying devices to be deployed that have the disaster recovery requirement and are of a same device type on different target racks respectively, wherein a number of devices of each device type deployed on each target rack is less than or equal to a disaster recovery ratio of a total number of devices of each device type;

deploying devices to be deployed that have the air supply mode security requirement and different air supply modes on different target racks respectively, wherein each of different target racks achieves the air supply mode security requirement; and

deploying devices to be deployed that have the electromagnetic security requirement and different electromagnetic types on different target racks respectively, wherein each of different target racks achieves the electromagnetic security requirement.

4. The method of claim 2, wherein obtaining the deployed rack by deploying the plurality of devices to be deployed on the corresponding target racks according to the private network deployment requirement information comprises:

in response to determining that the device to be deployed is deployed on a currently selected target rack, and a sum of a post-deployment power consumption requirement and a reserved power consumption requirement of the currently selected target rack is greater than a rack power consumption setting value, deploying the device to be deployed on a new target rack; and

deploying devices to be deployed that have the power type requirement and different power types on different target racks or different areas of a same target rack respectively, wherein each of different target racks achieves the power type requirement.

5. The method of claim 1 or 2, wherein obtaining the deployed rack by deploying the plurality of devices to be deployed on the corresponding target racks according to the private network deployment requirement information comprises:

in response to determining that the device to be deployed is deployed on a currently selected target rack, and a sum of an occupied space and a reserved space of the currently selected target rack is greater than a rack size limit, deploying the device to be deployed on a new target rack; and

in response to determining that the device to be deployed has been deployed on the currently selected target rack, and a sum of a post-deployment weight and a reserved weight of the currently selected target rack exceeds a preset load-bearing limit of the machine room, deploying the device to be deployed on a new target rack.

5 6. The method of claim 1 or 2, wherein obtaining the deployed rack by deploying the plurality of devices to be deployed on the corresponding target rackss according to the private network deployment requirement information comprises:

 deploying each of the devices to be deployed on one of a plurality of target racks in sequence according to the private network deployment requirement information and a
10 deployment priority;

 for each of the devices to be deployed, deploying the device to be deployed on a first target rack according to the device security requirement; and

 in response to determining that there is a device to be deployed on the first target rack that does not meet the device hardware requirement and the device environment requirement,
15 deploying the device to be deployed on a second target rack.

 7. The method of claim 1 or 2, wherein obtaining the rack installation and configuration in the private network by adjusting installation and configuration of the deployed rack according to device hardware characteristics of the devices to be deployed and the specification requirement of user rack installation and configuration comprises:

20 obtaining an adjusted configuration by adjusting installation and configuration of the deployed rack within a same rack according to the device hardware characteristics of the device to be deployed, wherein the device hardware characteristics comprises at least one of a power supply mode, an air supply mode, or a device weight; and

 obtaining the rack installation and configuration in the private network by adjusting the
25 installation and configuration adjusted again according to the specification requirement of user rack installation and configuration.

 8. An apparatus for rack installation and configuration in a private network, comprising:

 a determination module, configured to determine private network deployment requirement information according to a private network service requirement, deploying device hardware
30 characteristics, and an environmental resource situation of a machine room, wherein the private network deployment requirement information comprises at least one of a device security

requirement, a device hardware requirement, or a device environment requirement;

a deployment module, configured to obtain a deployed rack by deploying a plurality of devices to be deployed on corresponding target racks according to the private network deployment requirement information;

5 an adjustment module, configured to obtain the rack installation and configuration in the private network by adjusting installation and configuration of the deployed rack according to device hardware characteristics of the device to be deployed and a specification requirement of user rack installation and configuration.

10 9. A device for rack installation and configuration in a private network, comprising a processor, a memory, a communication interface and a communication bus, wherein the processor, the memory and the communication interface communicate with each other via the communication bus;

15 the memory is configured to store at least one executable instruction, wherein the executable instruction causes the processor to perform operations of the method for rack installation and configuration in a private network according to any one of claims 1 to 7.

10. A computer readable storage medium for storing at least one executable instruction which, when executed by a device for rack installation and configuration in a private network, causes the processor to perform operations of the method for rack installation and configuration in a private network according to any one of claims 1 to 7.

20 11. A computer program product, comprising computer instructions, which, when executed by a computer device, cause the computer device to perform operations of the method for rack installation and configuration in a private network according to any one of claims 1 to 7.