| | |
|---|---|
| United States Patent | 12386649 |
| Kind Code | B2 |
| Date of Patent | August 12, 2025 |
| Inventor(s) | Saito; Shogo et al. |


# Server maintenance control device, server maintenance system, server maintenance control method, and program


## Abstract

A controller server includes an assignment unit that assigns devices connected to a server to virtual machines, a usage status management unit that records correspondence between the virtual machines and devices used by the virtual machines, a warning relation management unit that records types of warnings that may occur for each of the devices during maintenance, a maintenance control unit that determines an order of an instruction for suppressing issuance of a warning that may occur for the devices during maintenance and an instruction for evacuating an affected virtual machine among the virtual machines to another server, a warning exclusion setting unit that instructs the server to exclude issuance of a warning that may occur for a device due to the maintenance, and an affected user specification evacuation unit that specifies the affected virtual machine, and evacuates the affected virtual machine from the server to the another server.



**Inventors:** **Saito; Shogo (Musashino, JP), Takada; Naoki (Musashino, JP)**

**Applicant:** **Nippon Telegraph and Telephone Corporation** (Tokyo, JP)



**Family ID:** **1000008750028**

**Assignee:** **Nippon Telegraph and Telephone Corporation (Tokyo, JP)**

**Appl. No.:** **18/014855**

**Filed (or PCT Filed):** **September 08, 2020**

**PCT No.:** **PCT/JP2020/033954**

**PCT Pub. No.:** **WO2022/009438**

**PCT Pub. Date:** January 13, 2022

## Prior Publication Data

| Document Identifier | Publication Date |
|---|---|
| US 20230289203 A1 | Sep. 14, 2023 |

## Foreign Application Priority Data

| | | |
|---|---|---|
| WO | PCT/JP2020/026992 | Jul. 10, 2020 |

## Publication Classification

**Int. Cl.:** **G06F9/455** (20180101)

**U.S. Cl.:**

CPC **G06F9/45558** (20130101); G06F2009/45591 (20130101); G06F2009/45595 (20130101)

## Field of Classification Search

**USPC:** None

## References Cited

**U.S. PATENT DOCUMENTS**

| Patent No. | Issued Date | Patentee Name | U.S. Cl. | CPC |
|---|---|---|---|---|
| 8874749 | 12/2013 | Vittal | 709/226 | H04L 67/1001 |
| 9361139 | 12/2015 | Baig | N/A | G06F 9/5077 |
| 10725885 | 12/2019 | Paraschiv | N/A | G06F 11/3433 |
| 11157263 | 12/2020 | Zhang | N/A | G06F 8/65 |
| 11474857 | 12/2021 | Biemueller | N/A | G06F 9/45558 |
| 2006/0085668 | 12/2005 | Garrett | 714/4.1 | G06F 9/5061 |
| 2008/0163207 | 12/2007 | Reumann | 718/1 | H04L 63/0263 |
| 2009/0144579 | 12/2008 | Swanson | 718/1 | G06F 11/0712 |
| 2009/0300606 | 12/2008 | Miller | 718/1 | G06F 9/45558 |
| 2010/0017800 | 12/2009 | Dow | 718/1 | G06F 9/45533 |
| 2010/0071025 | 12/2009 | Devine | 718/1 | G06F 9/4856 |
| 2010/0161922 | 12/2009 | Sharp | 718/1 | G06F 9/45558 |
| 2010/0306381 | 12/2009 | Lublin | 709/226 | G06F 15/16 |
| 2011/0107148 | 12/2010 | Franklin | 718/1 | G06F 11/0748 |
| 2012/0066677 | 12/2011 | Tang | 718/1 | G06F 9/4856 |
| 2012/0195187 | 12/2011 | Ashihara | 370/235 | G06Q 50/00 |
| 2013/0191543 | 12/2012 | Abbondanzio | 709/226 | H04L 47/70 |
| 2013/0205106 | 12/2012 | Tati | 711/159 | G06F 3/061 |
| 2013/0219384 | 12/2012 | Srinivasan | 718/1 | H04L 12/462 |
| 2014/0007089 | 12/2013 | Bosch | 718/1 | G06F 9/4856 |
| 2014/0082616 | 12/2013 | Kurita | 718/1 | H04L 49/70 |
| 2014/0115164 | 12/2013 | Kalyanaraman | 709/226 | H04L 67/34 |
| 2014/0372788 | 12/2013 | Vavrick | 714/4.1 | G06F 9/45558 |

| | | | | |
|---|---|---|---|---|
| 2015/0007174 | 12/2014 | Jain | 718/1 | G06F 9/45533 |
| 2015/0043379 | 12/2014 | Shimokuni | 370/254 | H04L 45/586 |
| 2015/0169349 | 12/2014 | Joffe | 718/1 | G06F 9/4856 |
| 2016/0077859 | 12/2015 | Cropper | 718/1 | G06F 9/4418 |
| 2016/0085560 | 12/2015 | Gourlay | 713/2 | G06F 9/45558 |
| 2016/0139946 | 12/2015 | Gardner | 718/1 | G06F 9/5077 |
| 2016/0253198 | 12/2015 | Gallant | 718/1 | G06F 9/45558 |
| 2016/0266923 | 12/2015 | Miyoshi | N/A | G06F 3/0647 |
| 2016/0283261 | 12/2015 | Nakatsu | N/A | G06F 9/45558 |
| 2017/0039120 | 12/2016 | Ganesan | N/A | G06F 11/3055 |
| 2017/0364394 | 12/2016 | Fujita | N/A | G06F 9/5088 |
| 2018/0136960 | 12/2017 | Zhang | N/A | G06F 9/4856 |
| 2018/0157532 | 12/2017 | Kumar | N/A | G06F 9/4881 |
| 2019/0068442 | 12/2018 | Kondo | N/A | H04L 41/0879 |
| 2019/0243550 | 12/2018 | Franciosi | N/A | G06F 3/0647 |
| 2019/0278624 | 12/2018 | Bade | N/A | G06F 9/4868 |
| 2019/0286475 | 12/2018 | Mani | N/A | G06F 9/45558 |
| 2019/0288914 | 12/2018 | Celozzi | N/A | H04L 41/0897 |
| 2020/0042340 | 12/2019 | Wiggers | N/A | G06F 9/5077 |
| 2020/0183725 | 12/2019 | Grehan | N/A | G06F 3/0664 |
| 2020/0257554 | 12/2019 | Okuno | N/A | G06F 9/5077 |
| 2020/0371830 | 12/2019 | Kalley | N/A | H04L 41/0816 |
| 2021/0004000 | 12/2020 | Kalaskar | N/A | G06F 9/45545 |
| 2021/0042197 | 12/2020 | Rivera | N/A | G06F 9/45558 |
| 2021/0149774 | 12/2020 | Denneman | N/A | G06F 11/1448 |
| 2021/0157624 | 12/2020 | Saxena | N/A | G06F 9/4856 |
| 2021/0263762 | 12/2020 | Kachare | N/A | G06F 12/0862 |
| 2021/0383206 | 12/2020 | Teppoeva | N/A | G06F 11/004 |

**OTHER PUBLICATIONS**

[No Author Listed] [online], “Chapter 12 Maintenance, Troubleshooting and Debugging,” OpenStack Operations Guide, retrieved on Mar. 30, 2020, retrieved from URL <http://openstack-ja.github.io/openstack-manuals/openstack-ops/content/maintenance.html>, 23 pages (with English Translation). cited by applicant

---

*Primary Examiner:* Lee; Adam

*Attorney, Agent or Firm:* Fish & Richardson P.C.

---

## Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS

(1) This application is a National Stage application under 35 U.S.C. § 371 of International Application No. PCT/JP2020/033954, having an International Filing Date of Sep. 8, 2020, which claims priority to International Application No. PCT/JP2020/026992, having an International Filing Date of Jul. 10, 2020. The disclosure of the prior applications are considered part of the disclosure of this application, and are incorporated by reference in their entirety into this application.

TECHNICAL FIELD

(2) The present invention relates to a server maintenance control device, a server maintenance system, a server maintenance control method, and a program used for detecting a failure of a device connected to a physical server and performing maintenance of the device in a system in which the physical server is assigned to users on demand and virtual machines on the physical server are used.

## BACKGROUND ART

(3) In recent years, a virtual infrastructure has been widespread. The virtual infrastructure is a system by which physical resources such as physical servers and networks are abstracted and concealed using virtualization technology and a common infrastructure for a plurality of applications and services is provided. The physical servers of the virtual infrastructure are assigned to users on demand in response to requests from the users. Furthermore, to the physical servers of the virtual infrastructure, a plurality of various external devices such as graphics processing units (GPUs), field programmable gate arrays (FPGAs), network interface cards (NICs), or the like (hereinafter, referred to as “devices”) is connected.

(4) Each of the users requests a resource from each of the physical servers and temporarily uses a virtual machine deployed on each of the physical servers. At this time, each virtual machine uses any number of devices. Each of the devices requires maintenance irregularly. The virtual machine cannot use a maintenance target device during maintenance of the device.

(5) Conventionally, in maintenance of a device, the following processing is performed by a controller server (see, for example, Non Patent Literature 1). (1) An entire physical server to which a maintenance target device is connected is set to be excluded from warning monitoring. (2) An instance (virtual machine) of a user using the physical server to which the maintenance target device is connected is evacuated (migrated) to another server.

## CITATION LIST

### Non Patent Literature

(6) Non Patent Literature 1: “open stack Operation Guide Chapter 12 Maintenance, Failure, and Debug”, [online], [Searched on Jun. 10, 2020], Internet <URL:http://openstack-ja.github.io/openstack-manuals/openstack-ops/content/maintenance.html>

## SUMMARY OF INVENTION

### Technical Problem

(7) However, in the related art, an instance (virtual machine) not using a maintenance target device has been also evacuated (migrated). Therefore, an instance (virtual machine) not using a maintenance target device has been affected, for example, to temporarily stop.

(8) Furthermore, in the related art, since an entire physical server is excluded from a warning monitoring target, a warning of an instance (virtual machine) not using a maintenance target device has been also suppressed. Furthermore, in a case of a device failure, the device requires maintenance, but if maintenance is not performed in a correct procedure at this time, an instance (virtual machine) not using the maintenance target device has stopped, or a warning associated with the maintenance of the device has occurred.

(9) The present invention has been made to solve the above issues, and a main object thereof is to provide a server maintenance control device, a server maintenance system, a server maintenance control method, and a program that, on a physical server to which a maintenance target device is connected, suppress issuance of a warning associated with the maintenance of the device while suppressing processing of evacuating a virtual machine not using the device to another physical server. Furthermore, another object is to perform maintenance of a device using detection of the device failure as a trigger.

### Solution to Problem

(10) In order to solve the above issues, a server maintenance control device according to the present invention includes an assignment unit that assigns devices connected to a server to virtual machines managed by users, a usage status management unit that records correspondence between

the virtual machines and devices used by the virtual machines, a warning relation management unit that records types of warnings that may occur for each of the devices during maintenance, a maintenance control unit that, upon accepting a maintenance request, determines an order of an instruction for suppressing issuance of a warning that may occur for the devices during maintenance and an instruction for evacuating an affected virtual machine affected by maintenance among the virtual machines to another server, a warning exclusion setting unit that instructs the server to suppress issuance of a warning that may occur for a device during the maintenance on the basis of the types of warnings recorded in the warning relation management unit, and an affected user specification evacuation unit that specifies the affected virtual machine on the basis of correspondence between the virtual machines and devices used by the virtual machines recorded in the usage status management unit, and evacuates the affected virtual machine from the server to the another server.

Advantageous Effects of Invention

(11) According to the present invention, on a physical server to which a maintenance target device is connected, issuance of a warning associated with maintenance of the device can be suppressed while processing of evacuating a virtual machine not using the device to another physical server is suppressed. Furthermore, maintenance of a device can be performed using detection of the device failure as a trigger.

---

## Description

BRIEF DESCRIPTION OF DRAWINGS

(1) FIG. **1**A is an explanatory diagram (1) of an overall configuration and operation of a server system including a controller server (server maintenance control device) according to a first embodiment.

(2) FIG. **1**B is an explanatory diagram (2) of the overall configuration and the operation of the server system including the controller server (server maintenance control device) according to the first embodiment.

(3) FIG. **1**C is an explanatory diagram (3) of the overall configuration and the operation of the server system including the controller server (server maintenance control device) according to the first embodiment.

(4) FIG. **2** is a configuration block diagram of the controller server.

(5) FIG. **3** is an explanatory diagram of a usage status database.

(6) FIG. **4** is an explanatory diagram of a warning relation database.

(7) FIG. **5** is a flowchart illustrating overall operation of the controller server.

(8) FIG. **6** is a flowchart illustrating operation of the controller server during warning relation recording.

(9) FIG. **7** is a flowchart illustrating operation of the controller server during maintenance preparation.

(10) FIG. **8** is an explanatory diagram of an overall configuration and operation of a server system including a controller server (server maintenance control device) according to a second embodiment.

(11) FIG. **9** is a configuration block diagram of the controller server.

(12) FIG. **10** is a configuration block diagram of a warning monitoring system.

(13) FIG. **11** is an explanatory diagram of a device failure database.

(14) FIG. **12** is a flowchart of registration processing in a usage status database.

(15) FIG. **13** is a flowchart of registration processing in a warning relation database.

(16) FIG. **14**A is a flowchart of device failure detection processing and virtual machine evacuation processing.

(17) FIG. **14**B is a flowchart of the device failure detection processing and the virtual machine evacuation processing.

## DESCRIPTION OF EMBODIMENTS

(18) Hereinafter, embodiments of the present invention (hereinafter, referred to as "the present embodiments") will be described in detail with reference to the drawings. Note that the drawings are only schematically illustrated to the extent that the present invention can be sufficiently understood. Therefore, the present invention is not limited only to the illustrated examples. Furthermore, in the drawings, the same reference signs are given to common components and similar components, and duplicate description thereof will be omitted.

### First Embodiment

(19) <Overall Configuration and Operation of Server System>

(20) Hereinafter, an overall configuration and operation of a server system **100** (server maintenance system) including a controller server **10** according to a first embodiment will be described with reference to FIGS. **1**A to **1**C. FIGS. **1**A to **1**C are explanatory diagrams of the overall configuration and the operation of the server system **100** including the controller server **10** (server maintenance control device) according to the first embodiment.

(21) As illustrated in FIGS. **1**A to **1**C, the server system **100** includes the controller server **10**, a plurality of physical servers, a maintenance instruction device **91**, and a warning monitoring system **92**. In the first embodiment, the description will be given on the assumption that the server system **100** includes two physical servers of a first server **20***a* and a second server **20***b*. However, the number of the physical servers may be three or more.

(22) The controller server **10** is a computer that functions as a server maintenance control device that controls maintenance processing of the physical servers.

(23) Each of the physical servers (the first server **20***a* and the second server **20***b* in the first embodiment) is a computer that provides users with a virtualized environment.

(24) The maintenance instruction device **91** is a terminal device that transmits a maintenance request Rq (see FIG. **1**B) to the controller server **10** at the time of maintenance of an external device connected to each of the physical servers.

(25) The warning monitoring system **92** is a system that monitors a warning issued from each of the physical servers and notifies an administrator or the like.

(26) Each of the physical servers is electrically connected to a plurality of various external devices. The plurality of external devices is, for example, graphics processing units (GPUs), field programmable gate arrays (FPGAs), network interface cards (NICs), or the like. Hereinafter, these external devices are simply referred to as "devices".

(27) For example, in an example illustrated in FIG. **1**A, a first device **31***a*, a second device **32***a*, and a third device **33***a* are connected to the first server **20***a*. Similarly, a first device **31***b*, a second device **32***b*, and a third device **33***b* are connected to the second server **20***b*. The devices connected to the first server **20***a* and the devices connected to the second server **20***b* are of the same type. That is, the first device **31***a* of the first server **20***a* and the first device **31***b* of the second server **20***b* are of the same type. Furthermore, the second device **32***a* of the first server **20***a* and the second device **32***b* of the second server **20***b* are of the same type. Furthermore, the third device **33***a* of the first server **20***a* and the third device **33***b* of the second server **20***b* are of the same type. Note that the first server **20***a* and the second server **20***b* can be connected to three or more devices.

(28) Note that, unlike a central processing unit (CPU), a device such as a GPU and an FPGA often does not have a function specialized for temporary evacuation (migration) of an internal state. For this reason, a device such as a GPU or an FPGA requires evacuation processing by software, and the evacuation processing requires a relatively long time. That is, a device such as a GPU and an FPGA is a device that requires a relatively high setting cost at the time of evacuation. A plurality of devices connected to the physical servers includes such devices such as GPUs and FPGAs. Therefore, even in maintenance work of a certain device, another virtual machine not using the

maintenance target device can preferably be continuously used without being evacuated.
(29) Furthermore, each of the physical servers includes a filter setting unit for filtering a warning that should not be issued (warning that is not a monitoring target) and suppressing issuance of the warning. For example, the first server **20***a* includes a filter setting unit **26***a*. Similarly, the second server **20***b* includes a filter setting unit **26***b*. In the first embodiment, the filter setting units **26***a* and **26***b* operate in a case where issuance of a warning associated with maintenance of a device is suppressed.
(30) In the controller server **10**, a control program Pr for causing a computer to function as a server maintenance control device is installed in advance from a storage medium **99**. The controller server **10** is communicably connected to each of the physical servers (the first server **20***a* and the second server **20***b* in the first embodiment) and the maintenance instruction device **91**.
(31) The controller server **10** internally constructs a configuration illustrated in FIG. **2** by performing the control program Pr. As a result, the controller server **10** implements the following first to sixth functions.
(32) An assignment unit **11***a* implements a device assignment function for virtual machines of users (first function) (see FIGS. **1**A and **1**B). The "device assignment function for users" is a function of assigning any number of devices connected to a server to each of the virtual machines managed by the users.
(33) A usage status management unit **11***b* implements a device usage status recording function (second function) (see FIGS. **1**A and **1**B). The "device usage status recording function" is a function of recording the correspondence between each of the virtual machines managed by the users and the devices used by each of the virtual machines. The device usage status recording function is implemented by the usage status management unit **11***b* and a usage status database **12***a* to be described below (see FIG. **2**).
(34) A warning relation management unit **11***c* implements a warning relation recording function (third function) (see FIGS. **1**A and **1**B). The "warning relation recording function" is a function of recording and managing the correspondence between the devices and types of warnings that may occur during maintenance of the devices, that is, recording and managing the correspondence relation between each of the devices and an exclusion target type of a warning that is an exclusion target of monitoring during the maintenance of each of the devices. The warning relation recording function is implemented by the warning relation management unit **11***c* and a warning relation database **12***b* to be described below (see FIG. **2**).
(35) A maintenance control unit **11***d* implements a maintenance request acceptance function (fourth function) (see FIG. **1**B). The "maintenance request acceptance function" is a function of, upon accepting a maintenance request Rq for a device (see FIG. **1**B) from the external maintenance instruction device **91**, determining the order of an instruction for excluding (suppressing) issuance of a warning that may occur during maintenance of the device, and an instruction for evacuating a virtual machine affected by the maintenance of the device to another physical server. Hereinafter, the virtual machine affected by maintenance of a device is referred to as an "affected virtual machine".
(36) A warning exclusion setting unit **11***e* implements a warning exclusion setting function (fifth function) (see FIG. **1**B). The "warning exclusion setting function" is a function of instructing a physical server to exclude (suppress) issuance of the warning that may occur due to the maintenance of the device.
(37) An affected user specification evacuation unit **11***f* implements an affected user specification/evacuation function (sixth function) (see FIG. **1**B). The "affected user specification/evacuation function" is a function of specifying an affected virtual machine and evacuating the affected virtual machine from the physical server (the first server **20***a* in the first embodiment) to another physical server (the second server **20***b* in the first embodiment).
(38) The physical server is provided on demand in response to requests from a plurality of user

terminals. Each user uses a virtual machine on the provided physical server. For example, in the example illustrated in FIG. **1**A, the first server **20***a* is provided to a first user on demand in response to a request from a first user terminal **61***a* used by the first user. The first user uses a first virtual machine **21***a* on the first server **20***a* via the first user terminal **61***a*. Furthermore, the first server **20***a* is provided to a second user on demand in response to a request from a second user terminal **61***b* used by the second user. The second user uses a second virtual machine **22***a* on the first server **20***a* via the second user terminal **61***b*.

(39) Each user requests a resource from each virtual machine on demand and temporarily uses the virtual machine. At this time, each virtual machine uses any number of devices. For example, in the example illustrated in FIG. **1**A, the first user requests the first device **31***a* that is a resource from the first virtual machine **21***a* on demand. At this time, the first virtual machine **21***a* uses the first device **31***a*. The second user requests the second device **32***a* and the third device **33***a* that are resources from the second virtual machine **22***a* on demand. At this time, the second virtual machine **22***a* uses the second device **32***a* and the third device **33***a*.

(40) The first virtual machine **21***a* is connected to the first device **31***a* and provides the first user terminal **61***a* with a virtualized environment. On the other hand, the second virtual machine **22***a* is connected to the second device **32***a* and the third device **33***a* and provides the second user terminal **61***b* with a virtualized environment.

(41) Each of the first device **31***a*, the second device **32***a*, and the third device **33***a* requires maintenance work irregularly. During maintenance of a device, the virtual machine cannot use said device.

(42) In a case of detecting a predetermined abnormality, each physical server actively issues a warning Wa (see FIG. **1**C) to the warning monitoring system **92**. In response to this, the warning monitoring system **92** issues a warning to an administrator or the like.

(43) As illustrated in FIG. **1**B, a maintenance request Rq is output from the maintenance instruction device **91** to the controller server **10** at any timing. The maintenance request Rq designates a device that is a maintenance target (hereinafter, referred to as a “maintenance target device”).

(44) Here, it is assumed that the maintenance request Rq designates the third device **33***a* as a maintenance target device. In this case, the second virtual machine **22***a* using the third device **33***a* that is a maintenance target device is an affected virtual machine.

(45) In response to the maintenance request Rq, the controller server **10** accepts the maintenance request by the maintenance control unit **11***d* (fourth function). Then, the controller server **10** specifies and evacuates the affected virtual machine by the affected user specification evacuation unit **11***f* (sixth function) while performing warning exclusion setting on the physical server by the warning exclusion setting unit **11***e* (fifth function). Here, the affected user specification evacuation unit **11***f* only evacuates the second virtual machine **22***a* that is the affected virtual machine. The affected user specification evacuation unit **11***f* does not evacuate the first virtual machine **21***a*.

(46) At this time, the controller server **10** outputs, to the first server **20***a*, a warning exclusion setting instruction Cm**1** for giving an instruction for excluding (suppressing) issuance of a warning associated with the maintenance of the device by the warning exclusion setting unit **11***e* (fifth function). In response to the warning exclusion setting instruction Cm**1**, the first server **20***a* performs, on the filter setting unit **26***a*, filter setting for excluding (suppressing) issuance of the warning associated with the maintenance of the third device **33***a* that is the maintenance target device.

(47) Furthermore, the controller server **10** outputs, to the first server **20***a*, an evacuation instruction Cm**2** for giving an instruction for evacuating (migrating) the affected virtual machine to another server by the affected user specification evacuation unit **11***f* (sixth function). In response to the evacuation instruction Cm**2**, the first server **20***a* evacuates (migrates) the second virtual machine **22***a* that is the affected virtual machine to the second server **20***b*.

(48) As a result, as illustrated in FIG. **1**C, the second user terminal **61***b* is connected to the second

virtual machine **22***b* constructed in the second server **20***b*. Then, the second virtual machine **22***b* of the second server **20***b* uses the second device **32***b* and the third device **33***b* and provides the second user with the same virtualized environment as that of the second virtual machine **22***a*.
(49) At this time, even in maintenance work of the third device **33***a*, the first virtual machine **21***a* not using the third device **33***a* can be continuously used without being evacuated.
(50) <Configuration of Controller Server (Server Maintenance Control Device)>
(51) Hereinafter, a configuration of the controller server **10** (server maintenance control device) will be described with reference to FIG. **2**. FIG. **2** is a configuration block diagram of the controller server **10**.
(52) As illustrated in FIG. **2**, the controller server **10** includes a control unit **11**, a storage unit **12**, and a communication unit **19**.
(53) The control unit **11** includes the assignment unit **11***a*, the usage status management unit **11***b*, the warning relation management unit **11***c*, the maintenance control unit **11***d*, the warning exclusion setting unit **11***e*, and the affected user specification evacuation unit **11***f*. The control unit **11** is a CPU of the controller server **10**, and implements the function of each unit by performing the control program Pr.
(54) The assignment unit **11***a* assigns any number of devices connected to a server to virtual machines managed by users on a physical server. As a result, the virtual machines can use the assigned devices.
(55) The usage status management unit **11***b* records the correspondence between the virtual machines managed by respective users and devices used by the virtual machines.
(56) The warning relation management unit **11***c* records the correspondence between the devices and types of warnings that may occur during maintenance of the devices.
(57) The maintenance control unit **11***d*, upon accepting a maintenance request Rq for a device from the external maintenance instruction device **91** or the like, determines the order of an instruction for excluding (suppressing) issuance of a warning that may occur due to the maintenance of the device, and an instruction for evacuating an affected virtual machine that is a virtual machine of a user affected by the maintenance of the device to another physical server. In the first embodiment, the maintenance control unit **11***d* causes a warning exclusion setting instruction Cm**1** (see FIG. **1**B) to be output to the first server **20***a* earlier than an evacuation instruction Cm**2** (see FIG. **1**B).
(58) The warning exclusion setting unit **11***e* instructs the physical server to exclude (suppress) the issuance of the warning that may occur due to the maintenance of the device on the basis of the types of warnings recorded by the warning relation management unit **11***c*.
(59) The affected user specification evacuation unit **11***f*, using an identification (ID) of the maintenance target device as a key, specifies the affected virtual machine on the basis of the correspondence between devices and virtual machines using the devices, and evacuates the affected virtual machine to another physical server. The correspondence between the devices and the virtual machines using the devices is recorded in the usage status database **12***a* by the usage status management unit **11***b*.
(60) The storage unit **12** stores the control program Pr. Furthermore, in the storage unit **12**, the usage status database **12***a* and the warning relation database **12***b* are constructed.
(61) The usage status database **12***a* (first database) is a device assignment function for users, and records the correspondence between the virtual machines managed by the respective users and the devices used by the virtual machines.
(62) The warning relation database **12***b* (second database) records the correspondence between each of the devices and a type of a warning that may occur for the device during maintenance.
(63) <Configuration of Usage Status Database>
(64) Hereinafter, a configuration of the usage status database **12***a* will be described with reference to FIG. **3**. FIG. **3** is an explanatory diagram of the usage status database **12***a*.
(65) The usage status database **12***a* associates user IDs for identifying the virtual machines of the

users with device IDs of the devices used by the virtual machines. In the example illustrated in FIG. **3**, the first device **31***a* is associated with the first virtual machine **21***a* of the first user. Furthermore, the second device **32***a* and the third device **33***a* are associated with the second virtual machine **22***a* of the second user.

(66) The affected user specification evacuation unit **11***f*, upon accepting a maintenance request, specifies a virtual machine using a maintenance target device designated in the maintenance request as an affected virtual machine with reference to the usage status database **12***a*. In this manner, the affected user specification evacuation unit **11***f* can easily specify a virtual machine associated with a device ID of a maintenance target device in a short time.

(67) <Configuration of Warning Relation Database>

(68) Hereinafter, a configuration of the warning relation database **12***b* will be described with reference to FIG. **4**. FIG. **4** is an explanatory diagram of the warning relation database **12***b*.

(69) The warning relation database **12***b* associates device IDs with exclusion target types of warnings. Here, an "exclusion target type of a warning" means a type of a warning to be excluded from monitoring during maintenance of a device indicated by a device ID. In an example illustrated in FIG. **4**, "reboot (Reboot)" is associated as an exclusion target type of a warning for the first device **31***a*. Reboot means restarting a device. Furthermore, "shut down (Shut down)" is associated as an exclusion target type of a warning for the first device **31***b*. Shut down means terminating a device and turning off power. Furthermore, "unavailable (unavailable)" is associated as an exclusion target type of a warning for **31***c*. Unavailable means that a device is unusable.

(70) The warning exclusion setting unit **11***e*, upon accepting a maintenance request, instructs a physical server to suppress issuance of a warning that may occur due to the maintenance of a device specified in the maintenance request with reference to the warning relation database **12***b*. In this manner, the warning exclusion setting unit **11***e* can exclude (suppress) issuance of a warning that may occur due to maintenance of a device.

(71) <Operation of Controller Server (Server Maintenance Control Device)>

(72) Hereinafter, operation of the controller server **10** (server maintenance control device) will be described with reference to FIGS. **5** to **7**. FIG. **5** is a flowchart illustrating overall operation of the controller server **10**. FIG. **6** is a flowchart illustrating operation of the controller server **10** during warning relation recording in step S**125** illustrated in FIG. **5**. FIG. **7** is a flowchart illustrating operation of the controller server **10** during maintenance preparation in step S**140** illustrated in FIG. **5**.

(73) As illustrated in FIG. **5**, the maintenance control unit **11***d* of the controller server **10** repeatedly determines whether there is a request from the maintenance instruction device **91** that is a user terminal (step S**105**), and in a case where there is a request from the user terminal (in a case of "Yes"), the maintenance control unit **11***d* accepts the request from the user terminal (step S**110**). The request from the user terminal includes an ID of a device to be used.

(74) In step S**105**, in a case where there is no request from the user terminal (in a case of "No"), the maintenance control unit **11***d* returns to the processing of step S**105**.

(75) Next, the assignment unit **11***a* of the controller server **10** assigns the requested device to a virtual machine of a user (step S**115**). Then, the usage status management unit **11***b* of the controller server **10** records the correspondence between IDs of respective virtual machines managed by users and IDs of devices used by the virtual machines in the usage status database **12***a*, thereby recording the usage status of the devices (step S**120**). Furthermore, the warning relation management unit **11***c* of the controller server **10** records the correspondence relation between the device IDs and types of warnings that may occur during maintenance of the devices in the warning relation database **12***b* (step S**125**).

(76) In step S**125**, for example, the warning relation recording processing illustrated in FIG. **6** is performed.

(77) As illustrated in FIG. **6**, first, the warning relation management unit **11***c* of the controller

server **10** accepts input of the types of the warnings that may occur during maintenance of the respective devices from user terminals after the users start using the devices (step S**125***a*). Next, the warning relation management unit **11***c* records the types of the warnings that may occur during maintenance of the respective devices in the warning relation database **12***b* (step S**125***b*). Note that the types of the warnings that may occur during maintenance of the respective devices are input by the users.

(78) The warning relation management unit **11***c* determines whether recording of entire relation of the warnings that may occur during maintenance of the devices has been completed (step S**125***c*). In step S**125***c*, in a case where the warning relation management unit **11***c* determines that the recording has not been completed (in a case of "No"), the processing returns to step S**125***b*. On the other hand, in a case where the warning relation management unit **11***c* determines that the recording has been completed (in a case of "Yes"), the processing of FIG. **6** ends. In this case, the processing proceeds to step S**130** in FIG. **5**.

(79) Returning to FIG. **5**, after step S**125**, the maintenance control unit **11***d* of the controller server **10** determines whether there is a maintenance request Rq for a device from the maintenance instruction device **91** (step S**130**). In a case where it is determined that there is no maintenance request Rq for a device (in a case of "No") in the determination of step S**130**, the processing returns to step S**130**.

(80) On the other hand, in a case where it is determined that there is a maintenance request Rq for a device (in a case of "Yes"), the maintenance control unit **11***d* accepts the maintenance request Rq for the device (step S**135**). At this time, the maintenance control unit **11***d* determines the order of an instruction for excluding (suppressing) issuance of a warning that may occur due to the maintenance and an instruction for evacuating an affected virtual machine affected by the maintenance to another physical server. Then, the maintenance control unit **11***d* performs maintenance preparation (step S**140**).

(81) In step S**140**, for example, processing illustrated in FIG. **7** is performed.

(82) As illustrated in FIG. **7**, first, the maintenance control unit **11***d* of the controller server **10** instructs the warning exclusion setting unit **11***e* to exclude (suppress) issuance of the warning that may occur due to the maintenance of the maintenance target device. In response to this, the warning exclusion setting unit **11***e* refers to the warning relation database **12***b* using a device ID given to the maintenance target device (hereinafter referred to as "designated device ID") as an argument (step S**140***a*). As a result, the warning exclusion setting unit **11***e* specifies the type of the warning that may occur due to the maintenance of this device. Then, the warning exclusion setting unit **11***e* determines whether there is an exclusion target warning associated with the designated device ID (step S**140***b*).

(83) In a case where it is determined that there is no exclusion target warning associated with the designated device ID (in a case of "No") in the determination of step S**140***b*, the processing returns to step S**140***d*. On the other hand, in a case where it is determined that there is an exclusion target warning associated with the designated device ID (in a case of "Yes"), the warning exclusion setting unit **11***e* outputs a warning exclusion setting instruction to the physical server, and causes a filter setting unit of the physical server to set a warning of the exclusion target warning type associated with the designated device ID in a filter (step S**140***c*). Specifically, as illustrated in FIG. **1**B, the warning exclusion setting unit **11***e* outputs a warning exclusion setting instruction Cm**1** to the first server **20***a*, and causes the filter setting unit **26***a* of the first server **20***a* to set the warning of the exclusion target warning type associated with the designated device ID. As a result, the first server **20***a* can suppress issuance of the warning in a case where the maintenance of the device is performed in step S**145** to be described below.

(84) In a case where it is determined that there is no exclusion target warning associated with the designated device ID (in a case of "No") in the determination in step S**140***b*, or after step S**140***c*, the maintenance control unit **11***d* instructs the affected user specification evacuation unit **11***f* to

evacuate the affected virtual machine that is the virtual machine affected by the maintenance to another physical server. In response to this, the affected user specification evacuation unit **11***f* refers to the usage status database **12***a* using the designated device ID as an argument (step S**140***d*). Then, the affected user specification evacuation unit **11***f* determines whether there is a user ID being used for the device having the designated device ID (that is, the maintenance target device) (step S**140***e*). The user ID identifies an affected virtual machine. Here, the affected user specification evacuation unit **11***f* determines whether there is the affected virtual machine.

(85) In a case where it is determined that there is a user ID being used for this device (in a case of "Yes") in the determination of step S**140***e*, the affected user specification evacuation unit **11***f* instructs the physical server to evacuate the affected virtual machine using the user ID as an argument (step S**140***f*). Specifically, as illustrated in FIG. **1**B, the affected user specification evacuation unit **11***f* instructs the first server **20***a* to evacuate the second virtual machine **22***a* that is the affected virtual machine using the user ID being used for the third device **33***a* as an argument. In response to this, the second virtual machine **22***a* is evacuated (migrated) between the first server **20***a* and the second server **20***b*.

(86) In a case where it is determined that there is no user ID being used (in a case of "No") in the determination of step S**140***e*, or after step S**140***f*, the processing of step S**140** ends. In this case, the processing proceeds to step S**145** in FIG. **5**.

(87) Returning to FIG. **5**, after step S**140**, an operator or the like performs the maintenance of the device (step S**145**), and the processing returns to step S**130**.

Second Embodiment

(88) In a server system **100**A of a second embodiment, a function of automatically performing maintenance in units of devices using a device failure as a trigger is added, and a series of processing from occurrence of a failure to maintenance in units of devices and evacuation of only affected user is autonomously performed.

(89) Hereinafter, an overall configuration and operation of the server system **100**A including a controller server **10**A according to the second embodiment will be described with reference to FIG. **8**. FIG. **8** is an explanatory diagram of the overall configuration and the operation of the server system including the controller server **10**A (server maintenance control device) according to the second embodiment.

(90) The server system **100**A illustrated in FIG. **8** includes the controller server **10**A and a warning monitoring system **92**A that are different from those in the first embodiment. Other configurations are similar to those of the server system **100** of the first embodiment.

(91) The controller server **10**A is a computer that functions as a server maintenance control device that controls maintenance processing of servers. The controller server **10**A further includes a maintenance request generation unit **11***g* in addition to the same configuration as that of the controller server **10** of the first embodiment.

(92) The warning monitoring system **92**A is a system that monitors a warning issued from each of physical servers and notifies an administrator or the like, and includes a device failure notification unit **921***a* and a device failure management unit **921***b*.

(93) The device failure notification unit **921***a* implements a device failure notification function (seventh function) (see FIGS. **8** and **9**). The "device failure notification function" is a function of notifying the maintenance request generation unit **11***g* of the controller server **10**A of failure information related to a device failure. That is, the device failure notification unit **921***a* determines whether a notification from a physical server on which the device is loaded is a device failure by comparing the notification with each record of the device failure notification function using the notification as input. If this notification relates to a device failure, the maintenance request generation unit **11***g* of the controller server **10**A is notified of the occurrence of a failure together with information for uniquely identifying the target physical server and device.

(94) Since the device failure notification unit **921***a* autonomously notifies the maintenance request

generation unit **11***g* of the server maintenance control device of the device failure, the device failure can be quickly dealt with.

(95) Here, the notification from a physical server on which a device is loaded is rsyslog or a simple network management protocol (SNMP) that transfers a system log to a remote server. However, the present invention is not limited thereto, and the warning monitoring system **92**A may periodically check a physical server on which a device is loaded by polling.

(96) In a case of detecting a device failure, the device failure notification unit **921***a* of the second embodiment autonomously notifies the maintenance request generation unit **11***g*. However, the present invention is not limited thereto, and the device failure notification unit **921***a* may notify an operator in case of detecting a device failure, and then the operator may determine whether to notify the maintenance request generation unit **11***g*.

(97) Furthermore, the device failure notification unit **921***a* may be disposed in the controller server **10**A or an independent server, and may accept a device failure notification by an interface independent of warning monitoring.

(98) The device failure management unit **921***b* implements a device failure notification function. The "device failure notification function" is a function of recording failure information corresponding to device failures in a device failure database **922***b* (see FIG. **10**). Since the device failure management unit **921***b* notifies the maintenance request generation unit **11***g* of only predetermined failure information, the load on the server maintenance control device can be reduced.

(99) The controller server **10**A internally constructs the configuration illustrated in FIG. **8** by performing a control program Pr. As a result, the controller server **10**A implements an eighth function in addition to first to sixth functions similar to those of the first embodiment.

(100) The maintenance request generation unit **11***g* implements a maintenance request generation function (eighth function). The "maintenance request generation function" is a function of notifying a maintenance control unit **11***d* of a maintenance request for dealing with a failure on the basis of device failure information and target server information in a notification from the warning monitoring system **92**A. As a result, maintenance of a device can be performed using detection of the device failure as a trigger.

(101) In a case where a failure occurs, the device failure notification unit **921***a* of the warning monitoring system **92**A determines whether a device failure has occurred. In a case of determining that a device failure has occurred, the device failure notification unit **921***a* notifies the maintenance request generation unit **11***g* of the controller server **10** while notifying an operator (user) by a warning.

(102) The maintenance request generation unit **11***g* generates a maintenance request Rq for the device on the basis of the device failure information, and notifies the maintenance control unit **11***d*. The maintenance request Rq for the device includes a device ID for uniquely identifying the failed device. As a result, in the second embodiment, a warning during occurrence of a failure is minimized while the user is notified of the device failure, and the effect on virtual machines is minimized.

(103) The subsequent operation of the server system **100**A is similar to the operation of the server system **100** of the first embodiment.

(104) FIG. **9** is a configuration block diagram of the controller server **10**A.

(105) As illustrated in FIG. **9**, the controller server **10**A includes a control unit **11**A, and a storage unit **12** and a communication unit **19** that are similar to those of the first embodiment.

(106) The control unit **11**A includes an assignment unit **11***a*, a usage status management unit **11***b*, a warning relation management unit **11***c*, the maintenance control unit **11***d*, a warning exclusion setting unit **11***e*, and an affected user specification evacuation unit **11***f* that are similar to those of the first embodiment. The control unit **11**A further includes the maintenance request generation unit **11***g*. The control unit **11**A is a CPU of the controller server **10**A, and implements the function of

each unit by performing the control program Pr. The function of the maintenance request generation unit **11***g* has already been described with reference to FIG. **8**.
(107) FIG. **10** is a configuration block diagram of the warning monitoring system **92**A.
(108) As illustrated in FIG. **10**, the warning monitoring system **92**A includes a control unit **921**, a storage unit **922**, and a communication unit **923**.
(109) The control unit **921** includes the device failure notification unit **921***a* and the device failure management unit **921***b*. The control unit **921** is a CPU of a device included in the warning monitoring system **92**A, and implements the function of each unit by performing a warning monitoring program **922***a* to be described below.
(110) The device failure notification unit **921***a* has already been described with reference to FIG. **8**.
(111) The device failure management unit **921***b* implements a device failure recording function. The "device failure recording function" is a function of recording and managing failure information corresponding to device failures. The device failure recording function is implemented by the device failure management unit **921***b* and the device failure database **922***b* to be described below.
(112) The storage unit **922** stores the warning monitoring program **922***a* and the device failure database **922***b*. The device failure database **922***b* is a third database in which failure information corresponding to device failures is recorded.
(113) FIG. **11** is an explanatory diagram of the device failure database **922***b*.
(114) As illustrated in FIG. **11**, failure information corresponding to device failures is recorded in the device failure database **922***b*. "Device Failure" is failure information indicating that the device has failed in operation. "Error" is failure information indicating that an error has occurred during operation of the device. "unavailable" is failure information indicating that the device is unusable.
(115) FIG. **12** is a flowchart of registration processing in a usage status database **12***a*.
(116) First, the assignment unit **11***a* assigns devices to virtual machines of users (S**200**), and registers the assignment result in the usage status database **12***a* (S**201**), then the processing of FIG. **12** ends. As a result, the correspondence between each of the virtual machines managed by the users and a device used by each of the virtual machines is recorded in the usage status database **12***a*.
(117) FIG. **13** is a flowchart of registration processing in a warning relation database **12***b*.
(118) The users input exclusion target types of warnings via terminals or the like (S**210**). Here, the exclusion target types of warnings refer to types of warnings that may occur during maintenance of the devices.
(119) The warning relation management unit **11***c* records one of the input exclusion target types of warnings in the warning relation database **12***b* (S**211**). Then, the warning relation management unit **11***c* determines whether the recording has been completed (S**212**). In a case where the recording has not been completed (No), the warning relation management unit **11***c* returns to the processing of step S**211**, and in a case where the recording has been completed (Yes), the processing of FIG. **13** ends.
(120) FIGS. **14**A and **14**B are flowcharts of device failure detection processing and virtual machine evacuation processing.
(121) First, the device failure notification unit **921***a* of the warning monitoring system **92**A collates with the device failure database **922***b* on the basis of an alarm from a device (S**221**). Then, in a case where the alarm is not a device failure (No), the device failure notification unit **921***a* ends the processing of FIG. **14**A, and in a case where the alarm is a device failure (Yes), the processing proceeds to step S**222**. As described above, since the device failure notification unit **921***a* notifies the controller server **10**A only in a case of a device failure, the load on the controller server **10**A can be reduced.
(122) In step S**222**, the device failure notification unit **921***a* notifies an operator of the device failure. The device failure notification unit **921***a* further calls the maintenance request generation unit **11***g* together with a device ID included in the alarm (S**223**).

(123) The maintenance request generation unit **11***g* calls the maintenance control unit **11***d* on the basis of the device ID (S**224**). Then, the maintenance control unit **11***d* calls the warning exclusion setting unit **11***e* on the basis of the device ID so as to instruct the warning exclusion setting unit **11***e* to exclude (suppress) issuance of a warning that may occur due to maintenance of the maintenance target device (S**225**), and then the processing proceeds to step S**226** in FIG. **14**B.
(124) In step S**226** in FIG. **14**B, the warning exclusion setting unit **11***e* refers to the warning relation database **12***b* using the device ID given to the maintenance target device that is a designated device ID as an argument. As a result, the warning exclusion setting unit **11***e* specifies the type of the warning that may occur due to the maintenance. Then, the warning exclusion setting unit **11***e* determines whether there is an exclusion target warning associated with the designated device ID (S**227**).
(125) In step S**227**, in a case where there is an exclusion target warning associated with the designated device ID (Yes), the processing proceeds to step S**228**, and the warning exclusion setting unit **11***e* sets the exclusion target warning in a filter setting unit, and the processing proceeds to step S**229**. In a case where there is no exclusion target warning associated with the designated device ID (No), the warning exclusion setting unit **11***e* proceeds to step S**229**.
(126) In step S**229**, the maintenance control unit **11***d* calls the affected user specification evacuation unit **11***f* using the device ID designated as the maintenance target as an argument.
(127) In step S**230**, the affected user specification evacuation unit **11***f* determines whether there is a user ID related to a virtual machine using the designated device ID. In a case where there is a user ID related to the virtual machine using the designated device ID (Yes), the affected user specification evacuation unit **11***f* gives an instruction for evacuating the virtual machine using the designated user ID as an argument, and the processing of FIG. **14**B ends. In a case where there is no user ID related to the virtual machine using the designated device ID (No), the affected user specification evacuation unit **11***f* ends the processing in FIG. **14**B.
(128) The warning monitoring system **92**A is activated using a device failure as a trigger, and the maintenance control unit **11***d* is further activated on the basis of the device information. As a result, the warning monitoring system **92**A issues a warning associated with failure detection, and the controller server **10**A evacuates an affected virtual machine using the device after suppressing issuance of a warning associated with maintenance of the device. As a result, maintenance can be quickly performed in a case of a failure of a device connected to a server.
(129) <Effects>
(130) Hereinafter, configurations and effects of the server maintenance control device according to the present invention will be described.
(131) (1) A server maintenance control device according to the present invention includes an assignment unit that assigns devices connected to a server to virtual machines managed by users, a usage status management unit that records correspondence between the virtual machines and devices used by the virtual machines, a warning relation management unit that records types of warnings that may occur for each of the devices during maintenance, a maintenance control unit that, upon accepting a maintenance request, determines an order of an instruction for suppressing issuance of a warning that may occur for the devices during maintenance and an instruction for evacuating an affected virtual machine affected by maintenance among the virtual machines to another server, a warning exclusion setting unit that instructs the server to suppress issuance of a warning that may occur for a device during the maintenance on the basis of the types of warnings recorded in the warning relation management unit, and an affected user specification evacuation unit that specifies the affected virtual machine on the basis of correspondence between the virtual machines and devices used by the virtual machines recorded in the usage status management unit, and evacuates the affected virtual machine from the server to the another server.
(132) Such a server maintenance control device according to the present invention manages assignment of devices to each of virtual machines. Then, in a case of performing maintenance on a

maintenance target device connected to a server (third device **33***a*), the server maintenance control device according to the present invention specifies a virtual machine assigned to the maintenance target device and evacuates (migrates) the virtual machine from the server (first server **20***a*) to another server (second server **20***b*) while causing the server (first server **20***a*) to perform filter setting so that a warning generated in association with the maintenance is not issued.

(133) In this manner, the server maintenance control device according to the present invention, on a server to which a maintenance target device is connected, can suppress issuance of a warning associated with maintenance while suppressing processing of evacuating a virtual machine not using the device to another physical server. As a result, the server maintenance control device according to the present invention can continue the operation of other virtual machines except an affected virtual machine. Furthermore, issuance of a warning associated with maintenance of a device can be suppressed.

(134) (2) The server maintenance control device according to claim **1**, in which the usage status management unit records correspondence between the virtual machines and devices used by the virtual machines in a first database, and the affected user specification evacuation unit, upon accepting a maintenance request, specifies a virtual machine using a device designated in the maintenance request as the affected virtual machine with reference to the first database.

(135) In this manner, the server maintenance control device according to the present invention can easily specify a virtual machine associated with a device ID of a maintenance target device in a short time.

(136) (3) The server maintenance control device according to claim **1**, in which the warning relation management unit records correspondence relation between each of the devices and an exclusion target type of a warning to be excluded from monitoring during maintenance of each of the devices in a second database, and the warning exclusion setting unit, upon accepting a maintenance request, instructs the server to suppress issuance of a warning that may occur due to maintenance of a device designated in the maintenance request with reference to the second database.

(137) In this manner, the server maintenance control device according to the present invention can exclude (suppress) issuance of a warning that may occur due to maintenance of a device.

(138) (4) The server maintenance control device according to claim **1** further including a maintenance request generation unit that generates a maintenance request of a device related to failure information of any of the devices on the basis of the failure information.

(139) In this manner, maintenance of a device can be performed using detection of the device failure as a trigger.

(140) (5) A server maintenance system of the present invention includes the server maintenance control device according to (4), and a warning monitoring device including a device failure notification unit that, upon detecting a failure of a device, notifies the maintenance request generation unit of failure information of said device.

(141) Since the maintenance request generation unit of the server maintenance control device is notified of a device failure in this manner, the device failure can be quickly dealt with.

(142) (6) The server maintenance system according to claim **5**, in which the warning monitoring device includes a third database in which failure information of which the device failure notification unit notifies the maintenance request generation unit is recorded.

(143) Since the maintenance request generation unit is notified of only predetermined failure information in this manner, the load on the server maintenance control device can be reduced.

(144) (7) A server maintenance control method according to the present invention is the server maintenance control method for a server maintenance control device, in which the server maintenance control device performs assigning devices connected to a server to virtual machines managed by users, recording correspondence between the virtual machines and devices used by the virtual machines in a first database, recording types of warnings that may occur for each of the

devices during maintenance in a second database, accepting a maintenance request, instructing the server to exclude issuance of a warning that may occur for the devices during maintenance on the basis of the types of warnings recorded in the second database, and specifying an affected virtual machine that is the virtual machine affected by maintenance on the basis of correspondence between the virtual machines and devices used by the virtual machines recorded in the first database, and evacuating the affected virtual machine from the server to another server.

(145) In this manner, the server maintenance control method according to the present invention, on a server to which a maintenance target device is connected, can suppress issuance of a warning associated with maintenance while suppressing processing of evacuating a virtual machine not using the device to another server. As a result, the server maintenance control method according to the present invention can make the operation of other virtual machines except an affected virtual machine continued. Furthermore, issuance of a warning associated with maintenance of a device is suppressed.

(146) (8) A program according to the present invention causes a computer as a server maintenance control device to perform a procedure of assigning devices connected to a server to virtual machines managed by users, a procedure of recording correspondence between the virtual machines and devices used by the virtual machines in a first database, a procedure of recording types of warnings that may occur for each of the devices during maintenance in a second database, a procedure of, upon accepting a maintenance request, determining an order of an instruction for suppressing issuance of a warning that may occur due to maintenance and an instruction for evacuating an affected virtual machine affected by maintenance among the virtual machines to another server, a procedure of instructing the server to exclude issuance of a warning that may occur due to the maintenance on the basis of the types of warnings recorded in the second database, and a procedure of specifying the affected virtual machine on the basis of correspondence between the virtual machines and devices used by the virtual machines recorded in the first database, and evacuating the affected virtual machine from the server to the another server.

(147) In this manner, the program according to the present invention, on a server to which a maintenance target device is connected, can suppress issuance of a warning associated with maintenance while suppressing processing of evacuating a virtual machine not using the device to another server. As a result, the program according to the present invention can make the operation of other virtual machines except an affected virtual machine continued. Furthermore, issuance of a warning associated with maintenance of a device is suppressed.

(148) Note that the present invention is not limited to the above embodiments, and various changes and modifications can be made without departing from the gist thereof. Furthermore, the above embodiments have been described in detail in order to facilitate understanding of the gist of the present invention. Therefore, the present invention is not necessarily limited to one including all the components described above. Furthermore, in the present invention, another component can be added to a certain component, or some components can be changed to other components. Furthermore, in the present invention, some components can be eliminated.

REFERENCE SIGNS LIST

(149) **10**, **10**A Controller server (server maintenance control device) **11**, **11**A Control unit **11***a* Assignment unit **11***b* Usage status management unit **11***c* Warning relation management unit **11***d* Maintenance control unit **11***e* Warning exclusion setting unit **11***f* Affected user specification evacuation unit **11***g* Maintenance request generation unit **12** Storage unit **12***a* Usage status database (first database) **12***b* Warning relation database (second database) **19** Communication unit **20***a* First server **20***b* Second server **21***a* First virtual machine **22***a*, **22***b* Second virtual machine **26***a*, **26***b* Filter setting unit **31***a*, **31***b* First device **32***a*, **32***b* Second device **33***a*, **33***b* Third device **61***a* First user terminal **61***b* Second user terminal **91** Maintenance instruction device **92**, **92**A Warning monitoring system **921** Control unit **921***a* Device failure notification unit **921***b* Device failure management unit **922** Storage unit **922***a* Warning monitoring program **922***b* Device failure database

(third database) **923** Communication unit **99** Storage medium **100**, **100**A Server system (server maintenance system) Cm**1** Warning exclusion setting instruction Cm**2** Evacuation instruction Pr Control program Rq Maintenance request Wa Warning

## Claims

1. A server maintenance control device comprising: a processor; and a memory device storing instructions that, when executed by the processor, configure the processor to: record first correspondence between virtual machines and corresponding devices used by the virtual machines, wherein the devices are connected to a server; record second correspondence between the devices and corresponding types of warnings that occur for each of the devices during maintenance of the devices; accept a maintenance request, wherein an order of a first instruction and a second instruction of the instructions is based on the acceptance of the maintenance request, wherein the first instruction when executed suppresses issuance of corresponding warnings that occur for each of the devices during the maintenance, and the second instruction when executed evacuates a virtual machine of the virtual machines affected by the maintenance from the server to another server; instruct the server to execute the first instruction based on the recorded second correspondence; and execute the second instruction based on the recorded first correspondence.
2. The server maintenance control device according to claim 1, wherein the processor is further configured to: record the first correspondence in a first database, wherein an indication of the affected virtual machine using a corresponding device designated in the maintenance request is based on the recorded first correspondence in the first database.
3. The server maintenance control device according to claim 1, wherein the processor is further configured to: record third correspondence between each of the devices and an exclusion target type of a warning to be excluded from monitoring during the maintenance of each of the devices in a second database, and upon accepting the maintenance request, instruct the server to suppress issuance of a warning that occurs due to the maintenance of a device designated in the maintenance request with reference to the second database.
4. The server maintenance control device according to claim 1, wherein the processor is further configured to: generate a maintenance request of a device based on failure information of any of the devices.
5. A server maintenance system comprising: the server maintenance control device according to claim 4; and a warning monitoring device comprising a processor configured to notify the server maintenance control device of failure information of a device upon failure of the device.
6. The server maintenance system according to claim 5, wherein the warning monitoring device comprises a third database, wherein the failure information of the device is recorded in the third database.
7. A server maintenance control method, comprising: recording first correspondence between virtual machines and corresponding devices used by the virtual machines in a first database, wherein the devices are connected to a server; recording second correspondence between the devices and corresponding types of warnings that occur for each of the devices during maintenance of the devices in a second database; accepting a maintenance request, wherein an order of a first instruction and a second instruction is based on accepting the maintenance request, wherein the first instruction when executed excludes issuance of corresponding warnings that occur for each of the devices during the maintenance, and the second instruction when executed evacuates a virtual machine of the virtual machines affected by the maintenance from the server to another server; instructing the server to execute the first instruction based on the second correspondence recorded in the second database; and executing the second instruction based on the first correspondence recorded in the first database.
8. A non-transitory computer readable medium storing a program, wherein execution of the

program causes a computer to execute: recording first correspondence between virtual machines and corresponding devices used by the virtual machines in a first database, wherein the devices are connected to a server; recording second correspondence between the devices and corresponding types of warnings that occur for each of the devices during maintenance of the devices in a second database; accepting a maintenance request, wherein an order of a first instruction and a second instruction is based on accepting the maintenance request, wherein the first instruction when executed suppresses issuance of corresponding warnings that occur for each of the devices during the maintenance, and the second instruction when executed evacuates a virtual machine of the virtual machines affected by the maintenance from the server to another server; instructing the server to execute the first instruction based on the second correspondence recorded in the second database; and executing the second instruction based on the first correspondence recorded in the first database.