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(54) **LOAD VERIFICATION SYSTEM AND LOAD VERIFICATION METHOD**

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(57) **ABSTRACT**

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There is provided a load verification system that performs load performance verification of a data storage area. The load verification system includes: a verification-purposed performance metrics collector that acquires performance metrics of the data storage area and a volume thereof that are load verification targets; an expected performance metrics data generator that generates performance metrics data that will be a result of a load, expected with respect to the load-verification-target volume; and an I/O pattern data generator that generates input/output pattern data based on which a load is generated that causes generation of performance metrics data whose performance is equivalent to expected performance indicated in the expected performance metrics data. An input/output pattern is reproduced by a reproduction section based on the data generated by the I/O pattern data generator, and performance metrics generated as a result of applying a load to the load-verification-target volume are collected.

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**G06F 11/34** (2006.01)

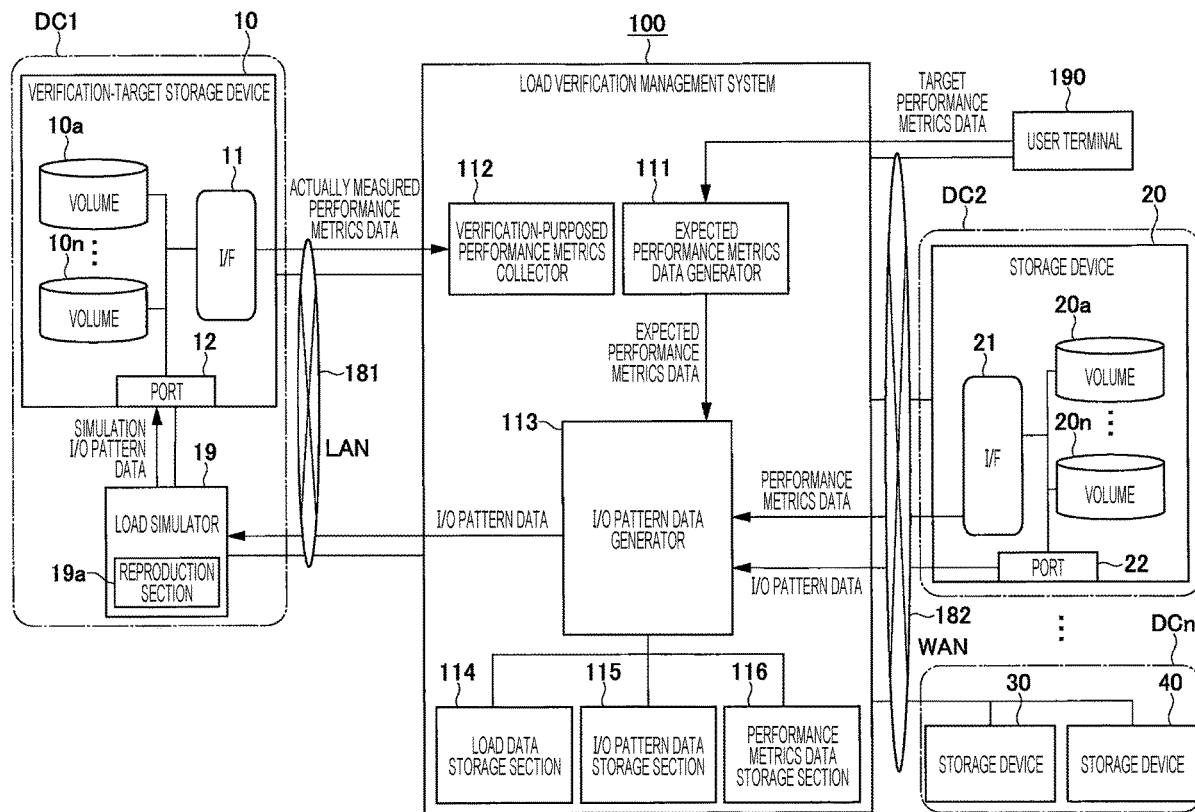


FIG. 1

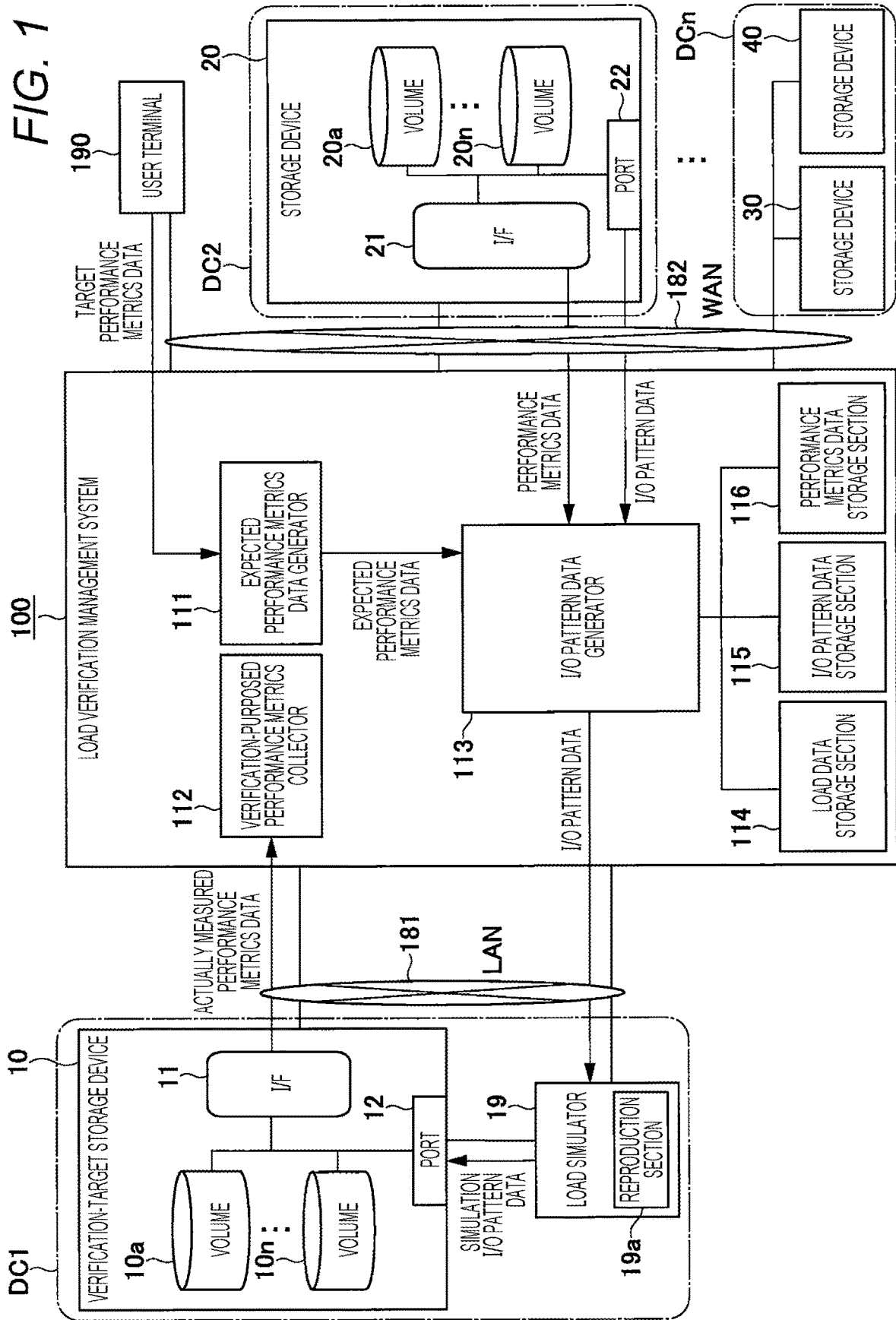


FIG. 2

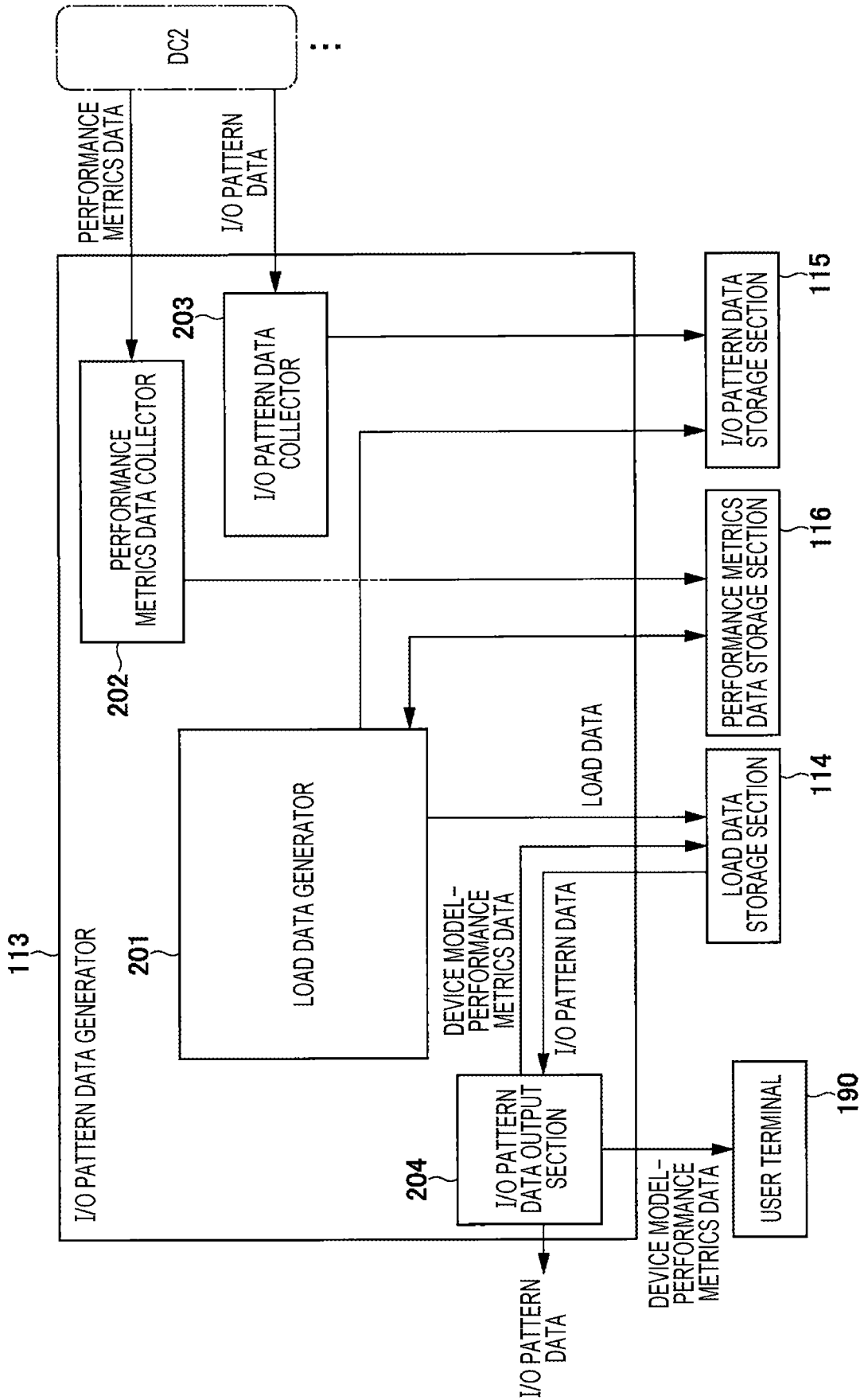


FIG. 3

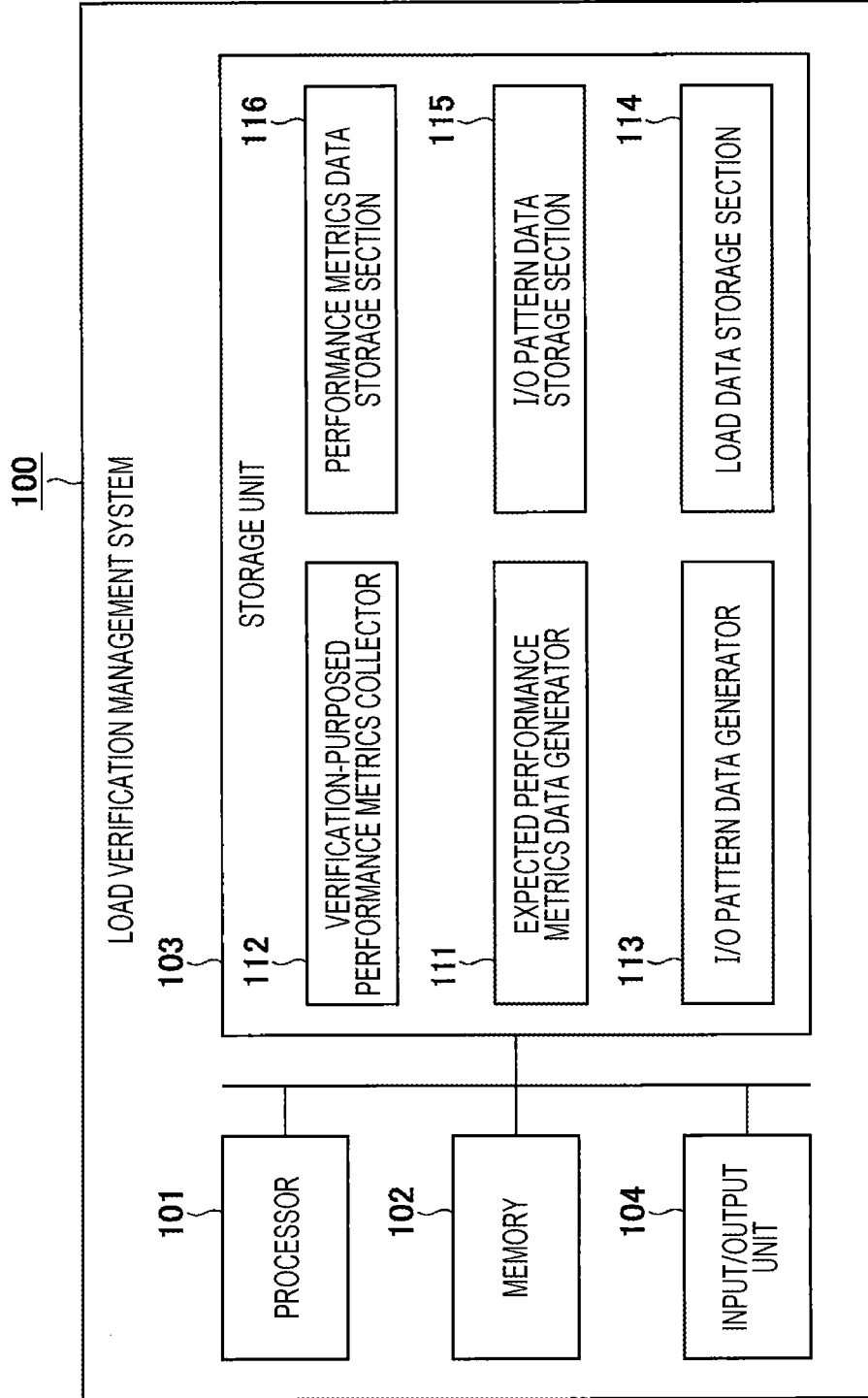


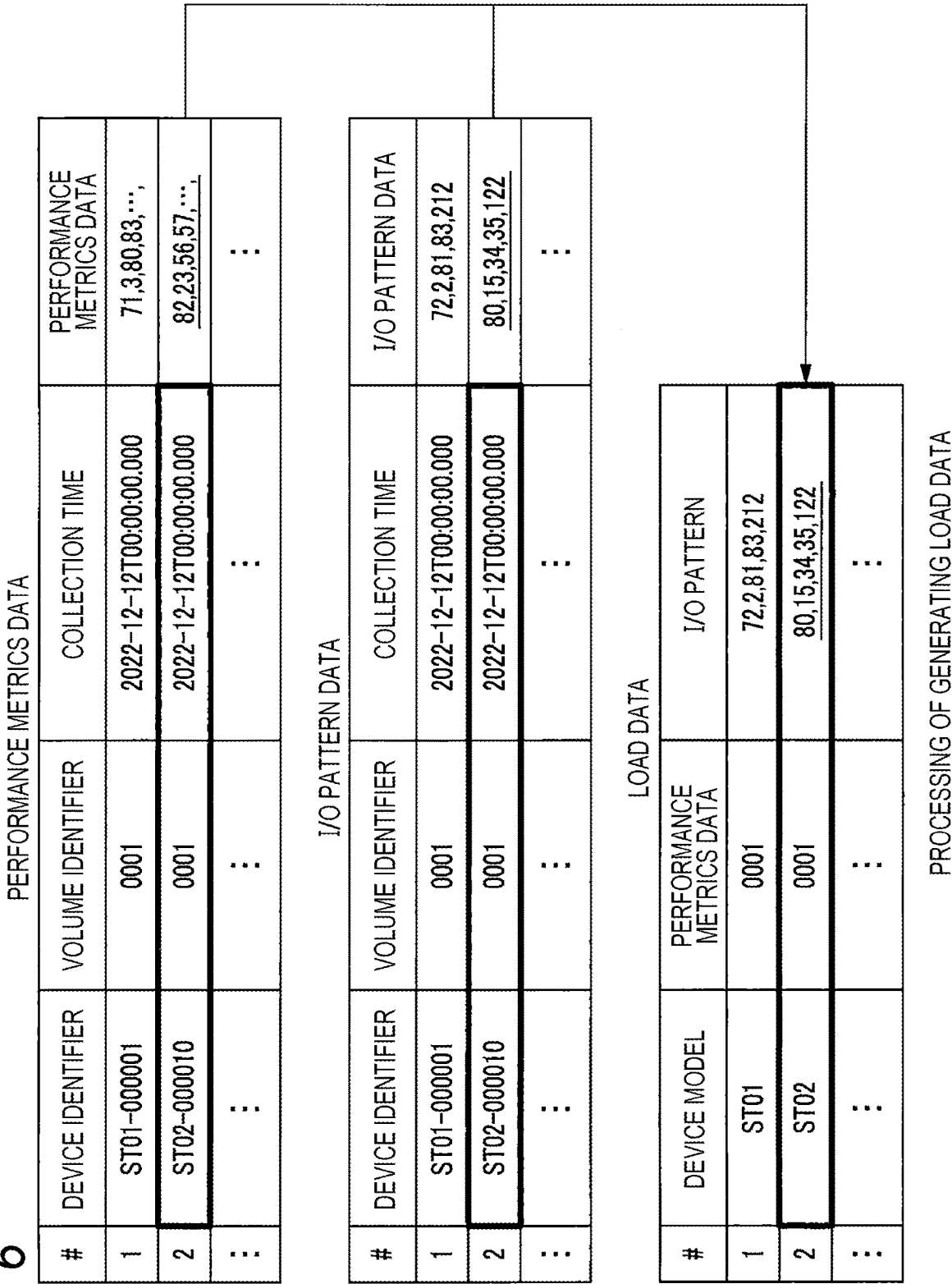
FIG. 4

#	DEVICE IDENTIFIER	VOLUME IDENTIFIER	COLLECTION TIME	PERFORMANCE METRICS DATA
1	ST01-000001	0001	2022-12-12T00:00:00.000	71,3,80,83,...,
2	ST02-000010	0001	2022-12-12T00:00:00.000	82,23,56,57,...,
⋮	⋮	⋮	⋮	⋮

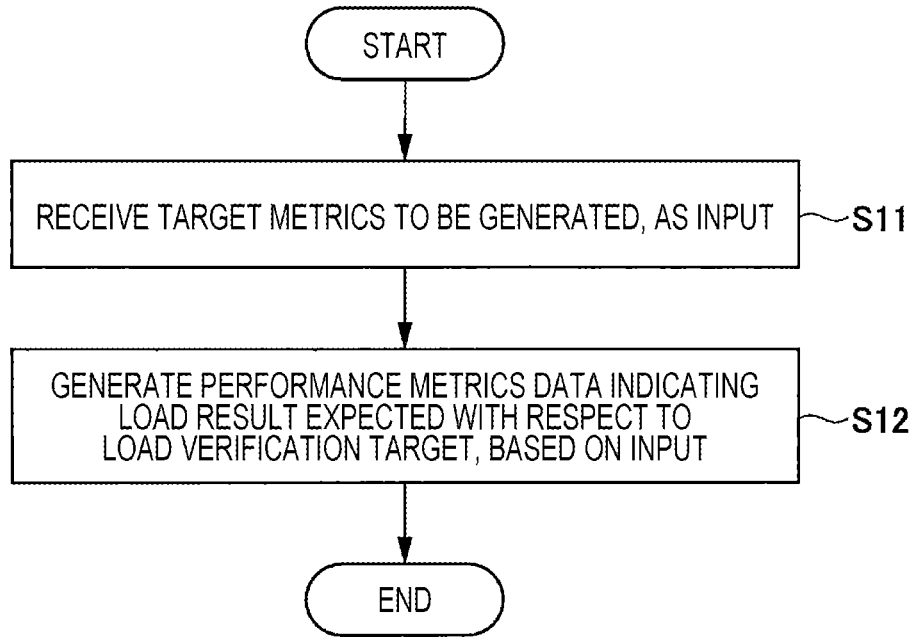
FIG. 5

#	DEVICE IDENTIFIER	VOLUME IDENTIFIER	COLLECTION TIME	I/O PATTERN DATA
1	ST01-000001	0001	2022-12-12T00:00:00.000	72,2,81,83,212
2	ST02-000010	0001	2022-12-12T00:00:00.000	80,15,34,35,122
⋮	⋮	⋮	⋮	⋮

FIG. 6



**FIG. 7**



**FIG. 8**

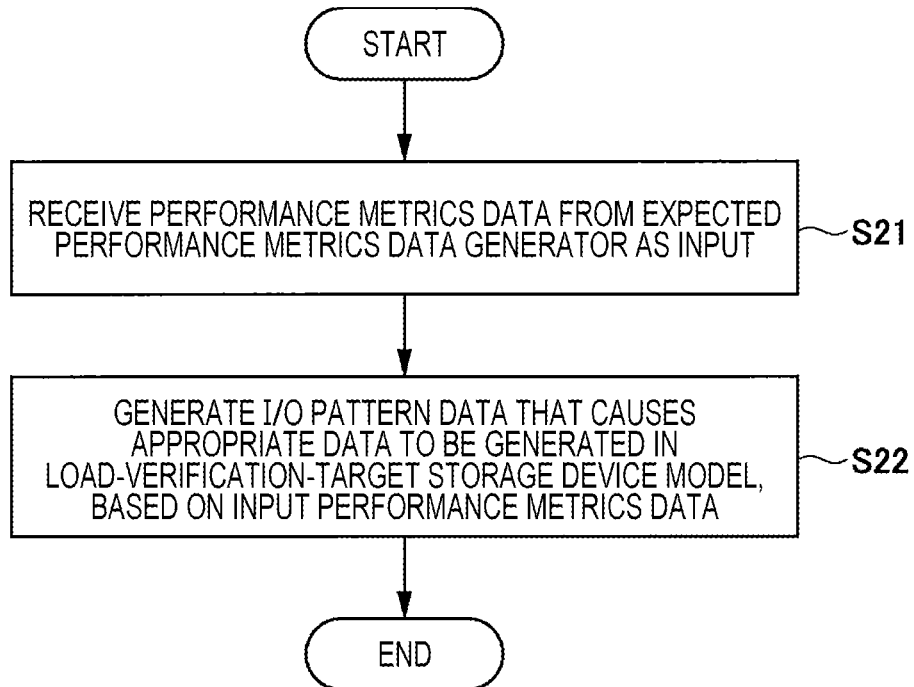
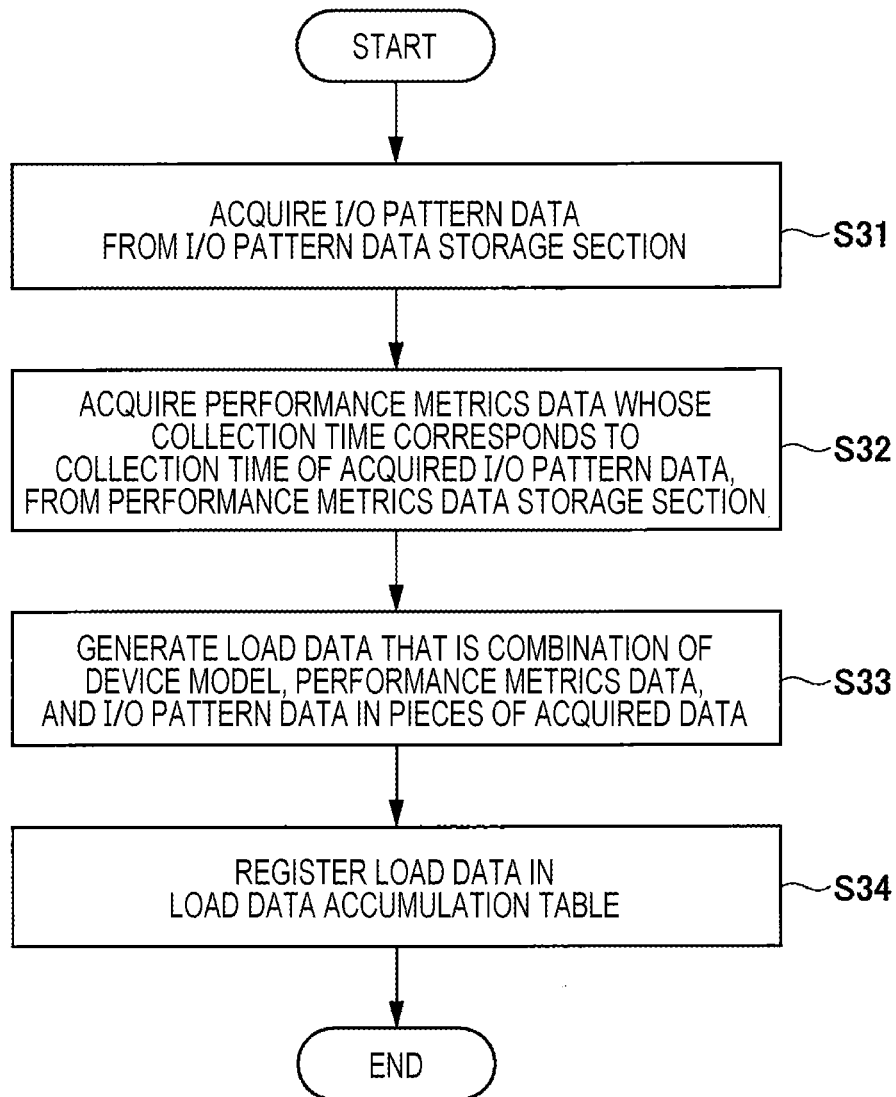
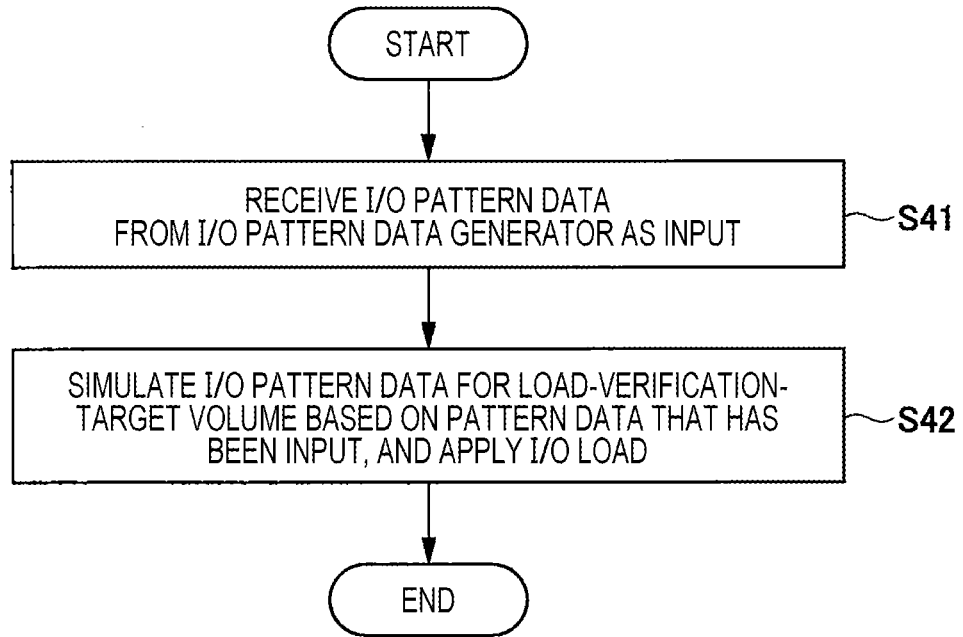




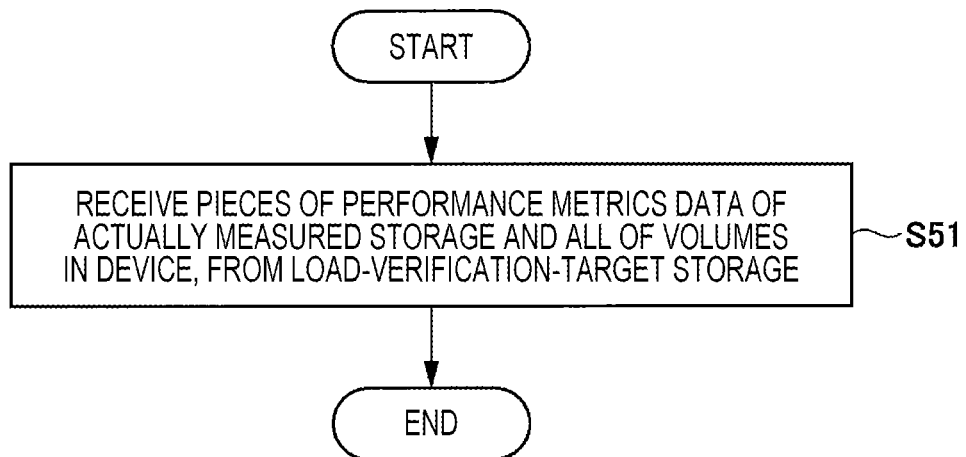
FIG. 9



**FIG. 10**



**FIG. 11**



## LOAD VERIFICATION SYSTEM AND LOAD VERIFICATION METHOD

[0001] The present application claims priority to Japanese Patent Application No. 2023-073183, filed on Apr. 27, 2023, the contents of which are incorporated herein by reference in their entirety.

### BACKGROUND OF THE INVENTION

#### 1. Field of the Invention

[0002] The present invention relates to a load verification system and a load verification method.

#### 2. Description of the Related Art

[0003] When data stored in a storage system is migrated, it is common to verify the performance of a volume in advance under the actual environment of a migration destination. In this performance verification, a load made by input/output (I/O) of data has been applied to a volume created in a target storage system, whereby it has been confirmed whether requirements are satisfied as to influences on performance with respect to a volume after migration and on another operation (application) using a migration-destination storage device.

[0004] WO 2015/049771 A describes a technique for constructing an environment equivalent to the environment of a migration destination when load verification of the migration destination is performed.

### SUMMARY OF THE INVENTION

[0005] A migration-destination target volume shares shared resources (a port, a processor, and the like) in its storage system with another volume used for other purposes. Thus, when a load is generated in the migration-destination target volume, the generated load has an influence on the performance of the other volume using the shared resources. Therefore, in data migration, it is necessary to verify an influence on the performance of other resources in a device as well as an influence on the performance of a target volume.

[0006] In the data migration, since tendencies match as to how volumes are used before and after the migration, a tendency in performance metrics indicating a result with respect to a load generated in a migration source also matches a tendency in performance metrics in a migration destination. Here, performance metrics that have been generated in a migration-source volume can be known in advance. That is, if I/O that causes specific performance metrics to be generated can be reproduced, a load equivalent to the load in the migration source can be reproduced with respect to the migration-destination volume. Thus, it is possible to verify an influence, when the load is generated, on the performance of another volume in a migration-destination device. However, in a case where there is a difference in device models (specifications) between a migration-source storage system and a migration-destination storage system, different values are exhibited for the respective models, in the performance metrics indicating the result of an influence on performance when exactly the same I/O is generated.

[0007] Conventionally, due to this aspect, in a case where there is a difference between a migration-source device model and a migration-destination device model, it has been

hard to identify I/O that generates performance metrics expected with respect to a migration-destination volume. Thus, it has been hard to achieve reproduction. For this reason, in order to reproduce the tendency, it has been necessary to measure an influence on performance by applying a load to the migration-destination volume in a trial and error manner, to confirm an influence on the performance of another volume at a time when matching has occurred. Here, applying a load in a trial and error manner means, for example, applying a load by using an I/O pattern extracted randomly or based on a specific rule from accumulated load data.

[0008] The problems in the case of a storage system have been described above. However, even when different types of data storage systems, called a hybrid cloud solution as a whole, are combined, similar problems occur at the time of verification in data migration.

[0009] The present invention has been made in view of such problems, and it is an object of the present invention to provide a load verification system and a load verification method capable of appropriately performing verification in a short time when data stored in a storage system or the like is migrated.

[0010] In order to solve the above problems, for example, the configurations described in the claims are adopted.

[0011] The present application includes a plurality of means for solving the above problems, and an example thereof is a load verification system configured to perform load performance verification of a predetermined data storage area. The load verification system includes: a verification-purposed performance metrics collector configured to acquire performance metrics of the data storage area as a load verification target and a volume of the data storage area, as a load verification target; an expected performance metrics data generator configured to generate performance metrics data that will be a result of a load, expected with respect to the volume as the load verification target; and an I/O pattern data generator configured to generate input/output pattern data based on which a load is generated that causes generation of performance metrics data whose performance is equivalent to expected performance indicated in the expected performance metrics data.

[0012] Input/output to/from the volume as the load verification target are performed based on the input/output pattern data generated by the I/O pattern data generator, and the verification-purposed performance metrics collector collects performance metrics generated as a result of applying a load.

[0013] According to the present invention, it is possible to provide data having an input/output pattern that reproduces expected performance metrics with respect to a load-verification-target volume. Thus, a load generated in a migration-source environment can be reproduced in a migration destination, the verification period can be shortened, and an application service to be operated can be provided in a timely manner.

[0014] Problems, configurations, and effects other than those described above will be made apparent by the following description of an embodiment.

## BRIEF DESCRIPTION OF THE DRAWINGS

[0015] FIG. 1 is a configuration diagram illustrating an example of an overall configuration of a load verification system according to an embodiment of the present invention;

[0016] FIG. 2 is a block diagram illustrating an example of a configuration of an I/O pattern data generator according to the embodiment of the present invention;

[0017] FIG. 3 is a block diagram illustrating an example of a configuration of a load verification management system according to the embodiment of the present invention;

[0018] FIG. 4 is a diagram illustrating an example of a format of performance metrics data according to the embodiment of the present invention;

[0019] FIG. 5 is a diagram illustrating an example of a format of I/O pattern data according to the embodiment of the present invention;

[0020] FIG. 6 is a diagram illustrating an example of processing of generating load data according to the embodiment of the present invention;

[0021] FIG. 7 is a flowchart illustrating an example of processing executed by an expected performance metrics data generator according to the embodiment of the present invention;

[0022] FIG. 8 is a flowchart illustrating an example of processing executed by the I/O pattern data generator according to the embodiment of the present invention;

[0023] FIG. 9 is a flowchart illustrating an example of processing executed by a load data generator according to the embodiment of the present invention;

[0024] FIG. 10 is a flowchart illustrating an example of processing executed by a load simulator according to the embodiment of the present invention; and

[0025] FIG. 11 is a flowchart illustrating an example of processing executed by a verification-purposed performance metrics collector according to the embodiment of the present invention.

## DESCRIPTION OF THE PREFERRED EMBODIMENT

[0026] Hereinafter, a load verification system according to an embodiment (hereinafter, referred to as “present embodiment”) of the present invention will be described with reference to the accompanying drawings.

[Configuration of Load Verification System]

[0027] FIG. 1 illustrates an overall configuration of the load verification system according to the present embodiment.

[0028] The load verification system according to the present embodiment includes a load verification management system 100 and a load simulator 19, and is configured to perform verification of a verification-target storage device 10 installed in a data center DC1. The verification-target storage device 10 is a migration destination of data.

[0029] The verification-target storage device 10 includes a plurality of volumes 10a to 10n (n is any integer), and each of the volumes 10a to 10n has a predetermined data storage area. The load simulator 19 is installed in the data center DC1.

[0030] The verification-target storage device 10 includes an interface 11 and a port 12, and simulation input/output pattern data from a reproduction section 19a of the load

simulator 19 is supplied to the verification-target volumes 10a to 10n via the port 12. Note that the input/output pattern data and input/output data are referred to as I/O pattern data and I/O data, respectively, in the following description.

[0031] Performance metrics data actually measured in each of the volumes 10a to 10n is transmitted from the interface 11 to the load verification management system 100 via a predetermined local area network (LAN) 181.

[0032] As the performance metrics data of a storage (volume), there are various types of data indicating the performance of a relevant storage, and for example, there are read throughput, write throughput, the number of operations of read requests per unit time, the number of operations of write requests per unit time, read latency, write latency, a usage rate, and the like. These performance metrics change depending on an environment in which a device (storage) that is a data storage area is installed as well as the performance of the device (storage) itself.

[0033] The load verification management system 100 receives, as input, target performance metrics data from a user terminal 190 which is an external terminal, then generates I/O pattern data, and supplies the generated I/O pattern data to the load simulator 19. The load simulator 19 applies, based on the data, a load using simulation I/O pattern data to a verification-target volume. Then, the load verification management system 100 collects performance metrics data actually measured when the load is applied by the load simulator 19, and performs load verification.

[0034] In addition, a plurality of (a large number of) storage devices 20, 30, 40, . . . that are storage devices as migration sources of data are connected to the load verification management system 100 via a network. For example, the storage device 20 installed in a data center DC2 and the storage devices 30, 40 installed in a data center DCn (n is any integer) or the like are connected to the load verification management system 100 via a wide area network (WAN) 182, and the load verification management system 100 collects performance metrics data from each storage device. The plurality of storage devices 20, 30, 40, . . . are storage devices of different types. Alternatively, even if the storage devices are the same type, the storage devices are desirably installed in different environments.

[0035] A specific configuration of the load verification management system 100 will be described. The load verification management system 100 includes an expected performance metrics data generator 111, a verification-purposed performance metrics collector 112, an I/O pattern data generator 113, a load data storage section 114, an I/O pattern data storage section 115, and a performance metrics data storage section 116.

[0036] The expected performance metrics data generator 111 generates expected performance metrics data based on the target performance metrics data input from the user terminal 190. In the user terminal 190, there are a case in which the performance metrics data is obtained by user's input, and a case in which the performance metrics data is obtained automatically by using a program implemented in the user terminal 190.

[0037] The expected performance metrics data generated in the expected performance metrics data generator 111 is supplied to the I/O pattern data generator 113.

[0038] The verification-purposed performance metrics collector 112 collects performance metrics data transmitted

from the verification-target storage device **10** in the data center DC1 via the LAN **181**.

**[0039]** The I/O pattern data generator **113** generates and outputs I/O pattern data that matches the expected performance metrics data, by using data stored in the load data storage section **114**, the I/O pattern data storage section **115**, and the performance metrics data storage section **116**. A detailed configuration for generating the I/O pattern data will be described later with reference to FIG. 2.

**[0040]** The I/O pattern data output from the I/O pattern data generator **113** is supplied to the load simulator **19** via the LAN **181**.

**[0041]** In the load simulator **19**, the reproduction section **19a** generates simulation I/O pattern data based on the I/O pattern data supplied from the I/O pattern data generator **113**. The simulation I/O pattern data generated by the reproduction section **19a** is supplied to the verification-target volumes **10a** to **10n** via the port **12**.

[Configuration of I/O Pattern Data Generator]

**[0042]** FIG. 2 illustrates a configuration of the I/O pattern data generator **113**.

**[0043]** The I/O pattern data generator **113** includes a load data generator **201**, a performance metrics data collector **202**, an I/O pattern data collector **203**, and an I/O pattern data output section **204**.

**[0044]** The performance metrics data collector **202** collects performance metrics data from a storage device that is a migration source of data. The I/O pattern data collector **203** collects I/O pattern data from a storage device that is a migration source of data. The example of FIG. 2 illustrates an example in which the performance metrics data and the I/O pattern data are collected from the storage device **20** installed in the data center DC2. However, from the storage devices **30**, **40**, and the like installed in the data center of another environment, the performance metrics data collector **202** and the I/O pattern data collector **203** also respectively collect the performance metrics data and the I/O pattern data.

**[0045]** The pieces of performance metrics data of the plurality of storage devices collected by the performance metrics data collector **202** are stored in the performance metrics data storage section **116**.

**[0046]** FIG. 4 illustrates an example of a format of pieces of performance metrics data that are collected by the performance metrics data collector **202** and that are stored in the performance metrics data storage section **116**.

**[0047]** In the performance metrics data stored in the performance metrics data storage section **116**, a combination of a device identifier indicating a storage device configuration, a target volume identifier, a time at which the data has been collected, and actually measured performance metrics data is set as one record.

**[0048]** The pieces of I/O pattern data of the plurality of storage devices collected by the I/O pattern data collector **203** are stored in the I/O pattern data storage section **115**. The performance metrics data stored in the performance metrics data storage section **116** and the I/O pattern data stored in the I/O pattern data storage section **115** are read by the load data generator **201**.

**[0049]** FIG. 5 illustrates an example of a format of pieces of I/O pattern data that are collected by the I/O pattern data collector **203** and that are stored in the I/O pattern data storage section **115**.

**[0050]** In the I/O pattern data stored in the I/O pattern data storage section **115**, a combination of a device identifier indicating a storage device configuration, a target volume identifier, a time at which the data has been collected, and actually measured I/O pattern data is set as one record.

**[0051]** Returning to the description of FIG. 2, the load data generator **201** maps each piece of stored data, generates load data, and stores the generated load data in the load data storage section **114**. When the load data generator **201** generates the load data, the load data generator **201** acquires I/O pattern data from the I/O pattern data storage section **115**, and acquires performance metrics data whose collection time corresponds to the collection time of the acquired I/O pattern data, from the performance metrics data storage section **116**. Then, the load data generator **201** generates load data that is a combination of the pieces of acquired data, and stores the generated load data in the load data storage section **114**.

**[0052]** FIG. 6 illustrates an example of a state of processing in which the load data generator **201** generates load data.

**[0053]** From the table prepared in the performance metrics data storage section **116** and the table prepared in the I/O pattern data storage section **115**, the load data generator **201** sets, as mapping targets, records between which respective values of “device identifier—volume identifier—collection time” are the same. Then, the load data generator **201** generates load data organized by setting “device configuration—performance metrics data—I/O pattern data” of appropriate mapping targets as one record, and stores the generated load data in a table in the load data storage section **114**.

**[0054]** Returning again to the description of FIG. 2, the I/O pattern data output section **204** searches the load data storage section **114** for data stored therein based on input, from the user terminal **190**, indicating a combination of a device configuration and performance metrics data. Then, the I/O pattern data output section **204** reads appropriate I/O pattern data, and outputs the I/O pattern data to the load simulator **19** (see FIG. 1).

[Example of Hardware Configuration of Load Verification Management System]

**[0055]** FIG. 3 illustrates an example of a hardware configuration of the load verification management system **100**.

**[0056]** The configuration of the load verification management system **100** illustrated in FIG. 3 is an exemplary case of a configuration in which the load verification management system **100** includes a computer.

**[0057]** That is, the load verification management system **100** including a computer includes a processor **101**, a memory **102**, a storage unit **103**, and an input/output unit **104**, and the components are connected via a bus line whereby data can be transferred mutually between the components.

**[0058]** Then, the processor **101** executes a program stored in the storage unit **103** to cause the expected performance metrics data generator **111**, the verification-purposed performance metrics collector **112**, and the I/O pattern data generator **113** to be configured in the storage unit **103**. In addition, the load data storage section **114**, the I/O pattern data storage section **115**, and the performance metrics data storage section **116** are configured by using part of the storage area of the storage unit **103**.

**[0059]** Note that the case in which the load verification management system **100** includes the computer including

the processor **101** is an example, and another configuration may be adopted. For example, part or all of the load verification management system **100** may be implemented by dedicated hardware such as a field programmable gate array (FPGA) or an application specific integrated circuit (ASIC).

**[0060]** Alternatively, the load verification management system **100** may be a so-called cloud computer prepared on a server accessible via the Internet or the like. In this case, each storage section such as the load data storage section **114** is also stored on the server. Alternatively, each storage section such as the load data storage section **114** may be provided on a server, and a computer included in the load verification management system **100** may read storage data from the server to perform management processing on load verification. [Processing executed by expected performance metrics data generator]

**[0061]** FIG. 7 is a flowchart illustrating an example of processing executed by the expected performance metrics data generator **111**.

**[0062]** First, the expected performance metrics data generator **111** receives target metrics to be generated, from the user terminal **190** as input (step **S11**).

**[0063]** Then, the expected performance metrics data generator **111** executes expected performance metrics data generation processing of generating performance metrics data indicating a load result expected with respect to a load verification target, based on the received input (step **S12**). The performance metrics data generated in step **S12** is supplied to the I/O pattern data generator **113**.

[Processing Executed by I/O Pattern Data Generator]

**[0064]** FIG. 8 is a flowchart illustrating an example of processing executed by the I/O pattern data generator **113**.

**[0065]** The I/O pattern data generator **113** receives the expected performance metrics data supplied from the expected performance metrics data generator **111** as input (step **S21**).

**[0066]** Then, the I/O pattern data generator **113** executes I/O pattern data generation processing of generating I/O pattern data that causes appropriate performance metrics data to be generated in a load-verification-target storage system, based on the received performance metrics data (step **S22**). That is, the I/O pattern data generator **113** generates this I/O pattern data by retrieving I/O pattern data based on which performance metrics data equivalent to the expected performance metrics data is generated, from among various pieces of load data stored in the load data storage section **114**.

[Processing Executed by Load Data Generator]

**[0067]** FIG. 9 is a flowchart illustrating an example of processing executed by the load data generator **201**. The load data generator **201** acquires I/O pattern data from the I/O pattern data storage section **115** (step **S31**). Then, the load data generator **201** acquires performance metrics data whose collection time corresponds to the collection time of the I/O pattern data acquired in step **S31**, from the performance metrics data storage section **116** (step **S32**).

**[0068]** Subsequently, the load data generator **201** generates load data that is a combination of the pieces of acquired data (step **S33**). Thereafter, the load data generator **201**

registers (stores) the load data generated in Step **S33** in the load data storage section **114** (Step **S34**).

[Processing Executed by Load Simulator]

**[0069]** FIG. 10 is a flowchart illustrating an example of processing executed by the reproduction section **19a** of the load simulator **19**.

**[0070]** The load simulator **19** receives the I/O pattern data transmitted from the I/O pattern data generator **113** as input (step **S41**). Then, the reproduction section **19a** of the load simulator **19** simulates an I/O pattern for a load-verification-target volume based on the pattern data that has been input, and executes processing of applying input and output loads (step **S42**).

[Processing Executed by Verification-Purposed Performance Metrics Collector]

**[0071]** FIG. 11 is a flowchart illustrating an example of processing executed by the verification-purposed performance metrics collector **112**.

**[0072]** The verification-purposed performance metrics collector **112** executes verification-purposed performance metrics collection processing of receiving pieces of performance metrics data of the actually measured storage system and all of the volumes in the storage device **10**, from the load-verification-target storage device **10** (step **S51**).

**[0073]** The load verification management system **100** compares the performance metrics data received by the verification-purposed performance metrics collector **112** and the expected performance metrics data generated by the expected performance metrics data generator **111**, to verify whether the storage device **10** exhibits the expected performance. The result of the verification is displayed on the user terminal **190**, for example.

[Effects Produced by Load Verification System]

**[0074]** As described above, according to the load verification system of the present embodiment, it is possible to provide data having an input/output pattern that reproduces expected performance metrics with respect to a load-verification-target volume. Thus, a load generated in a migration-source environment can be reproduced in a migration destination, the verification period can be shortened, and an application service to be operated can be provided in a timely manner.

**[0075]** That is, conventionally, in a case where there is a difference in models between a migration-source storage device and a migration-destination storage device, it has been hard to identify I/O pattern data that generates performance metrics expected with respect to a migration-destination volume. Thus, it has been hard to achieve reproduction. For this reason, conventionally, in order to reproduce a tendency, an influence on performance has been measured by applying a load to the migration-destination volume in a trial and error manner using I/O pattern data extracted randomly or based on a specific rule from accumulated load data. Then, an influence on the performance of another volume at a time when matching has occurred has been confirmed.

**[0076]** In contrast, in the case of the load verification system of the present embodiment, combinations each of which includes performance metrics data and I/O pattern data are collected in advance from the plurality of storage

devices **20**, **30**, **40**, . . . that are different types or that are installed in different environments. Then, I/O pattern data matching expected performance is retrieved to perform simulation in the verification-target storage device **10**.

**[0077]** Thus, according to the load verification system of the present embodiment, it is possible to shorten a time of I/O load verification, which has been conventionally performed by using a large number of test patterns. Therefore, it is possible to obtain an effect of shortening the verification period.

**[0078]** In the case of the load verification system of the present embodiment, the load verification management system **100** includes the load data storage section **114**, the I/O pattern data storage section **115**, and the performance metrics data storage section **116**, to allow I/O pattern data matching expected performance to be extracted from load data. Thus, it is possible to verify various types of expected performance.

[Modifications]

**[0079]** Note that the embodiment described up to here has been described in detail for easy understanding of the present invention. Therefore, the present invention is not necessarily limited to those including all the configurations described therein.

**[0080]** For example, in the embodiment described above, a storage device installed in a data center is used as a device including a verification-target data storage area. However, alternatively, data storage areas of predetermined volumes provided in a cloud solution or a hybrid cloud solution may be used for verification. That is, in a case where data storage areas prepared in various devices such as servers connected via the Internet or the like are used as a predetermined number of volumes, that is, as data storage areas, the volumes may be used as verification targets.

**[0081]** In this case, the storage devices **20**, **30**, **40**, . . . from which performance metrics data and I/O pattern data are collected may also be configured as volumes provided in the cloud solution or the hybrid cloud solution.

**[0082]** Further, the load simulator **19** is desirably installed at the same location as the location where the storage device **10** is installed to supply simulation I/O pattern data, in a case where the storage device **10** installed in the data center is verified as illustrated in FIG. 1. However, alternatively, the load simulator **19** may be provided at a location different from a location where a data storage area is installed.

**[0083]** Further, in the embodiment described above, the I/O pattern data generator **113** causes pieces of I/O pattern data, based on which various performance metrics are generated, to be stored by collecting them from the plurality of storage devices **20**, **30**, **40**, and obtains I/O pattern data that achieves equivalent performance from among the pieces of stored data. However, alternatively, the I/O pattern data generator **113** may generate I/O pattern data corresponding to expected performance metrics through certain arithmetic processing.

**[0084]** Further, in the embodiment described above, the processing has been described until the verification-purposed performance metrics collector **112** collects performance metrics generated as a result of applying a load. However, alternatively, the load verification management system **100** may perform verification based on the collected data. Alternatively, the collected performance metrics may

be transmitted to the user terminal **190** to be subjected to verification by the user terminal **190** side.

**[0085]** Further, in the diagrams of the configurations illustrated in FIGS. 1 to 3, the control lines and the information lines considered to be minimally necessary for the description are illustrated. Therefore, all the control lines and all the information lines for the product may not necessarily be illustrated. In practice, it may be considered that almost all the components are connected to one another.

**[0086]** Further, each of the flows of the pieces of processing illustrated in the flowcharts in FIGS. 7 to 11 is also an example. Thus, in a case where the processing results are the same, a part of the order in the processing may be changed, or a plurality of pieces of processing may be executed simultaneously.

**[0087]** Further, the load verification management system **100** described in the embodiment can be configured by implementing a program for load verification management on a general computer as described with reference to FIG. 3. As well as being prepared in a storage unit in the computer, the program for implementing each processing function in this case may be stored in a recording medium such as an external memory, an IC card, an SD card, or an optical disk to be transferred.

What is claimed is:

1. A load verification system configured to perform load performance verification of a predetermined data storage area, the system comprising:

- a verification-purposed performance metrics collector configured to acquire performance metrics of the data storage area as a load verification target and a volume of the data storage area, as the load verification target;
- an expected performance metrics data generator configured to generate performance metrics data that will be a result of a load, expected with respect to the volume as the load verification target; and

- an I/O pattern data generator configured to generate input/output pattern data based on which a load is generated that causes generation of performance metrics data whose performance is equivalent to expected performance indicated in the expected performance metrics data, wherein

input/output to/from the volume as the load verification target are performed based on the input/output pattern data generated by the I/O pattern data generator, and the verification-purposed performance metrics collector collects performance metrics generated as a result of applying a load.

2. The load verification system according to claim 1, further comprising:

- a performance metrics data collector configured to collect performance metrics of configuration elements used for executing input/output processing, from a plurality of data storage areas;

- a performance metrics data storage section configured to store performance metrics data collected by the performance metrics data collector;

- an I/O pattern data collector configured to monitor input/output data of the plurality of data storage areas and collect input/output pattern data of the plurality of data storage areas;

- an I/O pattern data storage section configured to store the input/output pattern data collected by the I/O pattern data collector;

a load data generator configured to generate load data in which a configuration element of the data storage area, and performance metrics and input/output pattern data of the configuration element are mapped based on data stored in the performance metrics data storage section and the I/O pattern data storage section; and  
 a load data storage section configured to store the load data generated by the load data generator.

3. The load verification system according to claim 1, wherein the expected performance metrics data generator is configured to generate the expected performance metrics data based on target performance metrics data input from an external terminal.

4. The load verification system according to claim 1, wherein the data storage area is a storage device including a predetermined volume.

5. The load verification system according to claim 1, further comprising a load simulator configured to reproduce the input/output to/from the volume as the load verification target based on the input/output pattern data generated by the I/O pattern data generator.

6. The load verification system according to claim 1, wherein the data storage area is a data storage area of a predetermined volume provided in a hybrid cloud solution.

7. A load verification method for performing load performance verification of a data storage area including a prede-

termined volume provided in a storage device or a hybrid cloud solution, the method comprising:

verification-purposed performance metrics collection processing of acquiring performance metrics of the data storage area as a load verification target and a volume of the data storage area, as the load verification target; expected performance metrics data generation processing of generating performance metrics data that will be a result of a load, expected with respect to the volume as the load verification target;

I/O pattern data generation processing of generating input/output pattern data based on which a load is generated that causes generation of performance metrics data whose performance is equivalent to expected performance indicated in the expected performance metrics data; and

reproduction processing of reproducing input/output to/from the volume as the load verification target based on the input/output pattern data generated in the I/O pattern data generation processing, wherein

performance metrics generated as a result of applying a load to the volume as the load verification target are collected in the verification-purposed performance metrics collection processing.

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