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Tomida et al.

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(54) **FILE SERVER THAT ALLOWS AN END USER TO SPECIFY STORAGE CHARACTERISTICS WITH EASE**

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G06F 7/00 (2006.01)

(52) **U.S. Cl.** **707/828**

(58) **Field of Classification Search** **707/828,**
707/999.205

See application file for complete search history.

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Jon William Toigo, The Holy Grail of Network Storage management (Indianapolis: Prentice Hall Professional Technical Reference, Oct. 2003), p. 61-67.

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Primary Examiner — Tony Mahmoudi

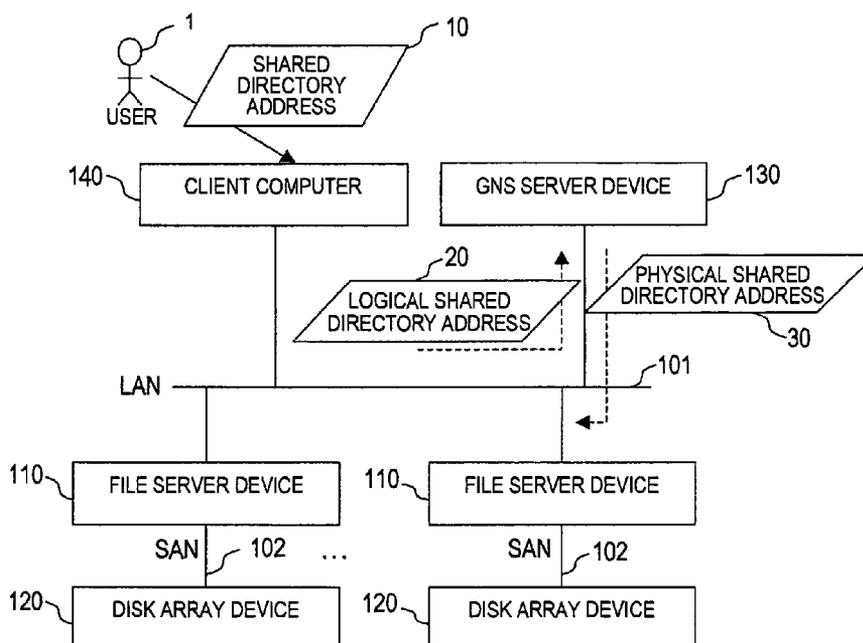
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(57) **ABSTRACT**

A file server device is provided which has less chance of error in changing directory settings information. A file server device that has access to a client computer and a disk array device receives a directory settings file, and writes the directory settings file in a specified shared directory. The file server device chooses, as a migration destination candidate, a volume whose settings information matches new settings information of the shared directory which is set as specified in the directory settings file. The file server device migrates information in the shared directory whose settings information is changed to the volume chosen as a migration destination candidate.

16 Claims, 16 Drawing Sheets



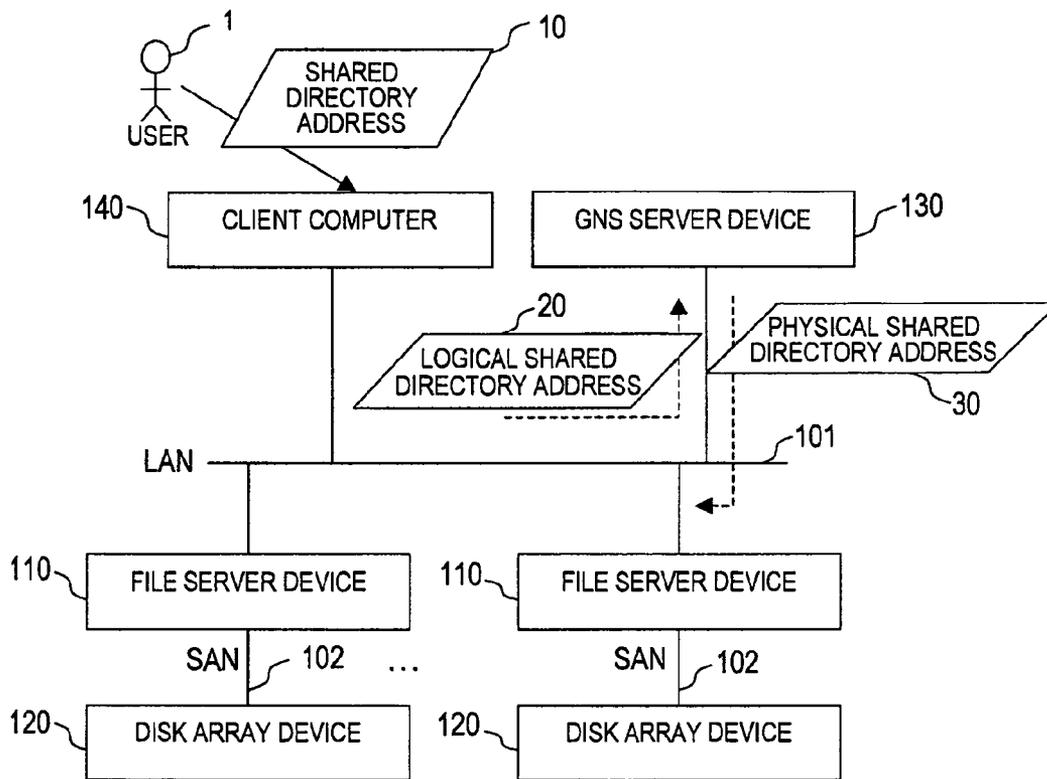


FIG. 1

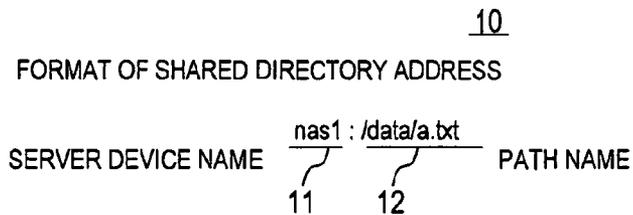


FIG. 2

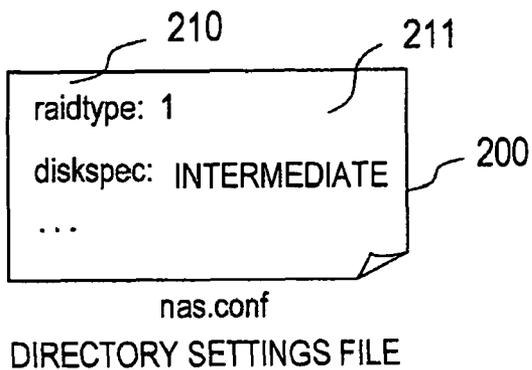


FIG. 3

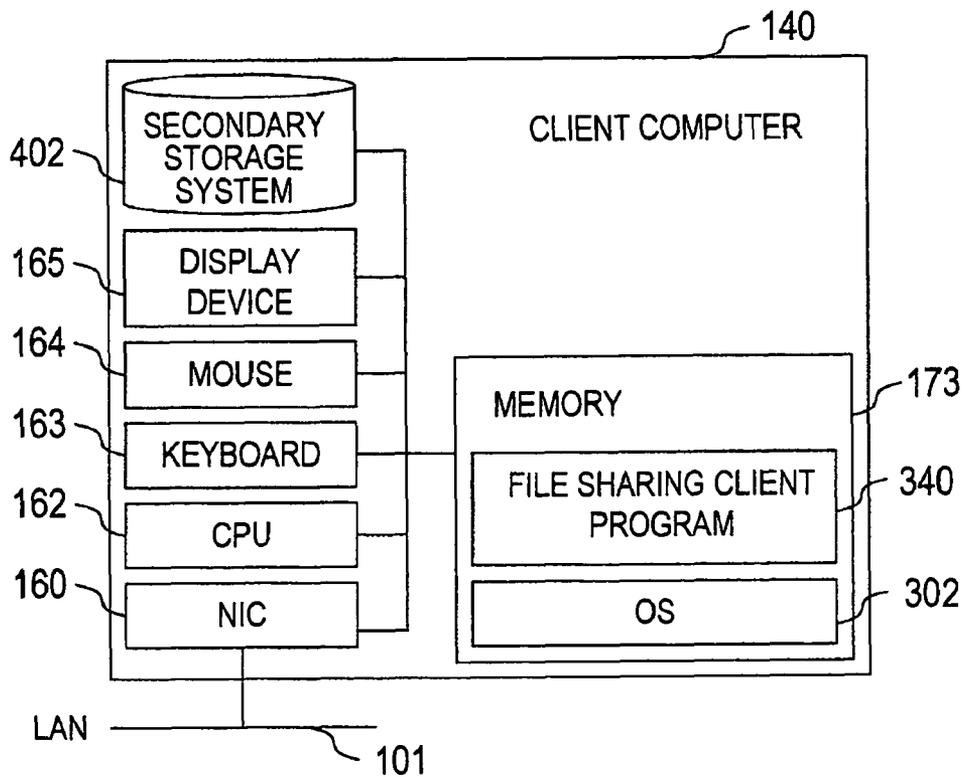


FIG. 4

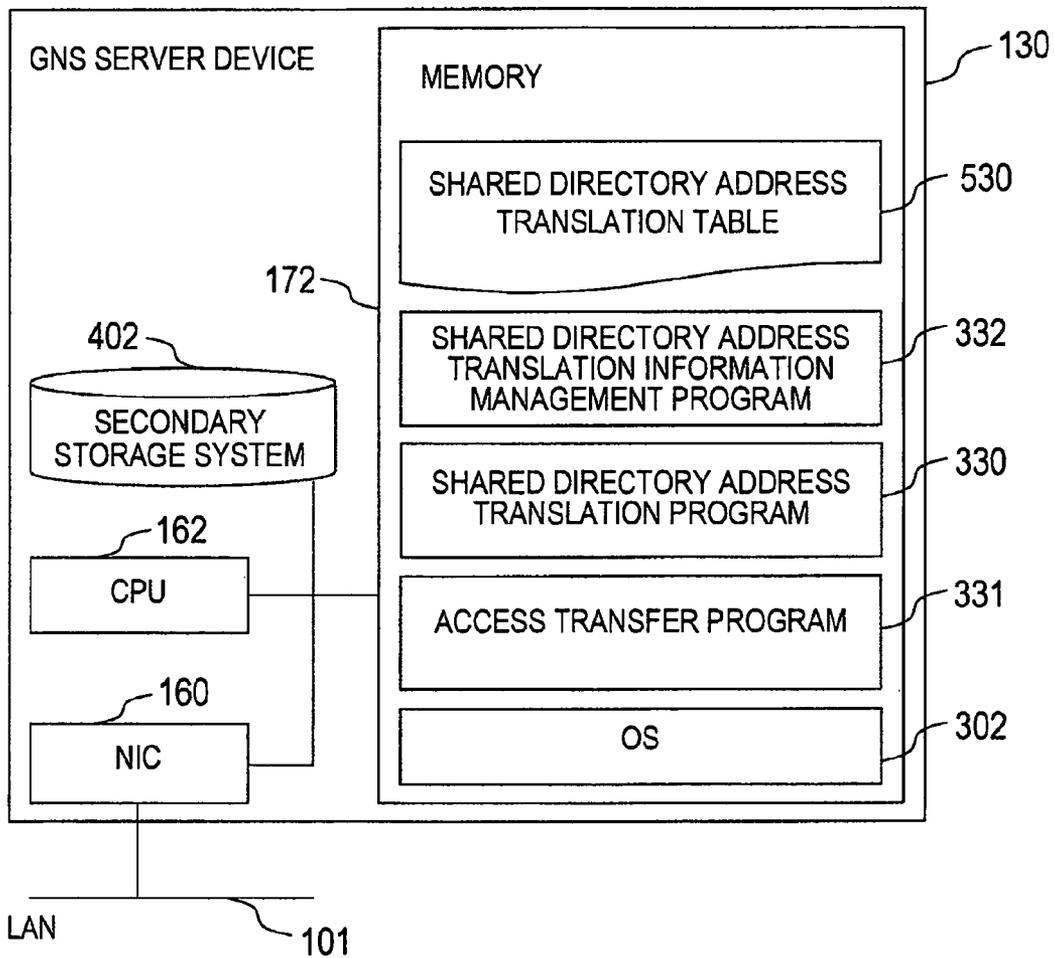


FIG. 5

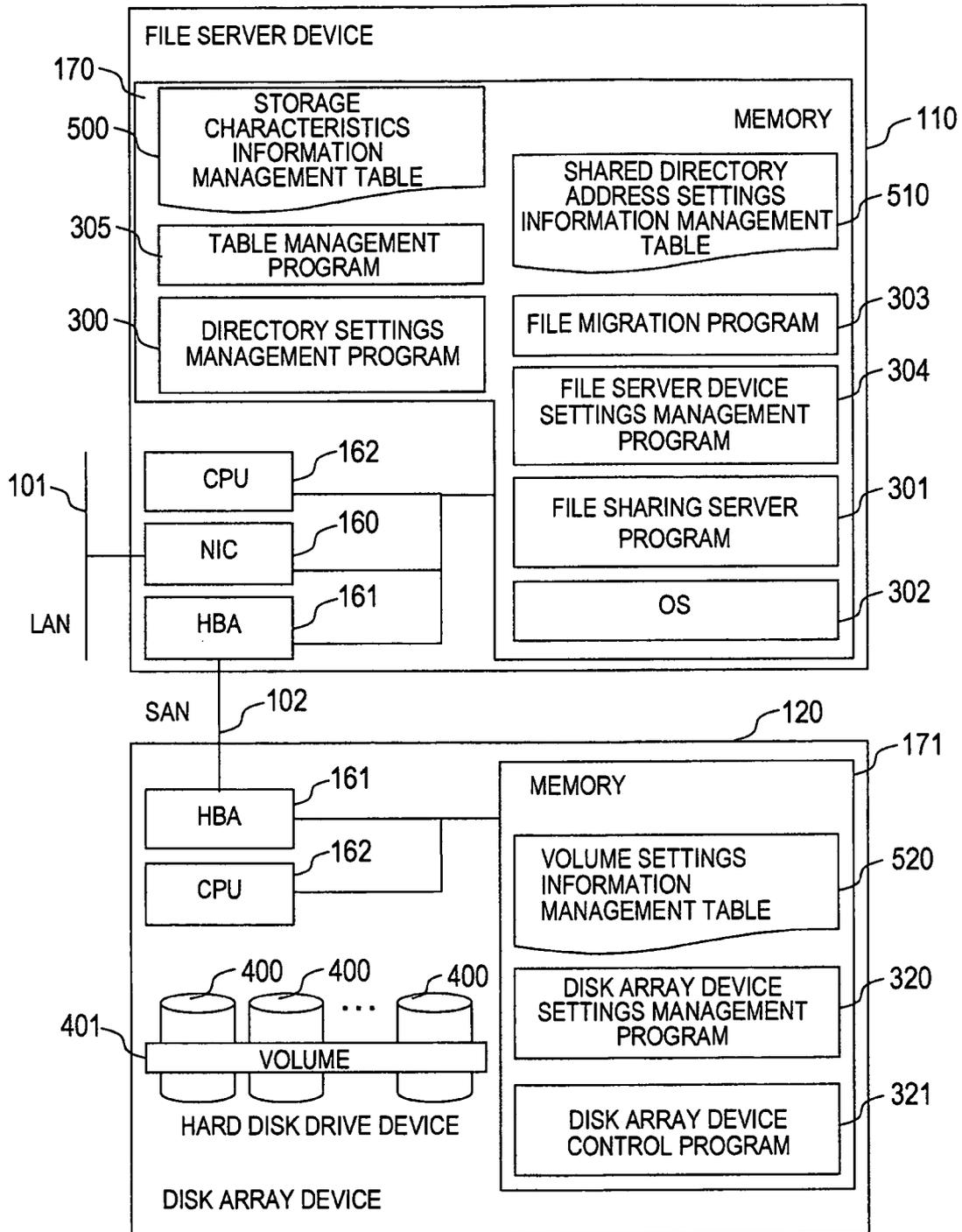


FIG. 6

530

SHARED DIRECTORY ADDRESS TRANSLATION TABLE

LOGICAL SHARED DIRECTORY ADDRESS PATH NAME	PHYSICAL SHARED DIRECTORY ADDRESS
/mail	nas1:/mail
/rdb	nas2:/rdb
/webcontents	nas2:/webcontents
...	...

FIG. 7

520

VOLUME SETTINGS INFORMATION MANAGEMENT TABLE

VOLUME ID	RAID TYPE	HARD DISK DRIVE DEVICE PERFORMANCE
vol3	5	INTERMEDIATE
vol7	1	HIGH
...

FIG. 8

510

SHARED DIRECTORY ADDRESS SETTINGS
INFORMATION MANAGEMENT TABLE

511 SHARED DIRECTORY ADDRESS PATH NAME	512 SHARED DIRECTORY INTERNAL PATH NAME
/mail	/fs2/mail
/rdb	/fs3/rdb
...	...

FIG. 9

500

STORAGE CHARACTERISTICS INFORMATION MANAGEMENT TABLE

501 FILE SERVER DEVICE NAME	502 INTERNAL PATH NAME	503 VOLUME ID	504 RAID TYPE	505 HARD DISK DRIVE DEVICE PERFORMANCE
nas1	/fs3	vol3	5	INTERMEDIATE
nas2	/fs7	vol7	1	HIGH
...

FIG. 10

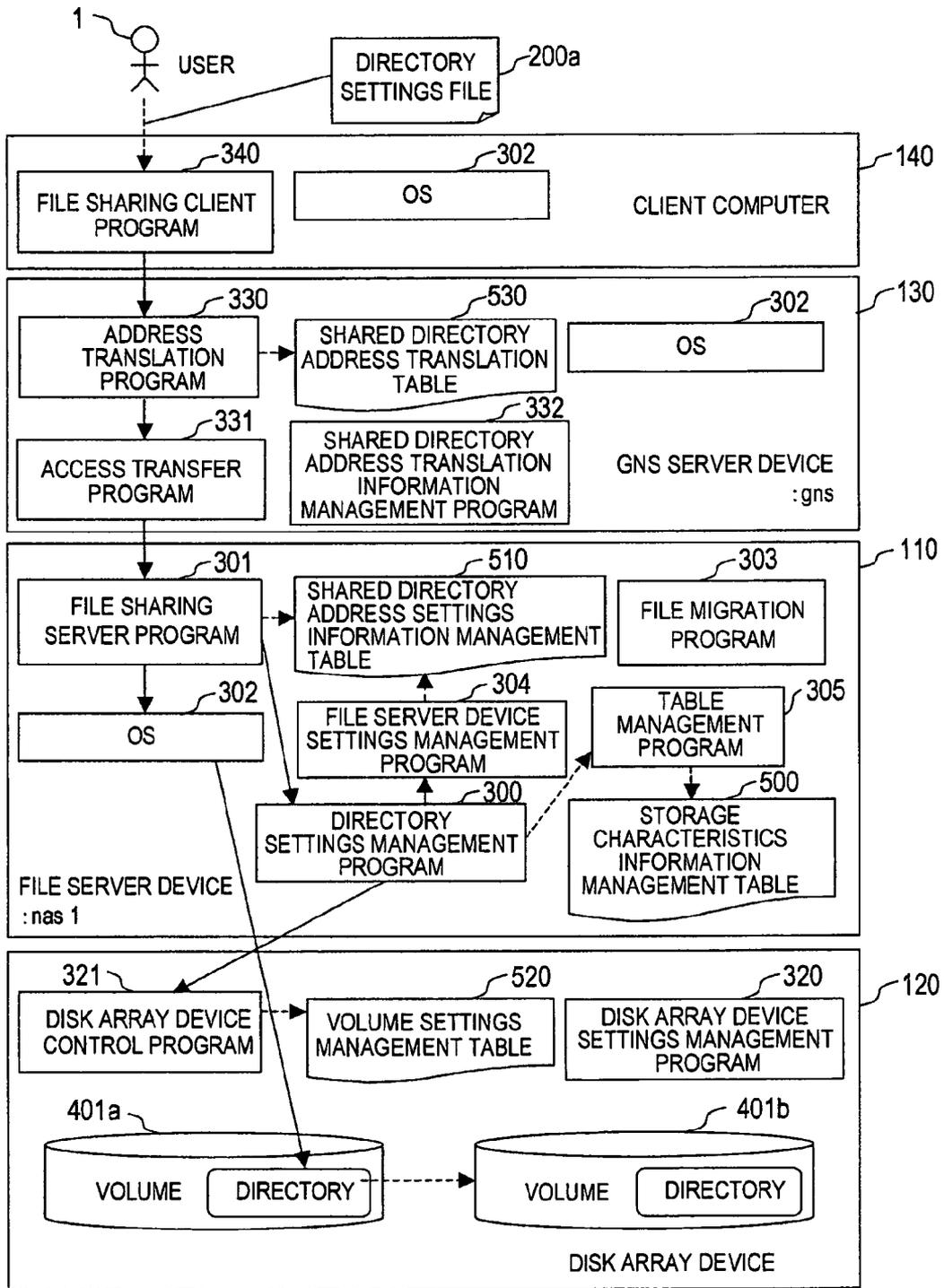


FIG. 11

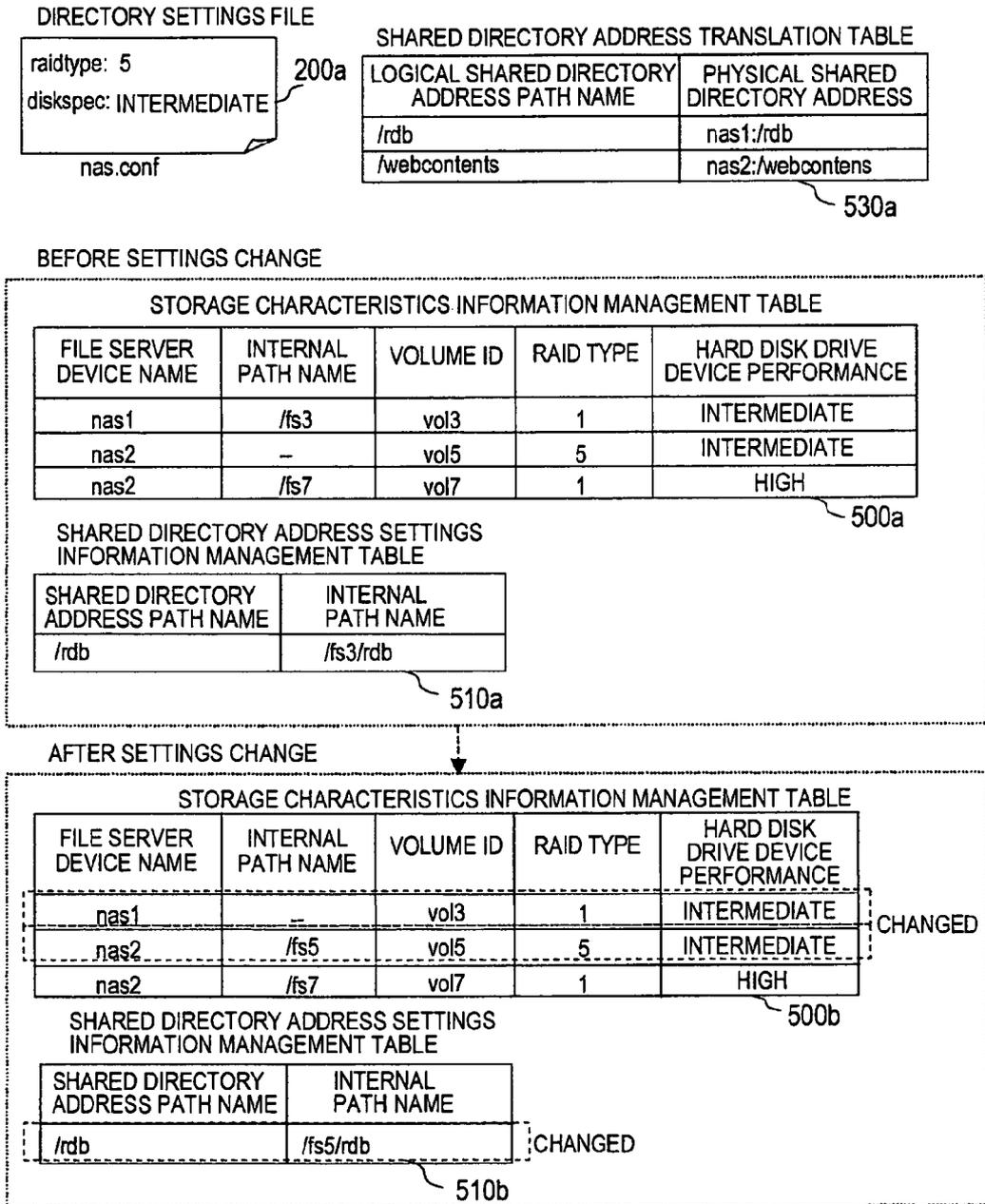


FIG. 12

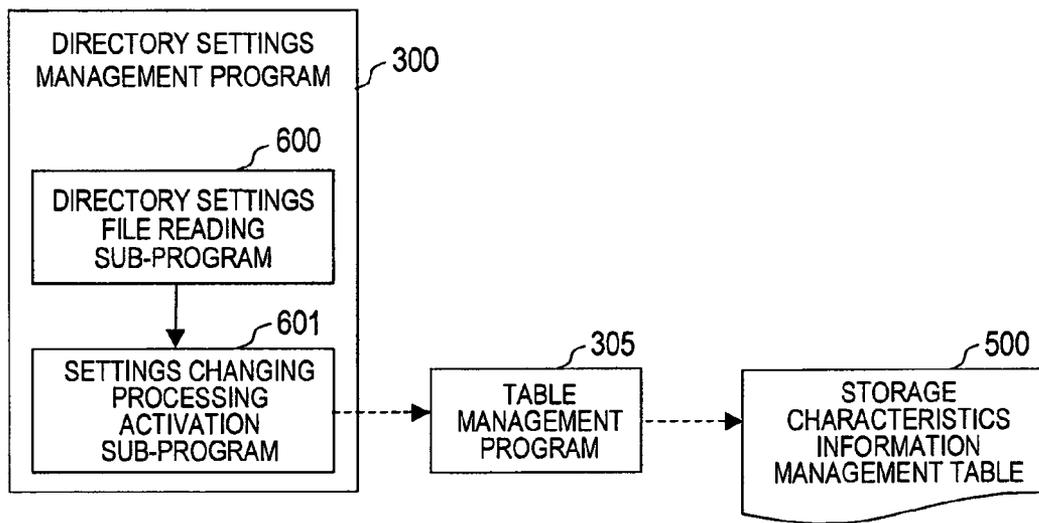


FIG. 13

600

DIRECTORY SETTINGS FILE READING SUB-PROGRAM

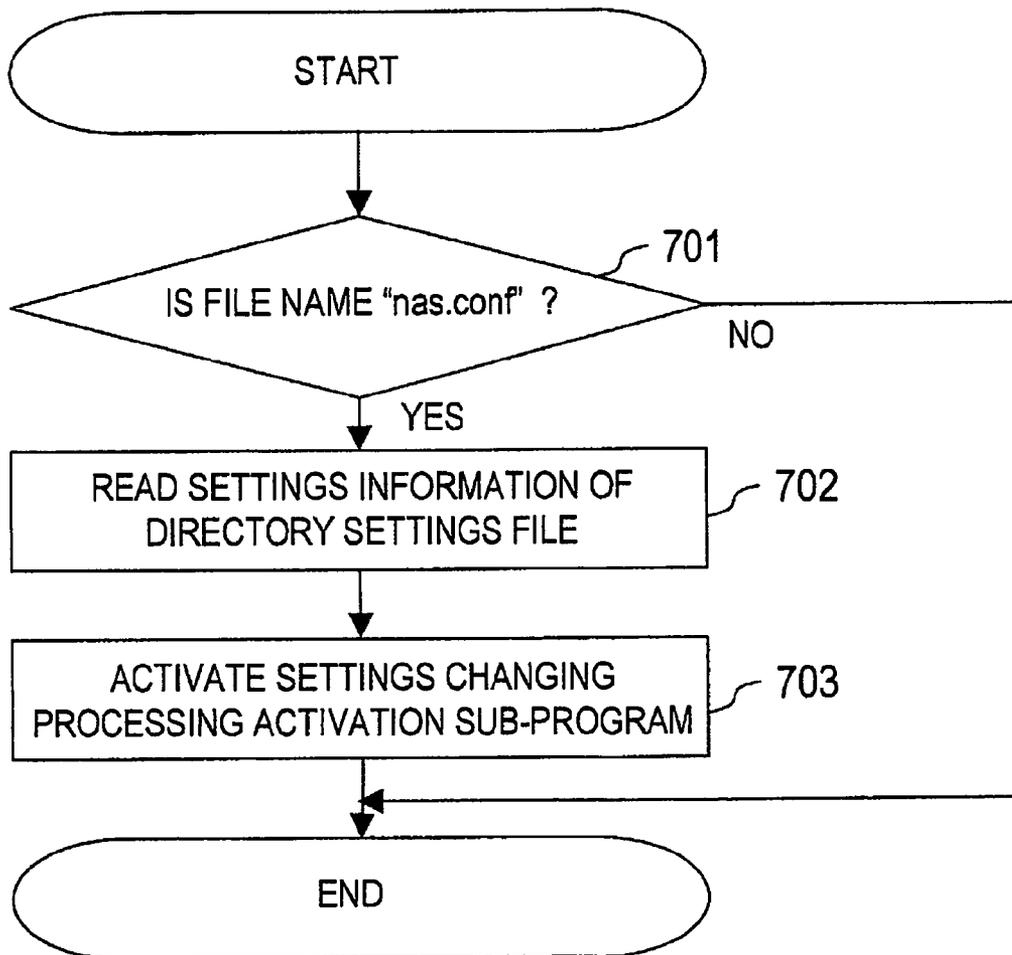


FIG. 14

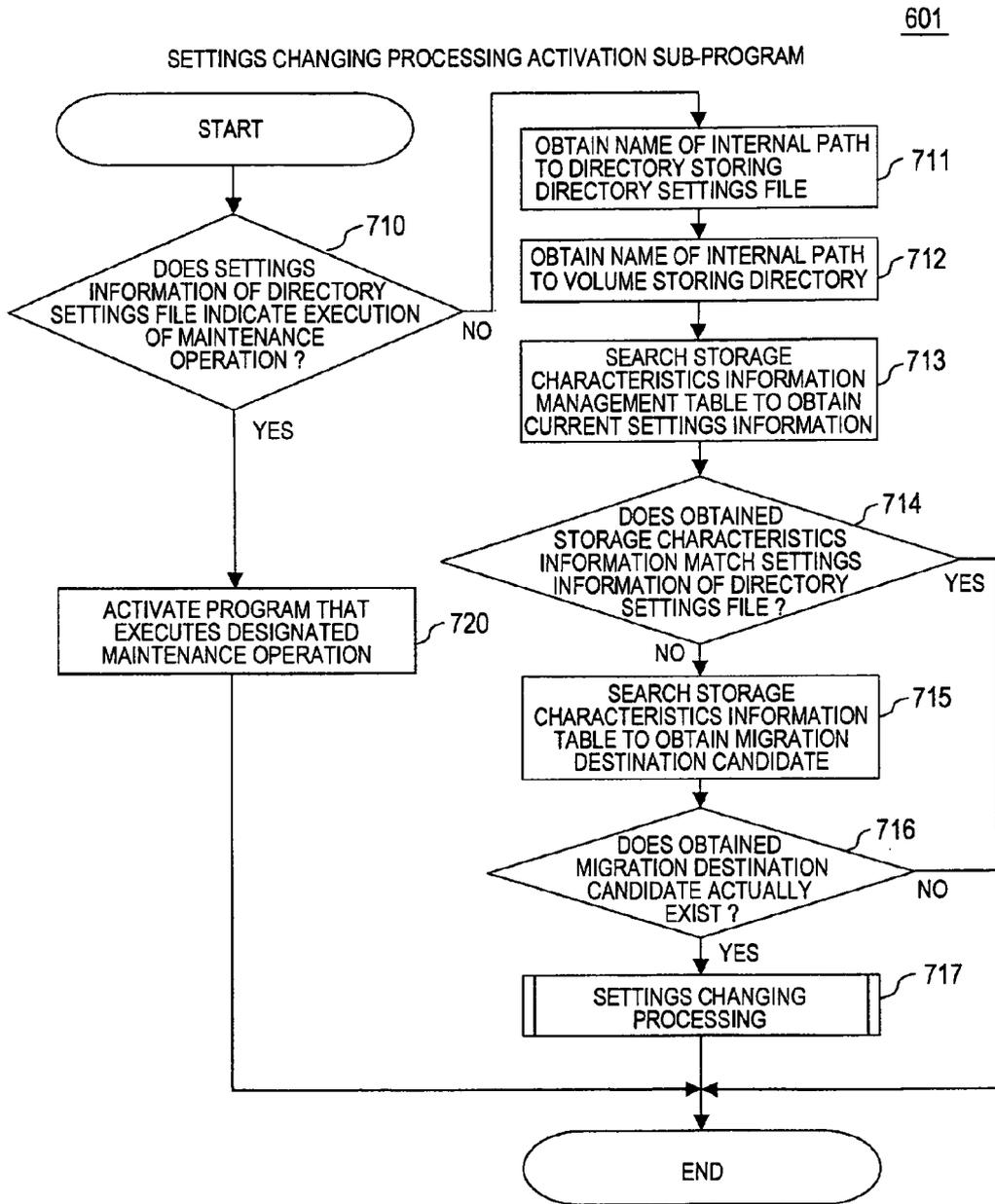


FIG. 15

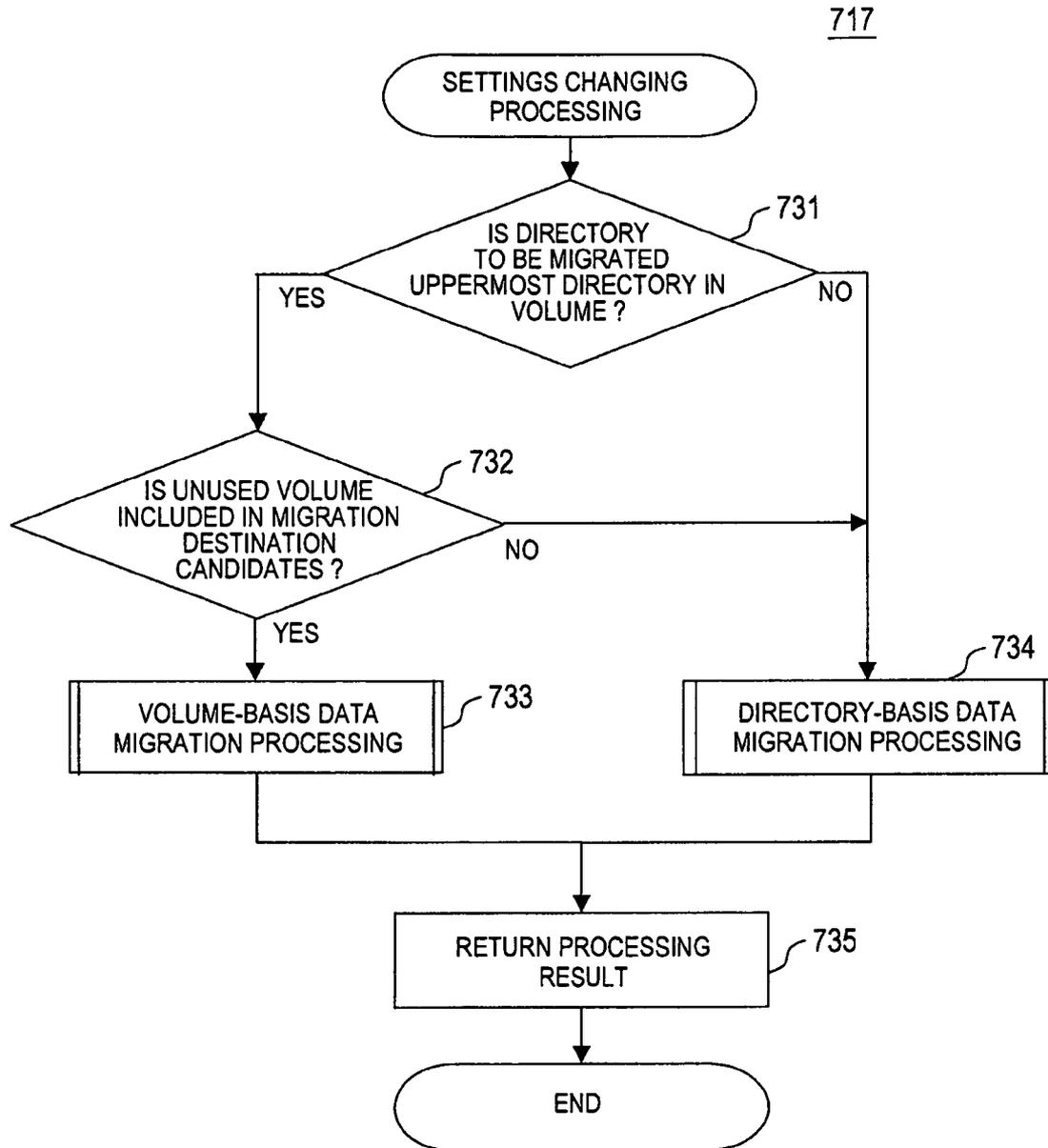


FIG. 16

733

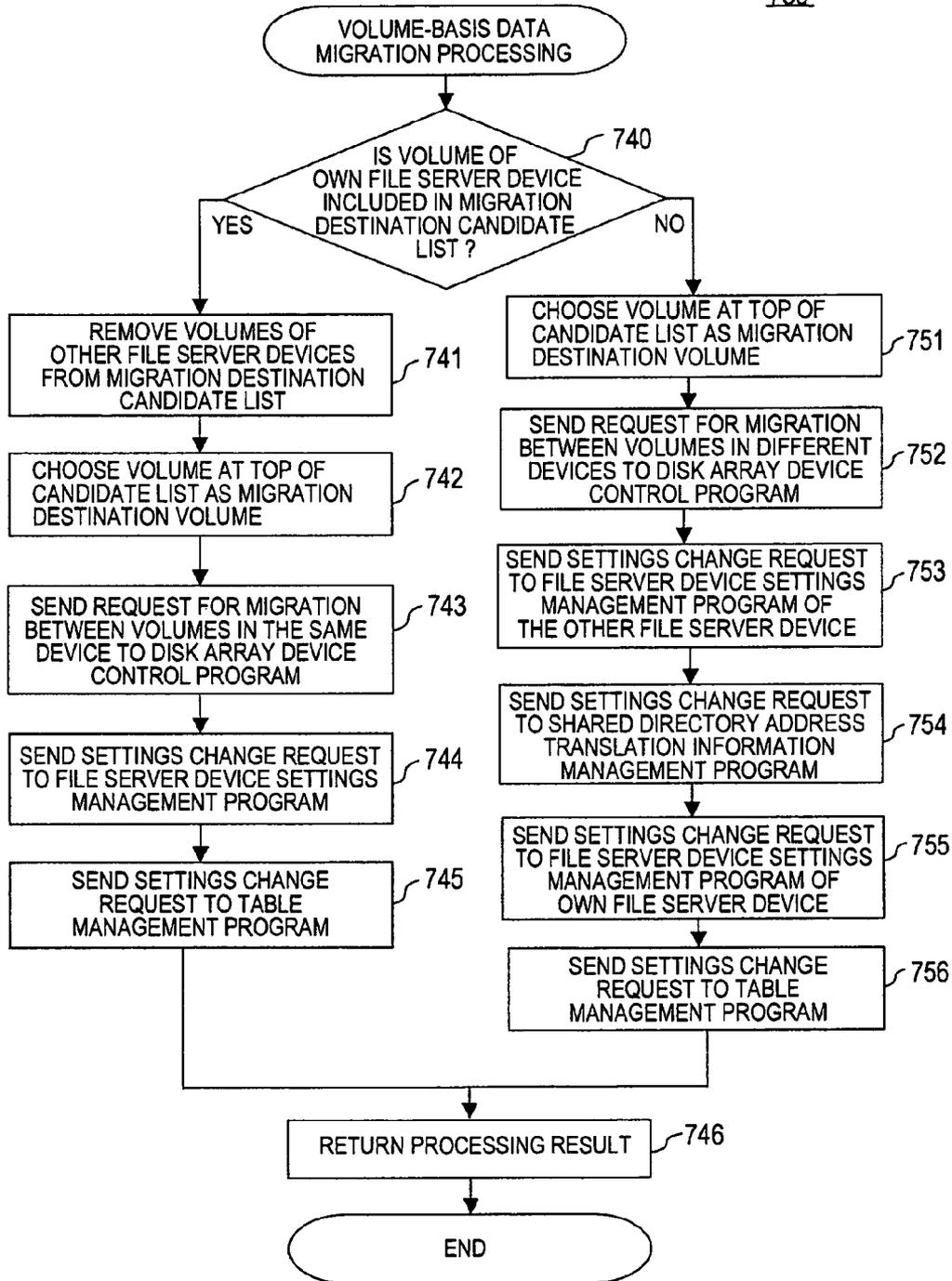


FIG. 17

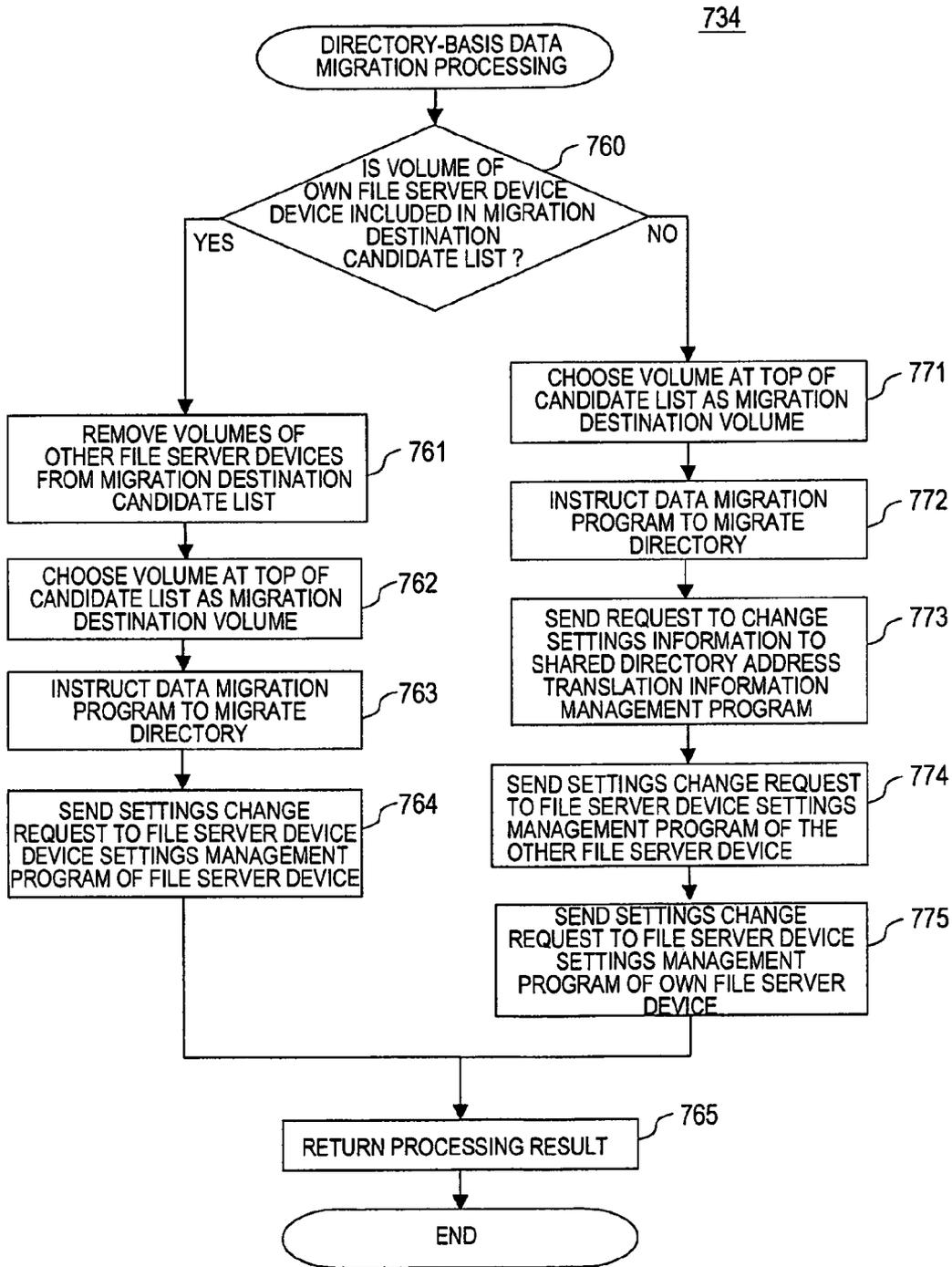


FIG. 18

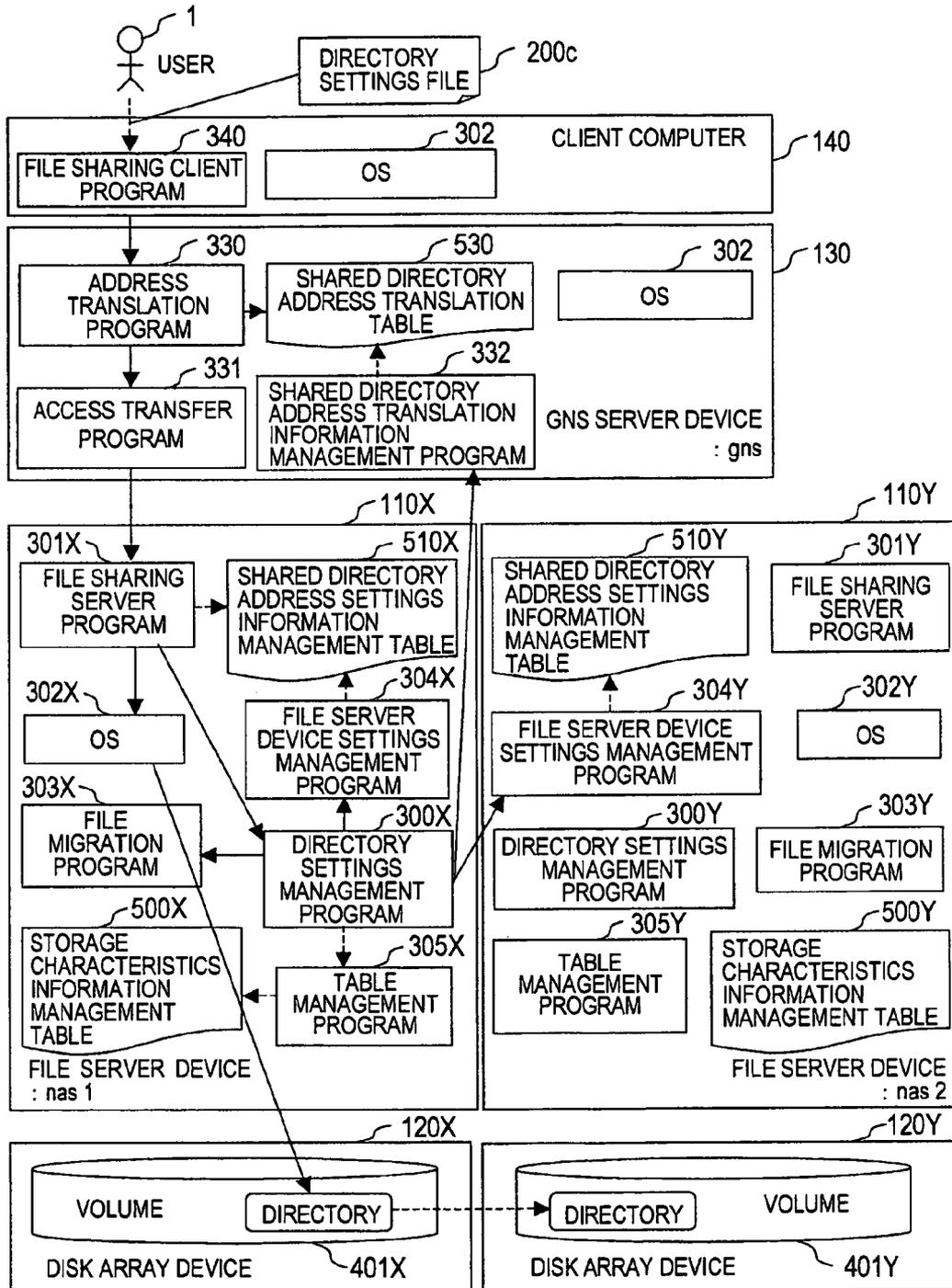


FIG. 19

DIRECTORY SETTINGS FILE

```

raidtype: 1
diskspce: HIGH
nas.conf
    
```

200c

STORAGE CHARACTERISTICS INFORMATION MANAGEMENT TABLE

FILE SERVER DEVICE NAME	INTERNAL PATH NAME	VOLUME ID	RAID TYPE	HARD DISK DRIVE DEVICE PERFORMANCE
nas1	/fs3	vol3	1	INTERMEDIATE
nas2	-	vol5	5	INTERMEDIATE
nas2	/fs7	vol7	1	HIGH

500c

BEFORE SETTINGS CHANGE

SHARED DIRECTORY ADDRESS TRANSLATION TABLE

LOGICAL SHARED DIRECTORY ADDRESS PATH NAME	PHYSICAL SHARED DIRECTORY ADDRESS
/rdb	nas1:/rdb
/webcontents	nas2:/webcontents

530c

MIGRATION SOURCE FILE SERVER DEVICE SHARED DIRECTORY ADDRESS SETTINGS INFORMATION MANAGEMENT TABLE

SHARED DIRECTORY ADDRESS PATH NAME	INTERNAL PATH NAME
/rdb	/fs3/rdb

510Xc

MIGRATION DESTINATION FILE SERVER DEVICE SHARED DIRECTORY ADDRESS SETTINGS INFORMATION MANAGEMENT TABLE

SHARED DIRECTORY ADDRESS PATH NAME	INTERNAL PATH NAME
/webcontents	/fs7/web

510Yc

AFTER SETTINGS CHANGE

SHARED DIRECTORY ADDRESS TRANSLATION TABLE

LOGICAL SHARED DIRECTORY ADDRESS PATH NAME	PHYSICAL SHARED DIRECTORY ADDRESS
/rdb	nas1:/rdb
/rdb/index	nas2:/rdb/index
/webcontents	nas2:/webcontents

530d

ADDED

MIGRATION SOURCE FILE SERVER DEVICE SHARED DIRECTORY ADDRESS SETTINGS INFORMATION MANAGEMENT TABLE

SHARED DIRECTORY ADDRESS PATH NAME	INTERNAL PATH NAME
/rdb	/fs3/rdb

510Xd

MIGRATION DESTINATION FILE SERVER DEVICE SHARED DIRECTORY ADDRESS SETTINGS INFORMATION MANAGEMENT TABLE

SHARED DIRECTORY ADDRESS PATH NAME	INTERNAL PATH NAME
/webcontents	/fs7/web
/rdb/index	/fs7/rdb/index

510Yd

ADDED

FIG. 20

**FILE SERVER THAT ALLOWS AN END USER
TO SPECIFY STORAGE CHARACTERISTICS
WITH EASE**

Matter enclosed in heavy brackets [] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

CLAIM OF PRIORITY

The present application claims priority from Japanese patent application P2006-330594 filed on Dec. 7, 2006, the content of which is hereby incorporated by reference into this application.

BACKGROUND

This invention relates to a method of changing settings information of a shared directory, and more particularly, to a method of allowing a client computer operated by a user to send a request to change settings information of a shared directory.

File server devices, which enable multiple client computers connected to one another via a local area network (LAN) to share a file, are widely used in business organizations and the like.

A file server device provides client computers with a shared directory, an area in which a file is written.

Each shared directory is identified by an identifier unique throughout the network. An identifier assigned to a shared directory is called a shared directory address.

Once a shared directory address is specified and entered in an operating system (OS) or a file sharing client program that is run in the client computers, the client computers can store files in, or read files out of, a shared directory at the shared directory address.

A file server device may be mounted as a special-use computer.

There has been known a technique with which a computer running an OS executes a file sharing server program to assume the function of a file server device which provides a shared directory (see, for example, Non-patent Document 1: Jay Ts, Robert Eckstein, and David Collier-Brown, Using Samba, (U.S.) 2nd ed. (Sebastopol, C A: O'Reilly and Associates Inc., Feb. 2003), p. 1-3).

A file sharing server program receives, from a client computer connected to a file server device via a LAN, a request to access a file that is stored in a secondary storage system in the file server device, and uses a function of an OS run in the file server device to access the file stored in the secondary storage system.

The file sharing server program operates according to settings information which is described in a settings file stored in the file server device. The settings information is managed by an administrator commissioned by a user of the client computer.

The secondary storage system in the file server device is a single hard disk drive. Instead, a disk array device may serve as the secondary storage system when the secondary storage system needs to have a large storage capacity.

A disk array device is a combination of multiple hard disk drives to provide redundant virtual storage areas. Such virtual storage areas are called volumes.

One way to build a virtual hard disk drive by combining hard disk drives is a technology called redundant array of

inexpensive disks (RAID). There are several different methods to combine hard disk drives and those variations are called RAID types. The price per capacity and price-performance ratio of a volume vary depending on the RAID type.

The price-performance ratio is also varied depending on the specification of the single hard disk drive. Therefore, a RAID type and a single hard disk drive that are suitable to the use of the secondary storage system should be chosen. Another factor that can make the performance, capacity, and the like to vary is the specification of the disk array device itself.

In an environment where a large storage capacity is necessary, many file server devices are connected to a single LAN. A shared directory in such an environment is migrated among the file server devices to balance, for example, the access load applied to the individual file server devices. This improves the overall price-performance ratio of the computer system.

However, migration of a shared directory makes it necessary for a user of a client computer to specify and enter a new shared directory address assigned to the migrated shared directory in the client computer without fail.

Global name space (GNS) is a known technology to relocate a shared directory in this type of environment in a manner that makes the relocation transparent to client computers (see, for example, Non-patent Document 2: Jon William Toigo, The Holy Grail of Network Storage Management (Indianapolis: Prentice Hall Professional Technical Reference, Oct. 2003), p. 61-64).

GNS is a technology for translating a logical shared directory address that is specified and entered in a client computer into a physical shared directory address at which a shared directory is actually located. GNS makes it possible to access a migrated shared directory by entering the same logical shared directory address that has been used prior to the relocation in the client computer, despite a change in physical shared directory address of the shared directory that accompanies the migration.

A user of a client computer may wish to change settings information of a shared directory such that the shared directory is placed in a file server device, a disk array device, a volume, or the like that has the optimum storage characteristics from the viewpoints of, for example, price per capacity and price-performance ratio according to the type, utilization state, and the like of files stored in the shared directory.

Conventionally, a user of a client computer accessing a file server device who wishes to change settings information of a shared directory notifies the administrator of new settings as well as the network address of the shared directory of which settings information is to be changed, and asks the administrator to change settings information of the shared directory.

Receiving the request, the administrator directly changes settings information of the shared directory or operates a management program or the like to change settings information of the shared directory. In short, the administrator changes setting information of each shared directory separately.

One of common ways for a user to request the administrator to change settings information of a shared directory is e-mail.

A Web server program Apache provides a user who publishes contents online with a measure to change settings information of a directory in which the contents are stored without the intervention of the administrator. Apache changes settings information of the directory storing the materials when a settings file which describes settings of the directory is stored in the directory (see, for example, Non-patent Document 3:

Ivan Ristic, Apache Security (Sebastopol, C.A.: O'Reilly and Associates Inc., May 2005), p. 137-139).

SUMMARY

In the prior art, a user who wishes to change settings information of a shared directory has to specify the address of the shared directory of which setting information is to be changed.

This leaves a risk that the user enters a wrong address for the shared directory of which settings information is to be changed, and a risk that the administrator asked to change settings information of the shared directory misreads the address of the shared directory, new settings information, and other information entered by the user.

A first problem with the prior art is, therefore, that there are many chances for wrong settings information to be set in a shared directory.

A second problem with the prior art is that a user has to specify new settings information for each shared directory of which settings information is to be changed. Specifying new settings information for each shared directory of which settings information is to be changed is inefficient and a tedious work for a user when the same settings information is to be set in two or more shared directories.

The first and second problems with the prior art are particularly noticeable in a computer system having a file server device that manages many files and users.

The technology described in Non-patent Document 3 enables a user to change settings information about the right to refer to a directory in a Web server. Also, a Web server described in this document has a measure to prevent a user from changing directory settings information by mistake and a measure to reuse settings information.

However, the technology described in Non-patent Document 3 is about a request to refer to a file in a Web server and, when applied to a computer system that has a file server device, does not enable a user to change settings information of a secondary storage system or a file system where data is stored. Therefore, applying the technology described in Non-patent Document 3 to a file server device does not solve the first and second problems with the prior art.

This invention has been made in view of the above-mentioned problems, and it is therefore an object of this invention to provide a file server device that has less chance of error in changing directory settings information. Another object of this invention is to provide a file server device that can reuse directory settings information.

According to an aspect of the present invention, there is provided a method of changing settings information of a shared directory in a computer system comprising at least one file server device, a client computer and a storage system, the settings information of the shared directory provided by the file server device, the file server device being accessible from the client computer, the storage system being accessible from the file server device, the client computer having a first processor, which performs computation processing, a first storage unit, which is coupled to the first processor, and a first interface, which is coupled to the first processor, the file server device having a second processor, which performs computation processing, a second storage unit, which is coupled to the second processor, and a second interface, which is coupled to the second processor, the storage system having a third processor, which performs computation processing, a third interface, which is coupled to the third processor, and a third storage unit in which at least one volume including a storage area, the method comprising: sending, by

the first processor, a write request to the file server device via the first interface and the second interface in order to request to write, in the shared directory whose settings information is to be changed, a directory settings file that describes new settings information for this shared directory; storing, in the second storage unit, storage characteristics information in which settings information of the volume is registered; providing, by the second processor, the client computer with a shared directory which is included in at least one volume included in the third storage unit; writing, by the second processor, in case of receiving the request to write the directory settings file via the first interface and the second interface, the directory settings file in the shared directory according to the received directory settings file writing request; referring, by the second processor, to the storage characteristics information to select, as data migration destination candidate, at least one volume whose settings information matches the new settings information described in the directory settings file; obtaining, by the second processor, information for identifying the selected volume; and executing, by the second processor, settings changing processing of migrating information from the shared directory in which the directory settings file is written to one of the selected volume.

According to an aspect of this invention, error in directory settings information can be avoided.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention can be appreciated by the description which follows in conjunction with the following figures, wherein:

FIG. 1 is a block diagram of a computer system according to an embodiment of this invention;

FIG. 2 is a diagram illustrating a format of a shared directory address, a logical shared directory address, and a physical shared directory address according to the embodiment of this invention;

FIG. 3 is a diagram showing a configuration of a directory settings file according to the embodiment of this invention;

FIG. 4 is a block diagram of a client computer according to the embodiment of this invention;

FIG. 5 is a block diagram of a GNS server according to the embodiment of this invention;

FIG. 6 is a block diagram of a file server device and a disk array device according to the embodiment of this invention;

FIG. 7 is a diagram showing a configuration of a shared directory address translation table according to the embodiment of this invention;

FIG. 8 is a diagram showing a configuration of a volume settings information management table according to the embodiment of this invention;

FIG. 9 is a diagram showing a configuration of a shared directory address settings information management table according to the embodiment of this invention;

FIG. 10 is a diagram showing a configuration of a storage characteristics information management table according to the embodiment of this invention;

FIG. 11 is a sequence diagram for a change of shared directory settings which accompanies volume-basis data migration within the same file server device according to the embodiment of this invention;

FIG. 12 is a diagram illustrating tables before and after a change of settings of a shared directory that accompanies volume-basis data migration within the same file server device according to the embodiment of this invention;

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FIG. 13 is a diagram illustrating processing of updating the storage characteristics information management table according to the embodiment of this invention;

FIG. 14 is a flow chart of a directory settings file reading sub-program according to the embodiment of this invention;

FIG. 15 is a flow chart of a settings changing processing activation sub-program according to the embodiment of this invention;

FIG. 16 is a flow chart for settings changing processing which is executed by the settings changing processing activation sub-program according to the embodiment of this invention;

FIG. 17 is a flow chart for volume-basis data migration processing which is executed by the settings changing processing activation sub-program according to the embodiment of this invention;

FIG. 18 is a flow chart for directory-basis data migration processing which is executed by the settings changing processing activation sub-program according to the embodiment of this invention;

FIG. 19 is a sequence diagram for processing of changing shared directory settings information by moving information from a shared directory to a volume in a disk array device that is connected to another file server device according to a modification example of the embodiment of this invention; and

FIG. 20 is a diagram illustrating tables before and after a change of shared directory settings information which is caused by moving information from the shared directory to the volume in the disk array device that is connected to another file server device according to the modification example of the embodiment of this invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

A file server device according to this embodiment changes settings information of a shared directory when a directory setting file describing new settings information is written in the shared directory.

This enables a user to change shared directory settings information by himself/herself correctly without asking an administrator to change shared directory settings information. This also makes it possible to change settings information of multiple devices by writing a directory settings file once. Further, different shared directories can be changed the same settings information simply by making copies of the same directory settings file and storing the copies in different shared directories. Another advantage of a file server device according to this embodiment is that, even when shortage of free capacity or the like hinders the file server device from changing the current settings information of a shared directory to settings information that is described in a directory settings file, the settings information of the shared directory can still be changed when an expansion of a disk array device or the like creates a volume that matches the settings information described in the directory settings file. A shared directory can thus be set to optimum settings for the configuration of a device that constitutes a computer system.

Effects of this embodiment are prominent particularly in an intricate computer system having file server devices of different configurations, multiple disk array devices, a GNS server device, and others. A file server device according to this embodiment is applicable also to a computer system that does not have a disk array device and a GNS server device.

The embodiment of this invention is now described with reference to the accompanying drawings.

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FIG. 1 is a block diagram of a computer system according to the embodiment of this invention.

This computer system has a file server device 110, a disk array device 120, a global name space (GNS) server device 130, and a client computer 140.

The file server device 110, the GNS server device 130, and the client computer 140 are connected to one another via a local area network (LAN) 101. The file server device 110 and the disk array device 120 are connected to each other via a storage area network (SAN) 102.

FIG. 1 shows two file server devices 110 and disk array device 120 each, but the computer system may have at least one file server device 110 and disk array devices 120.

The client computer 140 is a computer operated by a user 1. The hardware configuration of the client computer 140 will be described in detail with reference to FIG. 4.

A shared directory address 10 specified by the user 1 is entered in the client computer 140. The shared directory address 10 is the address of a shared directory provided by the file server device 110. Specifically, the shared directory address 10 specifies the name of a server device that the client computer 140 accesses and the name of a path to a shared directory that the client computer 140 accesses. The name of the GNS server device 130 is specified as a server device name. The format of the shared directory address 10 will be described in detail with reference to FIG. 2.

When the specified shared directory address 10 is entered, the client computer 140 sends an access request to the GNS server device 130 according to the specified shared directory address 10.

The GNS server device 130 translates the shared directory address 10 (logical shared directory address 20) specified by the user 1 into a physical shared directory address 30. The hardware configuration of the GNS server device 130 will be described in detail with reference to FIG. 5.

The physical shared directory address 30 is the physical address of a shared directory provided by the file server device 110 which is connected to the GNS server device 130 via the LAN 101. The logical shared directory address 20 and the physical shared directory address 30 have the same format as that of the shared directory address 10.

After converting a logical shared directory address 20 into the physical shared directory address 30, the GNS server device 130 forwards the shared directory access request, which has been sent by the client computer 140, to the file server device 110.

The user 1 thus does not need to know the physical address of the file server device 110 that provides a shared directory that the user 1 wishes to access to make the client computer 140 access the shared directory, and instead, only has to specify and enter the shared directory address 10 in the client computer 140. For instance, after the configuration is changed such that another file server device 110 provides a shared directory, the user 1 can access the shared directory only by specifying and entering the same shared directory address 10 that has been used before the configuration change in the client computer 140.

The file server device 110 may be equipped with the functions of the GNS server device 130.

The disk array device 120 is a storage system for storing data. The disk array device 120 serves as a secondary storage system of the file server device 110. The hardware configuration of the disk array device 120 will be described in detail with reference to FIG. 6. The disk array device 120 may be equipped with functions of the file server device 110.

The file server device 110 receives a request to access a shared directory which is sent by the client computer 140, and

accesses the shared directory in the disk array device **120**. The hardware configuration of the file server device **110** will be described in detail with reference to FIG. 6.

The file server device **110** also receives a directory settings file **200**, which is sent by the client computer **140** and which is shown in FIG. 3. Receiving the directory settings file **200**, the file server device **110** changes a shared directory by changing settings of the disk array device **120** that is connected to this file server device **110**, settings of another file server device **110**, and settings of the GNS server device **130**. The directory settings file **200** will be described in detail with reference to FIG. 3.

It is also possible to apply the present invention to only one device chosen out of the file server device **110**, the disk array device **120** connected to the file server device **110**, and the GNS server device **130**.

FIG. 2 is a diagram illustrating the format of the shared directory address **10**, the logical shared directory address **20**, and the physical shared directory address **30** (hereinafter referred to as address format) according to the embodiment of this invention.

The address format contains a server device name **11** and a path name **12**. The name of a server device to be accessed is specified as the server device name **11**. As the path name **12**, the name of a path to a shared directory to be accessed is specified.

For instance, in case of the shared directory address **10** or the logical shared directory address **20**, the name of the GNS server device **130** is specified as the server device name **11**, and the name of a path to a shared directory to be accessed is specified as the path name **12**.

In a case of the physical shared directory address **30**, the name of the file server device **110** is specified as the server device name **11**, and a path name specified by the logical shared directory address **20** is designated as the path name **12**.

A path name specified by the logical shared directory address **20** is designated as the path name **12** of the physical shared directory address **30** in this embodiment for making the explanation simple. However, an arbitrary path name may be specified instead of a path name specified by the logical shared directory address **20**.

FIG. 3 is a diagram showing a configuration of the directory settings file **200** according to the embodiment of this invention.

The directory settings file **200** is a file in which settings information of a shared directory is described. The directory settings file **200** is created by the client computer **140**. Settings of a shared directory are changed when the directory settings file **200** is stored in the shared directory.

The directory settings file **200** has a file name "nas.conf". The file server device **110** judges a file stored in a shared directory as the directory settings file **200** when the file has the file name "nas.conf", and as a normal file when the file has other file names than "nas.conf".

The directory settings file **200** contains a settings item name **210** and a set value **211**.

Registered as the settings item name **210** is the name of a shared directory settings item that is to be changed. The set value of the item to be changed is registered as the set value **211**.

For instance, "raidtype" and "diskspec" are registered as the settings item name **210**. The item name "raidtype" indicates the RAID type of a volume where a shared directory of which settings are to be changed is located, whereas "diskspec" indicates the performance of the volume where the shared directory is located (volume **401** shown in FIG. 6). A performance of the volume **401** is determined by, for

example, how the file server device **110** and the disk array device **120** are connected and the maximum number of revolutions of a hard disk drive device **400**, which is provided in the disk array device **120** and which is shown in FIG. 6.

An instruction to execute maintenance operation such as taking a backup may be written as the settings item name **210**.

The client computer **140**, the GNS server device **130**, the file server device **110**, and the disk array device **120** will be described next with reference to FIGS. 4 to 6.

FIG. 4 is a block diagram of the client computer **140** according to the embodiment of this invention.

The client computer **140** has a network interface card (NIC) **160**, a CPU **162**, a keyboard **163**, a mouse **164**, a display device **165**, a memory **173**, and a secondary storage system **402**.

The keyboard **163** and the mouse **164** are input measures. The display device **165** is an output measure. The user **1** operates the client computer **140** through the keyboard **163** and the mouse **164** while checking information output to the display device **165**.

The NIC **160** in the client computer **140** is an interface that connects the client computer **140** to the LAN **101**.

The CPU **162** in the client computer **140** loads various programs stored in the secondary storage system **402** onto the memory **173**, and executes the programs loaded onto the memory **173**.

The secondary storage system **402** in the client computer **140** stores an OS **302** and a file sharing client program **340**. The OS **302** and the file sharing client program **340** are loaded onto the memory **173** when the client computer **140** is booted.

The OS **302** in the client computer **140** is a program that controls the operation of the client computer **140**. The file sharing client program **340** is a program that enables the client computer **140** to access a file stored in a shared directory, which is provided by the file server device **110**.

When the client computer **140** is to access a shared directory, the file sharing client program **340** sends a request to access the shared directory to a file sharing server program **301** shown in FIG. 6. The file sharing server program **301** that receives this access request is one stored in the file server device **110** that provides the shared directory to be accessed. The access request contains a shared directory address that is specified by the user **1** as the shared directory address of the shared directory to be accessed.

FIG. 5 is a block diagram of the GNS server device **130** according to the embodiment of this invention.

The GNS server device **130** has the NIC **160**, the CPU **162**, a memory **172**, and the secondary storage system **402**.

The NIC **160** in the GNS server device **130** is an interface that connects the GNS server device **130** to the LAN **101**.

The CPU **162** in the GNS server device **130** loads various programs stored in the secondary storage system **402** onto the memory **172**, and executes the programs loaded onto the memory **172**.

The secondary storage system **402** in the GNS server device **130** stores a shared directory address translation program **330**, an access transfer program **331**, a shared directory address translation information management program **332**, the OS **302**, and a shared directory address translation table **530**. The shared directory address translation program **330**, the access transfer program **331**, the shared directory address translation information management program **332**, the OS **302**, and the shared directory address translation table **530** are loaded onto the memory **172** when the GNS server device **130** is booted.

The shared directory address translation table **530** is used to manage the association relation between the logical shared

directory address **20** and the physical shared directory address **30**. The shared directory address translation table **530** will be described in detail with reference to FIG. 7.

The shared directory address translation program **330** refers to the shared directory address translation table **530** to translate the logical shared directory address **20** sent by the client computer **140** into the physical shared directory address **30** of a shared directory that is provided by one of the file server devices **110** connected to the GNS server device **130** via the LAN **101**.

The access transfer program **331** forwards a shared directory access request sent from the client computer **140** to the file server device **110** that is identified by a name registered as the server device name **11** in the physical shared directory address **30**. The access request sent by the access transfer program **331** contains the physical shared directory address **30** obtained through the translation.

The shared directory address translation information management program **332** changes an association relation registered in the shared directory address translation table **530**. When the GNS server device **130** receives a request to change settings in the shared directory address translation table **530** from the file server device **110**, the shared directory address translation information management program **332** adds a new association relation to the shared directory address translation table **530**, and deletes or changes an association relation registered in the shared directory address translation table **530**.

The OS **302** in the GNS server device **130** controls the operation of the GNS server device **130**.

The GNS server device **130** receives a request to access a shared directory which is sent by the client computer **140**. The GNS server device **130** forwards the received shared directory access request to the file server device **110** that actually provides the shared directory. The client computer **140** can thus access the shared directory.

FIG. 6 is a block diagram of the file server device **110** and disk array device **120** according to the embodiment of this invention.

The disk array device **120** will be described first.

The disk array device **120** has a host bus adapter (HBA) **161**, the CPU **162**, a memory **171**, and multiple hard disk drive devices **400**.

The HBA **161** in the disk array device **120** is an interface that connects the disk array device **120** to the SAN **102**.

The volume **401** is a logical storage area formed from different hard disk drive devices **400**. The disk array device **120** provides more than one volume **401**.

The volume **401** stores a disk array device settings management program **320**, a disk array device control program **321**, a volume settings information management table **520**, a directory settings management program **300**, the file sharing server program **301**, the OS **302**, a file migration program **303**, a file server device settings management program **304**, a table management program **305**, a storage characteristics information management table **500**, and a shared directory address settings information management table **510**.

The disk array device settings management program **320**, the disk array device control program **321**, and the volume settings information management table **520** are loaded onto the memory **171** when the disk array device **120** is booted. The CPU **162** executes the disk array device settings management program **320** and the disk array device control program **321** that are loaded onto the memory **171**.

The volume settings information management table **520** is used to manage settings information of the volume **401**. The

volume settings information management table **520** will be described in detail with reference to FIG. 8.

The disk array device settings management program **320** adds new settings information to the volume settings information management table **520**, and deletes or changes settings information registered in the volume settings information management table **520**. The disk array device settings management program **320** also sends settings information registered in the volume settings information management table **520** to the file server device **110**.

The disk array device control program **321** controls the operation of the disk array device **120**. The disk array device control program **321** creates the volume **401** that has a RAID type specified by the file server device **110**. Another function of the disk array device control program **321** is to migrate data from one volume **401** to another volume **401** that is in the same disk array device **120**. The disk array device control program **321** also migrates data from the volume **401** in one disk array device **120** to the volume **401** in another disk array device **120**.

The file server device **110** will be described next.

The file server device **110** has the NIC **160**, the HBA **161**, the CPU **162**, and a memory **170**.

The NIC **160** in the file server device **110** is an interface that connects the file server device **110** to the LAN **101**. The HBA **161** in the file server device **110** is an interface that connects the file server device **110** to the SAN **102**.

The directory settings management program **300**, the file sharing server program **301**, the OS **302**, the file migration program **303**, the file server device settings management program **304**, the table management program **305**, the storage characteristics information management table **500**, and the shared directory address settings information management table **510** are loaded onto the memory **170** when the file server device **110** is booted. The CPU **162** then executes the directory settings management program **300**, the file sharing server program **301**, the OS **302**, the file migration program **303**, the file server device settings management program **304**, and the table management program **305**.

The OS **302** in the file server device **110** controls the operation of the file server device **110**. The OS **302** also manages a file system created in the volume **401**.

The storage characteristics information management table **500** is used to manage settings information of a shared directory provided by the file server device **110**. The storage characteristics information management table **500** will be described in detail with reference to FIG. 10.

The shared directory address settings information management table **510** is used to manage information for translating a path name in the physical shared directory address **30** into the name of an internal path to a file system. The shared directory address settings information management table **510** will be described in detail with reference to FIG. 9.

The file sharing server program **301** provides a shared directory. Specifically, the file sharing server program **301** receives a shared directory access request forwarded by the GNS server device **130**. There are, for example, two types of access requests, a reading request to read a file out of a shared directory and a writing request to write a file in a shared directory.

The file sharing server program **301** refers to the shared directory address settings information management table **510** to translate a path name in the physical shared directory address **30** contained in the received access request into the name of an internal path to a file system.

The file sharing server program **301** then uses the function of the OS **302** to access the internal path name obtained

through the translation. Specifically, the file sharing server program **301** reads a file out of a shared directory when the received access request is a reading request. When the received access request is a writing request, the file sharing server program **301** stores a file in a shared directory.

The file sharing server program **301** also activates the directory settings management program **300** when the received access request is a writing request.

In a case where the received access request is judged as other requests than a request to write in a shared directory, the file sharing server program **301** does not activate the directory settings management program **300**.

The directory settings management program **300** judges whether or not a file written in a shared directory is the directory settings file **200**. When the file written in the shared directory is judged as the directory settings file **200** and information described in the directory settings file **200** does not coincide with the current settings of the shared directory, the directory settings management program **300** executes settings changing processing in order to make the settings of the shared directory consistent with the information in the directory settings file **200**.

Specifically, the directory settings management program **300** reads the directory settings file **200** stored at the file system internal path name. The directory settings management program **300** then refers to the storage characteristics information management table **500** to judge whether or not information described in the read directory settings file **200** coincides with the current shared directory settings.

In judging that the information described in the directory settings file **200** does not coincide with the current shared directory settings, the directory settings management program **300** chooses a device and a program that are necessary to make the shared directory settings consistent with the information described in the read directory settings file **200**, and sends a request to change settings to the chosen device and program.

While in judging that the information described in the directory settings file **200** coincides with the current shared directory settings, the directory settings management program **300** does not issue a request to change settings.

The directory settings management program **300** activates the table management program **305** in a case where the storage characteristics information management table **500** is referred to.

The table management program **305** refers to the storage characteristics information management table **500**. The table management program **305** also updates the storage characteristics information management table **500**. Specifically, the table management program **305** adds new shared directory settings information to the storage characteristics information management table **500**, and deletes or changes shared directory settings information registered in the storage characteristics information management table **500**. A common database management system (DBMS) program serves as the table management program **305**.

In the case of a computer system that has multiple file server devices **110** as in this embodiment, the table management program **305** that is executed by one file server device **110** has the table management program **305** that is executed by another file server device **110** retrieve shared directory settings information from the storage characteristics information management table **500** of the other file server device **110**. The former table management program **305** incorporates the retrieved shared directory settings information, and then refers to the consolidated shared directory settings information.

This enables the directory settings management program **300** in one file server device **110** to refer to the storage characteristics information management table **500** of any other file server device **110** in the computer system by simply executing the table management program **305** that is stored in its own file server device **110**.

The file server device settings management program **304** is a program for changing settings information of programs that give the file server device **110** the function of providing a shared directory. The programs that give the file server device **110** the function of providing a shared directory include the file sharing server program **301**, the OS **302**, and others.

In case where the file server device settings management program **304** receives a request to change settings the file server device settings management program **304** responds to the request by adding, deleting, or changing the association relation between a shared directory address path name and a file system internal path name registered in the shared directory address settings information management table **510**. The file server device settings management program **304** then sends, to the file sharing server program **301** and the OS **302**, the changed settings of the association relation between a shared directory address path name and a file system internal path name registered in the shared directory address settings information management table **510**. The file server device settings management program **304** also sends the current settings information in response to a settings information inquiry made by another program.

The file migration program **303** migrates data from a migration source shared directory to a migration destination shared directory when the name of an internal path to the migration source shared directory and the name of an internal path to the migration destination shared directory are entered. In short, the file migration program **303** migrates data stored in shared directories on a shared directory basis. In a case where the migration destination of data in a shared directory is a shared directory that is provided by another file server device **110**, the file migration program **303** migrates the data across different file server devices **110**.

The directory settings management program **300** in this embodiment is activated when the file sharing server program **301** receives a request to write a file in a shared directory and the file written in the shared directory is judged as the directory settings file **200**.

Alternatively, the file sharing server program **301** may activate the directory settings management program **300** when writing of a new file is detected through monitoring of files that are stored in a shared directory. The file sharing server program **301** may also activate the directory settings management program **300** when an update of time stamp for registering the date/time of creation or modification of a file is detected through monitoring of the time stamp.

The file server device **110** may store a program that periodically monitors the file sharing server program **301**, the OS **302**, and files.

The directory settings management program **300** is activated, in some cases, as a result of a change in configuration of the computer system such as an addition of a new disk array device **120** or file server device **110**.

When the configuration of the computer system is changed, the file sharing server program **301** judges whether or not a shared directory provided by the file server device **110** is storing the directory settings file **200**. Judging that there is the directory settings file **200** in a shared directory provided by the file server device **110**, the file sharing server program **301** activates the directory settings management program **300**.

In this way, when the configuration of the computer system is changed, the directory settings file **200** that has already been in a shared directory can be detected again and the shared directory can be set anew according to the detected file.

FIG. 7 is a diagram showing a configuration of the shared directory address translation table **530** according to the embodiment of this invention.

The shared directory address translation table **530** holds a logical shared directory address path name **531** and a physical shared directory address **532**.

As the logical shared directory address path name **531**, a path name contained in the logical shared directory address **20** is registered. A physical shared directory address that is associated with the logical shared directory address path name **531** is registered as the physical shared directory address **532**. The physical shared directory address **532** is constituted by adding the name of the file server device **110** that provides a specified shared directory to a path name contained in the logical shared directory address **20**.

FIG. 8 is a diagram showing a configuration of the volume settings information management table **520** according to the embodiment of this invention.

The volume settings information management table **520** holds a volume ID **521**, a RAID type **522**, and hard disk drive device performance **523**.

Registered as the volume ID **521** is an identifier uniquely assigned to each volume **401** in the disk array device **120**. A RAID type set to the volume **401** is registered as the RAID type **522**. The performance of each hard disk drive device constituting the volume **401** is registered as the hard disk drive device performance **523**. Specifically, one of "low", "intermediate", and "high" is registered as the hard disk drive device performance **523**.

FIG. 9 is a diagram showing a configuration of the shared directory address settings information management table **510** according to the embodiment of this invention.

The shared directory address settings information management table **510** holds a shared directory address path name **511** and a shared directory internal path name **512**.

Registered as the shared directory address path name **511** is the name of a path to a shared directory. Registered as the shared directory internal path name **512** is the name of an internal path through which the file server device **110** that provides the shared directory accesses the shared directory. Specifically, the shared directory internal path name **512** is constituted by adding the name of a path to the volume **401** that holds a shared directory in question to the shared directory address path name **511**.

FIG. 10 is a diagram showing a configuration of the storage characteristics information management table **500** according to the embodiment of this invention.

The storage characteristics information management table **500** holds a file server device name **501**, an internal path name **502**, a volume ID **503**, a RAID type **504**, and hard disk drive device performance **505**.

Registered as the file server device name **501** is the name of the file server device **110**. The name of an internal path used by the file server device **110** to access the volume **401** is registered as the internal path name **502**.

A unique identifier assigned to the volume **401** in the file server device **110** is registered as the volume ID **503**. A RAID type set to the volume **401** is registered as the RAID type **504**. The performance of each hard disk drive device constituting the volume **401** is registered as the hard disk drive device performance **505**.

The storage characteristics information management table **500** in its initial state holds relevant information registered as the file server device name **501**, the internal path name **502**, and the volume ID **503**, whereas there is no information registered as the RAID type **504** and the hard disk drive device performance **505**.

The directory settings management program **300** causes the disk array device settings management program **320** to obtain, from the volume settings information management table **520**, settings information of the volume **401** that is identified by an identifier registered as the volume ID **503**. Specifically, the disk array device settings management program **320** fetches information registered as the RAID type **522** and the hard disk drive device performance **523**.

The directory settings management program **300** then causes the table management program **305** to register, as the RAID type **504** and the hard disk drive device performance **505**, the settings information obtained by the disk array device settings management program **320**.

The storage characteristics information management table **500** is updated by the table management program **305** each time the directory settings management program **300** changes settings information.

The computer system may have a computer for managing storage characteristics information of every volume **401** of each disk array device **120** in the computer system. In this case, to refer to the storage characteristics information management table **500**, the file server device **110** accesses the computer that manages storage characteristics information. The computer that manages the storage characteristics information management table **500** may be one of the file server devices **110**.

Described next is processing of changing settings information of a shared directory when the shared directory address translation table **530** stored in the GNS server device **130** is not changed.

A case will be described with reference to FIGS. 11 and 12 in which settings information of a shared directory is changed as a result of migrating information in the volume **401** where the shared directory is located to another volume **401** of the same file server device **110**.

FIG. 11 is a sequence diagram for a change of shared directory settings that accompanies volume-basis data migration within the same file server device **110** according to the embodiment of this invention.

FIG. 12 is a diagram illustrating the tables before and after a change of settings of a shared directory that accompanies volume-basis data migration within the same file server device **110** according to the embodiment of this invention.

A directory settings file **200a** shown in FIG. 12 is described in the same format as the directory settings file **200** shown in FIG. 3. The directory settings file **200a** describes a settings change to change the raidtype to "5" and the diskspec to "intermediate".

A shared directory address translation table **530a** shown in FIG. 12 has the same format as the shared directory address translation table **530** shown in FIG. 7.

Storage characteristics information management tables **500a** and **500b** shown in FIG. 12 have the same format as the storage characteristics information management table **500** shown in FIG. 10. The storage characteristics information management table **500a** is the storage characteristics information management table **500** before shared directory settings information is changed. The storage characteristics information management table **500b** is the storage characteristics information management table **500** after shared directory settings information is changed.

Shared directory address settings information management table **510a** and **510b** have the same format as the shared directory address settings information management table **510** shown in FIG. 9. The shared directory address settings information management table **510a** is the shared directory address settings information management table **510** before shared directory address settings information is changed. The shared directory address settings information management table **510b** is the shared directory address settings information management table **510** after shared directory address settings information is changed.

The directory settings file **200a** is written in a shared directory that has a path name `"/rdb"`. The directory settings file **200a** describes a settings change in which the RAID type of the volume **401** containing the shared directory that has a path name `"/rdb"` is changed to RAID5 and the hard disk drive performance of this volume **401** containing the shared directory that has a path name `"/rdb"` is changed to "intermediate".

The directory settings file **200a** is written by the user **1** operating the client computer **140**. The user **1** designates `"gns:/rdb"` as a shared directory address for the directory settings file **200a**.

The file sharing client program **340** sends a request to write the directory settings file **200a** to the GNS server device **130** that has a server device name `"gns"`.

Receiving the request to write the directory settings file **200a**, the GNS server device **130** activates the shared directory address translation program **330**. The shared directory address translation program **330** refers to the shared directory address translation table **530a**, and translates the logical shared directory address path name `"/rdb"` into a physical shared directory address `"nas1:/rdb"`.

Specifically, the shared directory address translation program **330** chooses from among entries registered in the shared directory address translation table **530** one whose logical shared directory address path name **531** matches the logical shared directory address path name `"/rdb"` contained in the received request to write the directory settings file **200a**. The shared directory address translation program **330** then translates the logical shared directory address path name `"/rdb"` contained in the received request to write the directory settings file **200a** into a physical shared directory address `"nas1:/rdb"` registered as the physical shared directory address **532** in the chosen entry.

The request to write the directory settings file **200a** is then forwarded by the access transfer program **331** to the file server device **110** that has a server device name `"nas1"`.

Receiving the request to write the directory settings file **200a**, the file server device **110** activates the file sharing server program **301**.

The file sharing server program **301** refers to the shared directory address settings information management table **510a**, and translates the physical shared directory address path name `"/rdb"` into an internal path name `"/fs3/rdb"`.

Specifically, the file sharing server program **301** chooses from among entries registered in the shared directory address settings information management table **510a** one whose shared directory address path name **511** matches the physical shared directory address path name `"/rdb"` of the received directory settings file **200a**. The file sharing server program **301** translates the physical shared directory address path name `"/rdb"` of the received directory settings file **200a** into an internal path name `"/fs3/rdb"` registered as the internal path name **512** in the chosen entry.

The file sharing server program **301** then uses the function of the OS **302** to write the directory settings file **200a** in a

shared directory that is located in the internal path name `"/fs3/rdb"` obtained through the translation.

After writing the directory settings file **200a** in the shared directory, the file sharing server program **301** enters an internal path name `"/fs3/rdb/nas.conf"` for the written directory settings file **200a** and activates the directory settings management program **300**.

Using the internal path name `"/fs3/rdb/nas.conf"` for the written directory settings file **200a**, the directory settings management program **300** loads the settings information described in the directory settings file **200a** onto the memory **170**.

The directory settings management program **300** next activates the table management program **305** to refer to the storage characteristics information management table **500**. The directory settings management program **300** judges whether or not the settings information described in the directory settings file **200a** coincides with the current settings information of the shared directory in which the directory settings file **200a** has just been written.

Specifically, the directory settings management program **300** chooses from among entries registered in the storage characteristics information management table **500** one whose internal path name **502** matches `"/fs3"` in the internal path name `"/fs3/rdb"` of the shared directory where the directory settings file **200a** is written. The directory settings management program **300** judges whether or not information registered as the RAID type **504** and the hard disk drive device performance **505** in the chosen entry matches the settings information described in the directory settings file **200a**.

Settings information described in the directory settings file **200a** and the current settings information of the shared directory where the directory settings file **200a** is written are not judged as a match when even one of information registered as the RAID type **504** and information registered as the hard disk drive device performance **505** does not match the settings information described in the directory settings file **200a**. When information registered as the RAID type **504** and information registered as the hard disk drive device performance **505** both match the settings information described in the directory settings file **200a**, settings information described in the directory settings file **200a** and the current settings information of the shared directory where the directory settings file **200a** is written are judged as a match.

In this example, an entry of the storage characteristics information management table **500** that has `"/fs3"` in the internal path name `"/fs3/rdb"` of the shared directory where the directory settings file **200a** is written has RAID1 as the RAID type **504** and `"intermediate"` as the hard disk drive device performance **505**.

On the other hand, the settings information described in the directory settings file **200a** has RAID5 for the raidtype and `"intermediate"` for the diskspec. While the hard disk drive device performance of the shared directory where the directory settings file **200a** is written matches the diskspec described in the directory settings file **200a**, the RAID type of the shared directory where the directory settings file **200a** is written does not match the raidtype described in the directory settings file **200a**.

It is therefore judged in this example that settings information described in the directory settings file **200a** does not match the current settings information of the shared directory where the directory settings file **200a** is written.

Next, the directory settings management program **300** activates the table management program **305** to have the table management program **305** search the storage characteristics information management table **500a** for an entry that has `"5"`

as the RAID type **504** and “intermediate” as the hard disk drive device performance **505**.

In this example, the entry that has “5” as the RAID type **504** and “intermediate” as the hard disk drive device performance **505** is one whose volume ID **503** is “vol5”. The table management program **305** chooses, as a migration destination candidate, this entry’s file server device name **501**, internal path name **502**, and volume ID **503**, which are “nas1”, “- -”, and “vol5”, respectively. The table management program **305** sends the obtained migration destination candidate to the directory settings management program **300**.

Receiving the migration destination candidate, the directory settings management table **300** judges whether or not the shared directory where the directory settings file **200a** is written and whose internal path name is “/fs3/rdb” is the uppermost directory in a volume **401a** where this shared directory is located and whose volume ID is “vol3”, in order to judge whether volume-basis data migration is possible or not.

In this example, the volume **401a** identified by the volume ID “vol3” only has data in the directory that has the internal path name “/fs3/rdb” and its underlying directories. It is therefore judged that the shared directory that has the internal path name “/fs3/rdb” is the uppermost directory in the volume **401a** identified by the volume ID “vol3”.

When the shared directory that has the internal path name “/fs3/rdb” is judged as the uppermost directory in the volume **401a** identified by the volume ID “vol3”, the directory settings management program **300** judges whether a volume **401b**, which is identified by the volume ID “vol5” and which is a migration destination candidate, is an unused volume **401** or not. Since the volume **401b**, which is identified by the volume ID “vol5” and which is a migration destination candidate, has “ ” as the internal path name **502** in this example, the migration destination candidate volume **401b** identified by the volume ID “vol5” is judged as an unused volume **401**.

The directory settings management program **300** next judges whether or not the migration destination candidate volume **401b** identified by the volume ID “vol5” is in the disk array device **120** connected to the file server device **110** where this directory settings management program **300** is being executed and whose server device name is “nas1”, in order to judge whether data migration between different file server devices **110** is unnecessary or not.

In this example, the migration destination candidate volume **401b** identified by the volume ID “vol5” has “nas1” as the file server device name **501**, and it is therefore judged that the migration destination candidate volume **401b** identified by the volume ID “vol5” is in the disk array device **120** connected to the file server device **110** where this directory settings management program **300** is being executed and whose server device name is “nas1”.

Then, in order to change the current settings information of the shared directory storing the directory settings file **200a** to the settings information described in the directory settings file **200a**, the directory settings management program **300** migrates, on a volume basis, data in the volume **401a** where the shared directory storing the directory settings file **200a** is located to the volume **401b**, which matches the settings information described in the directory settings file **200a**.

The directory settings management program **300** activates the disk array device control program **321** stored in the disk array device **120** to migrate data in the volume **401a** identified by the volume ID “vol3” to the volume **401b** identified by the volume ID “vol5”.

Once the disk array device control program **321** migrates data in the volume **401a** identified by the volume ID “vol3” to

the volume **401b** identified by the volume ID “vol5”, the shared directory in which the directory settings file **200a** is written is now located in the volume **401b** identified by the volume ID “vol5”.

The directory settings management program **300** then activates the file server device settings management program **304** to change the shared directory address settings information management table **510**.

Specifically, the file server device settings management program **304** picks up an entry, from the shared directory address settings information management table **510**, that has “/rdb” as the shared directory address path name **511**, and changes the internal path name **512** of this entry from “/fs3/rdb” to “/fs5/rdb”. An internal path name “/fs5” is the internal path name of the volume **401b** to which the shared directory migrates. The volume **401b** may have any other internal path name than “/fs5” as long as it is a valid path name.

After the disk array device control program **321** finishes migrating data in the volume **401a** identified by the volume ID “vol3” to the volume **401b** identified by the volume ID “vol5”, the volume **401a** identified by the volume ID “vol3” becomes a volume **401** that is out of use whereas the volume **401b** identified by the volume ID “vol5” becomes a volume that is in use. The directory settings management program **300** activates the table management program **305** to change the storage characteristics information management table **500** accordingly.

Specifically, the table management program **305** picks up an entry, from the storage characteristics information management table **500**, that has “vol3” as the volume ID **503**, and changes the internal path name **502** of this entry to “- -”. The table management program **305** also picks up an entry, from the storage characteristics information management table **500**, that has “vol5” as the volume ID **503**, and changes the internal path name **502** of this entry to “/fs5”.

In this way, data in the shared directory whose internal path name **502** is “/rdb” is migrated from the volume **401a** which is RAID1 to the volume **401b** which is RAID5. The user **1** can thus access the shared directory relocated to the volume **401b** by specifying the same shared directory address as the one that has been used prior to the settings change.

Details of the directory settings management program **300** will be described next with reference to FIGS. **13** to **18**.

FIG. **13** is a diagram illustrating processing of updating the storage characteristics information management table **500** according to the embodiment of this invention.

The directory settings management program **300** contains a directory settings file reading sub-program **600** and a settings changing processing activation sub-program **601**.

The directory settings file reading sub-program **600** loads onto the memory **170** shared directory settings information that is described in the directory settings file **200** stored in a shared directory. The directory settings file **200** loaded onto the memory **170** is located in an internal path name obtained through translation by the file sharing server program **301**.

The settings changing processing activation sub-program **601** executes settings changing processing for a device and a program that need a settings change according to the directory settings file **200** loaded onto the memory **170**.

The settings changing processing activation sub-program **601** refers to the storage characteristics information management table **500** to judge whether or not settings described in the directory settings file **200** coincide with the current shared directory settings.

Judging that settings described in the directory settings file **200** do not match the current shared directory settings, the settings changing processing activation sub-program **601**

chooses a device and a program that are necessary to make the current shared directory settings consistent with the settings described in the read directory settings file **200**, and performs settings changing processing on the chosen device and program.

The settings changing processing activation sub-program **601** does not execute settings changing processing when it is judged that settings described in the directory settings file **200** match the current shared directory settings.

The settings changing processing activation sub-program **601** has the table management program **305** search the storage characteristics information management table **500** for the name and internal path name of the file server device **110** that provides a shared directory whose settings match those described in the read directory settings file **200**.

The settings changing processing activation sub-program **601** thus chooses a device and a program that are necessary to make the current shared directory settings consistent with settings described in the read directory settings file **200**.

In the case where settings information in the directory settings file **200** that is entered upon activation of the settings changing processing activation sub-program **601** indicates execution of maintenance operation, the settings changing processing activation sub-program **601** skips the step of judging whether or not settings described in the directory settings file **200** match the current shared directory settings, and immediately executes settings changing processing.

After executing setting changing processing, the settings changing processing activation sub-program **601** has the table management program **305** change the storage characteristics information management table **500** according to the storage characteristics information changed through the settings changing processing.

FIG. **14** is a flow chart of the directory settings file reading sub-program **600** according to the embodiment of this invention.

The directory settings file reading sub-program **600** judges whether a file stored in a shared directory is the directory settings file **200** or not (Step **701**). Specifically, the directory settings file reading sub-program **600** judges whether the name of a file stored in a shared directory is "nas.conf" or not.

The directory settings file reading sub-program **600** terminates the processing when it is judged that the file stored in the shared directory is not the directory settings file **200**.

When the file stored in the shared directory is judged as the directory settings file **200**, the directory settings file reading sub-program **600** loads onto the memory **170** settings information that the directory settings file **200** stored in the shared directory describes (Step **702**).

The directory settings file reading sub-program **600** then activates the settings changing processing activation sub-program **601** (Step **703**), and ends the processing.

FIG. **15** is a flow chart of the settings changing processing activation sub-program **601** according to the embodiment of this invention.

The settings changing processing activation sub-program **601** first judges whether or not settings information described in the read directory settings file **200** indicates execution of maintenance operation (Step **710**).

Judging that the settings information described in the read directory settings file **200** indicates execution of maintenance operation, the settings changing processing activation sub-program **601** activates a program that executes the maintenance operation specified by the directory settings file **200** (Step **720**), and terminates the processing.

Judging that the settings information described in the read directory settings file **200** does not indicate execution of

maintenance operation, the settings changing processing activation sub-program **601** obtains the name of an internal path to a shared directory storing the directory settings file **200** (Step **711**). In other words, the settings changing processing activation sub-program **601** obtains the internal path name of a shared directory on which settings changing processing is to be performed.

The settings changing processing activation sub-program **601** next obtains, from the internal path name of the shared directory storing the directory settings file **200** that has been obtained through the processing of Step **711**, the name of an internal path to the volume **401** storing the directory settings file **200** (Step **712**).

The settings changing processing activation sub-program **601** has the table management program **305** retrieve from the storage characteristics information management table **500** characteristics information of the volume **401** whose internal path name has been obtained through the processing of Step **712** (Step **713**).

Specifically, the table management program **305** picks up an entry from the storage characteristics information management table **500** whose internal path name **502** matches the internal path name of the volume **401** that has been obtained through the processing of Step **712**, and extracts information registered as the RAID type **504** and the hard disk drive device performance **505** from this entry. The table management program **305** sends the extracted information of the RAID type **504** and the hard disk drive device performance **505** to the settings changing processing activation sub-program **601** as characteristics information of the volume **401** that contains the shared directory storing the directory settings file **200**.

The settings changing processing activation sub-program **601** next judges whether or not settings information described in the directory settings file **200** coincides with settings information of the shared directory storing the directory settings file **200** (Step **714**).

When the settings information described in the directory settings file **200** and the settings information of the shared directory storing the directory settings file **200** are judged as a match, there is no need to execute settings changing processing. The settings changing processing activation sub-program **601** accordingly terminates the processing.

When it is judged that the settings information described in the directory settings file **200** does not coincide with the settings information of the shared directory storing the directory settings file **200**, the settings changing processing activation sub-program **601** has the table management program **305** search the storage characteristics information management table **500** for a migration destination candidate, which is the volume **401** whose settings information matches the settings described in the directory settings file **200** (Step **715**).

Specifically, the table management program **305** picks up an entry from the storage characteristics information management table **500** whose RAID type **504** and hard disk drive device performance **505** match the raidtype information and diskspec information described in the directory settings file **200**, respectively. The settings changing processing activation sub-program **601** extracts from this entry the file server device name **501**, the internal path name **502**, and the volume ID **503**, which respectively indicate an identifier assigned to the file server device **110**, the name of an internal path to the volume **401**, and an identifier assigned to the volume **401**. The table management program **305** sends the extracted information as a migration destination candidate to the settings changing processing activation sub-program **601**.

The settings changing processing activation sub-program 601 judges whether or not the migration destination candidate obtained through the processing of Step 715 actually exists (Step 716).

When it is judged that the migration destination candidate obtained through the processing of Step 715 does not exist, the settings of the shared directory storing the directory settings file 200 cannot be changed. The settings changing processing activation sub-program 601 therefore terminates the processing.

When it is judged that the migration destination candidate obtained through the processing of Step 715 actually exists, the settings changing processing activation sub-program 601 executes settings changing processing with the path name of the shared directory whose settings are to be changed and the migration destination candidate as arguments (Step 717), and then ends the processing. The settings changing processing will be described in detail with reference to FIG. 16.

FIG. 16 is a flow chart of the setting changing processing 717 executed by the settings changing processing activation sub-program 601 according to the embodiment of this invention.

The settings changing processing activation sub-program 601 judges whether or not the shared directory whose settings are to be changed is the uppermost directory in the volume 401 where this shared directory is located (Step 731).

When it is judged in the processing of Step 731 that the shared directory whose settings are to be changed is not the uppermost directory in the volume 401 where this shared directory is located, it means that the volume 401 has other directories in the same layer as the shared directory whose settings are to be changed.

Then the settings changing processing activation sub-program 601 cannot migrate, on a volume 401 basis, data stored in the volume 401 that contains the shared directory whose settings are to be changed to the volume 401 that matches the settings information described in the directory settings file 200. The settings changing processing activation sub-program 601 accordingly migrates the data on a directory basis (Step 734). The processing of Step 734 will be described in detail with reference to FIG. 18.

When it is judged in the processing of Step 731 that the shared directory whose settings are to be changed is the uppermost directory in the volume 401 where this shared directory is located, the settings changing processing activation sub-program 601 judges whether or not any volume 401 chosen as a migration destination candidate through the processing of Step 715 is an unused volume (Step 732).

Specifically, the settings changing processing activation sub-program 601 judges whether or not information extracted as a migration destination candidate through the processing of Step 715 contains an internal path name “-”.

When it is judged in the processing of Step 732 that no volume 401 chosen as a migration destination candidate is an unused volume, the settings changing processing activation sub-program 601 migrates on to processing of Step 734.

When it is judged in the processing of Step 732 that at least one volume 401 chosen as a migration destination candidate is an unused volume, the settings changing processing activation sub-program 601 performs volume-basis migration in which the volume 401 containing the shared directory whose settings are to be changed is migrated to the migration destination candidate volume 401 (Step 733). The processing of Step 733 will be described in detail with reference to FIG. 17.

The settings information of the shared directory storing the directory settings file 200 is thus changed to the settings information described in the directory settings file 200.

The settings changing processing activation sub-program 601 then returns the changed settings of the shared directory storing the directory settings file 200 (Step 735).

FIG. 17 is a flow chart of the volume-basis data migration processing 733 executed by the settings changing processing activation sub-program 601 according to the embodiment of this invention.

The settings changing processing activation sub-program 601 judges whether or not any volume 401 chosen as a migration destination candidate through the processing of Step 715 belongs to the file server device 110 that is executing this settings changing processing activation sub-program 601 (Step 740).

Specifically, the settings changing processing activation sub-program 601 judges whether or not information extracted as a migration destination candidate through the processing of Step 715 contains the name of the file server device 110 that is executing this settings changing processing activation sub-program 601.

When it is judged that no volume 401 chosen as a migration destination candidate through the processing of Step 715 belongs to the file server device 110 where this settings changing processing activation sub-program 601 is run, the settings changing processing activation sub-program 601 executes the processing of Step 751 to Step 756. The processing of Step 751 to Step 756 will be described in detail in a modification example of this embodiment.

When it is judged that at least one volume 401 chosen as a migration destination candidate through the processing of Step 715 belongs to the file server device 110 where this settings changing processing activation sub-program 601 is run, the settings changing processing activation sub-program 601 executes processing of Step S741 to Step 745. The processing of Step 741 to Step 745 corresponds to the one described in FIGS. 11 and 12.

The settings changing processing activation sub-program 601 removes, from the migration destination candidate entries, any entry that does not have the name of the file server device 110 running this settings changing processing activation sub-program 601 as the file server device name 501 (Step 741).

From the remaining migration destination candidate entries, the settings changing processing activation sub-program 601 selects entries that hold identifiers assigned to the volumes 401 that are not in use. The settings changing processing activation sub-program 601 chooses, as a migration destination volume, the volume 401 identified by a volume identifier that is held by the top entry among the selected entries (Step 742).

Instead of the volume 401 that is indicated by the top migration destination candidate entry, the settings changing processing activation sub-program 601 may choose as a migration destination volume the volume 401 whose capacity is the largest, yet the closest to the capacity of the migration source volume 401 in the candidate volumes 401.

Alternatively, the settings changing processing activation sub-program 601 may choose as a migration destination volume the volume 401 constituted of the hard disk drive device 400 that belongs to the same array group as the hard disk drive device 400 constituting the migration source volume 401.

In the case where the load characteristics of the respective volumes 401 are under monitoring, the choice of migration destination volume may be made based on the load characteristics of the volumes 401.

The settings changing processing activation sub-program 601 next sends a request to migrate information stored in every directory in the migration source volume 401 to the

chosen migration destination volume **401** to the disk array device control program **321** in the disk array device **120** connected to the file server device **110** (Step **743**).

The settings changing processing activation sub-program **601** sends a request to update the shared directory address settings information management table **510** to the file server device settings management program **304** (Step **744**).

Receiving the request to update the shared directory address settings information management table **510** from the settings changing processing activation sub-program **601**, the file server device settings management program **304** chooses an entry, from the shared directory address settings information management table **510**, whose shared directory address path name **511** matches the path name of the directory that has been migrated from the migration source volume **401** to the chosen migration destination volume **401**.

The file server device settings management program **304** extracts the internal path name of the volume **401** from an internal path name registered as the internal path name **512** in the chosen entry, and changes the extracted volume internal path name to the internal path name of the volume **401** chosen as the migration destination volume.

The settings changing processing activation sub-program **601** next sends a request to update the storage characteristics information management table **500** to the table management program **305** (Step **745**).

Receiving the request to update the storage characteristics information management table **500**, the table management program **305** chooses an entry, from the storage characteristics information management table **500**, whose volume ID **503** matches the identifier of the migration source volume **401**.

The table management program **305** changes a path name currently registered as the internal path name **502** in the chosen entry to “-”.

The table management program **305** also chooses from the storage characteristics information management table **500** an entry whose volume ID **503** matches the identifier of the volume **401** chosen as the migration destination volume.

The table management program **305** changes “-”, which is currently registered as the internal path name **502** in the chosen entry, to the internal path name of the migration destination volume.

The settings changing processing activation sub-program **601** returns the changed settings of the shared directory storing the directory settings file **200** (Step **746**).

FIG. **18** is a flow chart of the directory-basis data migration processing **734** executed by the settings changing processing activation sub-program **601** according to the embodiment of this invention.

The settings changing processing activation sub-program **601** first judges whether or not any volume **401** chosen as a migration destination candidate through the processing of Step **715** belongs to the file server device **110** that is executing this settings changing processing activation sub-program **601** (Step **760**). The processing of Step **760** is the same as the processing of Step **740**, and a specific description thereof will be omitted.

When it is judged that no volume **401** chosen as a migration destination candidate through the processing of **S715** belongs to the file server device **110** where this settings changing processing activation sub-program **601** is run, the settings changing processing activation sub-program **601** executes the processing of Step **771** to Step **775**. The processing of Step **771** to Step **775** will be described in a modification example of this embodiment. The processing of Step **771** to Step **775** will be described with reference to FIGS. **19** and **20**.

When it is judged that at least one volume **401** chosen as a migration destination candidate through the processing of **S715** belongs to the file server device **110** where this settings changing processing activation sub-program **601** is run, the settings changing processing activation sub-program **601** executes processing of Step **S761** to Step **764**.

The settings changing processing activation sub-program **601** removes, from the migration destination candidate entries, any entry that does not have the name of the file server device **110** running this settings changing processing activation sub-program **601** as the file server device name **501** (Step **761**).

The settings changing processing activation sub-program **601** chooses, as a migration destination volume, the volume **401** identified by a volume identifier that is held by the top entry among the selected entries (Step **762**). In the case where the volume **401** chosen as the migration destination volume is an unused volume, this volume is formatted.

As in the processing of Step **742**, the settings changing processing activation sub-program **601** may choose as a migration destination volume the volume **401** whose capacity is the largest than the capacity of the volume **401** out of which the shared directory is migrated and closer thereto than to any other candidate volumes **401**, instead of the volume **401** that is indicated by the top migration destination candidate entry.

Alternatively, the settings changing processing activation sub-program **601** may choose as a migration destination volume the volume **401** constituted of the hard disk drive volume **400** that belongs to the same array group as the hard disk drive device **400** constituting the volume **401** out of which the shared directory is migrated.

In the case where the load characteristics of the respective volumes **401** are under monitoring, the choice of migration destination volume may be made based on the load characteristics of the volumes **401**.

The settings changing processing activation sub-program **601** next sends a request to migrate the shared directory storing the directory settings file **200** to the volume **401** chosen as the migration destination volume to the file migration program **303** (Step **763**).

The settings changing processing activation sub-program **601** sends a request to change settings in the shared directory address settings information management table **510** to the file server device settings management program **304** (Step **764**).

Receiving the request to change settings in the shared directory address settings information management table **510** from the settings changing processing activation sub-program **601**, the file server device settings management program **304** chooses an entry from the shared directory address settings information management table **510** whose shared directory address path name **511** matches the path name of the shared directory to be relocated.

The file server device settings management program **304** extracts the internal path name of the volume **401** from an internal path name registered as the internal path name **512** in the chosen entry, and changes the extracted volume internal path name to the internal path name of the volume **401** chosen as the migration destination volume.

The settings changing processing activation sub-program **601** returns the changed settings of the shared directory storing the directory settings file **200** (Step **765**).

A modification example of this embodiment will be described next.

In the modification example of this embodiment, the shared directory address translation table **530** stored in the GNS server device **130** is changed when settings information of a shared directory is changed.

A description will be given with reference to FIGS. 19 and 20 on processing of changing shared directory settings information as a result of migration of information from a shared directory of one file server device 110 to the volume 401 in the disk array device 120 connected to another file server device 110.

FIG. 19 is a sequence diagram for processing of changing shared directory settings information by migrating information from a shared directory of one file server device 110 to the volume 401 in the disk array device 120 that is connected to another file server device 110 according to the modification example of this embodiment.

FIG. 20 is describing respective tables before and after changing shared directory settings information by migrating information from a shared directory of one file server device 110 to the volume 401 in the disk array device 120 that is connected to another file server device 110 according to the modification example of this embodiment.

The description given here with reference to FIG. 19 omits any mention of hardware, and a mention of programs run by disk array devices 120X and 120Y that do not participate in the processing of changing shared directory settings information as a result of migration of information from a shared directory of one file server device 110 to the volume 401 in the disk array device 120 connected to another file server device 110.

A file server device 110X is the file server device 110 that provides a migration source shared directory, and a file server device 110Y is the file server device 110 that provides a migration destination shared directory.

A directory settings management program 300X, a file sharing server program 301X, an OS 302X, a file migration program 303X, a file server device settings management program 304X, and a table management program 305X are programs run by the file server device 110X, which provides the migration source shared directory.

A storage characteristics information management table 500X and a shared directory address settings information management table 510X are tables loaded onto the memory 170 that is in the file server device 110X, which provides the migration source shared directory.

A directory settings management program 300Y, a file sharing server program 301Y, an OS 302Y, a file migration program 303Y, a file server device settings management program 304Y, and a table management program 305Y are programs run by the file server device 110Y, which provides the migration destination shared directory.

A storage characteristics information management table 500Y and a shared directory address settings information management table 510Y are tables loaded onto the memory 170 that is in the file server device 110Y, which provides the migration destination shared directory.

A directory settings file 200c shown in FIG. 20 is described in the same format as the directory settings file 200 shown in FIG. 3. The directory settings file 200c describes a settings change to change the raidtype to "1" and the diskspec to "high".

A storage characteristics information management table 500c shown in FIG. 20 has the same format as the storage characteristics information management table 500 shown in FIG. 10. The storage characteristics information management table 500c is the storage characteristics information management table 500 before shared directory settings information is changed. Shared directory address settings information management tables 510Xc, 510Xd, 510Yc, and 510Yd shown in FIG. 20 have the same format as the shared directory address settings information management table 510 shown in FIG. 9.

The shared directory address settings information management table 510Xc is the shared directory address settings information management table 510 that is loaded onto the memory 170 in the file server device 110X, which provides the migration source shared directory, before shared directory address settings information is changed. The shared directory address settings information management table 510Xd is the shared directory address settings information management table 510 that is loaded onto the memory 170 in the file server device 110X, which provides the migration source shared directory, after shared directory address settings information is changed.

The shared directory address settings information management table 510Yc is the shared directory address settings information management table 510 that is loaded onto the memory 170 in the file server device 110Y, which provides the migration destination shared directory, before shared directory address settings information is changed. The shared directory address settings information management table 510Yd is the shared directory address settings information management table 510 that is loaded onto the memory 170 in the file server device 110Y, which provides the migration destination shared directory, after shared directory address settings information is changed.

The directory settings file 200c is a request to change settings of a shared directory located at a shared directory address "nas1:/rdb" such that the RAID type is RAID1 and the hard disk drive device performance is "high".

In FIGS. 19 and 20, a volume that matches settings information described in the directory settings file 200c is found outside of the file server device 110X, namely, in the file server device 110Y, and shared directory in which the directory settings file 200c is written is not the uppermost directory in a volume 401X of the file server device 110X. The shared directory in which the directory settings file 200c is written is therefore migrated from the volume 401X to a volume 401Y on a directory basis.

The directory settings file 200c is described by the user 1 operating the client computer 140. The user 1 designates "gns:/rdb/index" as the shared directory address of the shared directory in which the directory settings file 200c is written.

The file sharing client program 340 sends a request to write the directory settings file 200c to the GNS server device 130 that has a server device name "gns".

Receiving the request to write the directory settings file 200c, the GNS server device 130 activates the shared directory address translation program 330. The shared directory address translation program 330 refers to the shared directory address translation table 530, and translates the logical shared directory address path name "/rdb/index" into a physical shared directory address "nas1:/rdb/index".

Specifically, the shared directory address translation program 330 chooses from among entries registered in the shared directory address translation table 530 one whose logical shared directory address path name 531 matches "/rdb" in the logical shared directory address path name contained in the received request to write the directory settings file 200c. The shared directory address translation program 330 then translates the logical shared directory address path name "/rdb/index" contained in the received shared directory writing request into a physical shared directory address "nas1:/rdb/index" registered as the physical shared directory address 532 in the chosen entry.

The request to write the directory settings file 200c is then forwarded by the access transfer program 331 to the file server device 110X, which has a server device name "nas1".

Receiving the request to write the directory settings file **200c**, the file server device **110X** activates the file sharing server program **301X**.

The file sharing server program **301X** refers to the shared directory address settings information management table **510X**, and translates the physical shared directory address path name “/rdb/index” into an internal path name “/fs3/rdb/index”. A specific description on the translation has been given above with reference to FIG. **11**, and will not be repeated here.

The file sharing server program **301X** then uses the function of the OS **302X** to write the directory settings file **200c** in a shared directory that is located in the internal path name “/fs3/rdb/index” obtained through the translation.

After writing the directory settings file **200c** in the shared directory, the file sharing server program **301X** enters an internal path name “/fs3/rdb/index/nas.conf” for the written directory settings file **200c** and activates the directory settings management program **300X**.

Based on the internal path name “/fs3/rdb/index/nas.conf” for the written directory settings file **200c**, the directory settings management program **300X** loads the settings information described in the directory settings file **200c** onto the memory **170**.

The directory settings management program **300X** next activates the table management program **305X** to refer to the storage characteristics information management table **500X**. The directory settings management program **300X** judges whether or not the settings information described in the directory settings file **200c** coincides with the current settings information of the shared directory in which the directory settings file **200c** has just been written. A specific description on the judging process has been given above with reference to FIG. **11**, and will not be repeated here.

In this example, an entry of the storage characteristics information management table **500X** that has “fs3” in the internal path name “/fs3/rdb/index” of the shared directory where the directory settings file **200c** is written has RAID1 as the RAID type **504** and “intermediate” as the hard disk drive device performance **505**.

On the other hand, the settings information described in the directory settings file **200c** has RAID1 for the raidtype and “high” for the diskspec. While the RAID type of the shared directory where the directory settings file **200c** is written matches the raidtype described in the directory settings file **200c**, the hard disk drive device performance of the shared directory where the directory settings file **200c** is written does not match the diskspec described in the directory settings file **200c**.

It is therefore judged in this example that settings information described in the directory settings file **200c** does not match the current settings information of the shared directory where the directory settings file **200c** is written.

Next, the directory settings management program **300X** activates the table management program **305X** to have the table management program **305X** search the storage characteristics information management table **500X** for a volume **401** which matches the settings information described in the directory settings file **200c**.

In this example, the entry that has “1” as the RAID type **504** and “high” as the hard disk drive device performance **505** is one whose volume ID **503** is “vol7”. The table management program **305X** chooses, as a migration destination candidate, this entry’s file server device name **501**, internal path name **502**, and volume ID **503**, which are “nas2”, “/fs7”, and “vol7”, respectively. The table management program **305X**

sends the obtained migration destination candidate to the directory settings management program **300X**.

Receiving the migration destination candidate, the directory settings management table **300X** judges whether or not the shared directory where the directory settings file **200c** is written and whose internal path name is “/fs3/rdb/index” is the uppermost directory in the volume **401X** where this shared directory is located and whose volume ID is “vol3”, in order to judge whether volume-basis data migration is possible or not.

In this example, the volume **401X** identified by the volume ID “vol3” has a directory that has an internal path name “/fs3/rdb” as a directory upstream of the directory that has the internal path name “/fs3/rdb/index”. It is therefore judged that the directory that has the internal path name “/fs3/rdb/index” is not the uppermost directory in the volume **401X** identified by the volume ID “vol3”.

Accordingly, the settings information of the shared directory in which the directory settings file **200c** is written is changed through directory-basis data migration.

The directory settings management program **300X** next judges whether or not the migration destination candidate volume **401Y** identified by the volume ID “vol7” is in a disk array device **120X** connected to the file server device **110X** where this directory settings management program **300X** is being executed and whose server device name is “nas1”, in order to judge whether data migration between different file server devices **110** is unnecessary or not.

In this example, the migration destination candidate volume **401Y** identified by the volume ID “vol7” has “nas2” as the file server device name **501**, and it is therefore judged that the migration destination candidate volume **401Y** identified by the volume ID “vol7” is not in the disk array device **120X** connected to the file server device **110X** where this directory settings management program **300X** is being executed and whose server device name is “nas1”.

Then, in order to change the current settings information of the shared directory where the directory settings file **200c** is written to the settings information described in the directory settings file **200c**, the directory settings management program **300X** performs directory-basis migration and migrates the shared directory where the directory settings file **200c** is written from the file server device **110X**, which is identified by the server device name “nas1”, to the file server device **110Y**, which is identified by the server device name “nas2”.

The directory settings management program **300X** activates the file migration program **303X** to migrate the shared directory where the directory settings file **200c** is written to the volume **401Y** identified by the volume ID “vol7”. The path name “/fs3/rdb/index” of the shared directory in which the directory settings file **200c** is written and the path name “nas2:/fs3” of the migration destination volume **401Y** are entered in the file migration program **303X**.

Once the shared directory where the directory settings file **200c** is written is migrated to the volume **401Y** identified by the volume ID “vol7”, the internal path name of the shared directory in which the directory settings file **200c** is written is changed from “/fs3/rdb/index” to “/fs7/rdb/index”.

The directory settings management program **300X** accordingly activates the file server device settings management program **304Y** in the file server device **110Y** to add the association relation between the shared directory address path name “/rdb/index” and the internal path name “/fs7/rdb/index” to the shared directory address settings information management table **510Yc**.

After the shared directory where the directory settings file **200c** is written is migrated to the volume **401Y** identified by

the volume ID “vol7”, the physical shared directory address of the shared directory in which the directory settings file **200c** is written is changed from “nas1:/rdb/index” to “nas2:/rdb/index”.

The directory settings management program **300X** accordingly activates the shared directory address translation information management program **332** in the GNS server device **130** to add the association relation between the logical shared directory address path name “/rdb/index” and the physical shared directory address “nas2:/rdb/index” to a shared directory address translation table **530c**.

The shared directory address translation table **530** after the shared directory migration is a shared directory address translation table **530d** shown in FIG. **20**. The shared directory address settings information management table **510** that is stored in the file server device **110X** after the relocation of the shared directory is the shared directory address settings information management table **510Xd** shown in FIG. **20**. The shared directory address settings information management table **510** that is stored in the file server device **110Y** after the migration of the shared directory is the shared directory address settings information management table **510Yd** shown in FIG. **20**.

In this way, the shared directory is migrated from the volume **401X** whose hard disk drive device performance is “intermediate” to the volume **401Y** whose hard disk drive device performance is “high”. The shared directory address translation table **530** and the shared directory address settings information management table **510** that need a settings change are set to post-shared directory migration settings after the migration of the shared directory is finished. The user **1** can thus access the shared directory migrated to the volume **401Y** by specifying the same shared directory address that has been used prior to the settings change.

Described next are the flow charts of FIGS. **17** and **18** which illustrate a case in which the shared directory address translation table **530** stored in the GNS server device **130** is changed after a settings change of a shared directory where the directory settings file **200** is written. A description on the same processing as the one in the above-mentioned embodiment will be omitted here.

The shared directory address translation table **530** stored in the GNS server device **130** is changed when a shared directory in which the directory settings file **200** is written is migrated from the file server device **110** that provides this shared directory where the directory settings file **200** is written to another file server device **110**.

The processing of Step **751** to Step **756** in FIG. **17** will be described first.

The settings changing processing activation sub-program **601** executes the processing of Step **751** when it is judged in the processing of Step **740** that no volume **401** chosen as a migration destination candidate through the processing of Step **715** belongs to the file server device **110** that is running this settings changing processing activation sub-program **601**. The processing of Step **751** is the same as the processing of Step **742**, and the description will not be repeated.

The settings changing processing activation sub-program **601** sends, to the disk array device control program **321** in the disk array device **120** that contains the volume **401** chosen through the processing of Step **751** as the migration destination volume, a request to migrate information stored in every directory in the migration source volume **401** to the chosen migration destination volume **401** (Step **752**).

After the disk array device control program **321** finishes migrating information that is stored in every directory in the migration source volume **401** to the volume **401** chosen as the

migration destination volume, the settings changing processing activation sub-program **601** causes the file server device **110** that is connected to the disk array device **120** containing the chosen migration destination volume **401** (hereinafter referred to as migration destination file server device **110**) to activate the file server device settings management program **304**.

The settings changing processing activation sub-program **601** sends, to the activated file server device settings management program **304**, a request to update the shared directory address settings information management table **510** loaded onto the memory **170** in the migration destination file server device **110** (Step **753**). For details of this processing, see the description given above on the processing of Step **744**.

The settings changing processing activation sub-program **601** then has the GNS server device **130** activate the shared directory address translation information management program **332**.

The settings changing processing activation sub-program **601** sends a request to update the shared directory address translation table **530** to the activated shared directory address translation information management program **332** (Step **754**).

Specifically, the shared directory address translation information management program **332** chooses, from among entries registered in the shared directory address translation table **530**, one whose logical shared directory address path name **531** matches a part of the internal path name of a shared directory in the chosen migration destination volume **401** that remains after a path name indicating the volume **401** is removed.

The shared directory address translation information management program **332** extracts a server device name from a physical shared directory address contained in the chosen entry, and changes the extracted server device name to a server device name that indicates the migration destination file server device **110**.

The settings changing processing activation sub-program **601** next causes the file server device **110** that is connected to the disk array device **120** containing the migration source volume **401** (hereinafter referred to as migration source file server device **110**) to activate the file server device settings management program **304**.

The settings changing processing activation sub-program **601** sends a request to update the shared directory address translation table **530** to the activated file server device settings management program **304** (Step **755**). For details of this processing, see the description given above on the processing of Step **744**.

The settings changing processing activation sub-program **601** next causes the migration source file server device **110** and the migration destination file server device **110** to activate their respective table management programs **305**.

The settings changing processing activation sub-program **601** sends a request to update the storage characteristics information management table **500** to each activated table management program **305** (Step **756**). For details of this processing, see the description given above on the processing of Step **745**.

Processing of Step **771** to Step **775** in the flow chart of FIG. **18** will be described next.

The settings changing processing activation sub-program **601** executes the processing of Step **771** when it is judged in the processing of Step **760** that no volume **401** chosen through the processing of Step **715** as a migration destination candidate belongs to the file server device **110** that is running this settings changing processing activation sub-program **601**.

The processing of Step 771 is the same as the processing of Step 762, and the description will not be repeated.

The settings changing processing activation sub-program 601 then causes the migration source file server device 110 to activate the file migration program 303. The settings changing processing activation sub-program 601 sends, to the activated file migration program 303, a request to migrate the shared directory where the directory settings file 200 is stored to the volume 401 chosen as the migration destination volume (Step 772).

The settings changing processing activation sub-program 601 then causes the GNS server device 130 to activate the shared directory address translation information management program 332.

The settings changing processing activation sub-program 601 sends a request to update the shared directory address translation table 530 to the activated shared directory address translation information management program 332 (Step 773). For details of this processing, see the description given above on the processing of Step 754.

The settings changing processing activation sub-program 601 then causes the migration destination file server device 110 to activate the file server device settings management program 304.

The settings changing processing activation sub-program 601 sends, to the activated file server device settings management program 304, a request to update the shared directory address settings information management table 510 loaded onto the memory 170 in the migration destination file server device 110 (Step 774). For details of this processing, see the description given above on the processing of Step 744.

The settings changing processing activation sub-program 601 then causes the migration source file server device 110 to activate the file server device settings management program 304.

The settings changing processing activation sub-program 601 sends, to the activated file server device settings management program 304, a request to update the shared directory address translation table 530 (Step 775). For details of this processing, see the description given above on the processing of Step 744.

Described next are application examples of this invention.

A first application example relates to operation of setting the same settings to different shared directories.

According to this application example, the user 1 who wishes to set the same settings to different shared directories writes, in one shared directory, the directory settings file 200 that describes settings information to be set. The user 1 then makes copies of the directory settings file 200 written in this shared directory, and writes the copies of the directory settings file 200 in shared directories that are to have the same settings as this shared directory. In this way, multiple shared directories are simultaneously changed to have the same storage characteristics.

The user 1 does not need to include in the directory settings file 200 an explicit description about which shared directory is to be set, but a shared directory in which the directory settings file 200 is automatically deemed as a shared directory to be set. This enables the user 1 to set the same settings to different shared directories by simply making copies of the directory settings file 200 and writing the copies in shared directories that the user 1 wishes to have the same settings.

A second application example relates to operation of setting directories concurrently with installation of software.

Software installation and directory setting are executed separately in the prior art. This application example makes simultaneous software installation and directory setting possible.

Specifically, an installer program contained in software to be installed creates directories for storing programs, data files, and others that are necessary to execute the software, and also writes the directory settings file 200 of this application example in the created directories.

When the installer program creates a directory and writes the directory settings file 200 in the created directory, directory settings changing processing is executed. This makes it possible to, for example, set a directory that stores a program and a directory that stores data to their respective optimum storage characteristics.

A third application example relates to operation of changing, upon addition of a new file server device 110 to the computer system, shared directory settings to settings information described in the directory settings file 200 that has already been written in a shared directory.

In some cases, a shared directory in which the directory settings file 200 is written is left unchanged from the former settings information instead of being set to settings information described in the directory settings file 200.

For that reason, when a new file server device 110 is added to the computer system, the directory settings file 200 that has already been written in a shared directory is read and shared directory settings changing processing is executed again to make the settings of this shared directory consistent with settings information described in the directory settings file 200.

According to this application example, shared directory settings changing processing is executed again when a new file server device 110 is added subsequently. In this way, in some cases, settings information of a shared directory that has failed to be changed to settings information described in the directory settings file 200 prior to an addition of a new file server device 110 can be set to the settings information described in the directory settings file 200. A specific procedure of the operation will be described below.

When the shared directory settings changing processing is executed, the directory settings management program 300 first determines whether to execute shared directory settings changing processing. When execution of shared directory settings changing processing is not going to make settings information of a shared directory consistent with settings information described in the directory settings file 200, the directory settings management program 300 terminates the processing without executing the shared directory settings changing processing.

Upon addition of a new file server device 110 to the computer system, the directory settings management program 300 refers to storage characteristics information of a volume in the disk array device 120 that is connected to the added file server device 110.

The directory settings management program 300 judges whether or not the storage characteristics information of the added volume matches the settings information described in the directory settings file 200.

Judging that the storage characteristics information of the added volume matches the settings information described in the directory settings file 200, the directory settings management program 300 changes settings of a shared directory in which this directory settings file 200 has been written.

An administrator of the computer system operates the file sharing server program 301 to activate the directory settings management program 300 and to cause the directory settings

management program **300** to process the directory settings file **200** stored in the shared directory that is provided by the existing file server device **110**.

The directory settings management program **300** executes the same settings changing processing as the one that is executed in case that the directory settings file **200** is written. The settings changing processing as requested by the user **1** is completed in a case where the settings information described in the directory settings file **200** does not match the current settings information of the shared directory and in a case where the addition of the new file server device **110** creates a volume that matches the settings information described in the directory settings file **200**.

According to this application example, the user **1** can change shared directory settings information without writing in the directory settings file **200** the shared directory address of a shared directory whose settings information is to be changed. Setting wrong settings information in a shared directory can thus be prevented.

This application example also enables the user **1** to reuse settings information described in the directory settings file **200** that is stored in one directory by writing the directory settings file **200** in another directory. Further, in a computer system that has the GNS server device **130**, the user **1** can change shared directory settings information without the knowledge of what physical shared directory address the file server device **110** has.

While the present invention has been described in detail and pictorially in the accompanying drawings, the present invention is not limited to such detail but covers various obvious modifications and equivalent arrangements, which fall within the purview of the appended claims.

What is claimed is:

1. A method for changing settings information of a shared directory in a computer system comprising at least one file server device, a client computer and a storage system, the settings information of the shared directory provided by the file server device, the file server device being accessible from the client computer, the storage system being accessible from the file server device, the client computer having a first processor, which performs computation processing, a first storage unit, which is coupled to the first processor, and a first interface, which is coupled to the first processor, the file server device having a second processor, which performs computation processing, a second storage unit, which is coupled to the second processor, and a second interface, which is coupled to the second processor, the storage system having a third processor, which performs computation processing, a third interface, which is coupled to the third processor, and a third storage unit in which at least one volume including a storage area, the method comprising:
 sending, by the first processor, a write request to the file server device via the first interface and the second interface in order to request to write, in the shared directory whose settings information is to be changed, a directory settings file that describes new settings information for this shared directory;
 storing, in the second storage unit storage characteristics information in which settings information of the volume is registered;
 providing, by the second processor, the client computer with a shared directory which is included in at least one volume included in the third storage unit;

writing, by the second processor, in case of receiving the request to write the directory settings file via the first interface and the second interface, the directory settings file in the shared directory according to the received directory settings file writing request;

referring, by the second processor, to the storage characteristics information to select, as data migration destination candidate, at least one volume whose settings information matches the new settings information described in the directory settings file;

obtaining, by the second processor, information for identifying the selected volume; and

executing, by the second processor, settings changing processing of migrating information from the shared directory in which the directory settings file is written to one of the selected volume,

executing, by the second processor, in a case where the shared directory in which the directory settings file is written is an uppermost directory in the volume in which this shared directory is included, where the directory settings file is written, volume-basis migrating processing of migrating, on a volume basis, information from the volume in which the shared directory is included, where the directory settings file is written to one of the migration destination candidate volume that is not in use; and

executing, by the second processor, in a case where the shared directory in which the directory settings file is written is not the uppermost directory in the volume in which this shared directory is included where the directory settings file is written, directory-basis migration processing of migrating, on a directory basis, information from the shared directory where the directory settings file is written to one of the migration destination candidate volume, and

wherein the computer system further includes an address translation computer accessible from the client computer,

wherein the address translation computer has a fourth processor, which performs computation processing, a fourth storage unit, which is coupled to the fourth processor, and a fourth interface, which is coupled to the fourth processor, and

wherein the address translation computer can access the file server device via the second interface and the fourth interface,

the method further comprising:

storing, in the fourth storage unit, shared directory address translation information to register an association relation between a path name for the shared directory and a name of the file server device that provides the shared directory;

sending, by the first processor, a request to write the directory settings file in the shared directory to the address translation computer via the first interface and the fourth interface;

referring, by the fourth processor, in case of receiving the write request via the first interface and the fourth interface, to the shared directory address translation information to identify which file server device provides a shared directory that is identified by a path name designated in the received write request; and

forwarding, by the fourth processor, the received write request to the identified file server device via the second interface and the fourth interface.

2. The method of changing settings information of a shared directory according to claim 1, further comprising:

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executing, by the second processor, the settings changing processing after referring to the storage characteristics information in a case where the new shared directory settings information described in the directory settings file does not match the settings information of the shared directory in which the directory settings file is written.

3. The method of changing settings information of a shared directory according to claim 1, further comprising:

5 additionally storing, in the second storage unit, address settings information to register an association relation between a path name for the shared directory and information for identifying the volume where the shared directory is included;

10 executing, by the second processor, the volume-basis migration processing in the file server device that provides the shared directory where the directory settings file is written;

15 updating, by the second processor, the address settings information such that a path name for the migrated shared directory is associated with information for identifying the volume where the migrated shared directory is included; and

20 updating, by the second processor, the storage characteristics information with settings information of the volume where the migrated shared directory is included.

4. The method of changing settings information of a shared directory according to claim 1, further comprising:

25 additionally storing, in the second storage unit, address settings information to register an association relation between a path name for the shared directory and information for identifying the volume where the shared directory is included;

30 executing, by the second processor, the volume-basis migration processing in the file server device that provides the shared directory where the directory settings file is written; and

35 updating, by the second processor, the address settings information such that a path name for the migrated shared directory is associated with information for identifying the volume where the migrated shared directory is included.

5. The method of changing settings information of a shared directory according to claim 3,

40 wherein the file server device includes a first file server device and a second file server device, and

45 wherein the storage system includes a first storage system, which is accessible from the first file server device, and a second storage system, which is accessible from the second file server device,

50 the method further comprising:

55 sending, by the first processor, the write request to the first file server device via the first interface and the second interface which the first file server device has;

60 storing, in the second storage unit which the first file server device has and the second storage unit which the second file server device has, address settings information to register an association relation between a path name for the shared directory and information for identifying the volume where the shared directory is included;

65 executing, by the second processor of the first file server device, the volume-basis migration processing for data migration between the first file server device and the second file server device in case where the write request is received via the first interface and the second interface which the first file server device has and in case where information for identifying the migration destination

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candidate volume does not contain information for identifying a volume that is included in the third storage unit of the first storage system;

updating, by the second processor of the first file server device, the address settings information that is stored in the second storage unit of the second file server device such that a path name for the migrated shared directory is associated with information for identifying a volume that contains the migrated shared directory;

10 updating, by the second processor of the first file server device, the shared directory address translation information stored in the fourth storage unit such that a path name for the migrated shared directory is associated with a name of the second file server device; and

15 updating, by the second processor of the first file server device, the storage characteristics information that is stored in the second storage unit of the first file server device and in the second storage unit of the second tile server device with settings information of the volume where the migrated shared directory is included.

6. The method of changing settings information of a shared directory according to claim 3,

20 wherein the file server device includes a first file server device and a second file server device, and

25 wherein the storage system includes a first storage system, which is accessible from the first file server device, and a second storage system, which is accessible from the second file server device,

the method further comprising:

30 sending, by the first processor, the write request to the first file server device via the first interface and the second interface which the first file server device is included;

35 storing, in the second storage unit which the first file server device has and the second storage unit which the second file server device has, address settings information to register an association relation between a path name for the shared directory and information for identifying the volume where the shared directory is included;

40 executing, by the second processor of the first file server device, the volume-basis migration processing for data migration between the first file server device and the second file server device in case where the write request is received via the first interface and the second interface which the first file server device has and in case where information for identifying the migration destination candidate volume does not contain information for identifying a volume that is included in the third storage unit of the first storage system;

45 updating, by the second processor of the first file server device, the address settings information that is stored in the second storage unit of the second file server device such that a path name for the migrated shared directory is associated with information for identifying a volume that contains the migrated shared directory; and

50 updating, by the second processor of the first file server device, the shared directory address translation information stored in the fourth storage unit such that a path name for the migrated shared directory is associated with a name of the file server device that provides the migrated shared directory.

7. The method of changing settings information of a shared directory according to claim 1, wherein the second interface is coupled to the third interface via a storage area network.

8. The method of changing settings information of a shared directory according to claim 1, wherein the file server device and the storage system are installed in the same casing.

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9. A file server device which is accessible from a client computer and accessible to a storage system, comprising:
 a processor which performs computation processing;
 a storage unit which is coupled to the processor; and
 an interface which is coupled to the processor,
 wherein the storage unit stores storage characteristics information to register settings information of at least one volume set in the storage system,
 wherein the processor provides the client computer with a shared directory, which is included in at least one volume included in the storage system accessible from the file server device,
 wherein, in case of receiving a request via the interface to write a directory settings file, the processor writes the directory settings file in a shared directory whose settings information is to be changed according to the received write request, the directory settings file describing new settings information for this shared directory whose settings information is to be changed,
 wherein the processor refers to the storage characteristics information in order to select, as data migration destination candidate, at least one volume whose settings information matches the new settings information described in the directory settings file,
 wherein the processor obtains information for identifying the selected volume, and
 wherein the processor executes settings changing processing of migrating information from the shared directory in which the directory settings file is written to one of the selected volume,
 wherein, in a case where the shared directory in which the directory settings file is written is an uppermost directory in the volume in which this shared directory is included, where the directory settings file is written, the processor executes volume-basis migration processing of migrating, on a volume basis, information from the volume in which the shared directory is included, where the directory settings file is written to one of the migration destination candidate volume that is not in use, and
 wherein, in a case where the shared directory in which the directory settings file is written is not the uppermost directory in the volume in which this shared directory is included where the directory settings file is written, the processor executes directory-basis migration processing of migrating, on a directory basis, information from the shared directory where the directory settings file is written to one of the migration destination candidate volume;
 wherein the file server device is further coupled to a shared directory address translation computer, and
 wherein the shared directory address translation computer identifies, based on a path name designated in the write request, to which file server device the write request is to be sent, and the processor thus receives the write request via the interface.

10. The file server device according to claim 9, wherein the processor executes the settings changing processing after referring to the storage characteristics information in a case where the new shared directory settings information described in the directory settings file does not match the settings information of the shared directory in which the directory settings file is written.

11. The file server device according to claim 9, wherein the storage unit further stores address settings information to register an association relation between a

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path name for the shared directory and information for identifying the volume where the shared directory is included,
 wherein the processor executes the volume-basis migration processing in the file server device that provides the shared directory where the directory settings file is written,
 wherein the processor updates the address settings information such that a path name for the migrated shared directory is associated with information for identifying the volume where the migrated shared directory is included, and
 wherein the processor updates the storage characteristics information with settings information of the volume where the migrated shared directory is included.
 12. The file server device according to claim 9, wherein the storage unit further stores address settings information to register an association relation between a path name for the shared directory and information for identifying the volume where the shared directory is included,
 wherein the processor executes the directory-basis migration processing in the file server device that provides the shared directory where the directory settings file is written, and
 wherein the processor updates the address settings information such that a path name for the migrated shared directory is associated with information for identifying the volume where the migrated shared directory is included.
 13. The file server device according to claim 11, wherein the storage unit stores address settings information to register an association relation between a path name for the shared directory and information for identifying the volume where the shared directory is included,
 wherein the processor executes the volume-basis migration processing for data migration between the file server device that is the receiver of the write request and another file server device in case where the write request is received via the interface and in case where information for identifying the migration destination candidate volume does not contain information for identifying a volume included in the storage system that has access to the file server device that is the receiver of the write request,
 wherein the processor updates the address settings information that is stored in a storage unit of the other file server device to which the shared directory is migrated such that a path name for the migrated shared directory is associated with information for identifying a volume where the migrated shared directory is included,
 wherein the processor notifies an address translation computer of the association relation between the path name for the migrated shared directory and the information for identifying the file server device which has access to the storage system where volume is included, in which the migrated shared directory is included, and
 wherein the processor updates the storage characteristics information stored in the storage unit with settings information of the volume where the migrated shared directory is included.
 14. The file server device according to claim 11, wherein the storage unit stores address settings information to register an association relation between a path

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name for the shared directory and information for identifying the volume where the shared directory is included,
 wherein the processor executes the volume-basis migration processing for data migration between the file server device that is the receiver of the write request and another file server device, in case where the write request is received via the interface and in case where information for identifying the migration destination candidate volume does not contain information for identifying a volume included in the storage system that has access to the file server device that is the receiver of the write request,
 wherein the processor updates the address settings information that is stored in a storage unit of the other file server device to which the shared directory is migrated

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such that a path name for the migrated shared directory is associated with information for identifying a volume where the migrated shared directory is included, and wherein the processor notifies an address translation computer of the association relation between the path name for the migrated shared directory and the information for identifying the file server device which has access to the storage system where volume is included, in which the migrated shared directory is included.
15. The file server device according to claim **9**, wherein the interface is coupled to the storage system via a storage area network.
16. The file server device according to claim **9**, wherein the file server device and the storage system are installed in the same casing.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : RE42,859 E
APPLICATION NO. : 12/662439
DATED : October 18, 2011
INVENTOR(S) : Tomida et al.

Page 1 of 1

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

On the Title Page:

Item [64], Replace sub-heading, PCT Filed: with sub-heading, Filed.

Signed and Sealed this
First Day of November, 2011

A handwritten signature in black ink that reads "David J. Kappos". The signature is written in a cursive, slightly slanted style.

David J. Kappos
Director of the United States Patent and Trademark Office