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(54) **METHOD FOR SWITCHING NODE AND AN INFORMATION PROCESSING SYSTEM**

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(57) **ABSTRACT**

In an information processing system including host computers and disk devices, each of an execution-node host and a standby-node host includes an I/O request unit and an access-right change command unit. The I/O request unit issues an I/O request. The access-right change command unit transmits an access-right change command. The access-right change command results from causing I/O-enable/disable information and the host identification information to correspond to each other. The disk device includes an access control table, an access control unit, and an access-right change unit. The access control table stores information of the access-right change commands from the hosts. The access control unit judges the execution enablement/disablement for the I/O requests from the host identification information and the access control table. The access-right change unit, in accordance with the access-right change commands from the hosts, changes in batch the I/O-enable/disable information on each host basis within the access control table.

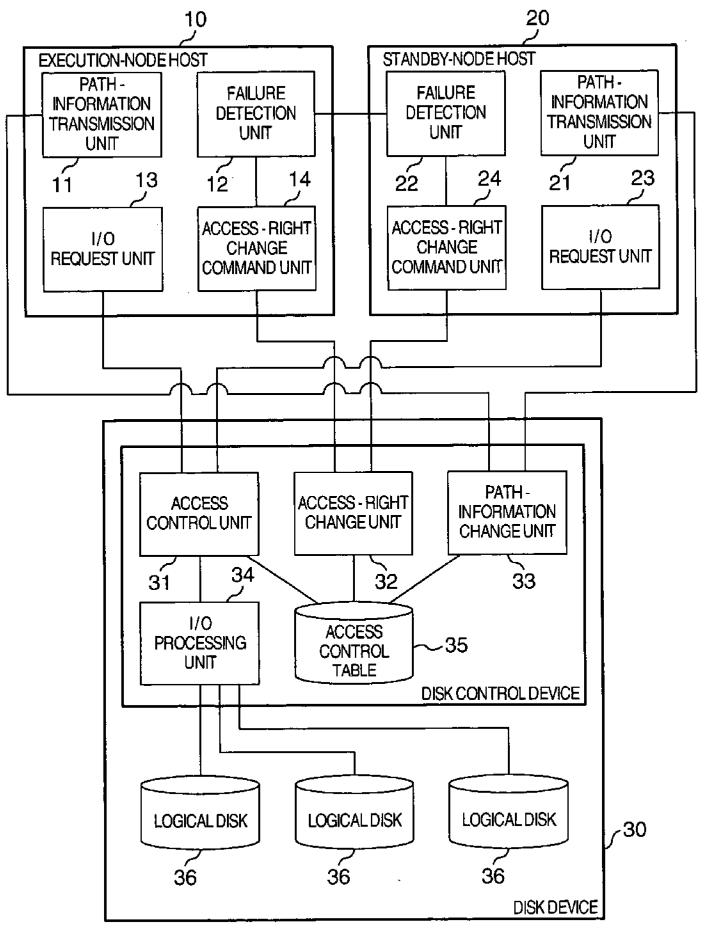


FIG.1

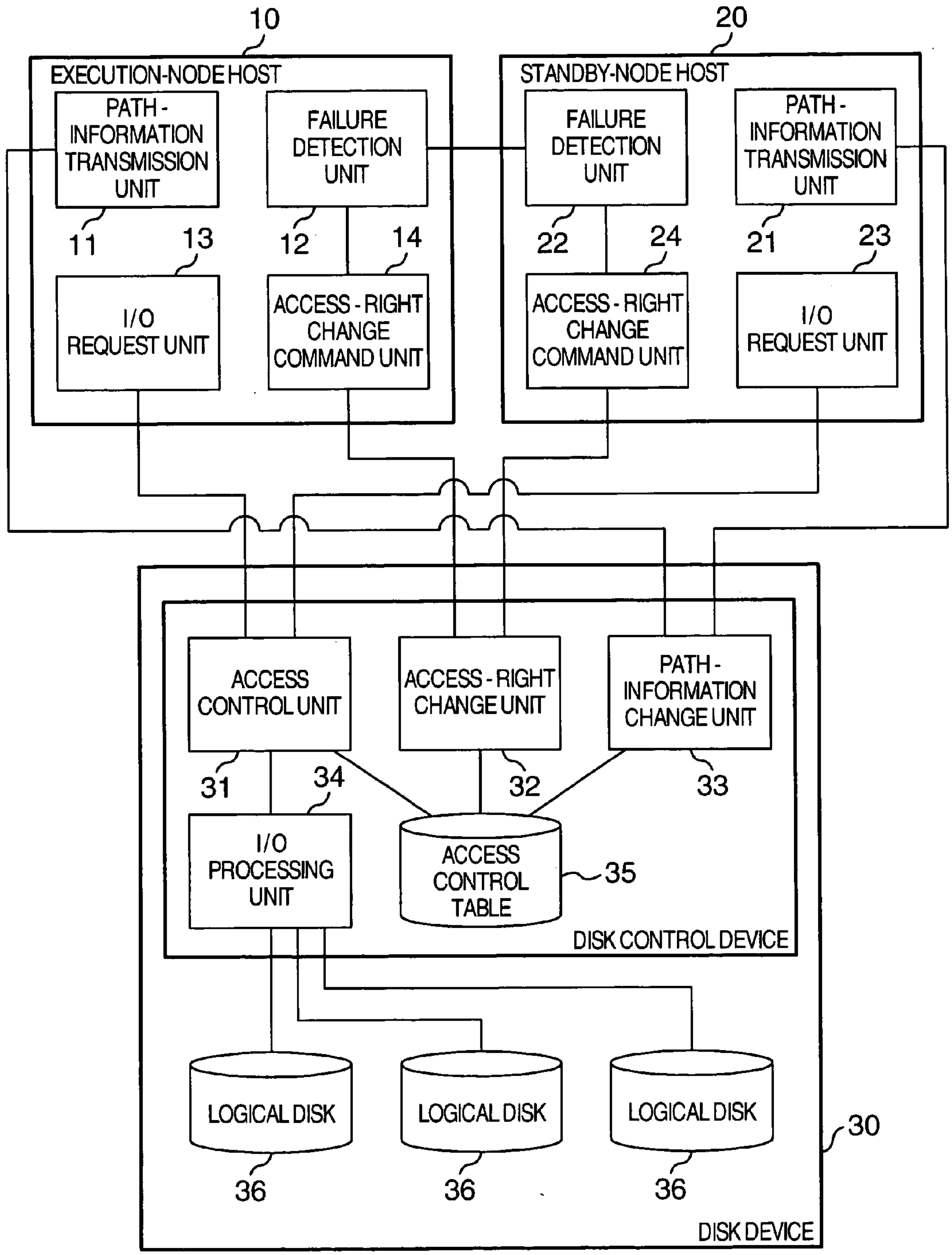

10
EXECUTION-NODE HOST
PATH-INFORMATION TRANSMISSION UNIT
FAILURE DETECTION UNIT
11
13
12
14
I/O REQUEST UNIT
ACCESS-RIGHT CHANGE COMMAND UNIT
20
STANDBY-NODE HOST
FAILURE DETECTION UNIT
PATH-INFORMATION TRANSMISSION UNIT
22
24
21
23
ACCESS-RIGHT CHANGE COMMAND UNIT
I/O REQUEST UNIT
ACCESS CONTROL UNIT
ACCESS-RIGHT CHANGE UNIT
PATH-INFORMATION CHANGE UNIT
31
34
32
33
I/O PROCESSING UNIT
ACCESS CONTROL TABLE
35
DISK CONTROL DEVICE
LOGICAL DISK
LOGICAL DISK
LOGICAL DISK
30
36
36
36
DISK DEVICE

FIG.2

ACCESS-RIGHT MANAGEMENT TABLE 35a

| HOST IDENTIFICATION INFORMATION | I/O-ENABLEMENT/ DISABLEMENT | IN-PROCESSING I/O NUMBER |
|---|---|---|
| HOST 1 | ENABLE | 1 |
| HOST 2 | DISABLE | 0 |

FIG.3

PATH-INFORMATION MANAGEMENT TABLE 35b

| PATH IDENTIFICATION INFORMATION | HOST IDENTIFICATION INFORMATION |
|---|---|
| PATH 1 | HOST 1 |
| PATH 2 | HOST 1 |
| PATH 3 | HOST 2 |
| PATH 4 | HOST 2 |

FIG.4

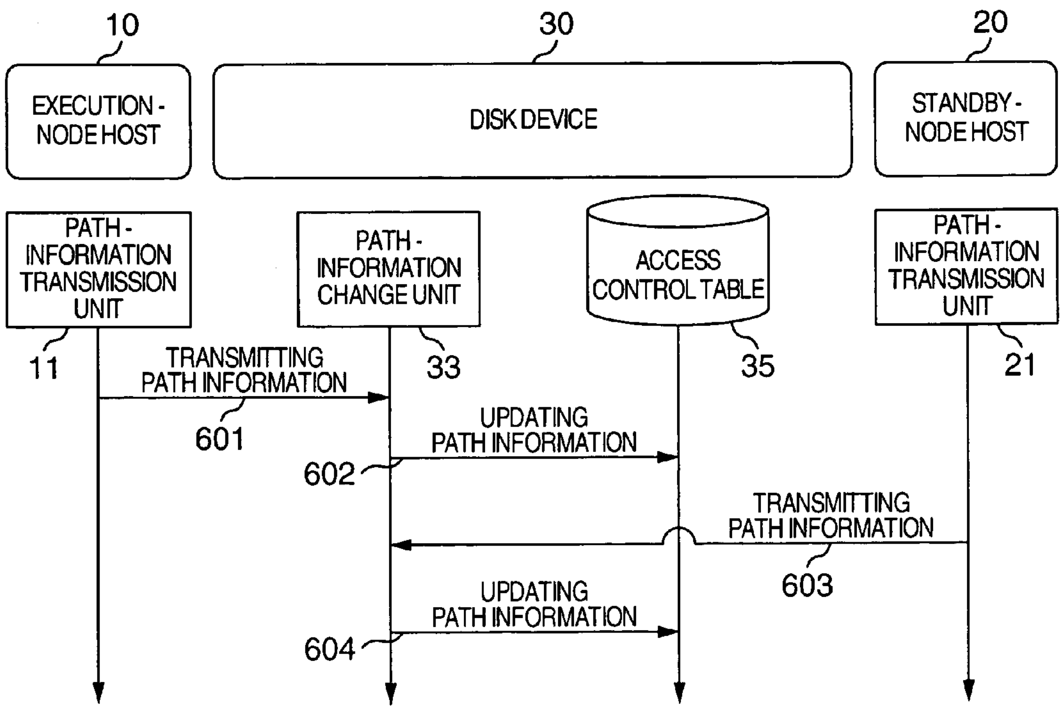


FIG.5

PATH INFORMATION 50

| HOST IDENTIFICATION INFORMATION | PATH IDENTIFICATION INFORMATION | |
|---|---|---|
| HOST 1 | PATH 1 | PATH 2 |

FIG.6

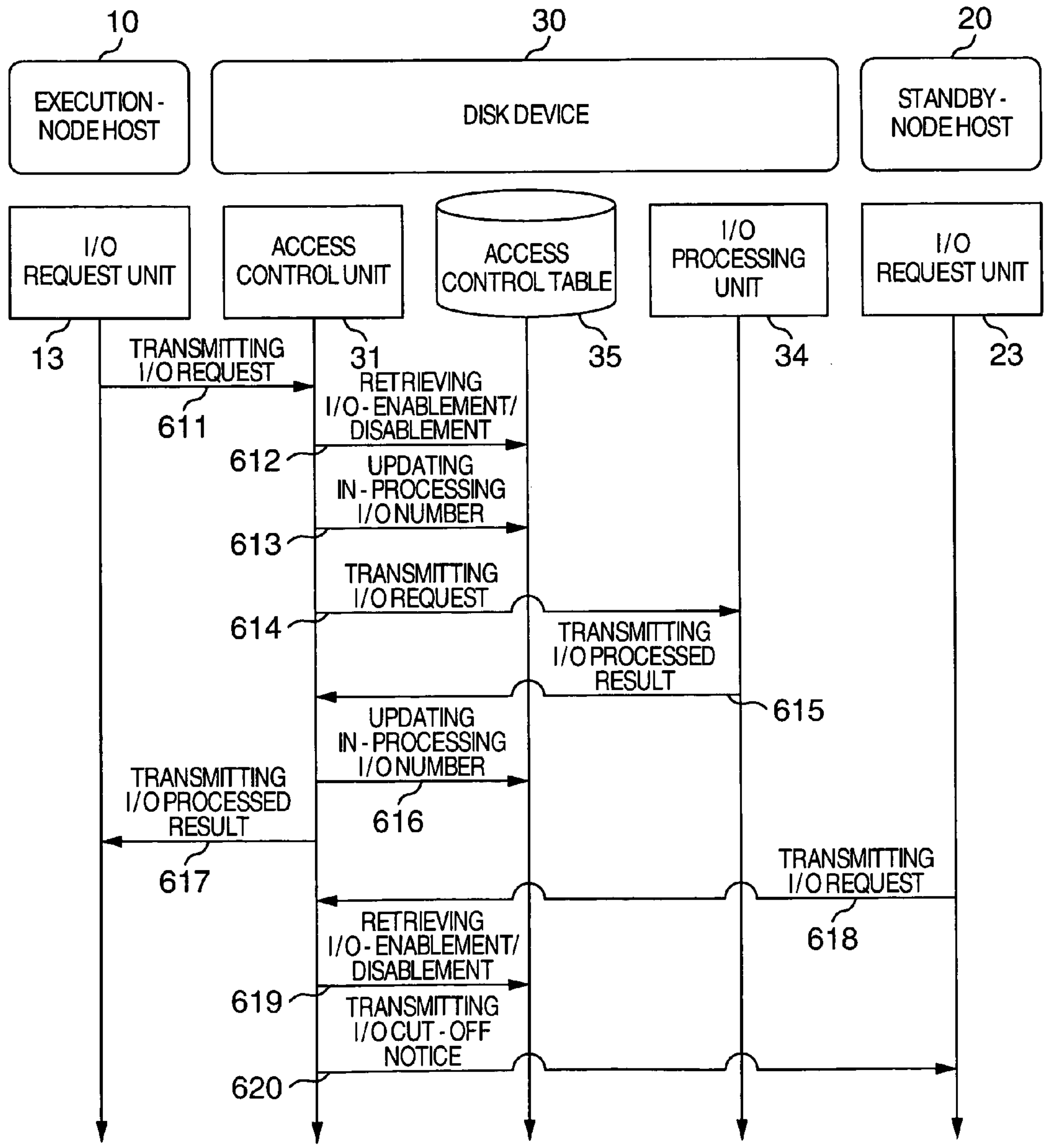


FIG.7

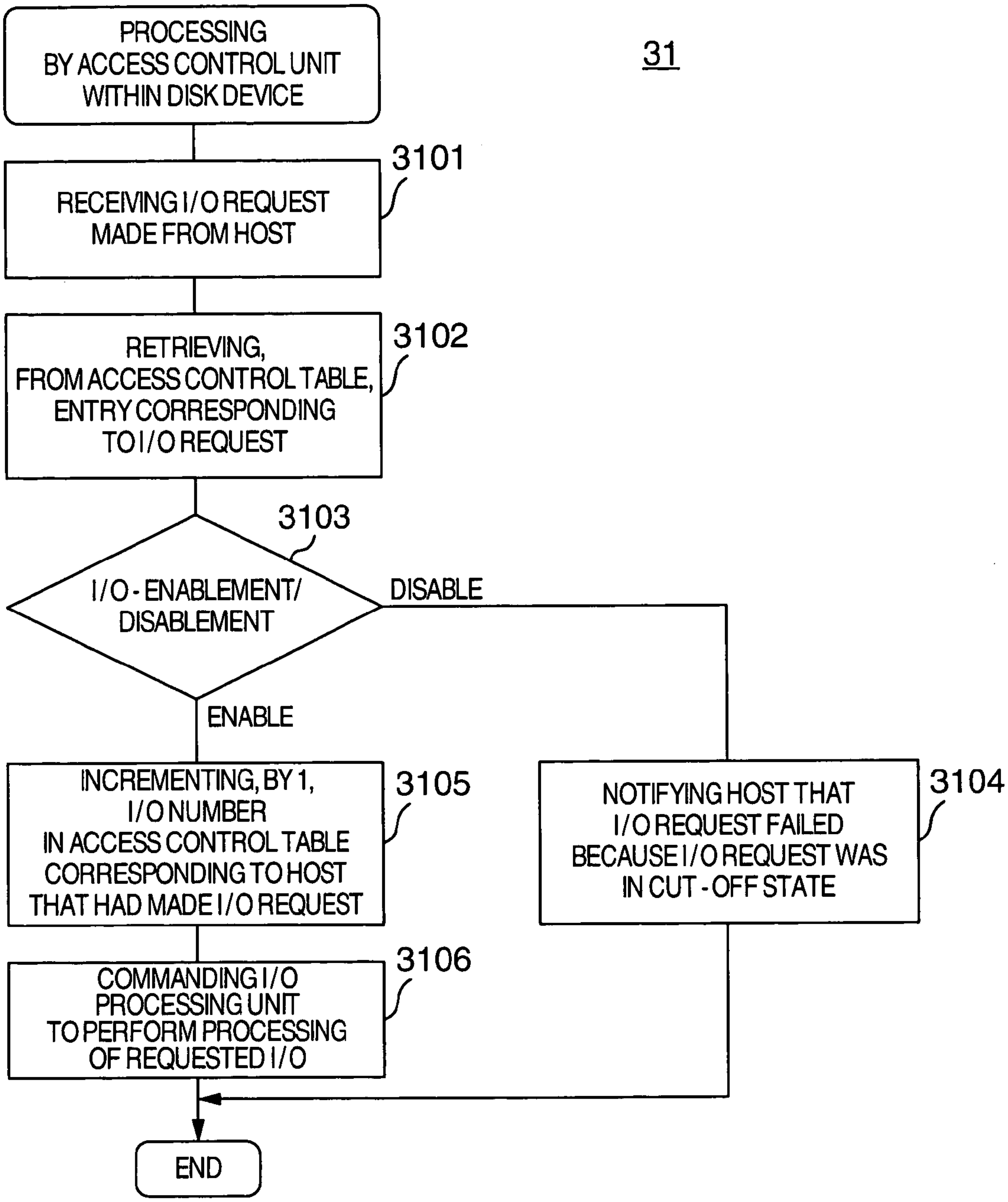

31
PROCESSING BY ACCESS CONTROL UNIT WITHIN DISK DEVICE
3101
RECEIVING I/O REQUEST MADE FROM HOST
3102
RETRIEVING, FROM ACCESS CONTROL TABLE, ENTRY CORRESPONDING TO I/O REQUEST
3103
I/O-ENABLEMENT/ DISABLEMENT
DISABLE
ENABLE
3105
INCREMENTING, BY 1, I/O NUMBER IN ACCESS CONTROL TABLE CORRESPONDING TO HOST THAT HAD MADE I/O REQUEST
3104
NOTIFYING HOST THAT I/O REQUEST FAILED BECAUSE I/O REQUEST WAS IN CUT-OFF STATE
3106
COMMANDING I/O PROCESSING UNIT TO PERFORM PROCESSING OF REQUESTED I/O
END

FIG.8

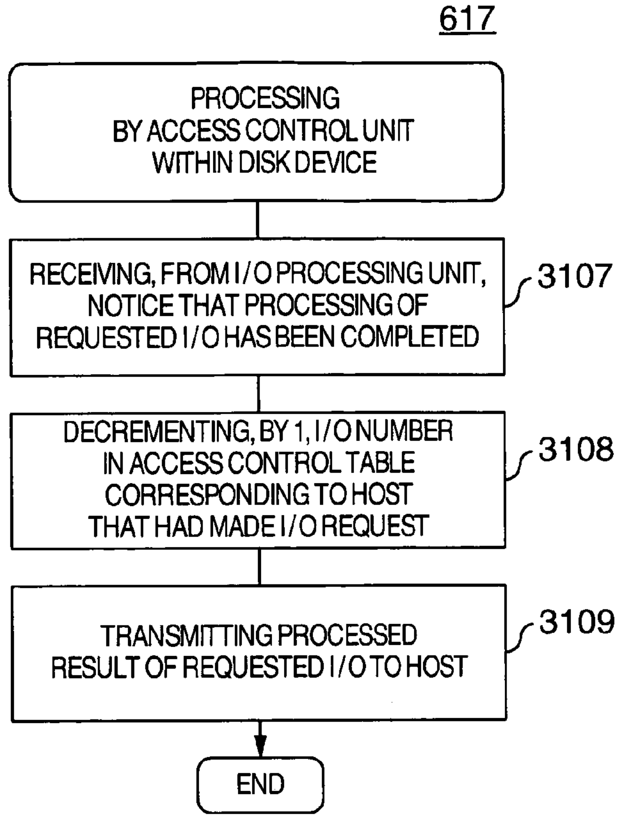

617
PROCESSING BY ACCESS CONTROL UNIT WITHIN DISK DEVICE
RECEIVING, FROM I/O PROCESSING UNIT, NOTICE THAT PROCESSING OF REQUESTED I/O HAS BEEN COMPLETED
3107
DECREMENTING, BY 1, I/O NUMBER IN ACCESS CONTROL TABLE CORRESPONDING TO HOST THAT HAD MADE I/O REQUEST
3108
TRANSMITTING PROCESSED RESULT OF REQUESTED I/O TO HOST
3109
END

FIG.9

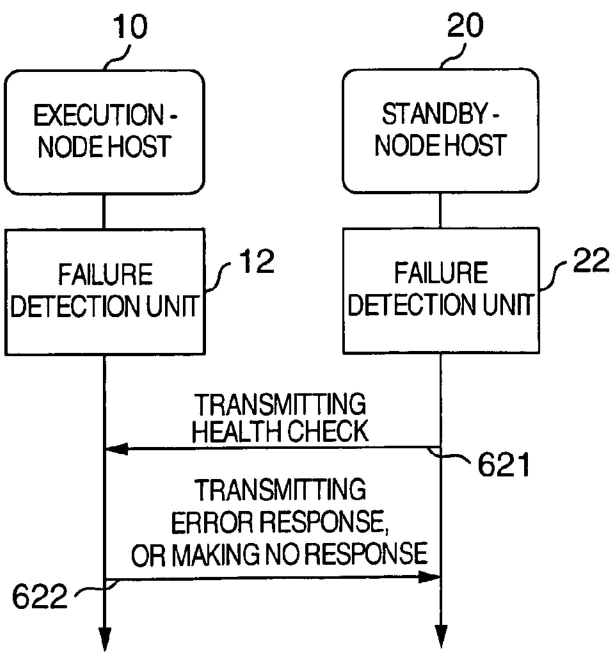

10
EXECUTION-NODE HOST
20
STANDBY-NODE HOST
FAILURE DETECTION UNIT
12
FAILURE DETECTION UNIT
22
TRANSMITTING HEALTH CHECK
621
TRANSMITTING ERROR RESPONSE, OR MAKING NO RESPONSE
622

FIG.10

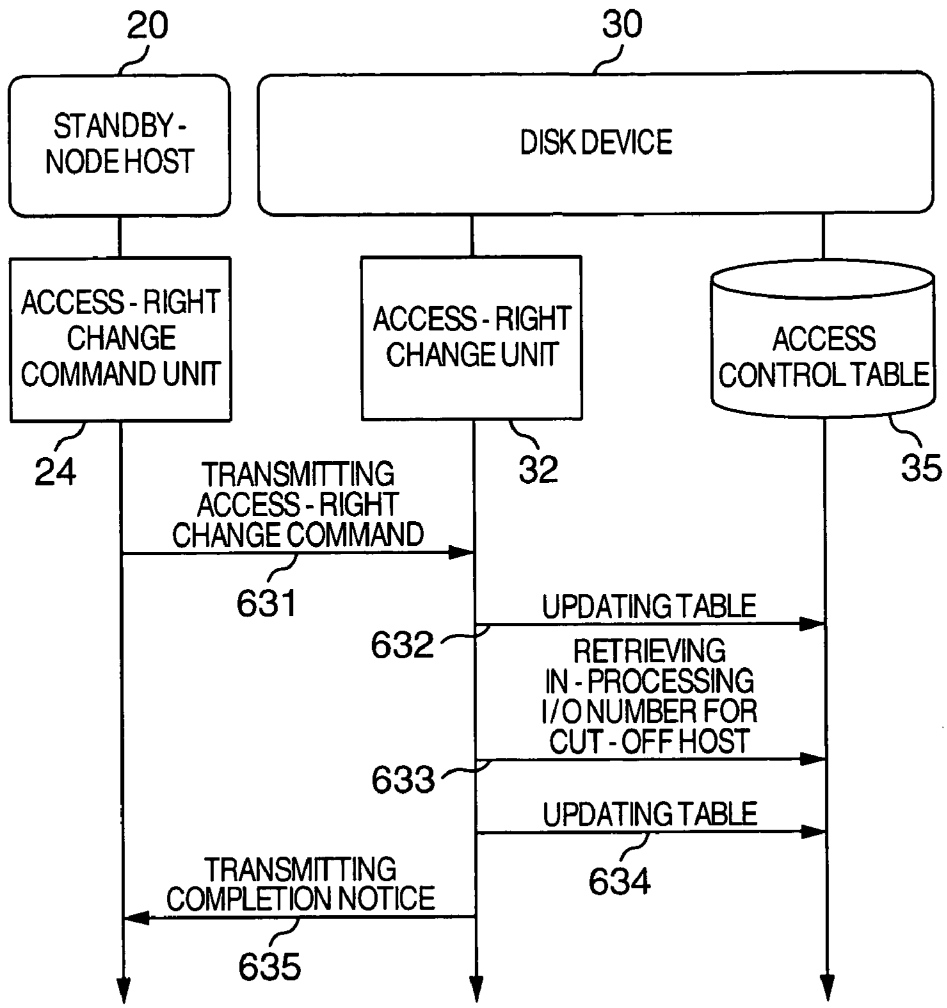



FIG.11

ACCESS-RIGHT CHANGE COMMAND

110

| HOST IDENTIFICATION INFORMATION | I/O-ENABLEMENT/ DISABLEMENT |
|---|---|
| HOST 1 | DISABLE |
| HOST 2 | ENABLE |

FIG.12

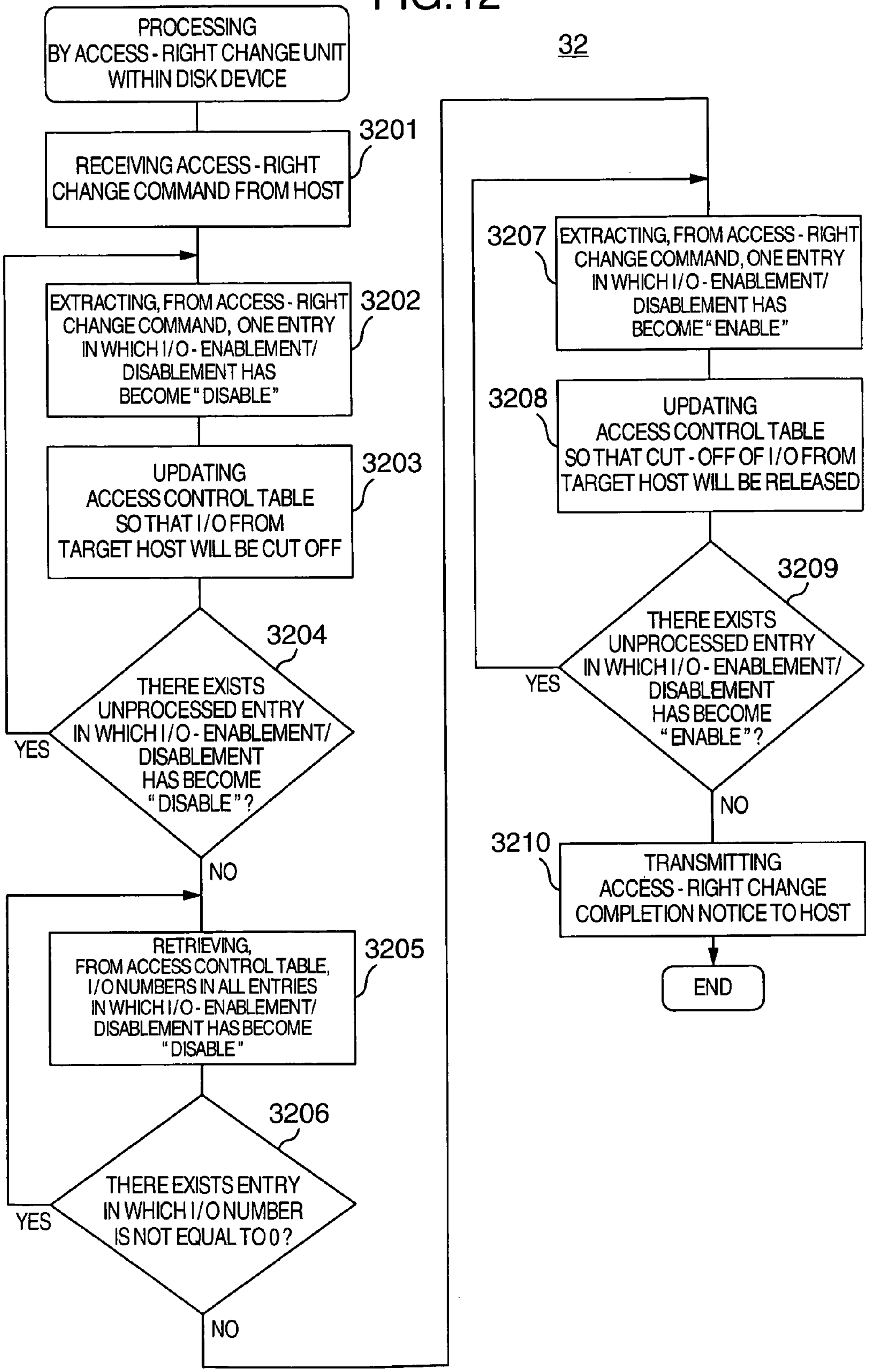

32
PROCESSING BY ACCESS - RIGHT CHANGE UNIT WITHIN DISK DEVICE
3201
RECEIVING ACCESS - RIGHT CHANGE COMMAND FROM HOST
3202
EXTRACTING, FROM ACCESS - RIGHT CHANGE COMMAND, ONE ENTRY IN WHICH I/O - ENABLEMENT/ DISABLEMENT HAS BECOME "DISABLE"
3203
UPDATING ACCESS CONTROL TABLE SO THAT I/O FROM TARGET HOST WILL BE CUT OFF
3204
THERE EXISTS UNPROCESSED ENTRY IN WHICH I/O - ENABLEMENT/ DISABLEMENT HAS BECOME "DISABLE"?
YES
NO
3205
RETRIEVING, FROM ACCESS CONTROL TABLE, I/O NUMBERS IN ALL ENTRIES IN WHICH I/O - ENABLEMENT/ DISABLEMENT HAS BECOME "DISABLE"
3206
THERE EXISTS ENTRY IN WHICH I/O NUMBER IS NOT EQUAL TO 0?
YES
NO
3207
EXTRACTING, FROM ACCESS - RIGHT CHANGE COMMAND, ONE ENTRY IN WHICH I/O - ENABLEMENT/ DISABLEMENT HAS BECOME "ENABLE"
3208
UPDATING ACCESS CONTROL TABLE SO THAT CUT - OFF OF I/O FROM TARGET HOST WILL BE RELEASED
3209
THERE EXISTS UNPROCESSED ENTRY IN WHICH I/O - ENABLEMENT/ DISABLEMENT HAS BECOME "ENABLE"?
YES
NO
3210
TRANSMITTING ACCESS - RIGHT CHANGE COMPLETION NOTICE TO HOST
END

FIG.13

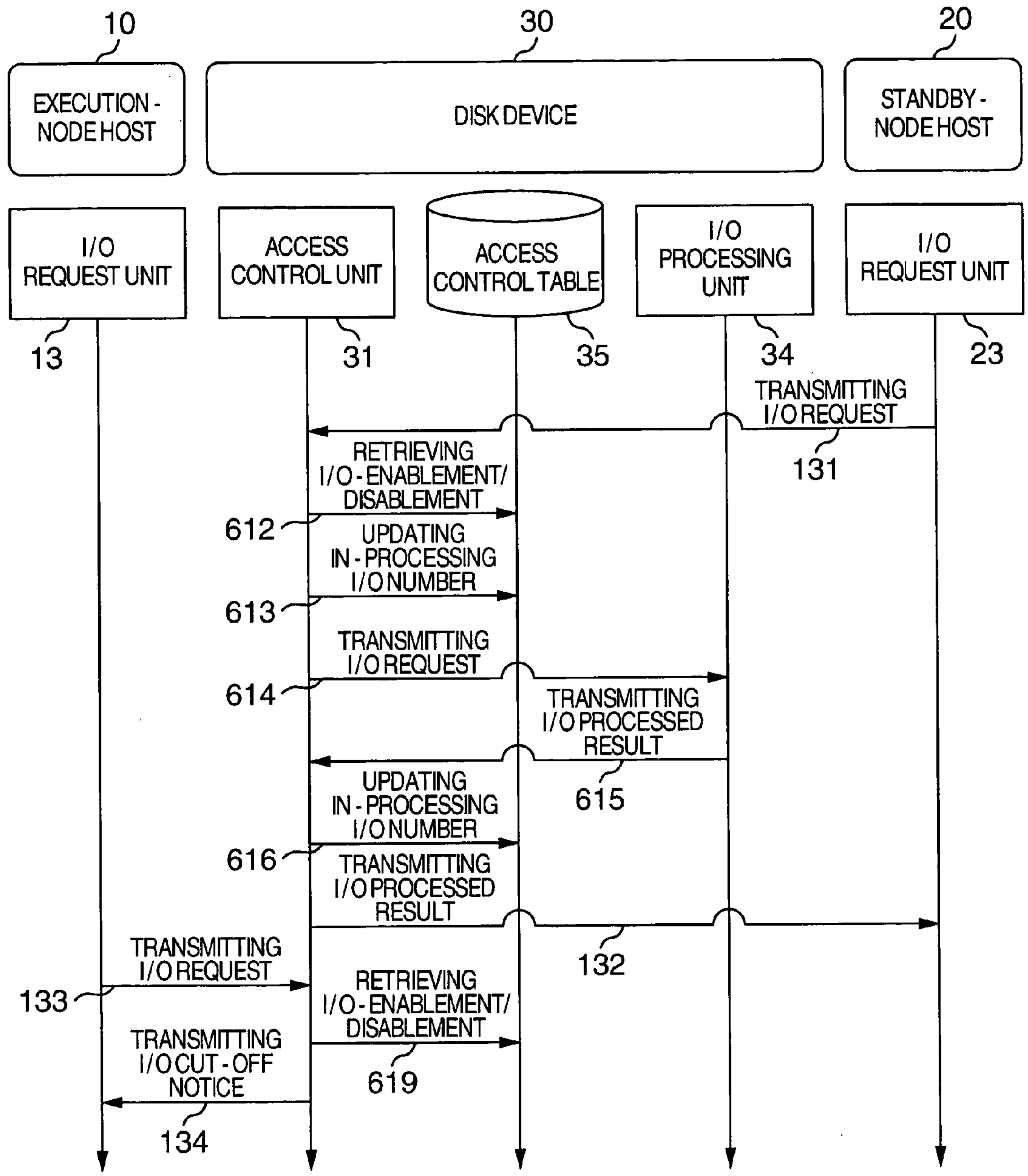

10
EXECUTION-NODE HOST
30
DISK DEVICE
20
STANDBY-NODE HOST
I/O REQUEST UNIT
ACCESS CONTROL UNIT
ACCESS CONTROL TABLE
I/O PROCESSING UNIT
I/O REQUEST UNIT
13
31
35
34
23
TRANSMITTING I/O REQUEST
131
RETRIEVING I/O-ENABLEMENT/DISABLEMENT
612
UPDATING IN-PROCESSING I/O NUMBER
613
TRANSMITTING I/O REQUEST
614
TRANSMITTING I/O PROCESSED RESULT
615
UPDATING IN-PROCESSING I/O NUMBER
616
TRANSMITTING I/O PROCESSED RESULT
132
TRANSMITTING I/O REQUEST
133
RETRIEVING I/O-ENABLEMENT/DISABLEMENT
619
TRANSMITTING I/O CUT-OFF NOTICE
134

FIG.14

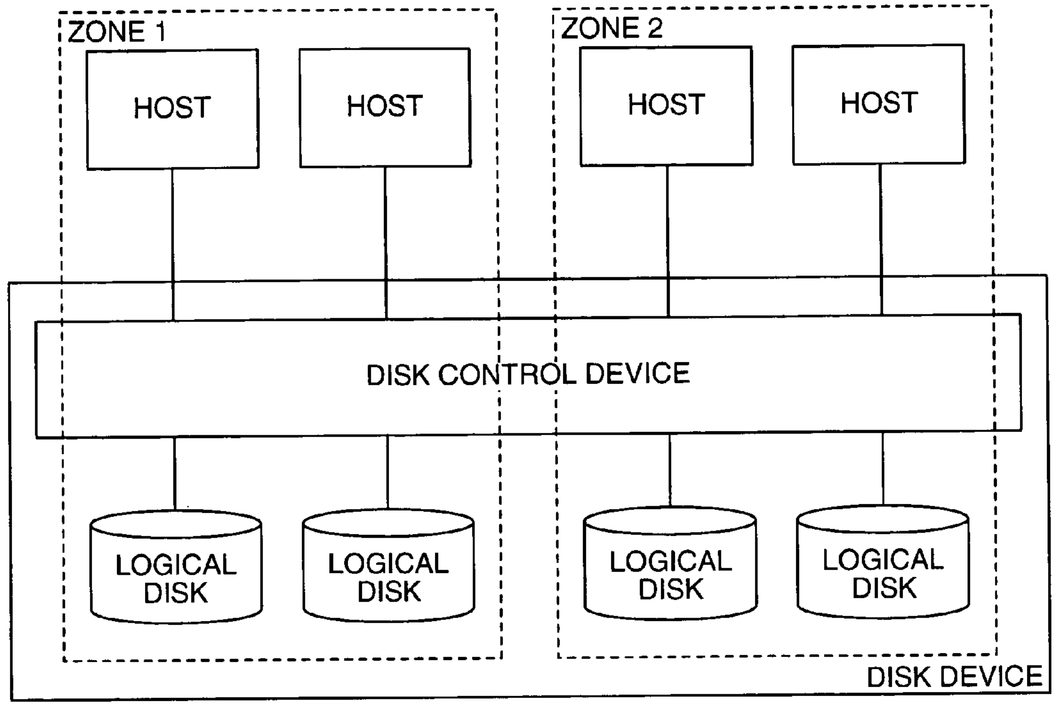

ZONE 1
HOST
HOST
ZONE 2
HOST
HOST
DISK CONTROL DEVICE
LOGICAL DISK
LOGICAL DISK
LOGICAL DISK
LOGICAL DISK
DISK DEVICE

FIG.15

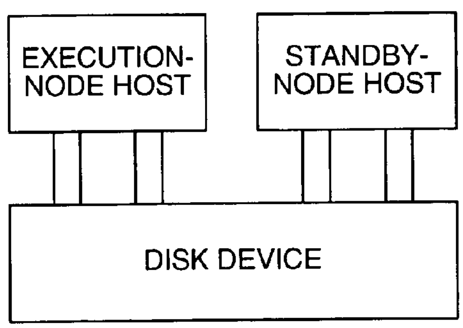
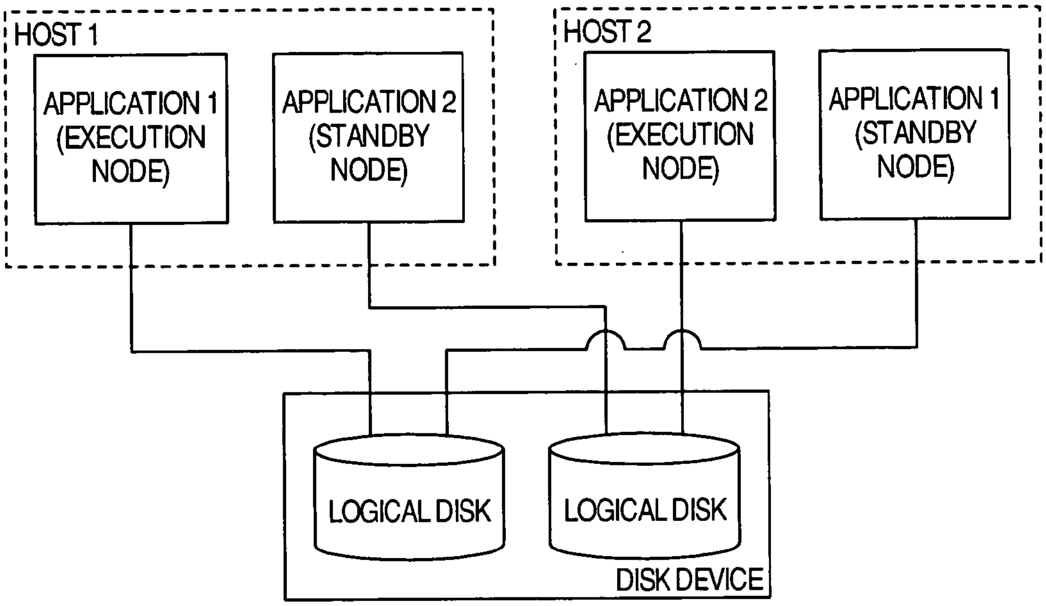

EXECUTION-NODE HOST
STANDBY-NODE HOST
DISK DEVICE

FIG.16



HOST 1
APPLICATION 1 (EXECUTION NODE)
APPLICATION 2 (STANDBY NODE)
HOST 2
APPLICATION 2 (EXECUTION NODE)
APPLICATION 1 (STANDBY NODE)
LOGICAL DISK
LOGICAL DISK
DISK DEVICE

FIG.17

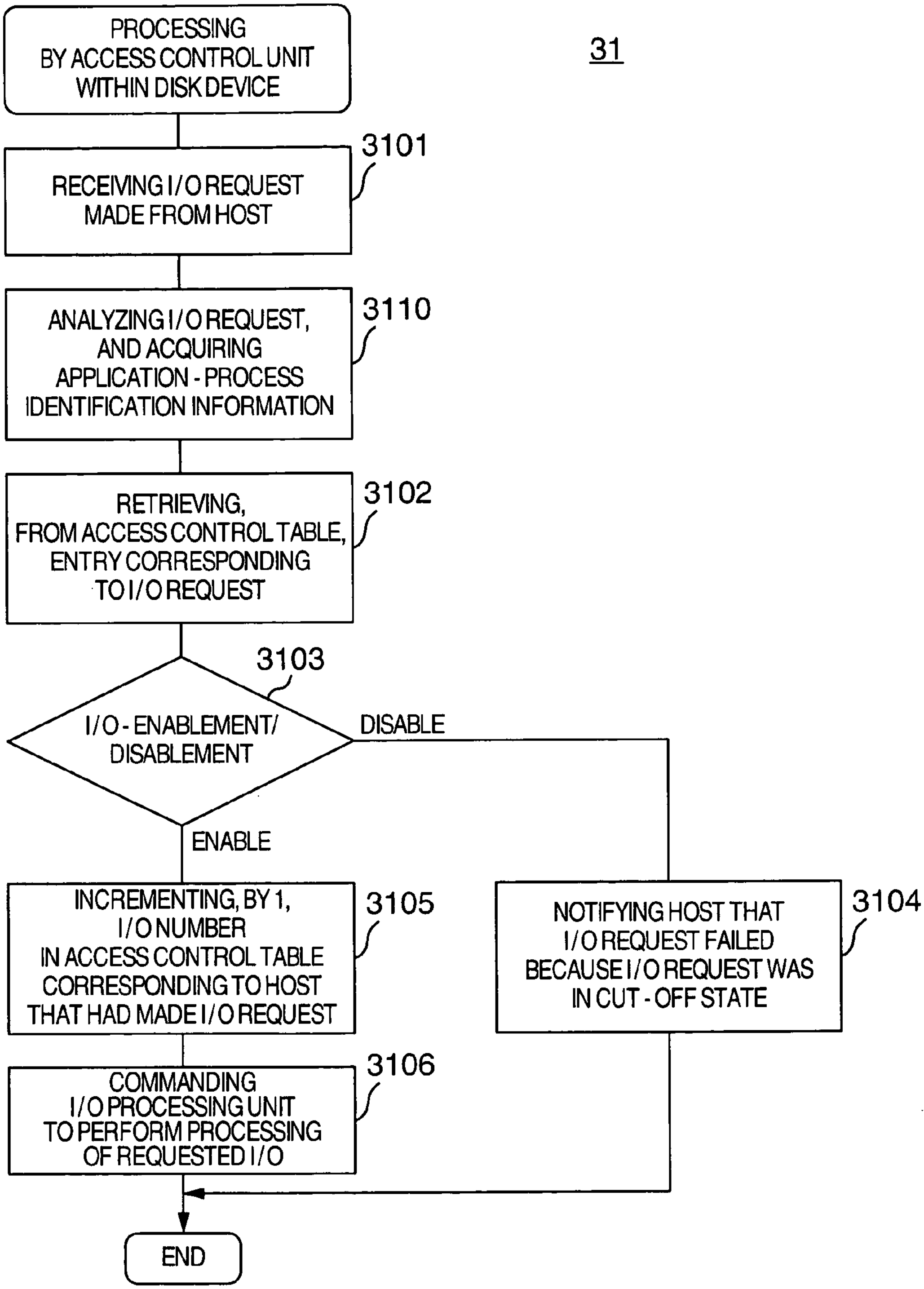

31
PROCESSING BY ACCESS CONTROL UNIT WITHIN DISK DEVICE
3101
RECEIVING I/O REQUEST MADE FROM HOST
3110
ANALYZING I/O REQUEST, AND ACQUIRING APPLICATION - PROCESS IDENTIFICATION INFORMATION
3102
RETRIEVING, FROM ACCESS CONTROL TABLE, ENTRY CORRESPONDING TO I/O REQUEST
3103
I/O - ENABLEMENT/ DISABLEMENT
DISABLE
ENABLE
3105
INCREMENTING, BY 1, I/O NUMBER IN ACCESS CONTROL TABLE CORRESPONDING TO HOST THAT HAD MADE I/O REQUEST
3104
NOTIFYING HOST THAT I/O REQUEST FAILED BECAUSE I/O REQUEST WAS IN CUT - OFF STATE
3106
COMMANDING I/O PROCESSING UNIT TO PERFORM PROCESSING OF REQUESTED I/O
END

FIG.18

ACCESS-RIGHT MANAGEMENT TABLE 35aa

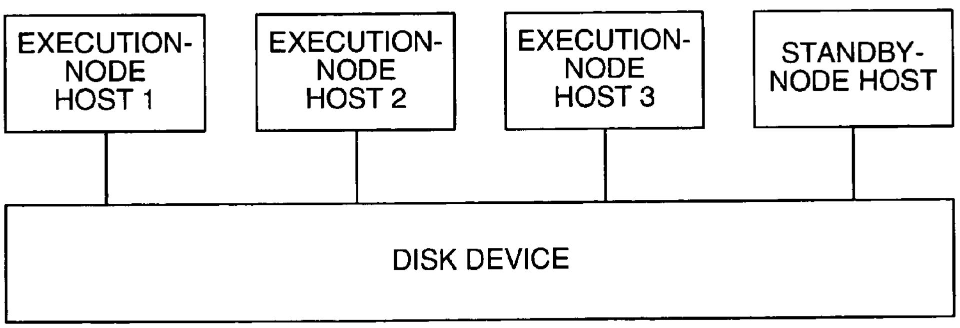
| LOGICAL-DISK IDENTIFICATION INFORMATION | HOST IDENTIFICATION INFORMATION | I/O-ENABLEMENT/ DISABLEMENT | IN-PROCESSING I/O NUMBER |
|---|---|---|---|
| LOGICAL DISC 1 | HOST 1 | ENABLE | 1 |
| LOGICAL DISC 1 | HOST 2 | DISABLE | 0 |
| LOGICAL DISC 2 | HOST 1 | DISABLE | 0 |
| LOGICAL DISC 2 | HOST 2 | ENABLE | 3 |

FIG.19

ACCESS-RIGHT CHANGE COMMAND 110a

| LOGICAL-DISK IDENTIFICATION INFORMATION | HOST IDENTIFICATION INFORMATION | I/O-ENABLEMENT/ DISABLEMENT |
|---|---|---|
| LOGICAL DISC 1 | HOST 1 | DISABLE |
| LOGICAL DISC 1 | HOST 2 | ENABLE |

FIG.20



# METHOD FOR SWITCHING NODE AND AN INFORMATION PROCESSING SYSTEM

## BACKGROUND OF THE INVENTION

[0001] The present invention relates to a node switching method and an information processing system. More particularly, it relates to an I/O node-switching method and an information processing system in the following case: At the time of a failure occurrence, a processing, which is being executed by a host where the failure has occurred, is taken over to another host so as to allow another host to continue this processing.

[0002] Generally speaking, starting with a financial system and a securities system, systems which form and support the social infrastructure are requested to exhibit a high reliability. Namely, these systems are not permitted to fall into the service interruption, i.e., the system down. On account of this requirement, these systems are configured as follows: Namely, devices which configure these systems, such as hosts and paths for connecting the hosts with a disk device, are formed into a dual-redundant structure. For example, even if a failure has occurred in an execution-node host, the processing is immediately switched to a standby-node host, thereby preventing the entire system from falling down for a long time. The switching operation like this is referred to as "node switching".

[0003] As described above, in the dual-redundant system, if a failure has occurred in an execution-node host and if the node switching to a standby-node host has been performed, the standby-node host becomes a new execution-node host. During the node switching and after the node switching, however, an I/O access control needs to be performed so that an I/O for the disk device from the host that had previously been the execution node will be cut off, and so that the cut-off of an I/O therefor from the host that had previously been the standby node will be released. This control is needed in order to prevent a data crash caused by a case where the shared disk is accessed simultaneously by both of the nodes, i.e., the host that has newly become the execution node and the host that had previously been the execution node.

[0004] As methods for performing the I/O access control as described above, there exists a method performed at the host side and a one performed at the disk-device side.

[0005] As the method of performing the node switching at the host side as a result of a failure of the OS itself or that of the node switching mechanism, there has been known a technology disclosed in JP-A-6-325008. This conventional technology is as follows: A standby-node host, which has detected the failure, performs a reset operation for an execution-node host so as to interrupt the I/O of the execution-node host, then performing the node switching.

[0006] The method of performing the I/O access control at the disk-device side is as follows: The I/O access control is performed with respect to plural paths, using the definition of a PERSISTENT RESERVE Command which exists in ANSI Standard SPC (i.e., SCSI-3 Primary Command). Also, I/Os from a certain path are cut off, thereby canceling all the I/Os from the path which are in processing. This method, which performs a logical-disk exclusion control on each host basis by using the PERSISTENT RESERVE, has been disclosed and known in JP-A-2000-322369. Moreover, a path which uses the PERSISTENT RESERVE, at first, registers the Reservation Key into logical disks. In this case, two ways of methods are prepared for the access control to the logical disks.

[0007] The first access-control method is a one where only an access from a path that has applied a Reservation is permitted regardless of the presence or absence of the Reservation Key's registration. The second access-control method is a one where accesses from all the paths that have registered the Reservation Keys are permitted if a Reservation has been applied from a certain path. Cutting off the access from a specific host and path necessitates the specification of the Reservation Key to be cut off.

[0008] Consequently, the access control to the logical disks by the above-described first method is performed in accordance with the following steps: An execution-node host and a standby-node host have performed in advance the registration of the Reservation Keys, and the execution-node host applies the Reservation. At the time of a failure occurrence, the standby-node host specifies the Reservation Key of the execution-node host, thereby performing the cut-off operation. After that, the standby-node host applies the Reservation.

[0009] Also, the access control to the logical disks by the above-described second method is performed in accordance with the following steps: Only the execution-node host performs the registration of the Reservation Keys for all the paths from the execution-node host to the disk device. Meanwhile, the standby-node host performs no registration of the Reservation Key. At the time of a failure occurrence, the standby-node host performs the registration of the Reservation Keys for all the paths from the standby-node host to the disk device. Next, the standby-node host specifies all the Reservation Keys of the execution-node host, thereby performing the cut-off operations. After that, the standby-node host applies the Reservation.

## SUMMARY OF THE INVENTION

[0010] In the conventional-technology method of performing the above-described I/O cut-off operation at the host side, the reset for the disk device clears all the I/O requests which are in processing within a disk control device. As a consequence, in a storage area network environment (SAN environment: Storage Area Network) where plural hosts and plural disk devices are connected to each other via switches, there exists a possibility that one disk control device makes I/O requests from the plural hosts to plural logical disks. This results in a problem that the above-described method is inapplicable in the SAN environment.

[0011] Also, of the conventional-technology methods of performing the I/O cut-off operation at the disk-device side, in the first method where only an access from a host that has applied a Reservation is permitted in the PERSISTENT RESERVE Command, there exists only one path whose access is permissible. As a consequence, it is impossible to apply the first method to situations where accesses from plural paths are wished to be permitted, such as a multi-path environment where there are provided plural paths from one host to a logical disk, and a case where plural operation-node hosts exist. This results in a problem that a limitation is imposed on the configuration to which the method is applicable.

[0012] Also, in the second method where the standby-node host performs no registration of the Reservation Key and, after detecting a failure, registers the Reservation Keys to perform the I/O cut-off operations, the standby-node host must perform these operations by the number which is equal to the number of the paths× the number of the logical disks. Here, when the second method is applied to a large-scale system, the number of the paths to be dealt with becomes equal to several to several tens of them, and the number of the logical disks becomes equal to several hundreds. As a consequence, it turns out that, even if it has been found successful to be able to process each operation in several milliseconds, processing all the operations necessitate a time of order of several to several tens of seconds in total. This gives rise to a problem that this total amount of time needed leads to an increase in the service interruption time-period at the time of the failure occurrence.

[0013] It is an object of the present invention to solve the above-described problems in the conventional technologies, and to provide a node switching method and an information processing system that allow a failure-occurrence-time I/O node-switching to be executed in a shorter time even in a large-scale system where hosts, logical disks, and paths connected to a disk device are large in number.

[0014] According to the present invention, the above-described object can be accomplished by a node switching method of controlling the execution enablement/disablement for I/O requests from plural host computers to a disk device so as to perform the switching to a node which is capable of executing the I/O requests. Here, the node switching method includes the following steps: The host computers transmit access-right change commands to the disk device in advance, the access-right change commands including one piece or plural pieces of information resulting from causing I/O-enable/disable information and host identification information to correspond to each other in a one-to-one correspondence manner, the I/O-enable/disable information indicating whether or not the disk device will execute the I/O requests from the host computers, the host identification information being designed for identifying the respective host computers, and the host computers issue, to the disk device, the I/O requests to which the host computers have added the host identification information, and the disk device, in accordance with the access-right change commands from the host computers, changes in batch the I/O-enable/disable information on each host-computer basis, and simultaneously stores and holds the access-right change commands, and the disk device identifies the request-source host computers in response to the I/O requests from the host computers, and, based on the host identification information and the I/O-enable/disable information that the disk device has held, the disk device judges the execution enablement/disablement for the I/O requests on each host-computer's node basis.

[0015] Also, the above-described object can be accomplished by a node switching method of controlling the execution enablement/disablement for I/O requests from plural host computers to a disk device so as to perform the switching to a node which is capable of executing the I/O requests. Here, the node switching method includes the following steps: The host computers possess plural application processes, and the application processes transmit access-right change commands to the disk device in advance, the access-right change commands including one piece or plural pieces of information resulting from causing I/O-enable/disable information and application-process identification information to correspond to each other in a one-to-one correspondence manner, the I/O-enable/disable information indicating whether or not the disk device will execute the I/O requests from the application processes, the application-process identification information being designed for identifying the respective application processes, and, the application processes issue, to the disk device, the I/O requests to which the application processes have added the application-process identification information, and the disk device, in accordance with the access-right change commands from the application processes, changes in batch the I/O-enable/disable information on each application-process basis, and simultaneously stores and holds the access-right change commands, and the disk device identifies the request-source application processes in response to the I/O requests from the application processes, and, based on the application-process identification information and the I/O-enable/disable information that the disk device has held, the disk device judges the execution enablement/disablement for the I/O requests on each application-process's node basis.

[0016] Moreover, the above-described object can be accomplished by an information processing system which is configured to control the execution enablement/disablement for I/O requests from plural host computers to a disk device so as to perform the switching to a node which is capable of executing the I/O requests. Here, each of the host computers includes an I/O request unit for issuing the I/O request to which the I/O request unit has added host identification information for identifying the respective host computers, and an access-right change command unit for transmitting an access-right change command to the disk device, the access-right change command including one piece or plural pieces of information resulting from causing I/O-enable/disable information and the host identification information to correspond to each other in a one-to-one correspondence manner, the I/O-enable/disable information indicating whether or not the disk device will execute the I/O requests from the host computers, the disk device including an access-right management table for storing and holding the access-right change commands from the host computers, an access control unit for identifying the request-source host computers of the I/O requests, and judging the execution enablement/disablement for the I/O requests on each host-computer basis from the host identification information and the access-right management table, and an access-right change unit that, in accordance with the access-right change commands from the host computers, changes in batch the I/O-enable/disable information on each host-computer basis within the access-right management table, the disk device judging the execution enablement/disablement for the I/O requests on each host-computer's node basis, the host computers being the I/O request sources.

[0017] The present invention makes it possible to cut off in batch the I/O requests from a host device where a failure has occurred, and to release in batch the cut-offs of the I/O requests from a standby-node host. This condition allows a high-safety node switching to be executed at a high speed, thereby making it possible to shorten a service interruption time-period in a system which is requested to exhibit a high reliability.

[0018] Other objects, features and advantages of the invention will become apparent from the following description of the embodiments of the invention taken in conjunction with the accompanying drawings.

## BRIEF DESCRIPTION OF THE DRAWINGS

[0019] **FIG. 1** is a block diagram for illustrating the entire configuration of an information processing system according to an embodiment of the present invention to which the present invention has been applied;

[0020] **FIG. 2** is a diagram for illustrating the configuration of an access-right management table within an access control table;

[0021] **FIG. 3** is a diagram for illustrating the configuration of a path-information management table within the access control table;

[0022] **FIG. 4** is a sequence diagram for explaining an operation of registering the path information into a disk device among an execution-node host, a standby-node host, and the disk device;

[0023] **FIG. 5** is a diagram for illustrating the configuration of the path information transmitted from an active-node host or the standby-node host;

[0024] **FIG. 6** is a sequence diagram for explaining the processing of I/O requests according to the embodiment of the present invention;

[0025] **FIG. 7** is a flowchart for explaining the processing operation by an access control unit **31** within the disk device in the processing sequences explained in **FIG. 6**;

[0026] **FIG. 8** is a flowchart for explaining the processing operation by the access control unit **31** when an I/O processed result is transmitted from an I/O processing unit;

[0027] **FIG. 9** is a sequence diagram for explaining in what manner the execution-node host and the standby-node host will detect failures of the partner hosts;

[0028] **FIG. 10** is a sequence diagram for explaining an access-right change processing operation when the standby-node host has detected a failure of the execution-node host;

[0029] **FIG. 11** is a diagram for illustrating the configuration of an access-right change command transmitted by the processing in the sequence **631** explained in **FIG. 10**;

[0030] **FIG. 12** is a flowchart for explaining the access-right change processing operation in an access-right change unit within the disk device in the processing sequence explained in **FIG. 10**;

[0031] **FIG. 13** is a sequence diagram for explaining a processing in the case where the execution-node host and the standby-node host make I/O requests to the disk device when the change of the access right has been performed by the processing explained in **FIG. 10**;

[0032] **FIG. 14** is a block diagram for illustrating the configuration of an information processing system according to a second embodiment of the present invention to which the present invention is applicable;

[0033] **FIG. 15** is a block diagram for illustrating the configuration of an information processing system according to a third embodiment of the present invention to which the present invention is applicable;

[0034] **FIG. 16** is a block diagram for illustrating the configuration of an information processing system according to a fourth embodiment of the present invention to which the present invention is applicable;

[0035] **FIG. 17** is a flowchart for explaining the processing operation in an access control unit within a disk device in the fourth embodiment of the present invention;

[0036] **FIG. 18** is a diagram for illustrating the configuration of an access-right management table within an access control table used in the fourth embodiment of the present invention;

[0037] **FIG. 19** is a diagram for illustrating the configuration of an access-right change command used in the fourth embodiment of the present invention; and

[0038] **FIG. 20** is a block diagram for illustrating the configuration of an information processing system according to a fifth embodiment of the present invention to which the present invention is applicable.

## DESCRIPTION OF THE EMBODIMENTS

[0039] Hereinafter, referring to the drawings, the detailed explanation will be given below concerning embodiments of the node switching method according to the present invention.

[0040] **FIG. 1** is a block diagram for illustrating the entire configuration of an information processing system according to a first embodiment of the present invention to which the present invention has been applied. In **FIG. 1**, the reference numerals denote the following configuration components: **10** an execution-node host computer (hereinafter, simply referred to as "execution-node host"), **11**, **21** path-information transmission units, **12**, **22** failure detection units, **13**, **23** I/O request units, **14**, **24** access-right change command units, **20** a standby-node host computer (hereinafter, simply referred to as "standby-node host"), **30** a disk device, **31** an access control unit, **32** an access-right change unit, **33** a path-information change unit, **34** an I/O processing unit, **35** an access control table, **36** logical disks.

[0041] The information processing system according to the first embodiment of the present invention includes the following configuration components: The execution-node host **10** which is executing an application process, the standby-node host **20** which is on standby in a state of being capable of executing the application process, and the disk device **30** for performing I/Os in accordance with I/O requests from the execution-node host **10** and the standby-node host **20**. In **FIG. 1**, connections among the execution-node host **10**, the standby-node host **20**, and the disk device **30** are illustrated such that the connections are established using different lines. The connections, however, are not limited to the different lines and may also be established using one and the same line. The execution-node host **10** includes the following configuration components: The path-information transmission unit **11** for transmitting path information on the hosts, the failure detection unit **12** for detecting a failure of the standby-node host **20**, the I/O request unit **13** for performing the I/O requests, and the access-right change command unit **14** for transmitting a command of the access-right change. The standby-node host **20**, similarly, includes the path-information transmission unit **21**, the failure detection unit **22**, the I/O request unit **23**, and the access-right change command unit **24**. The disk device **30** includes the following configuration components: The access control unit **31** for controlling cut-offs of the I/O requests, the access-right change unit **32** for changing the access right of the disk device **30** in accordance with the commands from the hosts, the path-information change unit **33** for receiving the path information transmitted from the hosts, the I/O processing unit **34** for actually performing the processings of the I/Os, the access control table **35** for holding information for controlling accesses from the hosts, and the plural logical disks **36** resulting from logically dividing an assembly of disk drives.

[**0042**] The access control table **35** includes two tables, i.e., an access-right management table **35***a* and a path-information management table **35***b*. Next, the explanation will be given below regarding these tables.

[**0043**] **FIG. 2** is a diagram for illustrating the configuration of the access-right management table **35***a* within the access control table **35**. **FIG. 3** is a diagram for illustrating the configuration of the path-information management table **35***b* within the access control table **35**.

[**0044**] The access-right management table **35***a* is a table for managing the enablement/disablement for the accesses on each host basis, and the number of the I/Os which are in processing. Accordingly, as illustrated in **FIG. 2**, the table **35***a* stores host identification information, I/O-enable/disable information, and in-processing I/O number information. Moreover, the table **35***a*, which holds one entry for one host, is initialized by commands from the hosts at the time of the hosts' system starting, and is updated by the access-right change commands from the hosts. At the time of the initialization, the I/O-enable/disable information in the entry corresponding to the execution-node host is set to be "enable", and the I/O-enable/disable information in the entry corresponding to the standby-node host is set to be "disable".

[**0045**] Meanwhile, the path-information management table **35***b* is a table for managing which of the hosts has held which of the paths. Accordingly, as illustrated in **FIG. 3**, the table **35***b* stores path identification information and the host identification information in a manner of being paired. Namely, the path-information management table **35***b* stores, as path information, the combination of the path identification information and the host identification information. Here, an example of the path identification information is N_Port ID in ANSI Standard FCP which is added to the I/O requests from the hosts for identifying logical paths from the transmission sources. Making reference to this table allows the access control on each I/O-request basis to be performed not on each path basis but on each host basis.

[**0046**] **FIG. 4** is a sequence diagram for explaining an operation of registering the path information into the disk device **30** among the execution-node host **10**, the standby-node host **20**, and the disk device **30**. Next, referring to **FIG. 4**, the explanation will be given below concerning the path-information registration operation in the embodiment of the present invention.

[**0047**] (1) At first, with respect to the disk device **30**, the execution-node host **10** transmits, from the path-information transmission unit **11** to the path-information change unit **33** of the disk device **30**, all the pieces of path information from the execution-node host **10** to the disk-device **30** (: sequence **601**).

[**0048**] (2) To the path-information management table **35***b* within the access control table **35**, the path-information change unit **33** of the disk device **30** adds, as one entry, the combination of the path identification information and the host identification information transmitted in the sequence **601** (: sequence **602**).

[**0049**] (3) Similarly, with respect to the disk device **30**, the standby-node host **20** transmits, from the path-information transmission unit **21** to the path-information change unit **33** of the disk device **30**, all the pieces of path information from the standby-node host **20** to the disk device **30**. Furthermore, to the path-information management table **35***b* within the access control table **35**, the path-information change unit **33** adds, as one entry, the combination of the path identification information and the host identification information transmitted (: sequences **603**, **604**).

[**0050**] **FIG. 5** is a diagram for illustrating the configuration of path information **50** transmitted from an execution-node host or the standby-node host. This path information **50** is the path information transmitted in the above-described sequences **601**, **603**. As illustrated in **FIG. 5**, this path information **50** includes the host identification information and the path identification information from the hosts to the disk device. Here, there may exist the plural pieces of path identification information.

[**0051**] **FIG. 6** is a sequence diagram for explaining the processing of I/O requests according to the embodiment of the present invention. Next, the explanation will be given below regarding this processing. The sequences indicated here are about the processing in the following case: In the state where the I/O-enablement/disablement in the access-right management table **35***a* corresponding to the execution-node host **10** is set to be "enable", and where the I/O-enablement/disablement in the access-right management table **35***a* corresponding to the standby-node host **20** is set to be "disable", the execution-node host **10** and the standby-node host **20** transmit the I/O requests to the disk device **30**.

[**0052**] (1) The I/O request unit **13** of the execution-node host **10** transmits an I/O request to the disk device **30**. The access control unit **31** of the disk device **30** receives this transmitted I/O request. Then, from the path-information management table **35***b* in the access control table **35**, the unit **31** retrieves an entry which coincides with path identification information included in the I/O request, thereby determining the corresponding host identification information. Next, from the access-right management table **35***a*, the unit **31** retrieves an entry which coincides with the corresponding host identification information, thereby acquiring I/O-enable/disable information in the entry which has coincided therewith. Moreover, the unit **31** updates the in-processing I/O number in the access-right management table **35***a* (: sequences **611** to **613**).

[**0053**] (2) The example explained here assumes that the I/O-enablement/disablement in the access-right management table **35***a* corresponding to the execution-node host **10** has been set to be "enable". Namely, the I/O-enable/disable information is "enable". Consequently, the access control unit **31** of the disk device **30** transmits the I/O request to the I/O processing unit **34**, then receiving an I/O processed result transmitted from the I/O processing unit **34** (: sequences **614**, **615**).

[**0054**] (3) After having received the I/O processed result transmitted from the I/O processing unit **34**, the access control unit **31** performs the updating of the in-processing I/O number in the access-right management table **35***a*. Simultaneously, the unit **31** transmits the I/O processed result to the I/O request unit **13** of the execution-node host **10** (: sequences **616**, **617**).

[**0055**] (4) Meanwhile, if the I/O request unit **23** of the standby-node host **20** transmits an I/O request to the disk device **30**, the access control unit **31** of the disk device **30** receives this I/O request. Then, similarly with the above-described case, the unit **31** retrieves an entry which coincides with path identification information included in the I/O request, thereby determining the corresponding host identification information. Next, from the access-right management table **35***a*, the unit **31** retrieves an entry which coincides with the corresponding host identification information, thereby acquiring I/O-enable/disable information in the entry which has coincided therewith. In this case, however, the I/O-enablement/disablement in the access-right management table **35***a* has been set to be "disable". Consequently, the access control unit **31** transmits an I/O cut-off notice to the I/O request unit **23** of the standby-node host **20** (: sequences **618** to **620**).

[**0056**] **FIG. 7** is a flowchart for explaining the processing operation by the access control unit **31** within the disk device **30** in the processing sequences explained in **FIG. 6**. Next, the explanation will be given below concerning this operation.

[**0057**] (1) Having received the I/O request from the I/O request unit **13** of the execution-node host **10** or the I/O request unit **23** of the standby-node host **20**, the access control unit **13** retrieves, from the path-information management table **35***b* in the access control table **35**, the entry which coincides with the path identification information included in the I/O request, thereby determining the corresponding host identification information. Next, from the access-right management table **35***a*, the unit **31** retrieves the entry which coincides with the corresponding host identification information, thereby acquiring the I/O-enable/disable information in the entry which has coincided therewith (: steps **3101**, **3102**).

[**0058**] (2) Moreover, the access control unit **31** judges whether the I/O-enable/disable information acquired has been set to be "enable" or "disable". If the information has been set to be "disable", the unit **31** transmits the I/O cut-off notice, which notifies that the I/O request has failed, to the I/O request unit of the host that had transmitted this I/O request (i.e., the I/O request unit **23** of the standby-node host **20** in the explained example) (: steps **3103**, **3104**).

[**0059**] (3) If, in the judgment at the step **3103**, the I/O-enable/disable information acquired has been set to be "enable", this I/O request is permitted. Accordingly, the access control unit **31** increments, by 1, the in-processing I/O number in the entry in the access-right management table **35***a* within the access control table **35** corresponding to the host that had transmitted this I/O request (i.e., the execution-node host **10** in the explained example) (: step **3105**).

[**0060**] (4) After that, the access control unit **31** transmits the command of the I/O processing requested to the I/O processing unit **34**. Next, the I/O processing unit **34** performs the I/O processing to the logical disks **36**, then waiting for the I/O processed result to be transmitted (: step **3106**).

[**0061**] **FIG. 8** is a flowchart for explaining the processing operation by the access control unit **31** when the I/O processed result is transmitted from the I/O processing unit **34**. Next, the explanation will be given below regarding this operation. The processing here is the one at the time when the sequence **617** in **FIG. 6** is performed.

[**0062**] (1) The access control unit **31** of the disk device **30** receives, from the I/O processing unit **34**, a notice that the I/O processing has been completed, and simultaneously the unit **31** receives the I/O processed result (: step **3107**).

[**0063**] (2) Having received the notice of the I/O-processing completion, the access control unit **31** decrements, by 1, the in-processing I/O number in the entry in the access-right management table **35***a* within the access control table **35** corresponding to the host that had requested the I/O processing (i.e., the execution-node host **10** in the explained example). Next, the unit **31** transmits the I/O processed result to the I/O request unit **13** of the execution-node host **10** (: steps **3108**, **3109**).

[**0064**] **FIG. 9** is a sequence diagram for explaining in what manner the execution-node host **10** and the standby-node host **20** will detect failures of the partner hosts. The example indicated in **FIG. 9** is a one where the standby-node host **20** performs the failure detection of the execution-node host **10**.

[**0065**] As illustrated in **FIG. 9**, the failure detection unit **22** of the standby-node host **20** transmits health check information to the failure detection unit **12** of the execution-node host **10** (: sequence **621**). In response to this transmission of the health check information, if the failure detection unit **12** of the execution-node host **10** returns an error (: sequence **622**), or makes no response within a certain time-period, the failure detection unit **22** of the standby-node host **20** judges that a failure has occurred in the execution-node host **10**. If, conversely, the execution-node host **10** performs the failure detection of the standby-node host **20**, the sequences are basically the same as the above-described ones except that the transmission of the health check information is just performed from the failure detection unit **12** of the execution-node host **10**. Incidentally, in the present invention, the failure detection method is not limited to the above-described one.

[**0066**] **FIG. 10** is a sequence diagram for explaining an access-right change processing operation when the standby-node host **20** has detected a failure of the execution-node host **10**. Next, the explanation will be given below concerning the access-right change processing at the time of a failure detection in the embodiment of the present invention.

[**0067**] (1) If the standby-node host **20** has detected a failure of the execution-node host **10**, the standby-node host **20**, which has detected the failure of the execution-node host **10**, transmits an access-right change command **110** from the access-right change command unit **24** to the access-right change unit **32** of the disk device **30**. Here, the access-right change command **110** is a command for cutting off I/O accesses from the execution-node host **10**, and for releasing the cut-offs of I/O accesses from the standby-node host **20** (: sequence **631**).

[**0068**] (2) Having received the access-right change command **110** in the sequence **631**, the access-right change unit **32** of the disk device **30** performs the following operation in order not to permit a new access from the execution-node host **10**: At first, the unit **32** extracts, from the access-right change command **110**, one entry in which the I/O-enablement/disablement has become "disable". Next, the unit **32** updates, to "disable", the I/O-enablement/disablement in the entry (i.e., the one corresponding to the execution-node host **10** in the case of the explained example) in the access-right management table **35***a* within the access control table **35** whose host identification information coincides with that of the extracted one entry (: sequence **632**).

[**0069**] (3) Also, the access-right change unit **32** retrieves the in-processing I/O number for the cut-off host, thereby judging whether or not there exist entries in which the in-processing I/O numbers are not equal to 0. If there exists at least one such entry, the unit **32** waits for all of the in-processing I/O numbers to become equal to 0 (: sequence **633**).

[**0070**] (4) If all of the in-processing I/O numbers have become equal to 0, the access-right change unit **32** performs the following operation in order to perform the operation of releasing the cut-offs of the I/O accesses: Namely, the unit **32** extracts, from the access-right change command **110**, one entry in which the I/O-enablement/disablement has become "enable". Next, the unit **32** updates, to "enable", the I/O-enablement/disablement in the entry (i.e., the one corresponding to the standby-node host **20** in the case of the explained example) in the access-right management table **35***a* within the access control table **35** whose host identification information coincides with that of the extracted one entry (: sequence **634**).

[**0071**] (5) After that, the access-right change unit **32** confirms that all the processings for the transmitted access-right change command **110** have been terminated, then transmitting a completion notice to the access-right change command unit **24** of the standby-node host **20** (: sequence **635**).

[**0072**] The above-described processing allows the cut-offs of the I/O requests from the plural hosts to be controlled in a batch manner on each host basis.

[**0073**] **FIG. 11** is a diagram for illustrating the configuration of the access-right change command **110** transmitted by the processing in the sequence **631** explained in **FIG. 10**. The transmitted access-right change command **110** includes the host identification information for identifying the hosts whose access rights should be changed and the information on the I/O-enablement/disablement. The example illustrated in **FIG. 11** is a one of transmitting the command in batch for cutting off in batch the I/O accesses from the host **1**, and for releasing in batch the cut-offs of the I/O accesses from the host **2**.

[**0074**] **FIG. 12** is a flowchart for explaining the access-right change processing operation by the access-right change unit **32** within the disk device **30** in the processing sequences explained in **FIG. 10**. Next, the explanation will be given below regarding this operation.

[**0075**] (1) Having received the access-right change command **110**, the access-right change unit **32** of the disk device **30** performs the following operation in order not to permit the new access from the execution-node host **10**: At first, the unit **32** extracts, from the access-right change command **110**, one entry in which the I/O-enablement/disablement has become "disable". Next, the unit **32** updates, to "disable", the I/O-enablement/disablement in the entry (i.e., the one corresponding to the execution-node host **10** in this embodiment) in the access-right management table **35***a* within the access control table **35** whose host identification information coincides with that of the extracted one entry (: steps **3201** to **3203**).

[**0076**] (2) Moreover, the access-right change unit **32** judges whether or not, of unprocessed entries in the access-right change command **110**, there further exists an entry in which the I/O-enablement/disablement has become "disable". If there exists the entry, the unit **32**, going back to the processing from the step **3202**, extracts the next entry, then performing basically the same processing. At this time, an I/O request which has been held by the disk device **30** but whose I/O processing has been not started yet is immediately returned back to the execution-node host **10** as an error. If the execution-node host **10** has fallen down, this error response is discarded (: step **3204**).

[**0077**] (3) The processings for all of the entries in the access-right change command **110** in which the I/O-enablement/disablement has become "disable" are eventually terminated. Namely, in the judgment at the step **3204**, if, of the unprocessed entries in the access-right change command **110**, the entries in which the I/O-enablement/disablement has become "disable" have been judged to disappear, the unit **32** retrieves, from the access-right management table **35***a* within the access control table **35**, the in-processing I/O numbers in all of the entries in which the I/O-enablement/disablement has become "disable" (: step **3205**).

[**0078**] (4) Next, the access-right change unit **32** judges whether or not, in all of the entries retrieved in the processing at the step **3205**, there exist the entries in which the in-processing I/O numbers are not equal to 0. If there exists at least one such entry, the unit **32** waits for all of the in-processing I/O numbers to become equal to 0 (: step **3206**).

[**0079**] (5) If all of the in-processing I/O numbers have become equal to 0, and, if, in the judgment at the step **3206**, such entries have been judged to disappear, then, the unit **32** performs the following operation in order to perform the I/O-access cut-off releasing operation: Namely, the unit **32** extracts, from the access-right change command **110**, the one entry in which the I/O-enablement/disablement has become "enable". Next, the unit **32** updates, to "enable", the I/O-enablement/disablement in the entry (i.e., the one corresponding to the standby-node host **20** in the case of the explained example) in the access-right management table **35***a* within the access control table **35** whose host identification information coincides with that of the extracted one entry (: steps **3207**, **3208**).

[**0080**] (6) Furthermore, the access-right change unit **32** judges whether or not, of the unprocessed entries in the access-right change command **110**, there further exists an entry in which the I/O-enablement/disablement has become "enable". If there exists the entry, the unit **32**, going back to the processing from the step **3207**, extracts the next entry, then performing basically the same processing (: step **3209**).

[**0081**] (7) In the judgment at the step **3209**, if, of the unprocessed entries in the access-right change command **110**, the entries in which the I/O-enablement/disablement has become "enable" have been judged to disappear, it turns out that all of the processings for the transmitted access-right change command **110** have been terminated. Accordingly, the access-right change unit **32** of the disk device **30** transmits the completion notice to the access-right change command unit **24** of the standby-node host **20** (: step **3210**).

[**0082**] **FIG. 13** is a sequence diagram for explaining a processing in the case where the execution-node host **10** and the standby-node host **20** make I/O requests to the disk device **30** when the change of the access right has been performed by the processing explained in **FIG. 10**. In the sequences indicated in **FIG. 13**, it turns out that, contrary to the sequences explained in **FIG. 6**, an I/O request from the standby-node host **20** is permitted (: **131, 132**), and an I/O request from the execution-node host **10** is cut off (: **133, 134**).

[**0083**] The above-describe embodiment of the present invention has been explained as the embodiment which results from applying the present invention to the information processing system with the configuration explained and indicated in **FIG. 1**. In addition to the system with the configuration indicated in **FIG. 1**, however, the present invention is also applicable to systems with various types of configurations. Next, the explanation will be given below concerning these systems.

[**0084**] **FIG. 14** is a block diagram for illustrating the configuration of an information processing system according to a second embodiment of the present invention to which the present invention is applicable. The second embodiment illustrated in **FIG. 14** is an embodiment configured such that a disk device is shared by plural systems each of which includes an active-node host and a standby-node host. In the case of this configuration, logical disks within the disk device are grouped into plural zones, and the logical disks within each zone are set in advance to deny an access from a path other than the one connected therewith. Even in the configuration like this, the present invention makes it possible to set the access right on each host basis grouped into each zone. This condition allows the co-use of the present invention with the already-existing function of zone-grouping the disk device.

[**0085**] **FIG. 15** is a block diagram for illustrating the configuration of an information processing system according to a third embodiment of the present invention to which the present invention is applicable. The third embodiment illustrated in **FIG. 15** is an embodiment configured as follows: Each of an active-node host and a standby-node host is connected to a disk device via plural paths, and thus each host finds it possible to perform the load distribution by using the plural paths simultaneously. The present invention performs the access control on each host basis and regardless of the path number. This condition makes the present invention also applicable to the configuration like this.

[**0086**] **FIG. 16** is a block diagram for illustrating the configuration of an information processing system according to a fourth embodiment of the present invention to which the present invention is applicable. The fourth embodiment illustrated in **FIG. 16** is an embodiment configured such that plural application processes are allowed to exist within one host, and such that the respective application processes use different logical disks. Namely, the fourth embodiment of the present invention is configured as follows: An application process **1** as an execution node and an application process **2** as a standby node are allowed to exist within a host **1**, and the application process **2** as an execution node and the application process **1** as a standby node are allowed to exist within a host **2**. Also, the application processes **1** as the execution node and the standby node are connected to one of logical disks within a disk device, and the application processes **2** as the execution node and the standby node are connected to the other logical disk within the disk device.

[**0087**] In the system according to the fourth embodiment of the present invention, when the application processes which are existing as an execution node in each host are being executed in each host, if a failure such as an application-process down occurs in one of the hosts, the execution of the application process falling down in the host where the failure has occurred is restarted on the other host where the other application process is being executed. In such a case, even in the case of I/O requests from one and the same host, an I/O request which should be permitted and an I/O request which should not be permitted must be distinguished on each application-process basis. For example, if, in **FIG. 16**, the application process **1** that is operating on the host **1** as the execution node falls down, the disk device cuts off an I/O request from the application process **1** on the host **1**, and releases the cut-off of an I/O request from the application process **1** on the host **2**. This procedure is needed to be performed without exerting influences on an I/O request from the application process **2** that is operating on the host **1**.

[**0088**] The explanation has been given so far concerning the above-described embodiments of the present invention on the assumption that that the embodiments perform the access control on each host basis. In the configuration indicated as the fourth embodiment, however, the present invention can be expanded to the access control on each application-process basis. This expansion can be implemented by employing either of two methods which will be explained below:

[**0089**] The first method is a one where identification information for identifying the application processes is added to the I/O requests. Namely, this method is as follows: This application-process identification information is added to the host identification information included in the access-right management table **35***a* explained in **FIG. 2** and the access-right change command **110** explained in **FIG. 11**. Moreover, the application-process identification information is also added to the I/O requests that the application processes transmit. Furthermore, the processing operation by the access control unit **31** within the disk device **30** is modified as will be explained below using **FIG. 17**.

[**0090**] **FIG. 17** is a flowchart for explaining the processing operation by the access control unit **31** within the disk device **30** in the fourth embodiment of the present invention. This flowchart results from adding the processing at a step **3110** to the flowchart illustrated in **FIG. 7**. The steps other than the step **3110** are the same as those in the case of **FIG.**

7. As illustrated in **FIG. 17**, the execution of the processing at the step **3110** analyzes the I/O requests, thereby acquiring the application-process identification information. This allows the implementation of a comparison on each received I/O-request basis between the I/O requests and the host identification information within the access control table **35** including the application-process identification information.

[**0091**] In the fourth embodiment of the present invention, the employment of the above-described method makes it possible to implement the access control without being conscious of the paths. This makes the following configuration elements unnecessary: The path-information transmission units of the hosts, the path-information change unit of the disk device, the path-information management table within the access control table of the disk device, the path information that the hosts transmit to the disk device, and the path-information registration processing in **FIG. 4**.

[**0092**] Next, in the system configuration of the fourth embodiment of the present invention, the second method for allowing the access control on each application-process basis is as follows: Namely, in addition to the access-right change on each host basis, the access-right change is performed on each logical-disk basis simultaneously. Next, the explanation will be given below regarding this method.

[**0093**] **FIG. 18** is a diagram for illustrating the configuration of an access-right management table **35***aa* within the access control table **35** used in the fourth embodiment of the present invention. Also, **FIG. 19** is a diagram for illustrating the configuration of an access-right change command **110***a* used in the fourth embodiment of the present invention. As shown from **FIG. 18** and **FIG. 19**, the access-right management table **35***aa* and the access-right change command **110***a* within the access control table **35** used in the fourth embodiment of the present invention are configured by adding identification information for identifying the logical disks to the table **35***a* and the command **110** explained in **FIG. 2** and **FIG. 11** each.

[**0094**] Furthermore, in the second method for allowing the access control on each application-process basis in the system configuration of the fourth embodiment of the present invention, in substitution for the step **3102** explained in **FIG. 7**, the following steps allow the execution of the access control on each host basis and on each logical-disk basis: Namely, a step of retrieving entries in which path identification information included in the I/O requests coincides with the path identification information within the path-information management table **35***b* illustrated in **FIG. 3**, and, based on the host identification information in the entries which have coincided therewith and target logical-disk information included in the I/O requests, a step of retrieving, from the access-right management table **35***aa* illustrated in **FIG. 18**, entries of the access control information in which the host identification information and the logical-disk identification information coincide with each other.

[**0095**] Also, when the hosts transmit the access-right change commands to the disk device, the hosts transmit the commands based on the access-right change command **110***a* which, as illustrated in **FIG. 19**, includes the logical disks becoming the access-right change targets, the host identification information on the hosts whose access rights are to be changed, and the access enablement/disablement information. The disk device changes, to "enable" or "disable", the I/O-enable/disable information in entries in which the logical disks and the host identification information within the access-right management table **35***aa* illustrated in **FIG. 18** and the logical disks and the host identification information included in the access-right change command **110***a* coincide with each other. This allows the implementation of the access-right changes on each host basis and on each logical-disk basis.

[**0096**] As described above, base on the second method in the fourth embodiment of the present invention, the access-right change commands are performed in batch with respect to the logical-disk group that the application processes access. This permits the implementation of the access control on each application-process basis.

[**0097**] The above-described first method in the fourth embodiment of the present invention requires that the application-process identification information be added to the I/O requests. On the other hand, the case of the second method permits the in-batch access control over the logical disks to be executed on each application-process basis without adding the application-process identification information to the I/O requests.

[**0098**] **FIG. 20** is a block diagram for illustrating the configuration of an information processing system according to a fifth embodiment of the present invention to which the present invention is applicable. The fifth embodiment illustrated in **FIG. 20** is an embodiment configured as follows: There exist plural execution-node hosts in such a manner that, even if a failure occurs in whatever execution-node host, one standby-node host will be able to restart the execution of a processing in the execution-node host where the failure has occurred. In this case, if I/O requests from the plural execution-node hosts occur simultaneously, and if a failure occurs in one of the execution-node hosts, it is required to cut off the I/O request from the execution-node host where the failure has occurred, and to release the cut-off of the I/O request from the standby-node host. The present invention performs the access control on each host basis, which makes the present invention applicable to even the configuration like this.

[**0099**] The above-described respective processings in the respective embodiments of the present invention can be configured as processing programs. These processing programs can be provided in a state of being stored into storage media such as a HD, a DAT, a FD, a MO, a DVD-ROM, and a CD-ROM.

[**0100**] It should be further understood by those skilled in the art that although the foregoing description has been made on embodiments of the invention, the invention is not limited thereto and various changes and modifications may be made without departing from the spirit of the invention and the scope of the appended claims.

What is claimed is:

**1**. A node switching method of controlling the execution enablement/disablement for I/O requests from plural host computers to a disk device so as to perform the switching to a node which is capable of executing said I/O requests, said node switching method comprising the steps of:

in said host computers,

transmitting access-right change commands to said disk device in advance, said access-right change commands including one piece or plural pieces of information resulting from causing I/O-enable/disable information and host identification information to correspond to each other in a one-to-one correspondence manner, said I/O-enable/disable information indicating whether or not said disk device will execute said I/O requests from said host computers, said host identification information being designed for identifying said respective host computers, and

issuing, to said disk device, said I/O requests to which said host computers have added said host identification information; and

in said disk device,

changing in batch said I/O-enable/disable information on each host-computer basis in accordance with said access-right change commands from said host computers, and simultaneously storing and holding said access-right change commands,

identifying said request-source host computers in response to said I/O requests from said host computers, and, based on said host identification information and said I/O-enable/disable information that said disk device has held,

judging said execution enablement/disablement for said I/O requests on each host-computer's node basis.

**2**. The node switching method according to claim 1, further comprising the steps of:

in said host computers,

transmitting path information to said disk device in advance, said path information resulting from causing said host identification information and path identification information to correspond to each other, said path identification information being designed for identifying all of logical paths from said host computers to said disk device, and

issuing said I/O requests to which said host computers have added said path identification information; and

in said disk device,

storing and holding said path identification information transmitted from said host computers,

extracting said path identification information from said I/O requests transmitted from said host computers, extracting said host identification information corresponding to said path identification information stored and held, and simultaneously extracting said I/O-enable/disable information with which said host identification information extracted coincides, and

judging said execution enablement/disablement for said I/O requests on each host-computer's node basis.

**3**. The node switching method according to claim 1, further comprising the steps of:

if an I/O-disable command is included in said I/O-enable/disable information in said access-right change commands transmitted from said host computers,

in said disk device,

extracting, from among said access-right change commands, host identification information corresponding to said I/O-enable/disable information with respect to all of I/O-disable commands included in said same access-right change commands, and

updating I/O-enable/disable information for host identification information into an I/O-disable state, said host identification information coinciding with said host identification information extracted and being stored and held in said disk device, and

if an I/O-enable command is included in said I/O-enable/disable information in said access-right change commands transmitted from said host computers,

in said disk device,

extracting, from among said access-right change commands, host identification information corresponding to said I/O-enable/disable information with respect to all of I/O-enable commands included in said same access-right change commands, and

updating said I/O-enable/disable information for host identification information into an I/O-enable state, said host identification information coinciding with said host identification information extracted and being stored and held in said disk device.

**4**. The node switching method according to claim 3, wherein

said processing of updating said I/O-enable/disable information for said host identification information into said I/O-enable state is kept waiting for all of I/Os to be completed, and is executed after the completion of all of said I/Os, said host identification information being stored and held in said disk device, all of said I/Os being in processing in said host computers.

**5**. The node switching method according to claim 2, wherein

said disk device is configured to include plural logical disks resulting from logically dividing an assembly of disk drives,

said host computers

transmitting said access-right change commands to said disk device in advance, said access-right change commands including one piece or plural pieces of information resulting from causing said I/O-enable/disable information, said host identification information and logical-disk identification information to correspond to each other, said I/O-enable/disable information indicating whether or not said disk device will execute said I/O requests from said host computers, said host identification information being designed for identifying said respective host computers, and said logical-disk identification information being designed for identifying said logical disks, and

issuing, to said disk device, said I/O requests to which said host computers have added said logical-disk identification information and said path identification information;

said disk device

changing in batch said I/O-enable/disable information on each host-computer basis in accordance with said access-right change commands from said host computers, and simultaneously storing and holding said access-right change commands,

extracting said path identification information from said I/O requests transmitted from said host computers, extracting said host identification information corresponding to said path identification information from said access-right change commands stored and held, and extracting said I/O-enable/disable information for which said host identification information extracted and logical-disk identification information on logical disks selected as targets of said I/O requests coincide with each other, and

judging said execution enablement/disablement for said I/O requests on each host-computer's node basis.

**6**. The node switching method according to claim 5, wherein

said extraction of said I/O-enable/disable information comprising the steps of:

extracting said logical-disk identification information and said host identification information from said access-right change commands, and

extracting said I/O-enable/disable information whose logical-disk identification information and host identification information coincide with said logical-disk identification information and said host identification information extracted.

**7**. A node switching method of controlling said execution enablement/disablement for I/O requests from plural host computers to a disk device so as to perform the switching to a node which is capable of executing said I/O requests, said node switching method, wherein

said host computers possesses plural application processes;

said application processes includes the steps of:

transmitting access-right change commands to said disk device in advance, said access-right change commands including one piece or plural pieces of information resulting from causing I/O-enable/disable information and application-process identification information to correspond to each other in a one-to-one correspondence manner, said I/O-enable/disable information indicating whether or not said disk device will execute said I/O requests from said application processes, said application-process identification information being designed for identifying said respective application processes, and,

issuing, to said disk device, said I/O requests to which said application processes have added said application-process identification information; and

said disk device includes the steps of:

changing in batch said I/O-enable/disable information on each application-process basis in accordance with said access-right change commands from said application processes, and simultaneously storing and holding said access-right change commands, identifying said request-source application processes in response to said I/O requests from said application processes, and, based on said application-process identification information and said I/O-enable/disable information that said disk device has held, and

judging said execution enablement/disablement for said I/O requests on each application-process's node basis.

**8**. An information processing system configured to control the execution enablement/disablement for I/O requests from plural host computers to a disk device so as to perform the switching to a node which is capable of executing said I/O requests,

each of said host computers comprising:

an I/O request unit for issuing said I/O request to which said I/O request unit has added host identification information for identifying said respective host computers, and

an access-right change command unit for transmitting an access-right change command to said disk device, said access-right change command including one piece or plural pieces of information resulting from causing I/O-enable/disable information and said host identification information to correspond to each other in a one-to-one correspondence manner, said I/O-enable/disable information indicating whether or not said disk device will execute said I/O requests from said host computers; and

said disk device comprising:

an access-right management table for storing and holding said access-right change commands from said host computers,

an access control unit for identifying said request-source host computers of said I/O requests, and judging said execution enablement/disablement for said I/O requests on each host-computer basis from said host identification information and said access-right management table, and

an access-right change unit that, in accordance with said access-right change commands from said host computers, changes in batch said I/O-enable/disable information on each host-computer basis within said access-right management table,

said disk device judging said execution enablement/disablement for said I/O requests on each host-computer's node basis, said host computers being said I/O request sources.

**9**. The information processing system according to claim 8, wherein

each of said host computers further comprises a path-information transmission unit for transmitting path information to said disk device, said path information resulting from causing said host identification information and path identification information to correspond to each other, said path identification information being designed for identifying all of logical paths from said host computers to said disk device,

said disk device further comprising a path-information management table for storing and holding said path information transmitted from said path-information transmission unit in each of said host computers,

said I/O request unit issuing, to said disk device, said I/O request to which said I/O request unit has added said path identification information,

said access control unit

extracting said path identification information from said I/O requests transmitted from said host computers, making reference to said path-information management table thereby to extract said host identification information corresponding to said path identification information extracted, and making reference to said access-right management table thereby to extract said I/O-enable/disable information with which said host identification information extracted coincides, and

judging said execution enablement/disablement for said I/O requests on each host-computer's node basis.

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