US 20030189929A1

(19) United States

(12) Patent Application Publication (10) Pub. No.: US 2003/0189929 A1

Matsuzaki et al. (43) Pub. Date: Oct. 9, 2003

(54) ELECTRONIC APPARATUS FOR ASSISTING REALIZATION OF STORAGE AREA NETWORK SYSTEM

(75) Inventors: **Noriaki Matsuzaki**, Kato-gun (JP); **Yasushi Kishimoto**, Kato-gun (JP); **Fumikazu Fujimoto**, Kato-gun (JP); **Kenichi Matsumoto**, Kato-gun (JP); **Hiroki Ohashi**, Kato-gun (JP); **Hideaki Hasegawa**, Kato-gun (JP); **Keiko Usunaga**, Kato-gun (JP); **Soichi Takeuchi**, Kato-gun (JP)

Correspondence Address:
STAAS & HALSEY LLP
SUITE 700
1201 NEW YORK AVENUE, N.W.
WASHINGTON, DC 20005 (US)

(73) Assignee: **FUJITSU LIMITED**, Kawasaki (JP)

(21) Appl. No.: **10/270,131**

(22) Filed: **Oct. 15, 2002**

(30) **Foreign Application Priority Data**

Apr. 4, 2002 (JP) 2002-102974

Publication Classification

(51) **Int. Cl.**[7] **H04L 12/28**

(52) **U.S. Cl.** **370/389**

(57) **ABSTRACT**

An apparatus for assisting the realization of a storage area network (SAN) system is provided. The assisting apparatus includes first and second information input means and plan generating means. The first information input means is provided for inputting device data of the servers, the storages and the fiber channel switches used for the SAN system. The second information input means is provided for inputting information about physical connection among the servers, the storages and the switches. The plan generating means is provided for generating, based on the information inputted through the two information input means, a plan of a virtual storage area network system. The generated plan is visually presented by a display.

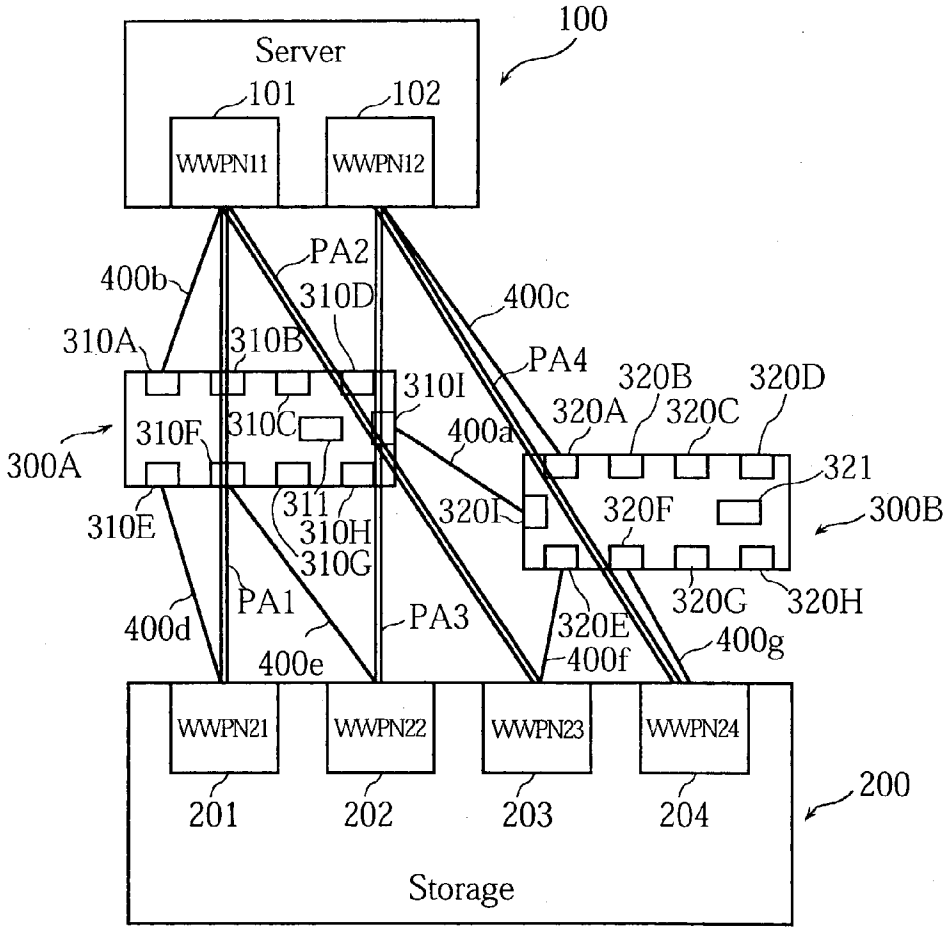


FIG.1

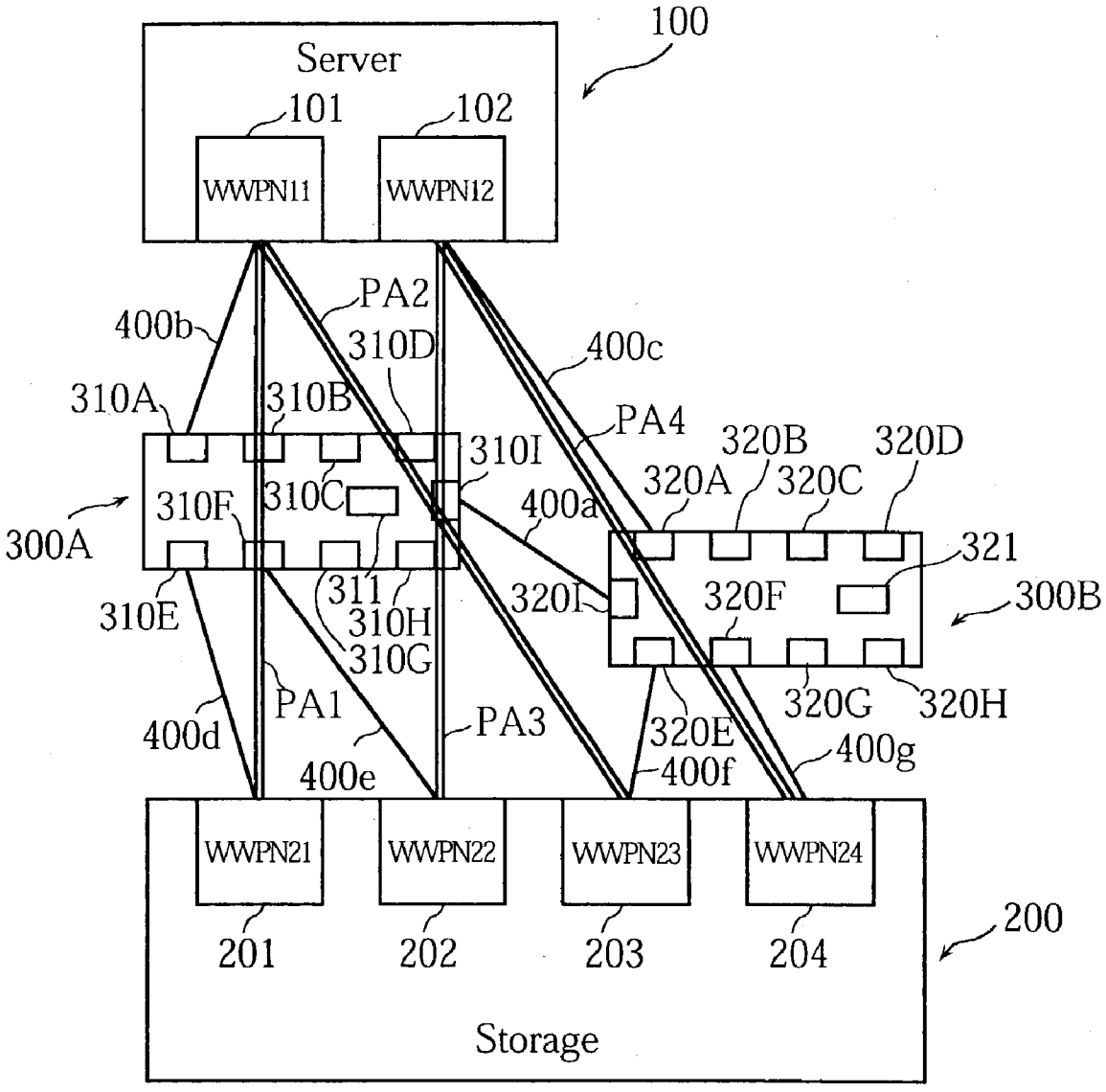

100
Server
101
102
WWPN11
WWPN12
PA2
400b
310D
400c
310A
310B
PA4
320B
320D
310I
320A
320C
310F
310C
400a
300A
321
311
320I
320F
300B
310E
310H
310G
320G
320H
PA1
PA3
400d
320E
400g
400e
400f
WWPN21
WWPN22
WWPN23
WWPN24
200
201
202
203
204
Storage

FIG.2

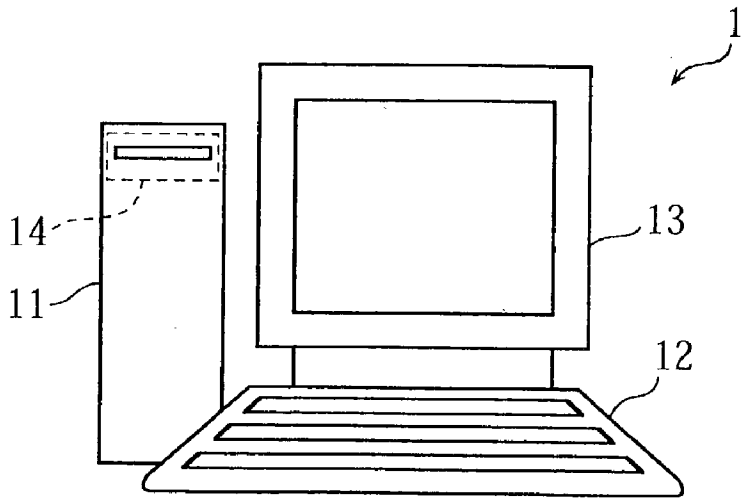

1
14
11
13
12

FIG.3

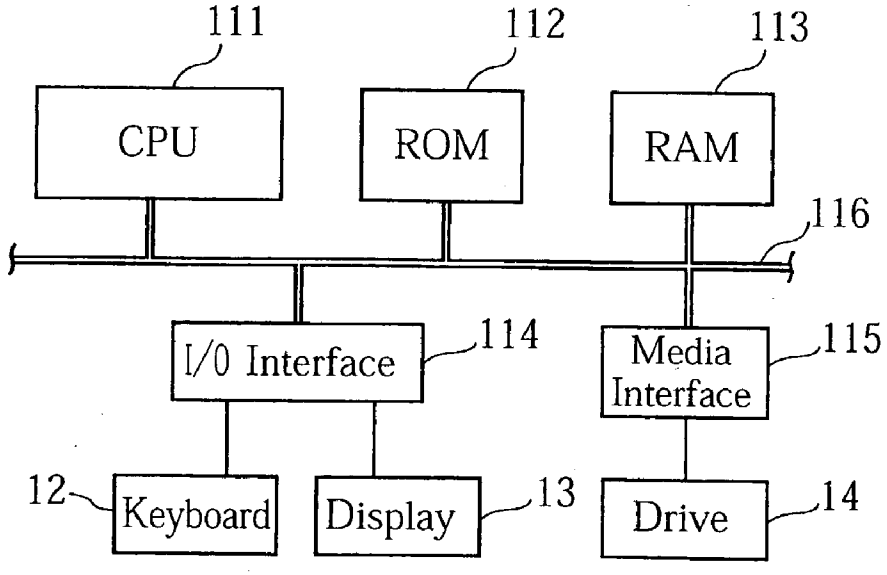

111
112
113
CPU
ROM
RAM
116
I/O Interface
114
Media Interface
115
12
Keyboard
Display
13
Drive
14

FIG.4

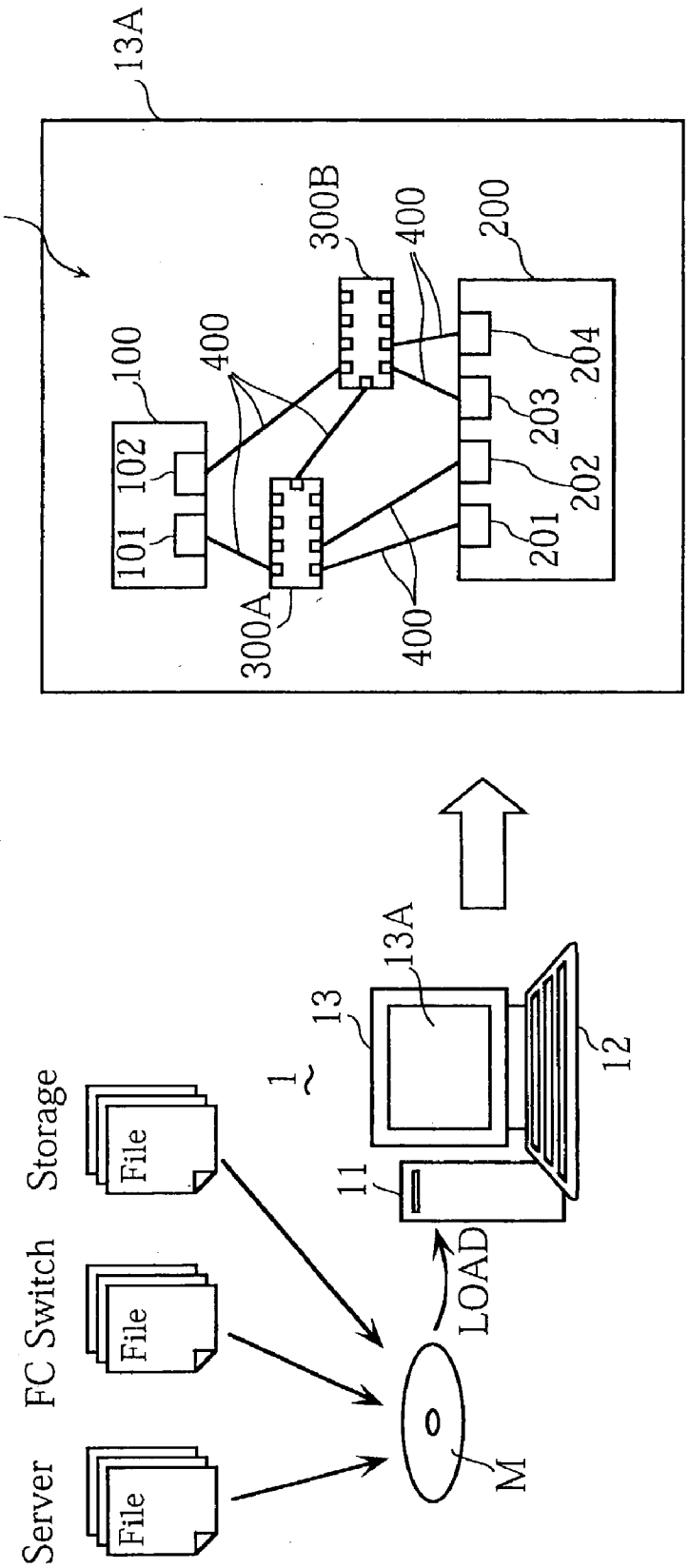

13A
G
300B
400
200
100
400
204
203
102
202
101
201
300A
400
Server
FC Switch
Storage
File
File
File
1
13
13A
12
11
LOAD
M

FIG.5

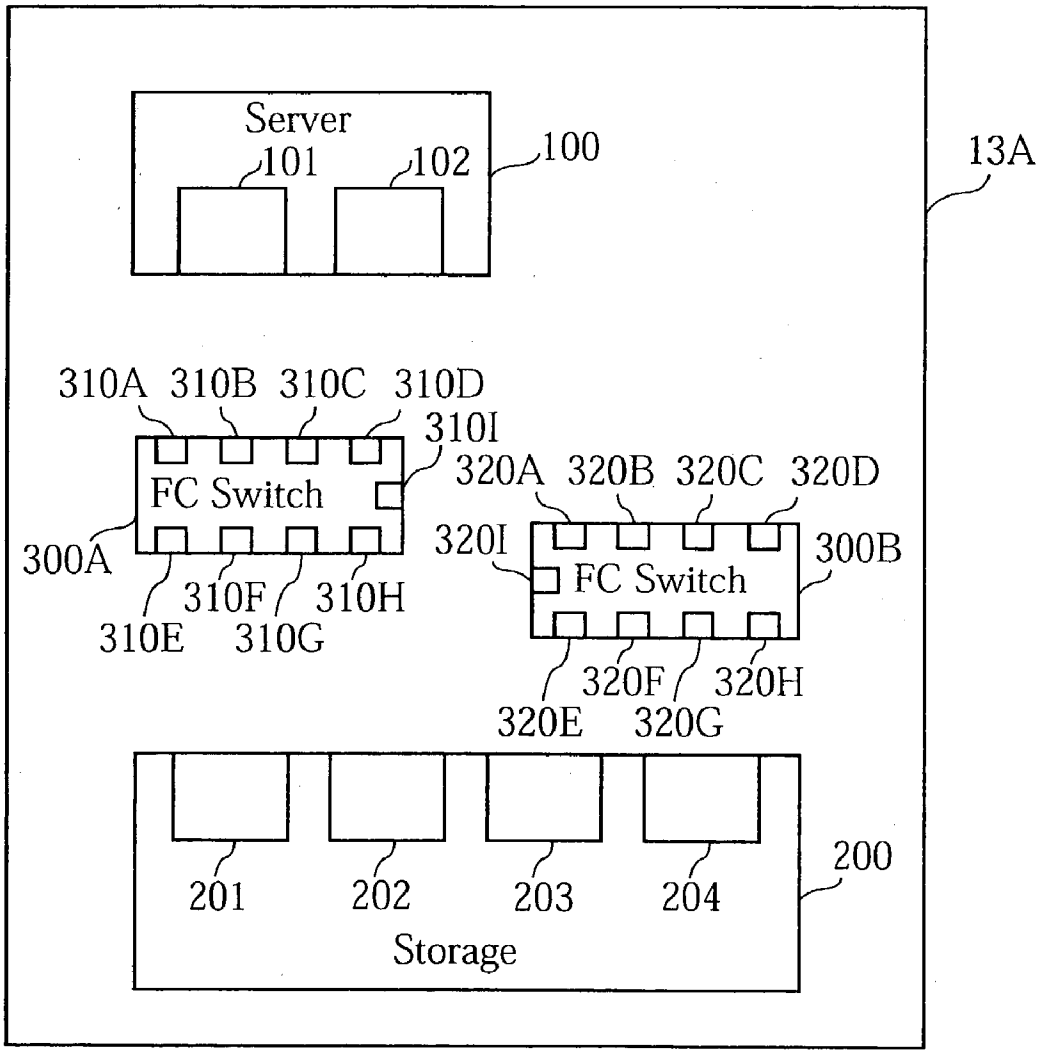

Server
101
102
100
13A
310A 310B 310C 310D
310I
FC Switch
300A
310E 310F 310G 310H
320A 320B 320C 320D
320I
FC Switch
300B
320E 320F 320G 320H
201 202 203 204
Storage
200

FIG.6

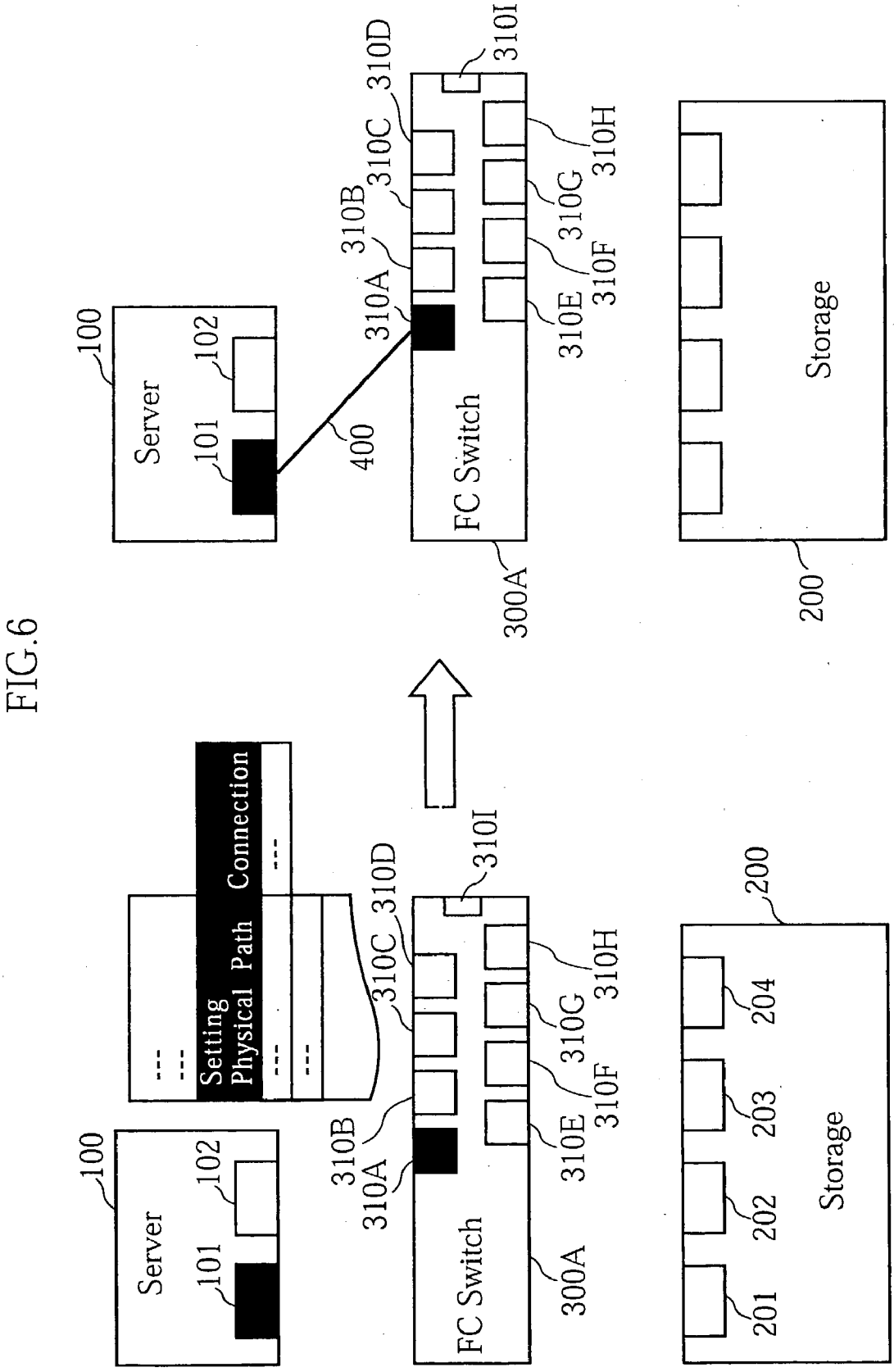

100
Server
101
102
400
310A
310B
310C
310D
310I
310E
310F
310G
310H
FC Switch
300A
Storage
200
201
202
203
204
Setting Physical Path Connection

FIG.7

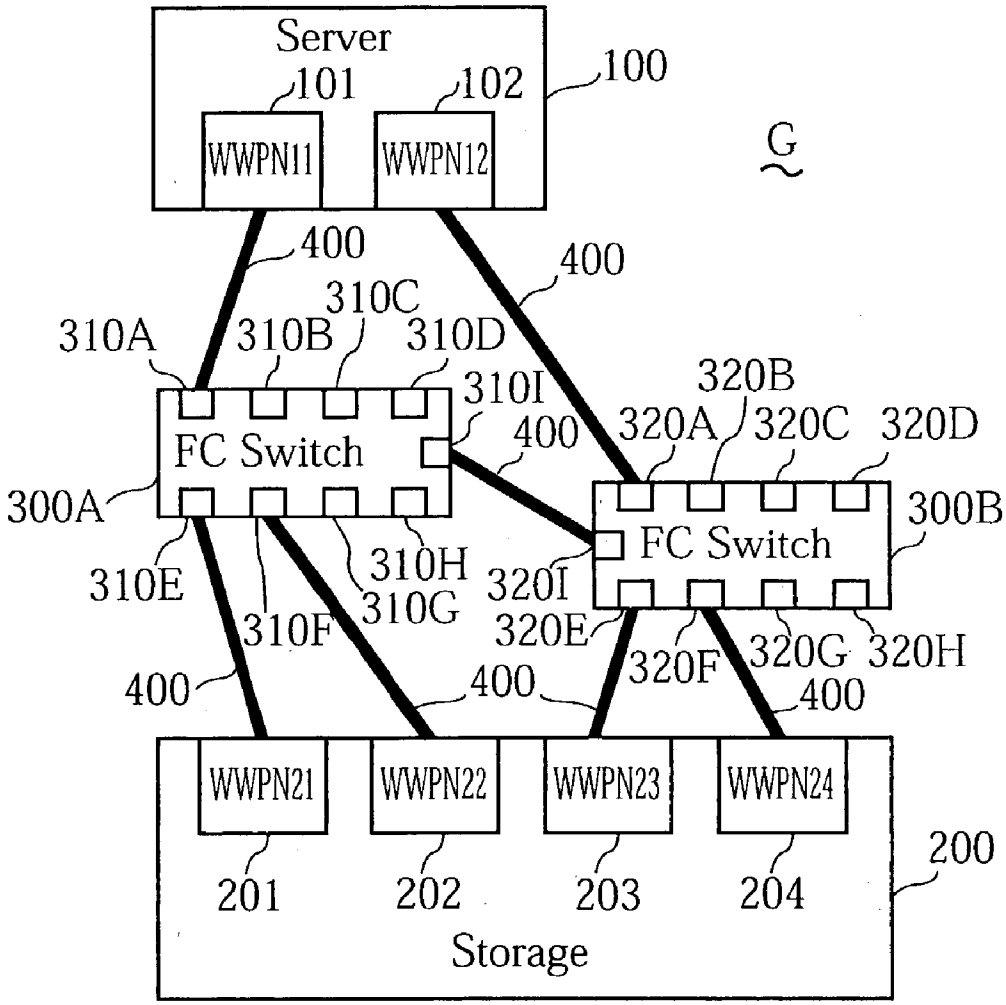

Server
101
102
100
WWPN11
WWPN12
G
400
400
310C
310A
310B
310D
310I
320B
320A
320C
320D
FC Switch
400
300A
FC Switch
300B
310E
310H
320I
310F
310G
320E
320F
320G
320H
400
400
400
WWPN21
WWPN22
WWPN23
WWPN24
200
201
202
203
204
Storage

FIG.8

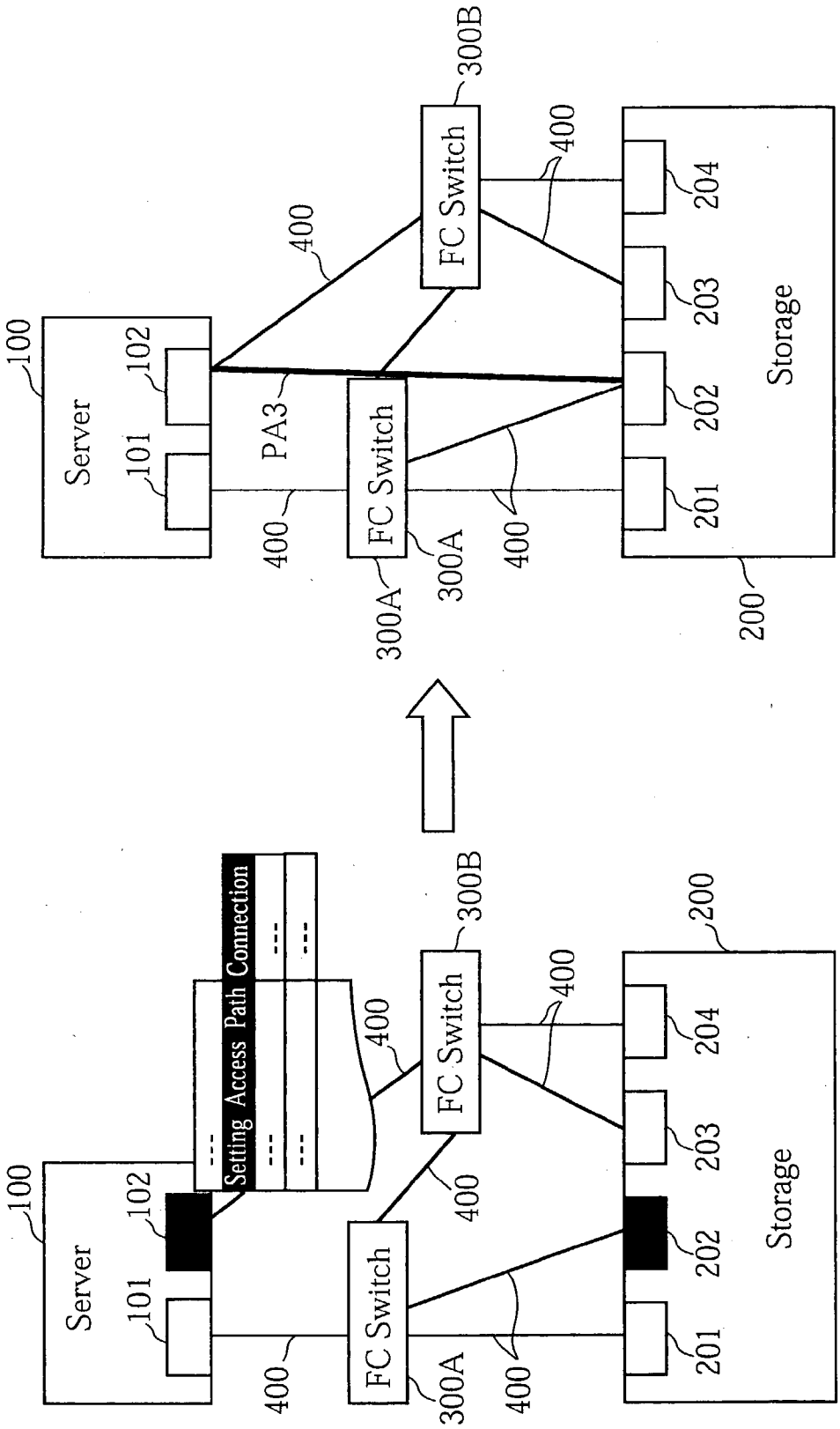

Server
100
101
102
PA3
400
FC Switch
300A
300B
Storage
200
201
202
203
204
Setting Access Path Connection

FIG.9

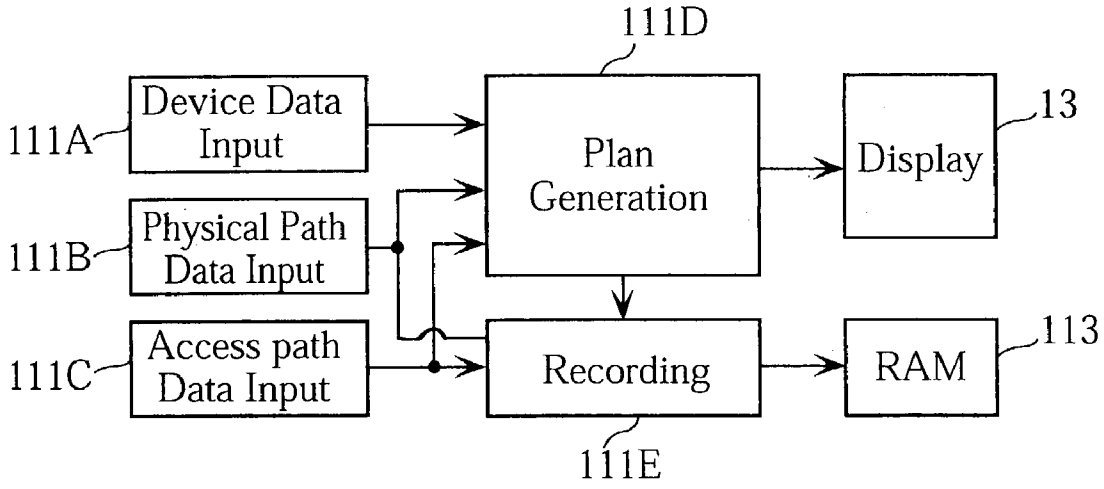

111D
111A
Device Data Input
111B
Physical Path Data Input
111C
Access path Data Input
Plan Generation
Display
13
Recording
RAM
113
111E

FIG.10

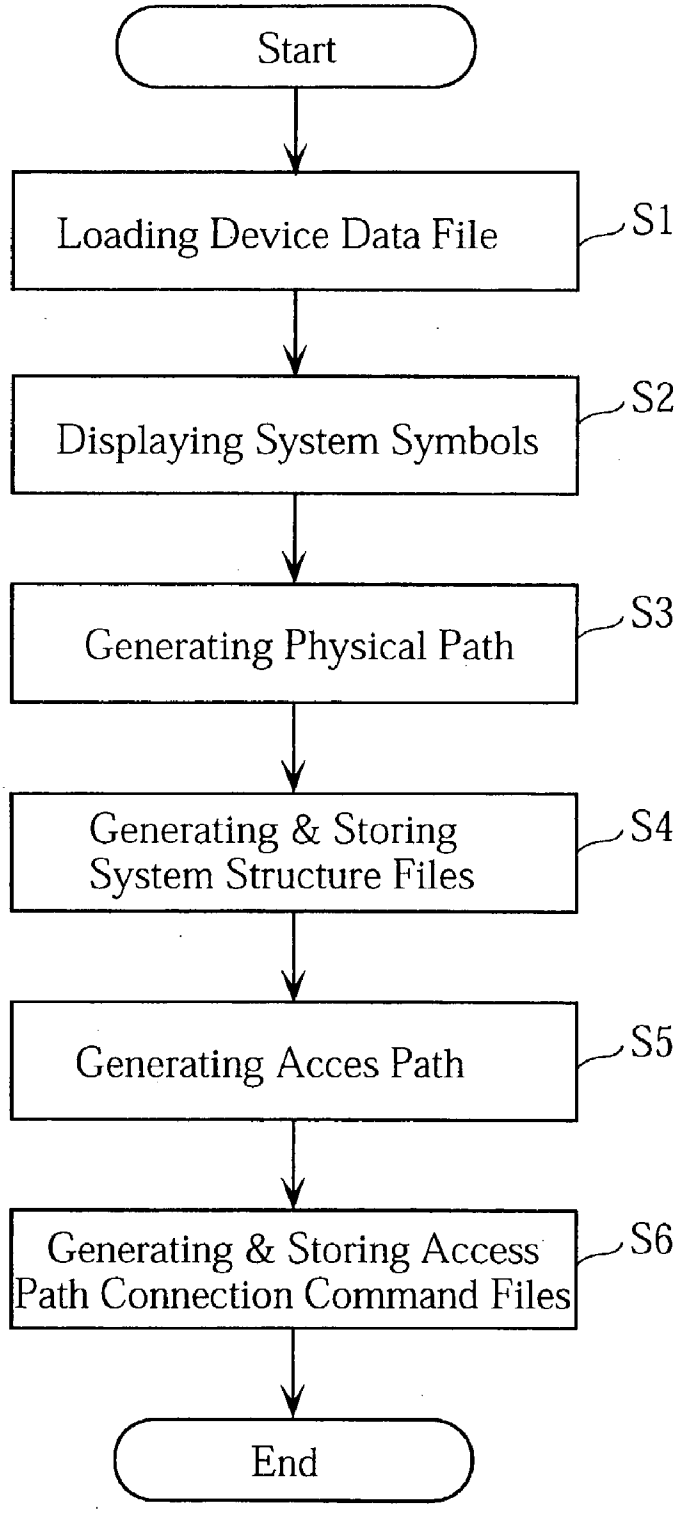

Start
Loading Device Data File
S1
Displaying System Symbols
S2
Generating Physical Path
S3
Generating & Storing System Structure Files
S4
Generating Acces Path
S5
Generating & Storing Access Path Connection Command Files
S6
End

FIG.11

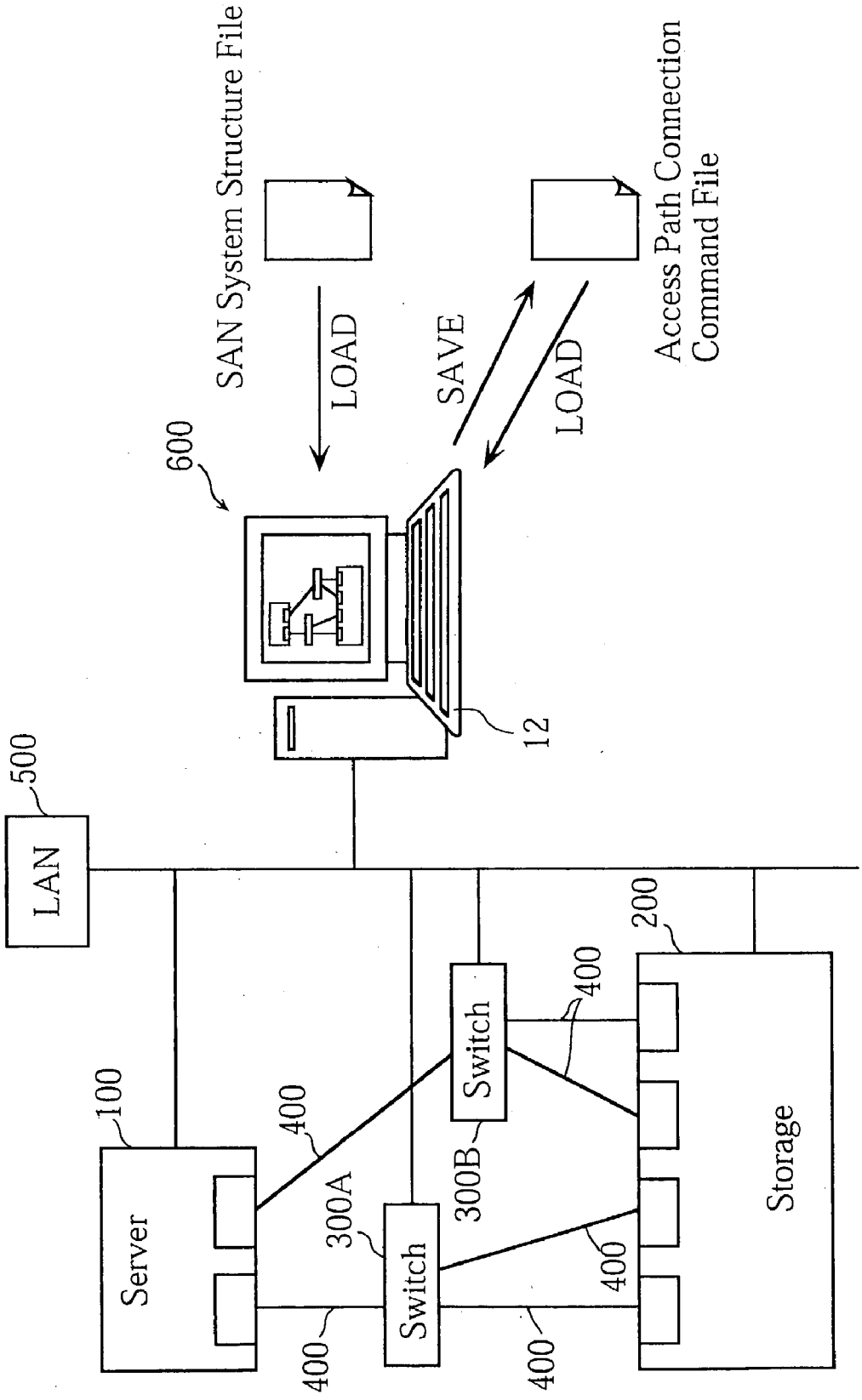

SAN System Structure File
LOAD
SAVE
LOAD
Access Path Connection Command File
600
12
500
LAN
100
Server
400
300A
Switch
400
300B
Switch
400
400
400
200
Storage

FIG.12

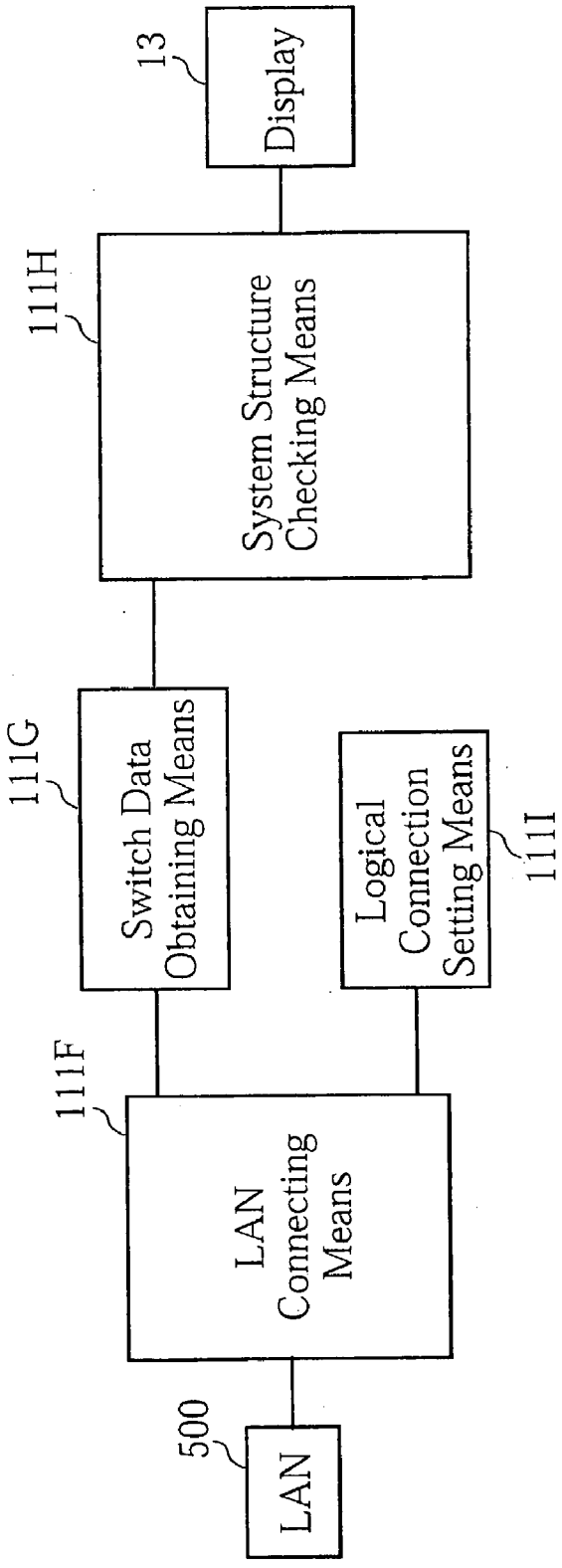

13
Display
111H
System Structure Checking Means
111G
Switch Data Obtaining Means
Logical Connection Setting Means
111I
111F
LAN Connecting Means
500
LAN

FIG.13

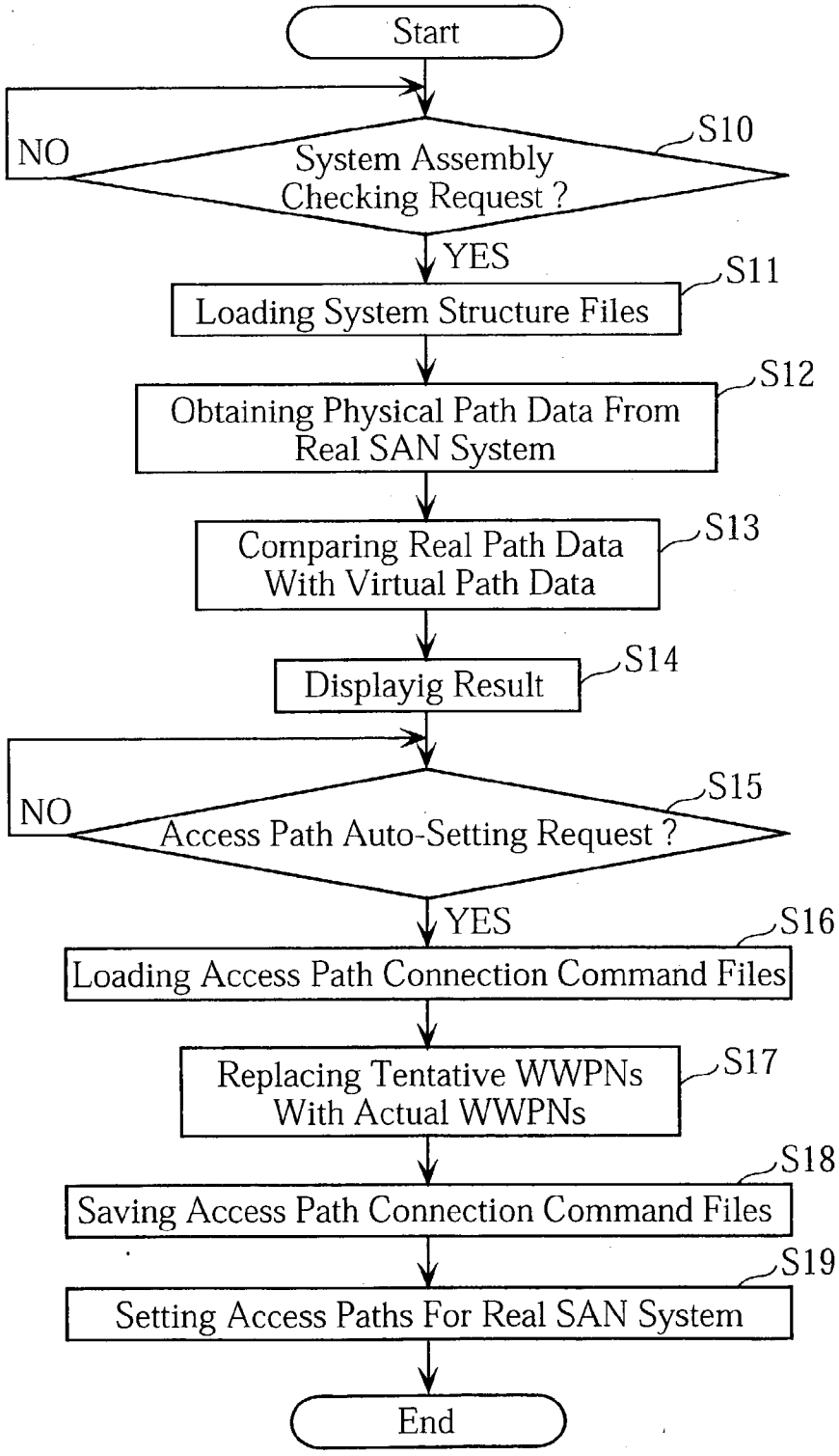

Start
S10
NO
System Assembly Checking Request ?
YES
S11
Loading System Structure Files
S12
Obtaining Physical Path Data From Real SAN System
S13
Comparing Real Path Data With Virtual Path Data
S14
Displayig Result
S15
NO
Access Path Auto-Setting Request ?
YES
S16
Loading Access Path Connection Command Files
S17
Replacing Tentative WWPNs With Actual WWPNs
S18
Saving Access Path Connection Command Files
S19
Setting Access Paths For Real SAN System
End

FIG.14

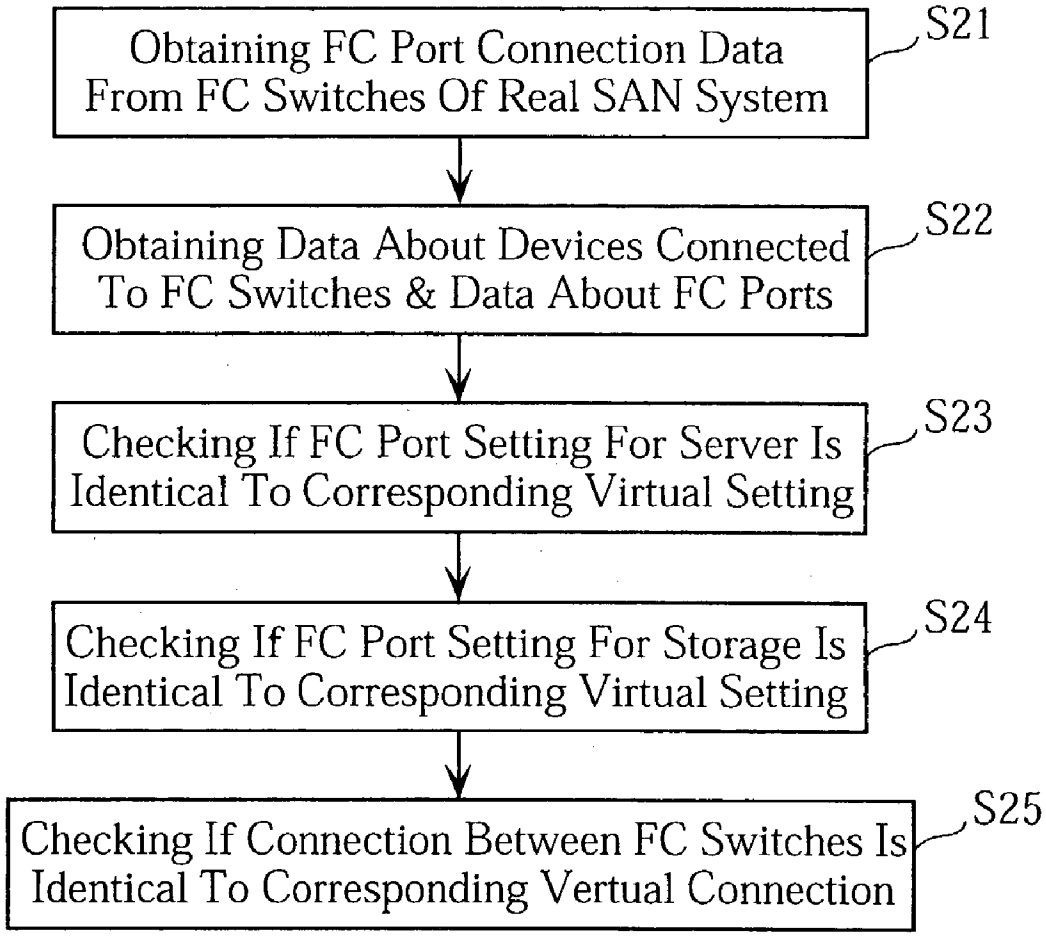
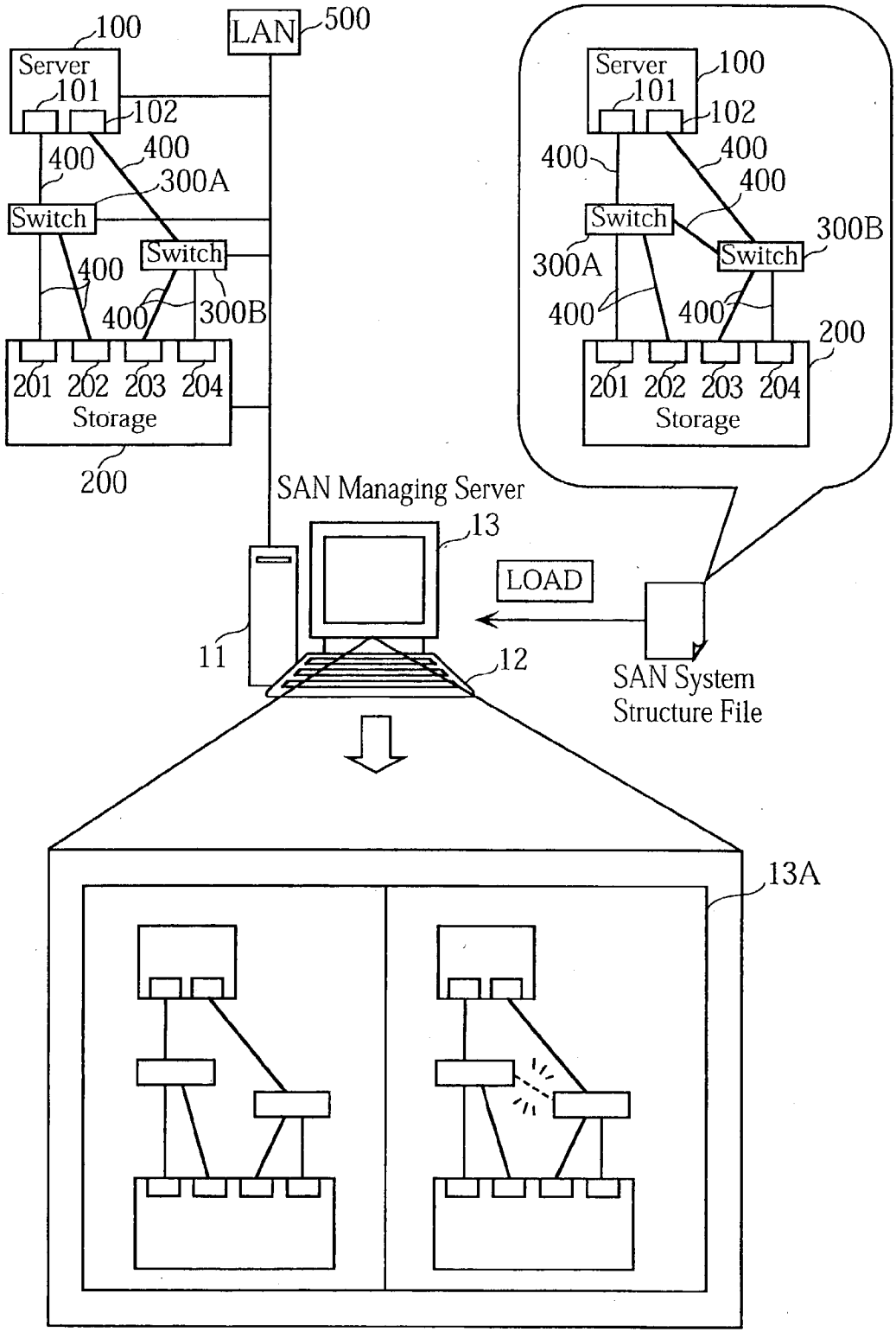

Obtaining FC Port Connection Data From FC Switches Of Real SAN System
S21
Obtaining Data About Devices Connected To FC Switches & Data About FC Ports
S22
Checking If FC Port Setting For Server Is Identical To Corresponding Virtual Setting
S23
Checking If FC Port Setting For Storage Is Identical To Corresponding Virtual Setting
S24
Checking If Connection Between FC Switches Is Identical To Corresponding Vertual Connection
S25

FIG.15


100
LAN
500
Server
101
102
400
400
300A
Switch
Switch
400
400
300B
201 202 203 204
Storage
200
SAN Managing Server
13
LOAD
11
12
SAN System
Structure File
Server
100
101
102
400
400
400
Switch
300B
Switch
300A
400
400
200
201 202 203 204
Storage
13A

ELECTRONIC APPARATUS FOR ASSISTING REALIZATION OF STORAGE AREA NETWORK SYSTEM

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates to an electronic assisting apparatus for enabling easy and low-cost realization of a storage area network system. The present invention also relates to a method and to a computer program for assisting the realization of a storage area network system.

[0003] 2. Description of the Related Art

[0004] For the purpose of communicating data electronically, two or more computers are connected with one another through various types of networks. As known in the art, two basic network types are local-area networks (LANs) and wide-area networks. Of these, LANs connect computers and peripheral devices in a limited physical area by means of permanent links, so that each computer on the network is allowed to access a common set of files. The largest wide-area network is the Internet, which is very popular.

[0005] A LAN may be built to connect several storages and servers. With the LAN, a storage area network (SAN) system is often employed to reduce the total cost of ownership (TCO) by centralizing the management of the storages.

[0006] The SAN system connects the servers and the storages through a route different from that of the LAN. The server-storage connection may be established with the use of fiber channels and fiber channel switches. Dynamically connecting the servers and the storages, this connection method (often called "Fabric") enables high-speed access to the storages from the servers.

[0007] **FIG. 1** illustrates the basic structure of a SAN system. For simplicity of illustration, **FIG. 1** shows only one server **100** and only one storage **200** that are connected to each other via fiber channels (consisting of seven optical fibers) **400***a*~**400***g*. As illustrated, the fiber cannels are provided with two intervening fiber channel switches ("FC switches") **300**A, **300**B.

[0008] The server **100** is provided with two fiber channel ports ("FC ports") **101**~**102**, while the storage **200** is provided with four FC ports **201**~**204**. The FC switches **300**A and **300**B are provided with FC ports **310**A~**310**I and **320**A-**320**I, respectively.

[0009] The fiber channels connect FC ports in a prescribed manner. Specifically, the fiber channel **400***a* connects the FC port **310**I of the FC switch **300**A to the FC port **320**I of the FC switch **300**B. The fiber channel **400***b* connects the FC port **101** of the server **100** to the FC port **310**A of the switch **300**A. The fiber channel **400***c* connects the FC port **102** of the server **100** to the FC port **320**A of the switch **300**B. The fiber channel **400***d* connects the FC port **310**E of the switch **300**A to the FC port **201** of the storage **200**. The fiber channel **400***e* connects the FC port **310**F of the switch **300**A to the FC port **202** of the storage **200**. The fiber channel **400***f* connects the FC port **320**E of the switch **300**B to the FC port **203** of the storage **200**. The fiber channel **400***g* connects the FC port **320**F of the switch **300**B to the FC port **204** of the storage **200**.

[0010] For effecting the fiber channels, each of the FC ports is assigned a specific ID code, or a World Wide Port Name ("WWPN") in a particular format. Based on the WWPNs, the zoning mechanisms **311**, **321** of the FC switches **300**A and **300**B divide the server-storage connecting situation into several zones. As a result, it is possible to dynamically control the connection between the FC ports of the server **100** and the FC ports of the storage **200**.

[0011] The zoning mechanisms **311**, **321** are supplied with zoning information specifying the connecting relationship between the FC ports **101**, **102** of the server **100** and the FC ports **201**~**204** of the storage **200**. Based on the zoning information, logical connection paths (access paths) are set between the FC ports **101**, **102** of the server **100** and the FC ports **201**~**204** of the storage **200**. In the example shown in **FIG. 1**, Zone A (WWPN11, WWPN21) and Zone B (WWPN11, WWPN23) are provided by the zoning mechanism **311** of the FC switch **300**A, while Zone C (WWPN12, WWPN22) and Zone D (WWPN12, WWPN24) are provided by the zoning mechanism **321** of the FC switch **300**B. Accordingly, four access paths PA1, PA2, PA3 and PA4 are respectively formed between the FC port **101** and the FC port **201**, between the FC port **101** and the FC port **203**, between the FC port **102** and the FC port **202**, and between the FC port **102** and the FC port **204**.

[0012] To construct a SAN system, the types and the number of servers, storages and FC switches are specified, and then the FC switches should be physically connected to the servers and the storages by fiber channels. Further, the zone setting for the FC switches should be performed to form access paths in the SAN system.

[0013] By a conventional constructing scheme, an actual (i.e. physically-built) SAN system is constructed after a blueprint of the system has been drawn by e.g. a system designer working with a traditional drafting board. Then, FC switches are connected to the servers and the storages by using optical fibers in conformity to the blueprint. After this connection is completed, the setting of access paths is performed by using SAN-managing software. Finally, a visual inspection (i.e. inspection by humans) is performed to see if the SAN system has been built correctly.

[0014] In the conventional scheme, the blueprint drawn by the system designer is the only representation of the SAN system to be built. Unfavorably, since a SAN system often has a complicated structure, drawing the blueprint tends to be a laborious job. Accordingly, the system introduction cost tends to be high.

[0015] Another problem is as follows. After the physical structure of the system has been built, the system is subjected to the access path setting procedure. However, it has been found that the conventional setting procedure often requires much labor and time even when the above-mentioned SAN-managing software is used. In addition, a number of errors can occur when necessary data is inputted into the SAN-managing software. This adverse trend becomes more serious as the SAN system is larger.

[0016] After the SAN system construction is over, inspection is performed to see if the system has been built properly (i.e. in conformity to the blueprint). However, the conventional inspection is made by humans (system designer, system engineer, etc.) with reference to the blueprint. Thus,

reviewing the entire system often takes much time. Moreover, human inspection may overlook many defects that can be entailed in the system.

SUMMARY OF THE INVENTION

[0017] The present invention has been proposed under the circumstances described above. According to the present invention, preparing the plan of a virtual SAN system is performed by a computer. Further, the physically-built SAN system is subjected to computer-aided structure checking.

[0018] According to a first aspect of the present invention, there is provided an apparatus for assisting the realization of a storage area network system in which a server with a fiber channel port, a storage with a fiber channel port and a fiber channel switch with a plurality of fiber channel ports are connected to each other via a plurality of fiber channels. The assisting apparatus includes: first information input means for inputting device data relating to the server, the storage and the fiber channel switch; second information input means for inputting information relating to physical connection among the server, the storage and the fiber cannel switch via the fiber channels; plan generating means for generating, based on the information inputted through the first and the second information input means, a plan of a virtual storage area network system in which the server, the storage and the fiber channel switch are physically connected via the fiber channels; and display means for displaying the generated plan.

[0019] Preferably, the assisting apparatus of the present invention may further include: third information input means for inputting information relating to logical connection among the server, the storage and the fiber channel switch of the virtual storage area network system; display control means for adding, based on the information inputted through the third information input means, a logical connection representing symbol to the displayed plan; and recording means for causing a recording medium to store information about a structure of the virtual storage area network system and information about logical connection of the virtual storage area network system.

[0020] Preferably, the assisting apparatus of the present invention may further include: information obtaining means for obtaining information about the fiber channel ports of the server, the storage and the fiber channel switch of a real storage area network system built in accordance with the plan of the virtual storage area network system; and system structure checking means for checking if the real storage area network system is identical in physical connection to the virtual storage area network system, the checking being performed by comparing the obtained information about the fiber channel ports and the information about the fiber channel ports of the virtual storage area network system.

[0021] Preferably, the information about the physical connection and the logical connection of the virtual storage area network system may be generated by using tentative world wide port names (WWPNs) set for the fiber channel ports of the server, the storage and the fiber channels.

[0022] Preferably, the assisting apparatus of the present invention may further include logical connection setting means for performing automatic logical connection setting with respect to the real storage area network system based on the information about the logical connection of the virtual storage area network system stored in the recoding means.

[0023] According to a second aspect of the present invention, there is provided a method of assisting the realization of a storage area network system in which a server with a fiber channel port, a storage with a fiber channel port and a fiber channel switch with a plurality of fiber channel ports are connected to each other via a plurality of fiber channels. The method includes: a first information inputting step for inputting into a computer device data relating to the server, the storage and the fiber channel switch; a second information inputting step for inputting information relating to physical connection among the server, the storage and the fiber cannel switch via the fiber channels; a plan generating step for generating, based on the information inputted at the first and the second information inputting steps, a plan of a virtual storage area network system in which the server, the storage and the fiber channel switch are physically connected via the fiber channels; and a displaying step for causing display means to display the generated plan.

[0024] Preferably, the method of the present invention may further include: a third information inputting step for inputting into the computer information relating to logical connection among the server, the storage and the fiber channel switch of the virtual storage area network system; a display renewing step for adding, based on the information inputted at the third information inputting step, a logical connection representing symbol to the displayed plan; and a recording step for causing a recording medium to store information about a structure of the virtual storage area network system and information about logical connection of the virtual storage area network system.

[0025] Preferably, the assisting method of the present invention may further include: a fourth information inputting step for inputting into the computer information about the fiber channel ports of the server, the storage and the fiber channel switch of a real storage area network system built in accordance with the plan of the virtual storage area network system; and a system structure checking step for checking if the real storage area network system is identical in physical connection to the virtual storage area network system, the checking being performed by comparing the information about the fiber channel ports inputted at the fourth information inputting step and the information about the fiber channel ports of the virtual storage area network system.

[0026] Preferably, the information about the physical connection and the logical connection of the virtual storage area network system may be generated by using tentative world wide port names set for the fiber channel ports of the server, the storage and the fiber channels.

[0027] Preferably, the assisting method of the present invention may further include a logical connection setting step for performing automatic logical connection setting with respect to the real storage area network system based on the information about the logical connection of the virtual storage area network system stored in the recoding means.

[0028] According to a third aspect of the present invention, there is provided a program for assisting the realization of a storage area network system in which a server with a fiber channel port, a storage with a fiber channel port and a fiber channel switch with a plurality of fiber channel ports

are connected to each other via a plurality of fiber channels. The program causes a computer to function as: first information input means for inputting device data relating to the server, the storage and the fiber channel switch; second information input means for inputting information relating to physical connection among the server, the storage and the fiber cannel switch via the fiber channels; plan generating means for generating, based on the information inputted through the first and the second information input means, a plan of a virtual storage area network system in which the server, the storage and the fiber channel switch are physically connected via the fiber channels; and display means for displaying the generated plan.

[0029] Preferably, the program of the present invention may further cause the the computer to function as: third information input means for inputting information relating to logical connection among the server, the storage and the fiber channel switch of the virtual storage area network system; display control means for adding, based on the information inputted through the third information input means, a logical connection representing symbol to the displayed plan; and recording means for causing a recording medium to store information about a structure of the virtual storage area network system and information about logical connection of the virtual storage area network system.

[0030] Preferably, the program of the present invention may further cause the computer to function as: information obtaining means for obtaining information about the fiber channel ports of the server, the storage and the fiber channel switch of a real storage area network system built in accordance with the plan of the virtual storage area network system; and system structure checking means for checking if the real storage area network system is identical in physical connection to the virtual storage area network system, the checking being performed by comparing the obtained information about the fiber channel ports and the information about the fiber channel ports of the virtual storage area network system.

[0031] Preferably, the program of the present invention may further cause the computer to function as logical connection setting means for performing automatic logical connection setting with respect to the real storage area network system based on the information about the logical connection of the virtual storage area network system stored in the recoding means.

[0032] Other features and advantages of the present invention will become apparent from the detailed description given below with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0033] **FIG. 1** shows the structure of a SAN system;

[0034] **FIG. 2** shows a general-purpose computer used for building the SAN system of the present invention;

[0035] **FIG. 3** is a block diagram for illustrating the main components incorporated in the general-purpose computer;

[0036] **FIG. 4** illustrates the basic concept of a system design assisting procedure of the present invention;

[0037] **FIG. 5** shows an on-screen plan in which the symbols representing a server, storage and FC switches appear;

[0038] **FIG. 6** illustrates how physical path setting is performed on the on-screen plan;

[0039] **FIG. 7** shows an example of physical construction of a virtual SAN system;

[0040] **FIG. 8** illustrates how access path setting is performed on the on-screen plan;

[0041] **FIG. 9** is a block diagram of the principal functional means of a SAN system design assisting apparatus of the present invention;

[0042] **FIG. 10** is a flow chart showing the system design assisting procedure;

[0043] **FIG. 11** illustrates a practical example where a SAN managing server is used as a SAN system assembly assisting apparatus for building a real SAN system;

[0044] **FIG. 12** is a block diagram of the principal functional means of the SAN system assembly assisting apparatus;

[0045] **FIG. 13** is a flow chart showing the system assembly assisting procedure;

[0046] **FIG. 14** is a flow chart showing a physical structure checking procedure performed in building the real SAN system; and

[0047] **FIG. 15** illustrates a possible way to present the result of checking the physical structure of the real SAN system.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0048] Preferred embodiments of the present invention will be described below with reference to the accompanying drawings.

[0049] According to the present invention, a SAN realization assisting apparatus utilizes two kinds of computer programs, namely, a first program ("Program 1") for assisting the preparation of a plan of the SAN system to be introduced and a second program ("Program 2") for assisting the completion of the physically-built SAN system. These programs may be installed in computers like the one shown in **FIG. 2**. More precisely, Program 1 may be installed in any general-purpose computer in light of the system-initiating (i.e. plan-preparing) purpose of the program. Typically, this computer is not connected to the LAN to which the present invention is to be applied.

[0050] Program 2, on the other hand, may be installed in a particular computer that is connected to a real (i.e. not virtual but physically-built) SAN system constructed in accordance with the plan prepared with the aid of Program 1. The particular computer may be a SAN system managing server. In this case, after Program 2 has been installed, the particular computer functions as both the system managing server and the SAN system realization assisting apparatus. Alternatively, the particular computer may be prepared separately from the units constituting the physically-built SAN system. In this case, after Program 2 has been installed, the particular computer is connected to the SAN system. Thereafter, the computer may function only as the SAN system realization assisting apparatus, or both as the system managing server and as the SAN system realization assisting apparatus.

[0051] Referring to **FIG. 2**, the assisting apparatus used for system introduction will be described.

[0052] The computer **1** shown in **FIG. 2** includes a main unit **11**, a data-input keyboard **12** connected to the main unit **11**, and a data-output display **13**. The main unit **11** is provided with a drive **14** for a removable storage medium such as a floppy disk or CD-ROM.

[0053] Inside the main unit **11**, referring to **FIG. 3, a** CPU **111**, a ROM **112**, a RAM **113**, an input/output interface **114** and a media interface **115** are provided. The ROM **112**, the RAM **113**, the input/output interface **114** and the media interface **115** are connected to the CPU **111** via a bus line **116**. The keyboard **12** and the display **13** are connected to the input/output interface **114**, while the removable disk drive **14** is connected to the media interface **115**.

[0054] The ROM **112** stores basic software (e.g. operating system) and SAN realization assisting programs in accordance with the present invention. The CPU **111** is provided with an arithmetic-logic unit and a control unit, where the control unit regulates the operations of the arithmetic-logic unit, ROM **112**, RAM **113**, keyboard **12**, display **13**, drive **14** and so forth. Under the control of the CPU **111**, the SAN realization assisting programs are read out from the ROM **112** and written to the RAM **113**. These programs are executed by the CPU **111** for assisting the design of the SAN system.

[0055] Referring to **FIG. 4**, to perform the system design assisting procedure, the data necessary for the system construction is input into the assisting apparatus **1**. Based on the supplied data, a plan G of a virtual SAN system is produced, and the data of the plan G is supplied to the display **13** for visual presentation.

[0056] The above-mentioned data necessary for the system construction comes in three types. The first one is "device data" relating to the servers, storages and fiber channel (FC) switches used for construction of the SAN system. More specifically, device data concerns the types, manufacturers, brand names, etc., of the relevant units as well as the number of the units to be used for the SAN system. The second one is "physical path data" relating to the physical connection paths of the fiber channel that connects the FC ports of the above-mentioned servers, storages and FC switches of the SAN system. More specifically, physical path data concerns "FC port connection setting" that specifies the matches between the FC ports (that is, which FC port a selected FC port should be connected to). The third one is "access path data" relating to the logical connection paths through which the servers can access the storages via the FC switches.

[0057] Each of the FC ports of the servers, storages and FC switches is allotted port-specific ID information called WWPN (World Wide Port Name) composed of two kinds of numbers, namely, a number to identify the manufacturer and a number selected by the manufacturer. The setting of the physical paths for the SAN system is performed by setting the WWPN of the counterpart FC port to which a selected FC port is to be connected through the fiber channel.

[0058] As will be described later, the SAN system realization assisting scheme of the present invention requires the generation of the plan of a virtual SAN system. In the virtual system, the FC ports of the servers, storages and FC switches are not assigned real WWPNs, but tentative ID numbers ("tentative WWPNs"). In this specification, the above-mentioned device data includes these tentative WWPNs. The physical path setting for the virtual SAN system is performed by the tentative WWPNs.

[0059] Access path data mentioned above concerns the "zoning, by the FC switches in which the FC ports of the storages are sorted (or "zoned") depending on the accessibility to the FC ports of the servers. Owing to the zoning function of the FC switches, each server can dynamically control the memory regions of accessible storages. As a result, these particular storages are regulated as if they provide a single, combined storage area. Advantageously, this realizes the effective use of the storages.

[0060] The zoning by the FC switches is also managed by the tentative WWPNs of the FC ports. Specifically, the FC ports of accessible servers and storages are divided into several zones, and the tentative WWPNs are used to specify which FC ports belong to a particular zone.

[0061] Referring to **FIG. 4**, device data is written to a removable data-storing medium M from which the SAN system realization assisting apparatus **1** retrieves the required data. More precisely, device data files are produced in advance for each of the servers, FC switches and storages, and these files are written to the data-storing medium M. Thereafter, the medium M is inserted into the drive **14**, and the SAN system realization assisting apparatus **1** reads out the data from the medium M to store it in the RAM **113**.

[0062] In accordance with device data, the CPU **111** reads out relevant image data (symbol data stored in the RAM **113**) representing the servers, storages and FC switches. Then, the CPU **111** causes the display **13** to visually represent a diagram in which the symbols of the specified components (servers, storages and FC switches) appear.

[0063] The on-screen representation of the FC ports shown in the diagram is GUI-controlled. Thus, a system designer can easily mark out a physical path by designating the FC ports to be connected by fiber channels. Upon receiving the physical path data, the CPU **111** adds a channel-representing symbol to the on-screen diagram. Repeating this procedure to complete the setting of all the desired physical paths, the CPU **111** generates a file of data concerning the physical structure of the on-screen SAN system (the data includes the physical path data). This file ("SAN system structure file") is stored in the RAM **113**.

[0064] After the setting of the physical paths is over, the setting of access paths is performed by designating the FC ports of the server and the storage to be accessed. Upon receiving the access path setting information, the CPU **111** adds access path representing symbols to the on-screen diagram. Repeating the designation of the ports to be connected, the access path setting is over. Thereafter, based on the access path setting information, the CPU **111** generates commands to set the access paths in the real SAN system to be built later. The file of the commands ("access connection command file") is stored in the RAM **113**.

[0065] The above-mentioned SAN system structure file and the access connection command file, both of which are stored in the RAM **113**, are used for building the real SAN system.

[0066] According to the above system design assisting scheme, an on-screen plan of the SAN system shown in **FIG. 1** is produced in a manner as follows. First, device data regarding the server **100**, storage **200** and FC switches **300**A, **300**B is inputted into the SAN system realization assisting apparatus **1**. The inputted data is stored in the RAM **113**.

[0067] Then, based on the device data, suitably arranged symbols representing the server **100**, storage **200** and FC switches **300**A, **300**B are caused to appear on the monitor **13**A of the display **13**, as shown in **FIG. 5**.

[0068] After the desired symbols are displayed, the physical path setting is performed. Specifically, as shown in **FIG. 6**, the system designer designates a pair of ports to be connected by a fiber channel. In the illustrated example, the FC port **101** of the server **100** and the FC port **310**A of the FC switch **300**A are selected, and a fiber channel **400** is displayed to connect these two ports.

[0069] In addition to the designation of the ports, the system designer is supposed to allot tentative WWPNs (e.g. WWPNs1 and WWPNa) to the selected FC ports **101** and **310**A, respectively. Then, at the FC port **101**, the system designer sets WWPNa, which is the tentative WWPN of the FC port **310**A to be connected with the FC port **101**. Likewise, at the FC port **310**A, the system designer sets WWPNs1, which is the tentative WWPN of the FC port **101** to be connected with the FC port **310**A.

[0070] After the physical path setting for the first pair of FC ports is over, the other pairs of FC ports are also subjected to physical path setting in the same manner. The resultant on-screen plan G is shown in **FIG. 7**, in which the server **100**, storage **200** and FC switches **300**A, **300**B are connected via seven fiber channels **400**. For the on-screen plan G, a SAN system structure file is produced and stored in the RAM **113**.

[0071] Referring to **FIG. 8**, after the desired fiber channels are produced, the system designer selects an on-screen pair of FC ports to be connected by an access path. In the illustrated example, the FC port **102** of the server **100** and the FC port **202** of the storage **200** are selected. As a result, an access path PA**3** appears on the screen, extending between the FC port **102** and the FC port **202**. In addition to the on-screen selection of the ports, the setting of the tentative WWPNs for the paired FC ports is performed, as in the physical path setting described above.

[0072] After the setting of the access path A3 is finished, the setting of the other access paths PA1, PA2 and PA4 (see **FIG. 1**) is performed in the same manner. Thereafter, an access connection command file is produced based on the access path data. This file is stored in the RAM **113**, and the system design assisting procedure ends.

[0073] Reference is now made to **FIG. 9** which is a block diagram for illustrating the system design assisting function of the above-described apparatus **1**.

[0074] Specifically, the device data input means **111**A is provided for inputting information about the servers, storages and FC switches. The input means **111**A may correspond to the removable medium M and the drive **14** (see **FIGS. 2 and 4**). The physical path data input means **111**B and the access path data input means **111**C are provided for inputting information about the physical paths and access paths, respectively. These input means may be the keyboard **12**. The system plan generating means **111**D is provided for generation of the plan of the virtual SAN system to be displayed on the monitor. The recording means **111**E is provided for generating SAN system structure files and access path connection command files and also for storing these files in the RAM **113**.

[0075] **FIG. 10** is a flow chart showing how the system design assisting scheme proceeds.

[0076] Specifically, at Step **1** (S1), the CPU **111** retrieves the device data files from the removable medium M (CD-ROM, floppy disk, MO, etc.) inserted into the drive **14**. As noted above, the device data files relate to the information about the servers, storages and FC switches of the SAN system. The retrieved files are stored in the RAM **113**.

[0077] Then, at Step **2**, based on both the device data stored in the RAM **113** and the numbers of the servers, storages and FC switches to be included in the system, the CPU **111** retrieves, from the ROM **112**, symbols representing the servers, storages and FC switches. Properly arranged, the symbols are displayed on the monitor **13**A (see **FIG. 5**).

[0078] Then, at Step **3**, the CPU **111** generates physical paths based on the physical path data inputted from the keyboard **12**. As a result, the desired fiber channels are added to the on-screen plan (see **FIGS. 6 and 7**).

[0079] Then, at Step **4**, the CPU **111** generates SAN system structure files based on the on-screen plan and the inputted physical path data, and stores the files in the RAM **113**.

[0080] Then, at Step **5**, the CPU **111** generates access paths based on the access path data inputted from the keyboard **12**. As a result, the desired access paths are added to the on-screen plan (see **FIG. 8**).

[0081] Finally, at Step **6**, the CPU **111** generates access path connection command files based on the inputted access path data, and stored the files in the RAM **113**.

[0082] According to the above-described system design assisting scheme, the display **13** electronically presents the plan of the SAN system under consideration, and the system designer can set physical paths and access paths with respect to the on-screen plan. In this manner, the plan of the SAN system can be generated more readily than by manually drawing the plan on paper. Another advantage of the electronically drawn plan is that modifications can be made more easily than on paper.

[0083] Next, a SAN system assembly assisting procedure will be described below. This procedure, which is performed subsequently to the above-noted design assisting procedure, assists the building of the real SAN system based on the system plan produced by the previous design assisting procedure. Further, in the assembly assisting procedure, physical path checking and automatic access path setting are performed with respect to the physically-built SAN system.

[0084] **FIG. 11** illustrates the physically-built SAN system and a SAN system managing server **600** connected to the SAN system via a LAN **500**. As will be described in detail

below, the managing server **600** is responsible for the system assembly assisting procedure.

[**0085**] As seen from **FIG. 11**, the physically-built SAN system includes a server **100**, a storage **200** and FC switches **300**A, **300**B. The system managing server **600** checks the setting state of the server **100**, storage **200** and FC switches **300**A, **300**B. In addition, the server **600** is responsible for repair of the SAN system.

[**0086**] The server **600** is load with the SAN system structure files and access path connection command files from the removable medium M. With the use of these files, the server **600** performs the system assembly assisting procedure.

[**0087**] **FIG. 12** is a block diagram showing the functional means of the server **600** when working as SAN system construction assisting apparatus.

[**0088**] The LAN connecting means **111**F is accessible to the server **100**, storage **200** and FC switches **300**A, **300**B via the LAN **500** for data communication. The switch data obtaining means **111**G obtains, from the FC switches of the SAN system, information relating to the connecting relation between the server and the storage. This information is about the WWPNs of the respective FC ports. The system structure checking means **111**H checks, if the physically-built SAN system is properly constructed. The checking is performed with reference to the FC port WWPNs of the physically-built SAN system and the tentative FC port WWPNs of the virtual SAN system. The result of the check is displayed on the monitor of the server **600**. The logical connection setting means **111**I sets the access paths for the physically-built SAN system based on the access path data in the access path connection command files.

[**0089**] Referring to the flow chart of **FIG. 13**, the system assembly assisting procedure will be described below.

[**0090**] After the real SAN system (as shown in **FIG. 11**) has been built in accordance with the electronically prepared plan of the virtual SAN system, a "SAN system assembly checking request" is inputted into the SAN managing server **600** from the keyboard **12** (YES at Step **10**). Upon receiving this request, the CPU **111** causes the SAN system structure files in the RAM **113** to be loaded to the work area of the RAM **113** (Step **11**). Then, the CPU **111** obtains physical path data from the real SAN system via the LAN (Step **12**). Then, the CPU **111** compares this obtained data with the physical path data of the virtual SAN system, so as to determine whether the real SAN system has been properly built in conformity to the electronically prepared plan (Step **13**).

[**0091**] In detail, the above determination is performed by the steps shown in **FIG. 14**. First, at Step **21**, the CPU **111** obtains FC port connection data from the FC switches **300**A, **300**B of the physically-built SAN system. Thereafter, Steps **22**~**25** are performed. The FC port connection data obtained during the procedure of **FIG. 14** is expressed in WWPNs of the FC ports of the server **100**, storage **200** or FC switches **300**A, **300**B. As previously stated, the WWPNs each include a manufacturer-specific number. Based on these numbers, the CPU **111** identifies the manufacturers and device types of the server **100**, storage **200** and FC switches **300**A, **300**B. After the identification, the CPU **111** checks if each of the components of the real SAN system is identical to the counterpart of the virtual SAN system. Also, the CPU **111** checks if the fiber channels **400** are properly connected between the designated FC ports. This checking is performed by referring o the WWPNs of the FC ports to which the FC ports **310**A~**310**I, **320**A~**320**I of the FC switches **300**A, **300**B are supposed to be connected.

[**0092**] The result of the check is visually presented by the display **13** (Step **14**). As shown in **FIG. 15**, the structure of the real SAN system appears in the left half region of the monitor **13**A, while the structure of the virtual SAN system appears in the right half region of the same monitor. In the illustrated example, the fiber channel **400** to be connected between the FC switch **300**A and the FC switch **300**B of the virtual SAN system is blinking. This indicates that the physically-built SAN system is missing the required cascade connection between the FC switch **300**A and the FC switch **300**B. Such on-screen indication is advantageous to prompting the system engineer to install the missing element. The way of error indication is not limited to the above example. As another way, the symbol of the missing fiber channel may be blinked in the left half region of the monitor **13**A.

[**0093**] When the real SAN system is built without any defection, no blinking symbol appears on the monitor **13**A. Thus, the system engineer can readily know that the physical structure of the SAN system is correct.

[**0094**] Thereafter, an "access path automatic setting request" is inputted from the keyboard **12** (YES at Step **15**). Upon receiving this request, the CPU **111** causes the access path connection command files stored in the RAM **113** to be loaded to the work area of the RAM **113** (Step **16**). Upon this, the CPU **111** replaces the virtual access paths specified by the tentative WWPNs (and stored in the access path connection command files) with the access paths specified by the actual WWPNs obtained from the real SAN system (Step **17**). The access path connection command files (with the modified WWPNs) are stored in the RAM **113** (Step **18**).

[**0095**] Then, the CPU **111** issues an access path connection command to the real SAN system so that the desired access paths are automatically set in the real SAN system (Step **19**). Specifically, the CPU **111** sends zoning data to the FC switches **300**A, **300**B. In the example shown in **FIG. 1**, the zoning data relates to Zone A (WWPN 11, WWPN 21), Zone B (WWPN 11, WWPN 23), Zone C (WWPN 12, WWPN 22) and Zone D (WWPN 11, WWPN 23). Upon receiving the zoning data, the zoning mechanisms **311**, **312** of the respective switches set zones to regulate the access of the server **100** to the storage **200**. As a result, the real SAN system is provided with the same access paths as the ones set for the virtual SAN system, and the system assembly assisting procedure ends.

[**0096**] In the above-described system assembly assisting procedure, the structure check of the physically-built SAN system is performed electronically (i.e. by a computer). In this manner, it is possible to make a fast and reliable determination of whether the SAN system is built in conformity to the original plan. Further, since the result of the check is visually presented by the display **13**, it is easy to recognize any structural discrepancy between the real SAN system and the original design plan.

[**0097**] Still further, the automatic access path setting is advantageous to enabling easy and reliable realization of the access paths of the real SAN system.

[0098] In the above-described example, use is made of a removable medium M for conveying the system assembly assisting program. Obviously, the present invention is not limited to this. Many kinds of networks, typically the Internet or LAN, may be used for conveying the program.

[0099] The present invention being thus described, it is, obvious that the same may be varied in many ways. Such variations are not to be regarded as a departure from the spirit and scope of the present invention, and all such modifications as would be obvious to those skilled in the art are intended to be included within the scope of the following claims.

1. An apparatus for assisting realization of a storage area network system in which a server with a fiber channel port, a storage with a fiber channel port and a fiber channel switch with a plurality of fiber channel ports are connected to each other via a plurality of fiber channels, the assisting apparatus comprising:

first information input means for inputting device data relating to the server, the storage and the fiber channel switch;

second information input means for inputting information relating to physical connection among the server, the storage and the fiber cannel switch via the fiber channels;

plan generating means for generating, based on the information inputted through the first and the second information input means, a plan of a virtual storage area network system in which the server, the storage and the fiber channel switch are physically connected via the fiber channels; and

display means for displaying the generated plan.

2. The apparatus according to claim 1, further comprising:

third information input means for inputting information relating to logical connection among the server, the storage and the fiber channel switch of the virtual storage area network system;

display control means for adding, based on the information inputted through the third information input means, a logical connection representing symbol to the displayed plan; and

recording means for causing a recording medium to store information about a structure of the virtual storage area network system and information about logical connection of the virtual storage area network system.

3. The apparatus according to claim 1, further comprising:

information obtaining means for obtaining information about the fiber channel ports of the server, the storage and the fiber channel switch of a real storage area network system built in accordance with the plan of the virtual storage area network system; and

system structure checking means for checking if the real storage area network system is identical in physical connection to the virtual storage area network system, the checking being performed by comparing the obtained information about the fiber channel ports and the information about the fiber channel ports of the virtual storage area network system.

4. The apparatus according to claim 2, wherein the information about the physical connection and the logical connection of the virtual storage area network system is generated by using tentative world wide port names set for the fiber channel ports of the server, the storage and the fiber channels.

5. The apparatus according to claim 4, further comprising logical connection setting means for performing automatic logical connection setting with respect to the real storage area network system based on the information about the logical connection of the virtual storage area network system stored in the recoding means.

6. A method of assisting realization of a storage area network system in which a server with a fiber channel port, a storage with a fiber channel port and a fiber channel switch with a plurality of fiber channel ports are connected to each other via a plurality of fiber channels, the method comprising:

a first information inputting step for inputting into a computer device data relating to the server, the storage and the fiber channel switch;

a second information inputting step for inputting information relating to physical connection among the server, the storage and the fiber cannel switch via the fiber channels;

a plan generating step for generating, based on the information inputted at the first and the second information inputting steps, a plan of a virtual storage area network system in which the server, the storage and the fiber channel switch are physically connected via the fiber channels; and

a displaying step for causing display means to display the generated plan.

7. The method according to claim 6, further comprising:

a third information inputting step for inputting into the computer information relating to logical connection among the server, the storage and the fiber channel switch of the virtual storage area network system;

a display renewing step for adding, based on the information inputted at the third information inputting step, a logical connection representing symbol to the displayed plan; and

a recording step for causing a recording medium to store information about a structure of the virtual storage area network system and information about logical connection of the virtual storage area network system.

8. The method according to claim 7, further comprising:

a fourth information inputting step for inputting into the computer information about the fiber channel ports of the server, the storage and the fiber channel switch of a real storage area network system built in accordance with the plan of the virtual storage area network system; and

a system structure checking step for checking if the real storage area network system is identical in physical connection to the virtual storage area network system, the checking being performed by comparing the information about the fiber channel ports inputted at the

fourth information inputting step and the information about the fiber channel ports of the virtual storage area network system.

9. The method according to claim 7, wherein the information about the physical connection and the logical connection of the virtual storage area network system is generated by using tentative world wide port names set for the fiber channel ports of the server, the storage and the fiber channels.

10. The method according to claim 9, further comprising a logical connection setting step for performing automatic logical connection setting with respect to the real storage area network system based on the information about the logical connection of the virtual storage area network system stored in the recoding means.

11. A program for assisting realization of a storage area network system in which a server with a fiber channel port, a storage with a fiber channel port and a fiber channel switch with a plurality of fiber channel ports are connected to each other via a plurality of fiber channels, the program causing a computer to function as:

first information input means for inputting device data relating to the server, the storage and the fiber channel switch;

second information input means for inputting information relating to physical connection among the server, the storage and the fiber cannel switch via the fiber channels;

plan generating means for generating, based on the information inputted through the first and the second information input means, a plan of a virtual storage area network system in which the server, the storage and the fiber channel switch are physically connected via the fiber channels; and

display means for displaying the generated plan.

12. The program according to claim 11, further causing the computer to function as:

third information input means for inputting information relating to logical connection among the server, the storage and the fiber channel switch of the virtual storage area network system;

display control means for adding, based on the information inputted through the third information input means, a logical connection representing symbol to the displayed plan; and

recording means for causing a recording medium to store information about a structure of the virtual storage area network system and information about logical connection of the virtual storage area network system.

13. The program according to claim 12, further causing the computer to function as:

information obtaining means for obtaining information about the fiber channel ports of the server, the storage and the fiber channel switch of a real storage area network system built in accordance with the plan of the virtual storage area network system; and

system structure checking means for checking if the real storage area network system is identical in physical connection to the virtual storage area network system, the checking being performed by comparing the obtained information about the fiber channel ports and the information about the fiber channel ports of the virtual storage area network system.

14. The program according to claim 12, wherein the information about the physical connection and the logical connection of the virtual storage area network system is generated by using tentative world wide port names set for the fiber channel ports of the server, the storage and the fiber channels.

15. The program according to claim 14, further causing the computer to function as logical connection setting means for performing automatic logical connection setting with respect to the real storage area network system based on the information about the logical connection of the virtual storage area network system stored in the recoding means.

16. A computer-readable recording medium that stores the program according to claim 11.

* * * * *