DATA BACK UP METHOD AND ITS PROGRAMS

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ABSTRACT
User data backup functions are realized through a computer, which is located on the management service provider company side and interfaces between a user side computer environment and a storage service side computer environment to support storage service. This computer selects storage devices which meet the user side conditions from a plurality of entirely or partially empty storage devices owned by the storage service side computer environment. The computer receives user data from the user side computer environment, divides the user data into records of a predetermined size and transmits the records to the storage service side computer environment so that the records are distributed and stored to the selected storage devices.
### FIG. 3

**DATA ALLOCATION TBL**

<table>
<thead>
<tr>
<th>USER DATA</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>USR1-A</td>
<td>SSP1-B1</td>
<td>SSP1-C1</td>
<td>SSP2-D1</td>
<td>SSP3-F1</td>
<td>SSP3-G1</td>
</tr>
<tr>
<td>USR2-B</td>
<td>SSP1-B2</td>
<td>SSP1-C2</td>
<td>SSP2-D2</td>
<td>SSP3-F2</td>
<td>SSP3-G2</td>
</tr>
</tbody>
</table>

### FIG. 4

**USER CONDITIONS TBL**

<table>
<thead>
<tr>
<th>USER DATA</th>
<th>CAPACITY</th>
<th>COST</th>
<th>TERM (START-END)</th>
<th>NUMBER OF DISTRIBUTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>USR1-A</td>
<td>100GB</td>
<td>10K ¥/100GB</td>
<td>2002 04-2003 03</td>
<td>5</td>
</tr>
<tr>
<td>USR2-B</td>
<td>500GB</td>
<td>7K ¥/50GB</td>
<td>2002 01-2002 12</td>
<td>2</td>
</tr>
</tbody>
</table>
### FIG. 5

**SSP CONDITIONS TBL**

<table>
<thead>
<tr>
<th>SSP DISK</th>
<th>CAPACITY</th>
<th>COST</th>
<th>TERM (START-END)</th>
<th>INSTALLATION SITE</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSP1-B</td>
<td>500GB</td>
<td>10K ¥/100GB</td>
<td>2002 01-02002 07</td>
<td>TOKYO</td>
</tr>
<tr>
<td>SSP1-C</td>
<td>100GB</td>
<td>6K ¥/50GB</td>
<td>2002 01-02002 07</td>
<td>TOKYO</td>
</tr>
<tr>
<td>SSP2-D</td>
<td>50GB</td>
<td>7K ¥/50GB</td>
<td>2002 01-02005 07</td>
<td>OSAKA</td>
</tr>
</tbody>
</table>

### FIG. 6

**DISK DIVIDING TBL**

<table>
<thead>
<tr>
<th>DISK</th>
<th>PARTITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSP1-B</td>
<td>B1</td>
</tr>
<tr>
<td>SSP1-C</td>
<td>C1</td>
</tr>
<tr>
<td>SSP2-D</td>
<td>D1</td>
</tr>
<tr>
<td>SSP3-F</td>
<td>F1</td>
</tr>
<tr>
<td>SSP3-G</td>
<td>G1</td>
</tr>
</tbody>
</table>
FIG. 7

300 OBTAIN THE USER CONDITIONS
301 OBTAIN THE SSP CONDITIONS
302 CALCULATE THE CAPACITY OF THE DISKS USED FOR BACK UP / THE CAPACITY OF THE DISK TO BACK UP / (THE NUMBER OF DISTRIBUTIONS - 1)

303 WHAT IS THE CONDITION LEVEL?
304 REPEAT AS MANY TIMES AS DISTRIBUTIONS
305 REPEAT AS MANY TIMES AS THE REGISTERED SSP DISKS
306 THE CAPACITY OF THE DISKS USED FOR BACK UP < THE CAPACITY OF THE OFFERED DISKS

307 CONDITION LEVEL 1
308 AVAILABLE START TIME < USER'S PREFERRED START TIME & AVAILABLE END TIME > USER'S PREFERRED END TIME

309 STORE THE HIT SSPS IN THE MEMORY
305 REPEAT AS MANY TIMES AS THE REGISTERED SSP DISKS
310 SELECT A SSP WITH THE LEAST COST AMONG THE HIT SSPS
311 ALLOCATE THE CAPACITY OF BACKUP DISK FROM THE SSP DISK
312 EXCLUDE THE ALLOCATED SSP FROM THE OBJECT OF COMPARISON

304 REPEAT AS MANY TIMES AS DISTRIBUTIONS

313 TOTAL COST < USER COST
315 ALLOCATE THE DATA / REGISTER THE DISK DIVIDING

END

304 REPEAT AS MANY TIMES AS DISTRIBUTIONS
305 REPEAT AS MANY TIMES AS THE REGISTERED SSP DISKS
306 THE CAPACITY OF THE DISKS USED FOR BACK UP < THE CAPACITY OF THE OFFERED DISKS

308 AVAILABLE START TIME < USER'S PREFERRED START TIME

309 STORE THE HIT SSPS IN THE MEMORY
305 REPEAT AS MANY TIMES AS THE REGISTERED SSP DISKS
310 SELECT A SSP WITH THE LEAST COST AMONG THE HIT SSPS
311 ALLOCATE THE CAPACITY OF BACKUP DISK FROM THE SSP DISK
304 REPEAT AS MANY TIMES AS DISTRIBUTIONS
DATA BACK UP METHOD AND ITS PROGRAMS

[0001] The present application is a continuation of application Ser. No. 10/367,767, filed Feb. 19, 2003, the contents of which are incorporated herein by reference.

BACKGROUND OF THE INVENTION

[0002] The present invention relates to storage backup techniques, and more particularly, to a technique for backing up storage in a remote place.

[0003] Since contents of disk storage may be lost by an unexpected accident, data backup is made in most computer systems. Further, data backup tape and other media are kept in a remote site so that they will not be lost together with the original copies in case of a fire, earthquake or the like. Accordingly, a SAN (storage area network)-used backup method is disclosed in Japanese Patent Lay-open No. 2002-7304. Also in Japanese Patent Lay-open No. 2000-82008, a data sharing-based backup method is disclosed.

[0004] Large-scale earthquakes, synchronized attacks by viruses, etc. prove a further growing threat to computer systems and their data, which is making it mandatory to keep two or three copies of each data as well as backing up them in a remote site. Backup is therefore becoming a swelling burden in terms of storage capacity, cost and overhead.

SUMMARY OF THE INVENTION

[0005] The present invention has been made in view of such a background as mentioned above and an object of the present invention is to provide a high safe data backup storage device advantageous in terms of cost.

[0006] According to one aspect of the present invention, there is provided a user data backup technique by computer means which resides between a user side computer environment and a storage service side computer environment to support storage service, the-data backup method comprising the steps of: selecting a storage device which meets the user side conditions from a plurality of entirely or partially empty storage devices owned by the storage service side computer environment; receiving user data from the user side computer environment; and transmitting the user data to the storage service side computer environment for storage in the selected storage device.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] FIG. 1 shows the configuration of a storage service system according to a preferred embodiment of the present invention;

[0008] FIG. 2 shows an example of disk dividing and data storage;

[0009] FIG. 3 shows an example of a data allocation TBL 123;

[0010] FIG. 4 shows an example of a user conditions TBL 122;

[0011] FIG. 5 shows an example of a SSP conditions TBL 124;

[0012] FIG. 6 shows an example of a disk dividing TBL 125;

[0013] FIG. 7 is a flowchart showing a processing procedure by a matching unit 115 in the preferred embodiment;

[0014] FIG. 8 is a time chart showing a processing procedure for data backup in the preferred embodiment;

[0015] FIG. 9 is a time chart showing a processing procedure for data restoration in the preferred embodiment;

[0016] FIG. 10 is a time chart showing a processing procedure for data migration in the preferred embodiment; and

[0017] FIG. 11 is a time chart showing a processing procedure for disk return in the preferred embodiment.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0018] Preferred embodiments of the present invention will be described in detail with reference to the accompanying drawings below.

[0019] FIG. 1 shows a configuration of a backup storage service system according to an embodiment of the present invention. In the system of FIG. 1, a management service provider corporation (hereinafter denoted as a MSP) provides data backup service to users (hereinafter denoted as USRs) by using idle resources of a plurality of storage service provider corporations (hereinafter denoted as SSPs). Each SSP has a SSP server 103 which is a computer environment on the storage service side. Each USR has a USR server 102 which is a computer environment on the user side. A MSP server 101 is a computer environment which interfaces between the two computer environments in order to support the storage service.

[0020] In FIG. 1, the MSP server 101 receives data from USR servers 102-1 and 102-2, divides the data into records and stores the records in idle resources managed by SSP servers 103-1, 103-2 and 103-3. Here, idle resources mean the currently unused areas of the storage devices such as tape libraries and RAID devices provided for data center business and storage service business. The MSP server 101, the USR servers 102 and the SSP servers 103 are connected via a network such as the Internet.

[0021] The MSP server 101 comprises a processing section composed of a service reception unit 113, a resource management unit 114, a matching unit 115, a data transfer unit 116, a data dividing unit 117, a data restore unit 118 and a data migration unit 119. Also there are provided, on its storage device, a user conditions TBL (table) 122, a data allocation TBL 123, a SSP conditions TBL 124 and a disk dividing TBL 125.

[0022] The service reception unit 113 is notified by the USR servers 102 of the size of each data to be backed up and the user's preferred condition (cost, etc.) for using the backup storage service. The service reception unit 113 stores those obtained conditions into the user conditions TBL 122. The resource management unit 114 is notified by the SSP servers 103 of their conditions (empty disk capacity, availability period, etc.) for providing disks. The resource management unit 114 stores those obtained conditions into the SSP conditions TBL 124.

[0023] The matching unit 115 searches the user conditions TBL 122 and SSP conditions TB 124 for mutually conform-
The data transfer unit 116 controls data transfer between the USR servers 102 and the MSP server 101 and between the MSP server 101 and the SSP services 103.

The data dividing unit 117 divides user data into records whose size is determined, depending on the empty disk capacities offered by the SSP servers for backup. The data restore unit 118 refers to the data allocation TBL 123 and reassembles original data from records distributed to a plurality of SSP disks. The data migration unit 119 moves data to an empty area in another SSP server 103 if the availability term of the current backup disk expires or if it becomes necessary during the availability term to return the disk which is currently used as an idle resource. The user is not required to be aware of any data migration executed since the pertinent processing completes within the MSP, which results in a reduced operational cost for the user.

The user conditions TBL 122 stores the user's preferred conditions such as cost and availability term. This table will be described later in detail with reference to FIG. 4. The data allocation TBL 123 stores information about how SSP disks are allocated to user data. In order to raise the safety of data, the data allocation TBL is duplicated. The other copy is held in a separate alternative MSP server. If the MSP server 101 becomes not available due to disaster or failure, the data allocation TBL 123 in the alternative MSP server is accessed. This table will be described later in detail with reference to FIG. 3. The SSP conditions TBL 124 stores disk loading conditions such as empty capacity and cost. This table will be described later in detail with reference to FIG. 5. The disk dividing TBL 125 stores how the lent disks are divided by the MSP into partitions. This table will be described later in detail with reference to FIG. 6.

Each USR server 102 comprises a service demanding unit 111 and a data transfer unit 112. The USR server 102-1 manages user data A (131) while the USR server 102-2 manages user data B (132) and user data C (133).

When a USR server 102 uses the storage service, the USR server 102 issues a backup demanding request to notify the MSP of the required disk capacity, preferred cost, term of use and number of distributions. The number of distributions, which may be specified arbitrarily by the user, is an index determining the number of sites to which the data is apportioned for storage. Generally in a local site, RAID technology is used so that accesses are dispersed to a plurality of storage devices such as hard disks. In this case of the present invention, data is apportioned to a plurality of separate SSP disks connected via a network. How many SSP disks are to be used is determined by the number of distributions, a variable specified by the user. Reliability can be raised by using them like a single disk.

Once some disks are judged appropriate for backup by the MSP server 101, the data is sent to the MSP server 101 from the data transfer unit 112. To restore data from backup disks, the USR server 102 issues a restore demanding request to the MSP server 101 and receives the data from the MSP server 101 via the data transfer unit 112.

Each SSP server 103 comprises a resource registering unit 120 and a data transfer unit 121. The SSP server 103-1 manages disk A (141), disk B (142) and disk C (143). The SSP server 103-2 manages disk D (144) and disk E (145). The SSP server 103-3 manages disk F (146), disk G (147) and disk H (148).

Of the disks managed by a SSP server 103, those disks available for the backup storage service are registered to the MSP server 101 by the resource registering unit 120. The data transfer unit 121 manages data exchange between the USR server and the MSP server.

For example, assume that the backup storage service is to be applied to the user data A (131) in the USR server 102-1 and the user data B (132) in the USR server 102-2. Hereinafter, a disk means a logically independent storage device. Empty disks lent as idle resources are the disk B (142) and disk C (143) under management of the SSP server 103-1, the disk D (144) under management of the SSP server 103-2 and the disk F (146) and disk q (147) under management of the SSP server 103-3. A total of five disks are offered for the backup storage service.

Disk B is divided into partition 1 (142-1), partition 2 (142-2) and partition 3 (142-3); Disk C is divided into partition 1 (143-1) and partition 2 (143-2); Disk D is divided into partition 1 (144-1), partition 2 (144-2) and partition 3 (144-3); Disk F is divided into partition 1 (146-1) and partition 2 (146-2), and divided into partition 1 (147-1), partition 2 (147-2) and partition 3 (147-3).

User data A (131), after given the matching processing and then divided into five records in the MSP server 101, is stored to disk B partition 1 (142-1) in the SSP server 103-1, disk C partition 1 (143-1) in the SSP server 103-1, disk D partition 1 (144-1) in the SSP server 103-2, disk F partition 1 (146-1) in the SSP server 103-3 and disk G partition 1 (147-1) in the SSP server 103-3.

FIG. 2 shows how data on a user disk may be divided and stored for backup in the aforementioned embodiment. An original disk 201 is divided into a plurality of records according to the capacities of the backup disks. The original disk 201 corresponds to user data A (131) or user data B (132). The backup disks are represented by disks given numerals 211, 212, 213, 214 and 215 respectively. Each record, labeled with symbol R, may be either a block, a character or a bit. One block is data consisting of characters. The resultant records are sequentially stored on the respective disk partitions in accordance with the number of distributions. In the case of FIG. 2 where the specified number of distributions is assumed to be 5, the records are sequentially stored on the five backup disk 211, 212, 213, 214 and 215. Also note that in this example an EDD or parity record is stored for every four data records (R1, R2, R3 and R4 for instance). If one of some four adjacent records is lost, its corresponding ECC or parity record, code information, is then used to regenerate the lost record. Thus, R1, R2, R3, R4 and their ECC or parity are stored on backup disks 211, 212, 213, 214 and 215 respectively. In this manner, the divided records are sequentially stored on the backup disks. Combining the apportioning of data among a plurality of disks depending on the number of distributions with a parity check or ECC technique, this method is aimed to not only improving access performance but also securing the data.

Since ECC or parity information is stored as a separate record, even if one disk becomes not available due to a failure or the like, it is possible to restore data from records on the other disks. In addition, since each disk is a separate SSP disk, it is not possible to restore the whole data from one disk, which brings about a merit that the security of important data can be protected. Generally, making the
size of each record smaller raises security although this requires longer processing time.

[0036] FIG. 3 is an example of the data allocation TBL. 123 showing how user data is allocated to backup disks. In the data allocation TBL 123, data 401 contains a user server name and a disk name, indicating which user data is backed up. Each backup disk 402 contains a SSP server name, disk name and a partition name, indicating which partition is hit by the matching unit 115. In the case of FIG. 3, user data stored on USR1-A is divided into five sets and stored respectively in SSP1-B1, SSP1-C1, SSP2-D1, SSP3-F1 and SSP3-G1. Likewise, user data stored on USR2-B is divided into five sets and stored respectively in SSP1-B2, SSP1-C2, SSP2-D2, SSP3-F2 and SSP3-G2.

[0037] FIG. 4 is an example of the user conditions TBL. 122 where user-specified conditions for using the backup storage service are stored. In the user conditions TBL. 122, each user data 501 contains a user server name and a disk name, indicating which user data is concerned. Each capacity 502 contains the size of the data. Each cost 503 contains a monthly rental fee per unit capacity. Each term (start-end) 504 contains two dates between which the service is to be used or the user data is to be backed up. Each number of distributions 505 contains an index indicating the number of disks to which the user data, including ECC or parity records, is to be apportioned. Specifying a higher value I for the number of distributions results in higher safety since the user data will be apportioned among a large number of disks.

[0038] FIG. 5 is an example of the SSP conditions TBL. 124 where SSP specified conditions or providing the backup storage service are stored. In the SSP conditions TBL. 124, each SSP disk 601 contains a SSP name and a disk name, identifying a disk registered by the SSP. Each capacity 602 indicates the empty capacity of the disk. Each cost 603 indicates the monthly rental fee per unit capacity charged for the disk. Each term (start-end) 604 contains two dates between which the disk is available. Each installation site 605 contains the name of the site where the disk resides.

[0039] FIG. 6 is an example of the disk dividing TBL. 125 where available SSP disks are divided into partitions before lent to users when the storage service is used in the present embodiment. In the disk providing TBL. 125, each disk 701 contains a SSP name and a disk name, identifying a SSP disk registered by the SSP. Each partition 702 contains the name of a partition on the disk. In FIG. 6, disk SSP1-B is divided into three partitions named B1, B2 and B3 respectively. Likewise, SSP1-C is divided into two partitions named C1 and C2 respectively. Information in each partition 702 field corresponds to the logical block number associated with the partition within the disk.

[0040] FIG. 7 shows a flowchart describing how the matching unit 115 operates to search the user conditions and SSP conditions for mutually conforming combinations. If the operation of the matching unit 115 is started, conditions for using the backup service are obtained from the user conditions TBL. 122 (Step 300). Then SSP conditions for providing the backup service are obtained from the SSP conditions TBL. 124 (Step 301). Then, the minimum backup capacity per disk is calculated by dividing the capacity to back up by (the number of distributions) (Step 302). The matching unit 115 searches for appropriate which meet this minimum backup disk capacity and other conditions. At first, the condition level is set toll before condition level judgment is done (Step 303). Search is done at each condition level.

[0041] At condition level 1, the minimum backup disk capacity is compared with the capacity 602 of a SSP disk (Step 306) and if the minimum backup disk capacity is smaller, the term (start and end) during which the SSP disk is available is compared with the term (start and end) during which the user wants to back up the data (Step 307). If the term during which the user wants to back up the data is within the term during which the SSP disk is available, the identifier of the SSP disk is stored to the memory (Step 309). This judgment flow is executed for each SSP disk registered (Step 305). Of the hit SSP disks, the lowest cost SSP disk is selected (Step 310) and the minimum backup disk capacity is allocated from the selected SSP disk (Step 311). The hit SSP disk is excluded from the object of comparison in Steps 306 and 307 (Step 312). This loop is repeated as many times as the number of distributions (Step 304) so that as many conforming backup disks as the number of distributions are detected. The total cost for using the backup disks hit in this manner is calculated and compared with the user cost (Step 313). If the calculated total cost exceeds the user cost, the condition level is incremented by 1 (Step 314) to execute another search flow.

[0042] At condition level 2, the date from which the SSP disk is available is compared with the date from which the user wants to back up the data (Step 308). Not like in Step 307, the date until which the SSP disk is available is not compared with the date until which the user wants to back up the data. Then, the total cost for using the backup disks hit in this manner is calculated and compared with the user cost (Step 313). If the calculated total cost exceeds the user cost, the condition level is incremented by 1 (Step 314) to execute another search flow.

[0043] At condition level 3, it is not required to distribute the data to different SSP disks and therefore it is allowed to store the data on the same SSP disk. That is, backup disk search is repeated without executing Step 312 where each hit SSP disk is excluded from the object of comparison.

[0044] At condition level 3, it is possible that all the user data is allocated to a single SSP disk. Instead of condition level 3, the processing procedure may also be altered in such a manner that 1 is subtracted from the number of distributions specified by the user and then condition level 1 is executed again from Step 302. In this case, the total cost may be reduced to the user cost or below without ignoring the user-desired number of distributions. Note that concentrating the user data to only one SSP disk or SSP server 103 is also an implementation of the present invention although the safety of the user data is sacrificed.

[0045] If backup disks are determined as mentioned above, the allocation and disk dividing are registered (Step 315). That is, the SSP disk partitions allocated according to the minimum backup disk capacity are registered to the disk dividing TBL. 125 and data allocation TBL. 122. Note that if the matching unit 115 fails to find any SSP disk conforming to the user conditions even at condition level 3, the matching unit 115 terminates its processing after notifying the user server 102 of the failure.

[0046] FIG. 8 is a time chart indicating how exchanges are done when data is backed up in the embodiment. The
For the USR server 102 to use the backup storage service, the service demanding unit 111 issues a service demanding request to the service reception unit 113 and notifies the unit of user-desired conditions (4). Upon receiving the request, the service reception unit 113 issues a matching processing request to the matching unit 115 (5). The matching unit 115 searches the user conditions and SSP conditions for mutually conforming combinations. After the search, the matching unit 115 notifies the resource management unit 114 of the matching result (6). The resource management unit 114 refers to the data allocation TBL. 123 and disk dividing TBL. 125 and issues a rental request unit 120 in a backup SSP server 103 (7). The rental request includes the specification of which disk partitions is to be used for backup. After a rental request is issued to each backup SSP server 103, the resource management unit 114 notifies the matching unit 115 of the completion (8). Then, the matching unit 115 issues a rental settlement notice to the service reception unit 113 (9). Finally, the service reception unit 113 issues a rental settlement notice to the service demanding unit 111 (10).

Upon receiving the rental settlement notice, the USR server 102 transmits the original data from the data transfer unit 112 to the data transfer unit 116 in the MSP server 101 (11). The transfer unit 116 passes the data to the data dividing unit 117 (12).

According to the data allocation TBL. 123, the data dividing unit 117 divides the data into records for distribution to the backup SSP servers 103 and transmits the records to the data transfer unit 116 (13). The data transfer unit 116 transfers the records to the data transfer unit 121 of each backup SSP server 103 (14).

FIG. 9 is a time chart indicating how exchanges are done when data is restored in the embodiment. For a USR server 102 to restore data by using the backup storage service, the service demanding unit 111 issues a service demanding request to the service reception unit 113 and specifies which user data 401 is to be restored (1). Upon receiving the service demanding request, the service reception unit 113 requests the resource management unit 114 to restore the data (2).

According to the data allocation TBL. 123 and disk dividing TBL. 125, the resource management unit 114 requests the resource registering unit 120 in each backup SSP server 103 to transfer the target data (3). This request includes the specification of a backup disk partition from which data is to be transferred. The data transfer unit 121 passes the data to the data transfer unit 116 in the MSP server 101 (4). The transferred data is allowed to enter the data restore unit 118 where restore processing is done (5). If the restore processing succeeds, the data is transferred from the data restore unit 118 via the data transfer unit 116 (6) to the data transfer unit 112 in the USR server 102 (7).

Note that if records cannot be obtained from a SSP server 103 due to failure or the like, the data restore unit 118 regenerates the lost records by using ECC or parity information.

FIG. 10 is a time chart indicating how processing is done for data migration. If the available term of a resource expires, the MSP server 101 must perform data migration. The resource management unit 114 checks the term 604 fields of the SSP conditions TBL. 124, and if the available term of any SSP disk expires, it issues a data migration request to the data migration unit 119 (1). The data migration unit 119 issues a matching processing request for the user data to be moved to the matching unit 115 (2). The user data to be moved is identified by referring to the disk dividing TBL. 125 and data allocation TBL. 123.

The matching unit 115 searches the user conditions and SSP conditions for mutually conforming combinations. Note that the data to be moved is limited to the data stored in resources whose availability term has expired. Therefore, the minimum backup capacity and the number of distributions are set for the data to be moved without using the initially set minimum backup space and number of distributions. At step 302, the number of SSP disks whose availability term has expired is used instead of (the number of distributions) 1. Cost comparison at Step 313 is omitted, too. After the search, the matching unit 115 notifies the resource management unit 114 of the matching result (3), and the resource management unit 114 issues a rental notice to the resource registering unit 120 of, for example, the SSP server 103-2 (4). The rental notice includes the specification of a new disk partition for backup. The resource management unit 114 requests the resource registering unit 120 of the SSP server 103-1 (whose availability term has expired) to collect the data (5). The collection 1cQuest includes the specification of the disk partition to which the data is to be moved. The data transfer unit 121 transfers the data to the data transfer unit 116 of the MSP server 101 (6).

The data migration unit 119 is notified that the data is transferred to the MSP server 101 (7). The data migration unit 119 notifies the data transfer unit 116 of the address of the data destination (the address of the SSP server 103-2, disk identifier, partition identifier, logical block number of the partition in the disk, etc.) (8). Then, the data transfer unit 116 transfers the received data to the data transfer unit 121 of the data destination SSP server 103-2 (9). When migration of the user data which must be moved to new backup disks is complete, the data migration unit 119 updates the disk dividing TBL. 125 and data allocation TBL. 123 so as to indicate the new backup disks. In addition, the resource management unit 114 of the MSP server 101 issues a rental ending request to the resource management unit 120 of the SSP server 103-1 used formerly for backup (10). This request includes the specification of the disk partition whose rental is to be terminated.

FIG. 11 is a time chart indicating how exchanges are done when a disk is returned. If a SSP server 103 requests the MSP server 101 to return a loaned storage device within its availability term, the MSP server 101 must execute data migration, too. Upon receiving a storage return request from the resource registering unit 120 of, for example, the SSP server 103-1 (0), the resource management unit 114 starts the data migration procedure based on this request.
This request includes the identifier of a disk which is to be returned. The subsequent procedure is same as described with reference to FIG. 10.

[0057] For user data under generation management, it is usual that a plurality of backup copies are held for the corresponding generations. Term 504 fields can be set so as to always retain a predetermined number of such backup copies. In this case, the MSP server 101 monitors the term 504 fields of the user conditions TBL 122, and if the term of a disk completes or expires, issues a rental ending request to the SSP server 103 having the disk in order to release its partitions.

[0058] According to the present invention, it is possible to provide users with a data backup storage device which shows high safety against disasters, etc. and is advantageous in terms of cost.

What is claimed is:

1. An information processing system comprising:
a plurality of storage systems having a plurality of storage means;
a computer, coupled to the storage systems, which responds to a data storing request from a user, and which is configured to obtain information relating to storage areas from each of the storage systems, select one or more storage areas which satisfy a user condition based on the information relating to storage areas of each of the storage systems, and transfer data to one or more storage systems having the selected one or more storage areas in response to the data storing request.

2. The information processing system according to claim 1, wherein the user condition includes at least one of a division number of the data, a cost to store the data, and a data storing term of the data.

3. The information processing system according to claim 2, wherein the obtained information includes at least one of an available storage area, a cost to use the available storage area, and an available term of each storage system.

4. The information processing system according to claim 3, wherein the computer is further configured to select storage areas corresponding to the division number included in the user condition, divide the data based on the division number, and transfer the divided data to storage systems having the selected storage areas in response to the data storing request.

5. The information processing system according to claim 4, wherein the computer responds to a data read request, and the computer is further configured to send a read request to each storage system which the divided data is transferred, and to generate data from the divided data in response to the data read request.

6. The information processing system according to claim 5, wherein each of the data size to be divided is determined by available storage area.

7. The information processing system according to claim 6, wherein the computer is further configured to re-select storage areas when a total cost of the selected storage areas is more than the cost included in the user condition.

8. The information processing system according to claim 7, wherein the computer is further configured to monitor available terms included in the obtained information, select a storage area if the available term is exceeded, and migrate the divided data stored in the storage area that has exceeded the available term to the selected area.

9. An information processing system comprising:
a plurality of storage systems having a plurality of storage areas;
a computer, coupled to the storage systems, which responds to a data storing request from a user, and which obtains information relating to storage areas from each of the storage systems, selects one or more storage areas which satisfy a user condition based on the information relating to storage areas of each of the storage systems, and transfers data to one or more storage systems having the selected one or more storage areas in response to the data storing request.

10. The information processing system according to claim 9, wherein the user condition includes at least one of a division number of the data, a cost to store the data, and a data storing term of the data.

11. The information processing system according to claim 10, wherein the obtained information includes at least one of an available storage area, a cost to use the available storage area, and an available term of each storage system.

12. The information processing system according to claim 11, wherein the computer selects storage areas corresponding to the division number included in the user condition, divides the data based on the division number, and transfers the divided data to storage systems having the selected storage areas.

13. The information processing system according to claim 12, wherein the computer responds to a data read request, and wherein the computer sends a read request to each storage system to which the divided data is transferred, and generates data from the divided data in response to the data read request.

14. The information processing system according to claim 13, wherein each of the data size is determined by available storage area.

15. The information processing system according to claim 14, wherein the computer re-selects storage areas when a total cost of the selected storage areas is more than the cost included in the user condition.

16. The information processing system according to claim 15, wherein the computer monitors available terms included in the obtained information, selects a storage area if the available term is exceeded, and migrates the divided data stored in the storage area that has exceeded the available term to the selected storage area.

17. A data storing method comprising:
obtaining information relating to storage areas from a plurality of storage systems;
selecting one or more storage areas which satisfy a user condition based on information relating to storage areas of each storage system; and
transferring data to one or more storage systems having the selected one or more storage areas.
18. A data storing method comprising:

obtaining information relating to storage areas from a plurality of storage systems;

selecting two or more storage areas which satisfy a user condition based on information relating to storage areas of each storage system,

dividing the data; and

transferring the divided data to two or more storage systems having the selected two or more storage areas.

19. The data storing method according to claim 17, wherein the user condition includes at least one of a division number of the data, a cost to store the data, and a data storing term of the data.

20. The data storing method according to claim 18, wherein the obtained information includes at least one of an available storage area, a cost to use the available storage area, and an available term of each storage system.

21. The data storing method according to claim 19, wherein the storage area is selected by the division number, and the data is divided by the division number.

22. The data storing method according to claim 17, further comprising:

- sending a read request to each storage system to which the divided data is transferred; and
- generating data from the divided data.

23. The data storing method according to claim 17, wherein each of the data size to be divided is determined by the available storage area.

24. The data storing method according to claim 18, further comprising:

- re-selecting storage areas when a total cost of the selected storage areas is more than the cost included in the user condition.

25. The data storing method according to claim 18, further comprising:

- monitoring available terms included in the obtained information;
- selecting a storage area if the available term is exceeded; and
- migrating the divided data stored in the storage area that has exceeded the available term to the selected storage area.