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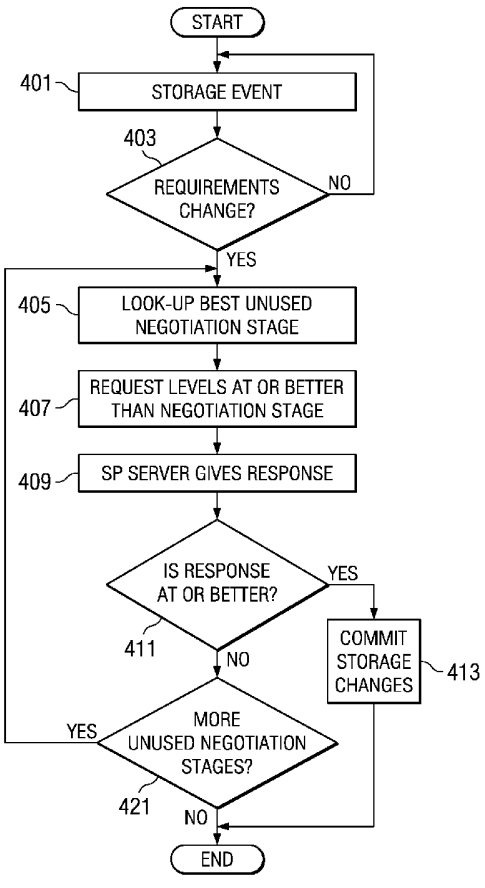
[Continued on next page]

(54) Title: METHOD AND APPARATUS FOR STORAGE RESOURCE ALLOCATION



(57) Abstract: Described is a way to adjust an application's storage availability by noting a storage event occurrence. An occurrence that necessitates a requirements change triggers negotiation, wherein a series of negotiation stages are presented to a storage provider server. For each storage provider response to a transmitted negotiation stage, a determination is made to see if the response is better than the proposal described in the negotiation stage. If so, the application commits the storage changes.

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METHOD AND APPARATUS FOR STORAGE RESOURCE ALLOCATION

BACKGROUND OF THE INVENTION

1. Technical Field:

The invention relates to the field of data storage and redundancy. More specifically the invention relates to a manner of fairly allocating storage resources, eg a multi-dimensioned disk array, through a negotiating process.

2. Description of Related Art:

Storage is a critical component of almost every software application in use today. As the storage industry has matured, there have been increases to both the number of storage options and the performance of data entry and retrieval. Storage options include, e.g., magnetic tape, Hard Disk Drives (HDD), CD-ROMs, DVD-ROMs, and optical media. HDD category includes, e.g., standalone HDDs, arrays of disks and complex virtual storage environments.

Disk arrays may be classified, e.g., Redundant Array of Inexpensive Disks (RAID) 0, RAID 1, RAID 0+1 (which have enhanced redundancy and performance), RAID 1+5 and RAID 5, among others. Virtual storage environments include Storage Area Networks (SANs). Each storage option has an associated cost and service level, both of which vary widely.

Some applications, e.g. hosted on one or more servers, occasionally get markedly increased demands for the features of the application. This can result in rapid fluctuations in CPU utilization, network traffic and particularly, for storage. Sometimes these "peak" times are well known and can be identified by a scheduled event, e.g. a date, time and duration. Other times, the peaks are unscheduled, and some responsiveness is needed in an ad hoc manner.

SUMMARY OF THE INVENTION

A method for allocating storage resources begins with monitoring a performance level. If the performance level is beyond a threshold, a further determination is made to see if a requirement change occurred. If so, the embodiment looks up an unused negotiation stage from a set of

negotiation stages stored in metadata. Provided the negotiation stage exists, a request is made to for a service based on the unused negotiation stage - wherein the request goes out to a storage provider server. The storage provider makes (or at least appears to make) a storage provider response. The embodiment determines if the SP response is acceptable. If so, the embodiment commits a storage change based on the SP response.

BRIEF DESCRIPTION OF THE DRAWINGS

An illustrative embodiment of the present invention will now be described, by way of example only, with reference to the following drawings:

Figure 1 shows a data processing system in accordance with an illustrative embodiment of the present invention;

Figure 2 shows a block diagram of some of the component parts in accordance with an illustrative embodiment of the present invention;

Figure 3 is a block diagram of a network in accordance with an illustrative embodiment of the present invention; and

Figure 4 shows a flow diagram expressing the steps that an embodiment may take to occasionally update requirements and an agreement with a storage provider server in accordance with an illustrative embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

With reference now to the figures and in particular with reference to **Figure 1**, a pictorial representation of a data processing system in which the present invention may be implemented is depicted in accordance with a preferred embodiment of the present invention. A computer **100** is depicted which includes system unit **102**, video display terminal **104**, keyboard **106**, storage devices **108**, which may include floppy drives and other types of permanent and removable storage media, and mouse **110**. Additional input devices may be included with personal computer **100**, such as, for example, a joystick, touchpad, touch screen, trackball, microphone, and the like. Computer **100** can be implemented using any suitable computer, such as an IBM eServer computer or IntelliStation computer, which are products of International Business Machines

Corporation, located in Armonk, New York. Although the depicted representation shows a computer, other embodiments of the present invention may be implemented in other types of data processing systems, such as a network computer. Computer **100** also preferably includes a graphical user interface (GUI) that may be implemented by means of systems software residing in computer readable media in operation within computer **100**.

With reference now to **Figure 2**, a block diagram of a data processing system is shown in which the present invention may be implemented. Data processing system **200** is an example of a computer, such as computer **100** in **Figure 1**, in which code or instructions implementing the processes of the present invention may be located. Data processing system **200** employs a peripheral component interconnect (PCI) local bus architecture. Although the depicted example employs a PCI bus, other bus architectures such as Accelerated Graphics Port (AGP) and Industry Standard Architecture (ISA) may be used. Processor **202** and main memory **204** are connected to PCI local bus **206** through PCI bridge **208**. PCI bridge 208 also may include an integrated memory controller and cache memory for processor **202**. Additional connections to PCI local bus **206** may be made through direct component interconnection or through add-in connectors. In the depicted example, local area network (LAN) adapter **210**, small computer system interface (SCSI) host bus adapter **212**, and expansion bus interface **214** are connected to PCI local bus **206** by direct component connection. In contrast, audio adapter **216**, graphics adapter **218**, and audio/video adapter **219** are connected to PCI local bus **206** by add-in boards inserted into expansion slots. Expansion bus interface **214** provides a connection for a keyboard and mouse adapter **220**, modem **222**, and additional memory **224**. SCSI host bus adapter **212** provides a connection for hard disk drive **226**, tape drive **228**, and CD-ROM drive **230**. Typical PCI local bus implementations will support three or four PCI expansion slots or add-in connectors.

An operating system runs on processor **202** and is used to coordinate and provide control of various components within data processing system **200** in Figure 2. The operating system may be a commercially available operating system such as Windows XP, which is available from Microsoft Corporation. Instructions for the operating system, an object-oriented programming system, and applications or programs are located on storage

devices, such as hard disk drive **226**, and may be loaded into main memory **204** for execution by processor **202**.

Those of ordinary skill in the art will appreciate that the hardware in **Figure 2** may vary depending on the implementation. Other internal hardware or peripheral devices, such as flash read-only memory (ROM), equivalent nonvolatile memory, or optical disk drives and the like, may be used in addition to or in place of the hardware depicted in **Figure 2**. Also, the processes of the present invention may be applied to a multiprocessor data processing system.

For example, data processing system **200**, if optionally configured as a network computer, may not include SCSI host bus adapter **212**, hard disk drive **226**, tape drive **228**, and CD-ROM **230**. In that case, the computer, to be properly called a client computer, includes some type of network communication interface, such as LAN adapter **210**, modem **222**, or the like. As another example, data processing system **200** may be a stand-alone system configured to be bootable without relying on some type of network communication interface, whether or not data processing system **200** comprises some type of network communication interface. As a further example, data processing system **200** may be a personal digital assistant (PDA), which is configured with ROM and/or flash ROM to provide non-volatile memory for storing operating system files and/or user-generated data.

The depicted example in **Figure 2** and above-described examples are not meant to imply architectural limitations. For example, data processing system **200** also may be a notebook computer or hand held computer in addition to taking the form of a PDA. Data processing system **200** also may be a kiosk or a Web appliance.

The processes of the present invention are performed by processor **202** using computer implemented instructions, which may be located in a memory such as, for example, main memory **204**, memory **224**, or in one or more peripheral devices **226-230**.

Table 1 depicts a metadata structure. For the computer system of **Figure 2**, there is a single metadata structure that has one, and often several negotiation stages. A negotiation stage is a list of at least two requirements. The requirements are usually a kind of test or criteria with which to measure the "goodness" of the proposal from the perspective of

the storage consumer. As such, each parameter (as shown in the rows in Table 1) is sought to be "as good or better". This may mean, in some circumstances, that a parameter must be "equal or greater than" to satisfy the criteria. In other circumstances, a parameter must be "equal or lesser than".

MetaData	**Example Values** **Negotiation Stage 1** **Negotiation Stage 2** **Negotiation State…N**		
Redundancy			
RAID Level	RAID 5	RAID 1	RAID 0
External Backup	Required	Required	Optional
General			
Time Range 8:00 am – 11:00 am 8:00 am – 11:00 am 8:00 am – 11:00 am			
Date Range	M-F, Aug 19-22, 1st and 3rd Tuesday		
Space Needed	20GB	18GB	15GB
Delay to next negotiation	10 mins	2 hours	4 hours
Performance			
Throughput	1.544 TI Sustained	300kbps sustained, 1.2Mbps burst	250kbps minimum
Time to recover	5 minutes	30 minutes	2 hours
SLA Availability	99.999%	99.9%	95%

Cost			
Disk Usage	$.05/MB/day	$.05/MB/day	$.04/MB/day
Admin	$.10/negotiation	$.10/negotiation	$.10/negotiation
Data Transfer	$.0001/MB I/O	$.0001/MB I/O	$.0001/MB I/O

Parameters may include a data throughput rate, either measured in a long-term sustained rate, or on a burst criteria. Other parameters may be the percent availability during a contracted or negotiated period, which

may be during a month. Time to recover from failure may be a parameter. Presence of backup as being either "none", "optional" or "required" could be another parameter. Space could be another parameter. Architecture among the Redundant Array of Inexpensive Disks (RAID) also could be a parameter, wherein requirements could be for RAID 0, RAID 1, RAID 5, among others.

Other parameters do not measure goodness. Those parameters include: time range, date range and delay to next negotiation.

The final three lines of Table 1 show a monetary exchange for various features of the storage on a 'per' basis, i.e. for each accounted consumption or use, a charge is applied which may be later used for billing. It is appreciated that a instead of monetary units, a token accounting may be applied. Here, a pool of credits or tokens would be allocated to several applications (each distinct embodiments of the invention). Each application would have its tokens limited to those with which it is configured, as from time to time replenished by a common administrative team. Such an environment would be suited, for example, to a corporation or other common legal entity which owns or controls the storage provider server and the various computers that run applications that are operating embodiments of the invention. It would thus be the relative scarcity of tokens that would guide the establishment of (by delegated personnel of the entity) negotiation stages within each application.

Figure 3 is a block diagram of a network in accordance with an illustrative embodiment of the present invention. Storage consumer **301** may support a running application that is constructed using a data processing system, such as data processing system **200** of **Figure 2**. Of course, storage consumer **301** may be implemented with any suitable data processing system. Storage consumer **301** may run an operating system **303**, which may provide partitioned access to hardware resources to one or more applications **305** that, from time to time, may be run on storage consumer **301**. An application may execute the steps of an embodiment of the present invention, and via the network **311**, may communicate with storage provider **321**. Storage provider **321**, likewise, may operate hardware constructed according a data processing system, such as data processing system **200** in to **Figure 2**. An operating system **323** may operate upon such hardware, and support one or more applications **325**. Storage provider **321** may merely be a commercial, widely available storage, such as, e.g. gmail.com,

photobucket.com or any other service that describes a rudimentary storage made available online.

Figure 4 is a flowchart showing the steps performed at a storage consumer. The storage consumer may measure a performance level that may correlate with data storage requirement fluctuations. For example, the storage consumer may measure CPU usage which might suggest that locally run applications need more or less data storage. Another example may be shifts in the network throughput. Still another example might be the occurrence of a certain time - which may denote usage shifts as may occur, e.g. with the lull that happens on websites when a geographic area finishes celebrating the New Year, and thus people are retiring to bed. These changes in CPU usage, network throughput and time are examples of changes in performance level. When the performance level, however measured, goes beyond a threshold, a storage event (step **401)** is deemed to have occurred.

A storage event may also occur based on a scheduled event. Thus an alternative storage event occurs when detecting a scheduled event. Either an internal timekeeping device may signal an event occurrence, or the data processing system **200** may determine time through a network available resource, among other things.

Following the detected storage event, the embodiment, hereinafter called "consumer" makes an evaluation of whether currently available (or committed) resources are sufficient to meet the anticipated needs, i.e. it determines whether a requirements change occurred (step **403**). If the determination is "no", then continued monitoring for a storage event continues. If the determination is "yes", then the embodiment looks up (step **405**) an unused negotiation stage from among at least one negotiation stages stored in a metadata structure or storage requirements profile. The unused negotiation stage is unused from the perspective that it has not been used in a recent iteration of the steps (step **405**) **through** (step **411**). The unused negotiation stage may be selected on the basis of its "goodness". Such negotiation stages may be used in order, and may be exhausted when the worst negotiation stage is used in the steps (step **405**) through (step **411**).

The embodiment may request (step **407**) a service based on the unused negotiation stage. The service request may contain two or more of the parameters from the unused negotiation stage. The use of "as good or

better" or "equal or greater than" in the request is unnecessary, as such conditions are implicit in the role of storage consumer - i.e. its obvious that a user of storage would prefer, all other things being equal, that the storage amount be greater than required. Thus the request may be a packet or series of packets that carry two or more of the parameters from the unused negotiation stage. The request may include the steps of forming the packet or packets, as well as the sending of such packet or packets via a LAN adapter **210** from **Figure 2**. The request (step **407**) of the storage consumer, may be an http request or SOAP request made to a terms of service page or a known service parameter page of the storage provider, wherein the http request or Simple Object Access Protocol (SOAP) request may carry parameters of the negotiation stage to the storage provider.

A storage provider (SP) may create a service provider response or SP response. The SP response may acknowledge and accept the request. The SP response may echo back the parameters in the request - an indication of acceptance. The SP response may vary one or more parameters, showing what it is committing. In any event, the consumer may receive the response (step **409**). The request may return a hypertext markup page from the storage provider as the SP response. As needed the storage consumer may screen scrape the hypertext markup page to select the details that are applicable, e.g. storage capacity, duration of offer and the like in association with the receiving the response **(step 409)**.

Consumer may evaluate to see if the SP response is at or better than the request parameters, i.e. determining that the SP response is acceptable (step **411**). If not, more negotiation stages are looked up (step **405**), provided there are more unused negotiation stages (step **421**).

Eventually, it is hoped that the SP response is acceptable (step **411**), which is known to occur if all parameters are at or better than any request made. If this happens, the consumer commits the storage change (step **413**). And such committed changes may form the basis for determining if a requirements change happens later. Committing the storage change could be as simple as lighting a green LED for as long as adequate storage has been committed for the next 24 hour period. Committing the storage change could be establishing a reference table of the network location of the storage that is intended to be used during an interval, e.g. by mapping a network drive to a preferred letter designation. The committing of the storage may include calling a program to automatically give registration details to a known registration page of the storage provider.

At the conclusion of committing the storage changes (step **413**), the steps of the embodiment may end. At this time, any entry or row in a metadata structure (Table 1) is considered to be renewed and, once again, in an unused state.

Among the advantages, the present invention may be able to respond to changing conditions, or anticipated changes, and attempt to obtain revised storage size, speed, durability among other parameters, without discernable operator intervention.

It is important to note that while the present invention has been described in the context of a fully functioning data processing system, those of ordinary skill in the art will appreciate that the processes of the present invention are capable of being distributed in the form of a computer readable medium of instructions and a variety of forms and that the present invention applies equally regardless of the particular type of signal bearing media actually used to carry out the distribution. Examples of computer readable media include recordable-type media, such as a floppy disk, a hard disk drive, a RAM, CD-ROMs, DVD-ROMs, and transmission-type media, such as digital and analog communications links, wired or wireless communications links using transmission forms, such as, for example, radio frequency and light wave transmissions. The computer readable media may take the form of coded formats that are decoded for actual use in a particular data processing system.

The description of the present invention has been presented for purposes of illustration and description, and is not intended to be exhaustive or limited to the invention in the form disclosed. Many modifications and variations will be apparent to those of ordinary skill in the art. The embodiment was chosen and described in order to best explain the principles of the invention, the practical application, and to enable others of ordinary skill in the art to understand the invention for various embodiments with various modifications as are suited to the particular use contemplated.

CLAIMS

1. A method for allocating storage resources comprising the steps of:

detecting a storage event;

determining whether a requirement change occurred in response to detecting a performance level being beyond a threshold;

looking up an unused negotiation stage from among at least one negotiation stage stored in a metadata structure in response to a determining that a requirement change occurred;

requesting a service based on the unused negotiation stage;

receiving a service provider response;

determining whether the service provider response is acceptable; and

committing a storage change based on the service provider response.

2. The method of claim 1 wherein the step of detecting comprises the steps of:

monitoring a performance level; and

detecting whether the performance level is beyond a threshold.

3. The method of claim 1 wherein the step of detecting comprises the step of:

detecting a scheduled event.

4. The method of claim 1 wherein the step of requesting a service based on the unused negotiation stage comprises:

requesting a service based on the unused negotiation stage, wherein the unused negotiation stage has a token accounting.

5. The method of claim 1 following the step of determining whether the storage provider response is acceptable, comprising the steps:

determining whether a second unused negotiation stage exists in response to a determining that the service provider response is not acceptable;

looking up the second unused negotiation stage from among the at least one negotiation stage stored in the metadata structure in response to the determining that the second unused negotiation stage exists;

requesting a service based on the second unused negotiation stage;

receiving a second service provider response; and

determining whether the second service provider response is acceptable.

6. The method of claim 5 wherein the step of detecting comprises the steps of:

monitoring a performance level; and

detecting whether the performance level is beyond a threshold.

7. The method of claim 5 wherein the step of detecting comprises the step of:

detecting a scheduled event.

8. Apparatus for allocating storage resources comprising:

a means for detecting a storage event;

a means for determining whether a requirement change occurred in response to detecting a performance level being beyond a threshold;

a means for looking up an unused negotiation stage from among at least one negotiation stage stored in a metadata structure in response to a determining that a requirement change occurred;

a means for requesting a service based on the unused negotiation stage;

a means for receiving a service provider response;

a means for determining whether the service provider response is acceptable; and

a means for committing a storage change based on the service provider response.

9. The apparatus of claim 8 wherein the means for detecting comprises:

a means for monitoring a performance level; and

a means for detecting whether the performance level is beyond a threshold.

10. The apparatus of claim 8 wherein the means for detecting comprises:

a means for detecting a scheduled event.

11. The apparatus of claim 8 wherein the means for requesting a service based on the unused a means for negotiation stage comprises:

a means for requesting a service based on the unused negotiation stage, wherein the unused negotiation stage has a token accounting.

12. The apparatus of claim 8 following the step of determining whether the storage provider response is acceptable, comprising:

a means for determining whether a second unused negotiation stage exists in response to a determining that the service provider response is not acceptable;

a means for looking up the second unused negotiation stage from among the at least one negotiation stage stored in the metadata structure in response to the determining that the second unused negotiation stage exists;

a means for requesting a service based on the second unused negotiation stage;

a means for receiving a second service provider response; and

a means for determining whether the second service provider response is acceptable.

13. The apparatus of claim 12 wherein the means for detecting comprises:

a means for monitoring a performance level; and

a means for detecting whether the performance level is beyond a threshold.

14. The apparatus of claim 12 wherein the means for detecting comprises:

a means for detecting a scheduled event.

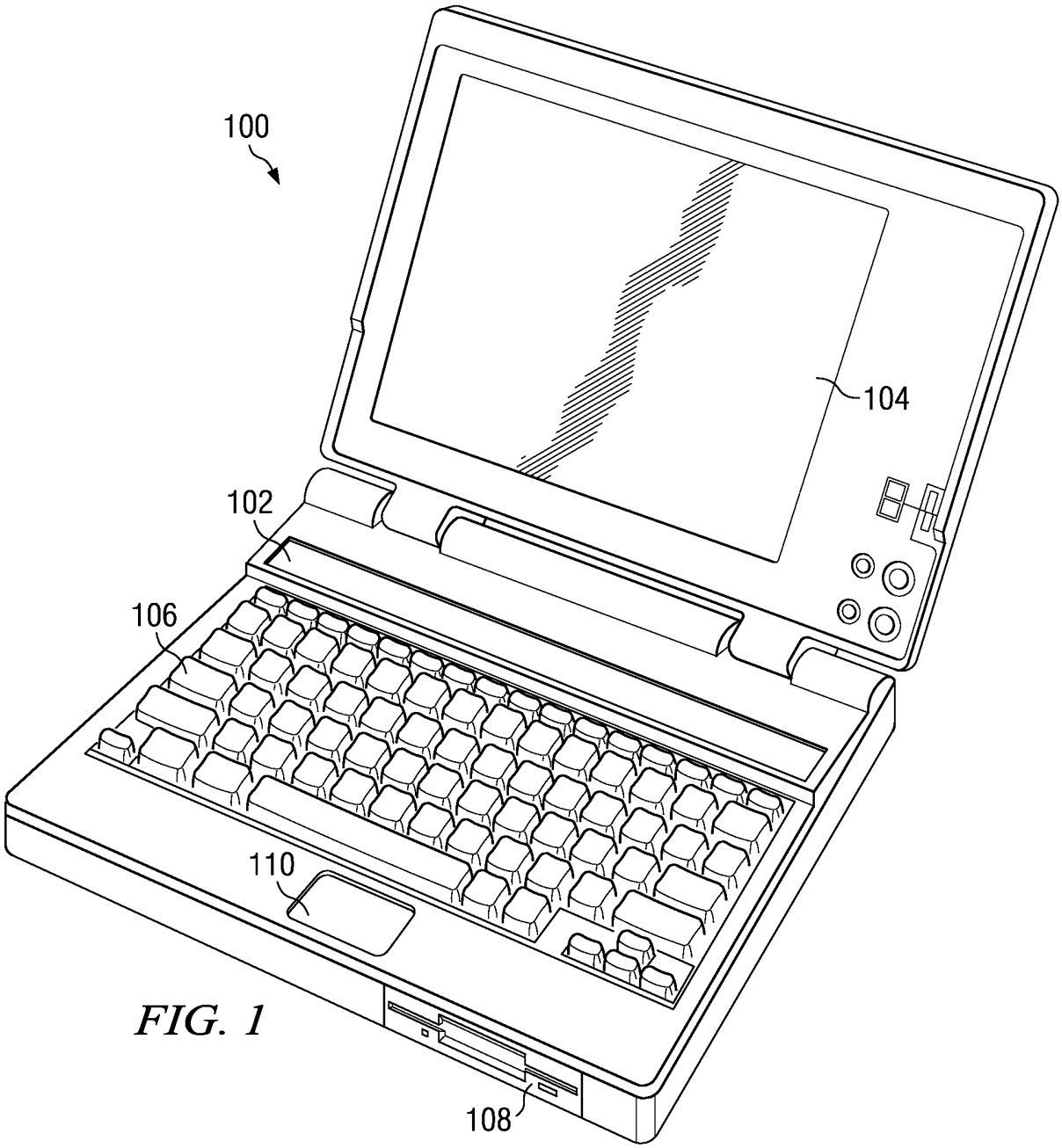

FIG. 1

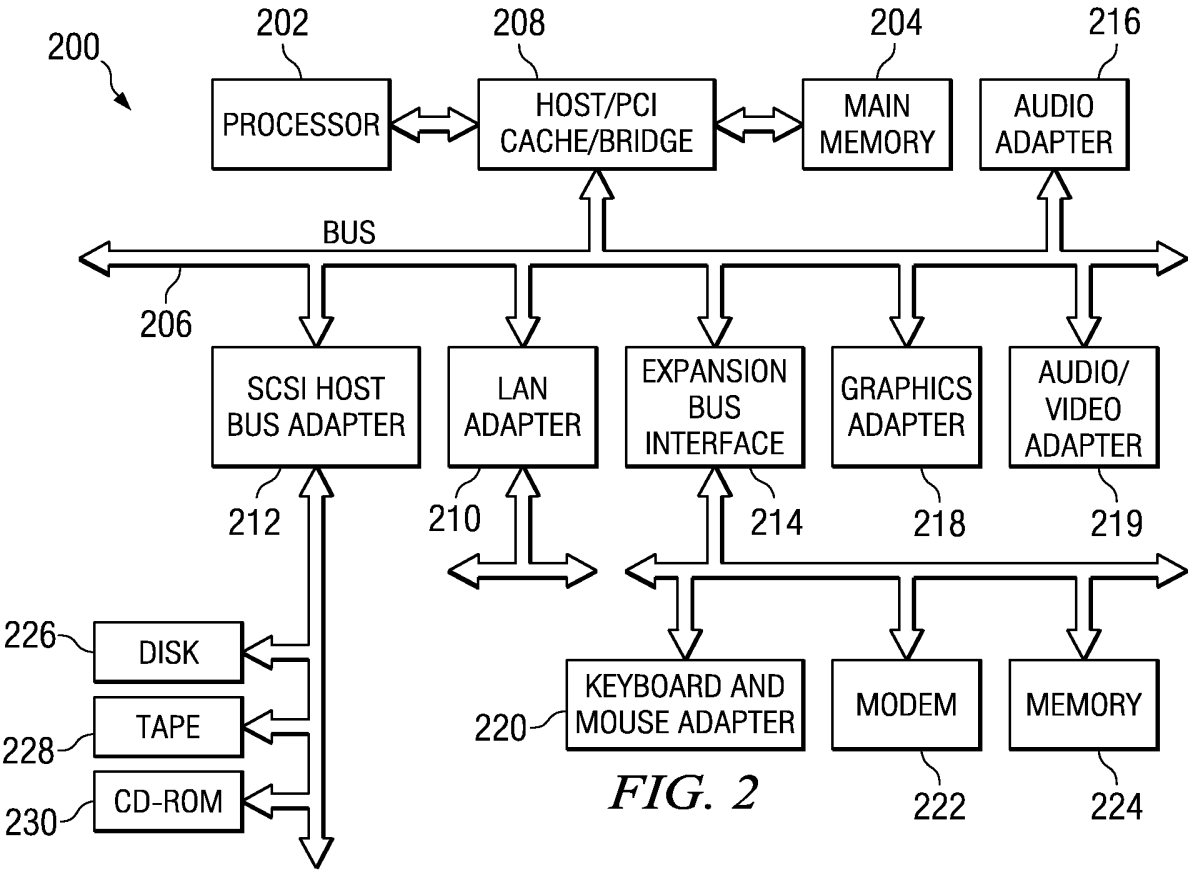
200
202
208
204
216
PROCESSOR
HOST/PCI CACHE/BRIDGE
MAIN MEMORY
AUDIO ADAPTER
BUS
206
SCSI HOST BUS ADAPTER
LAN ADAPTER
EXPANSION BUS INTERFACE
GRAPHICS ADAPTER
AUDIO/ VIDEO ADAPTER
212
210
214
218
219
226
DISK
228
TAPE
230
CD-ROM
220
KEYBOARD AND MOUSE ADAPTER
MODEM
MEMORY
222
224

FIG. 2

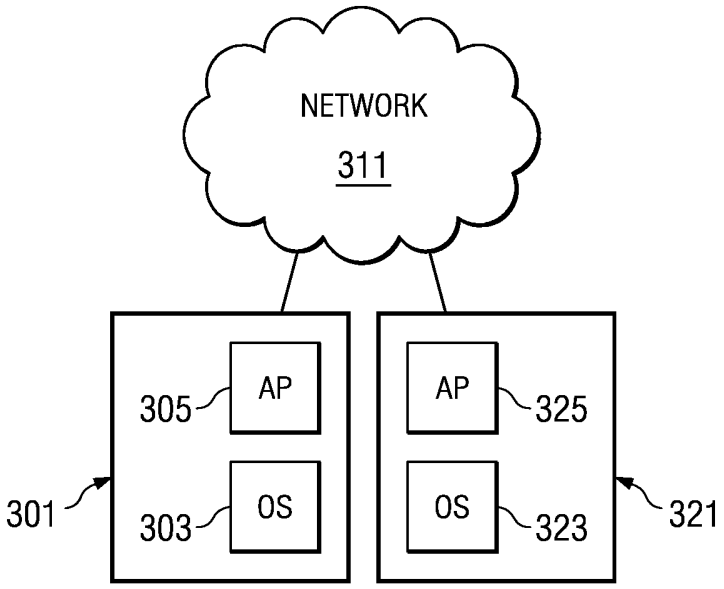
NETWORK
311
305
AP
303
OS
301
325
AP
323
OS
321

FIG. 3

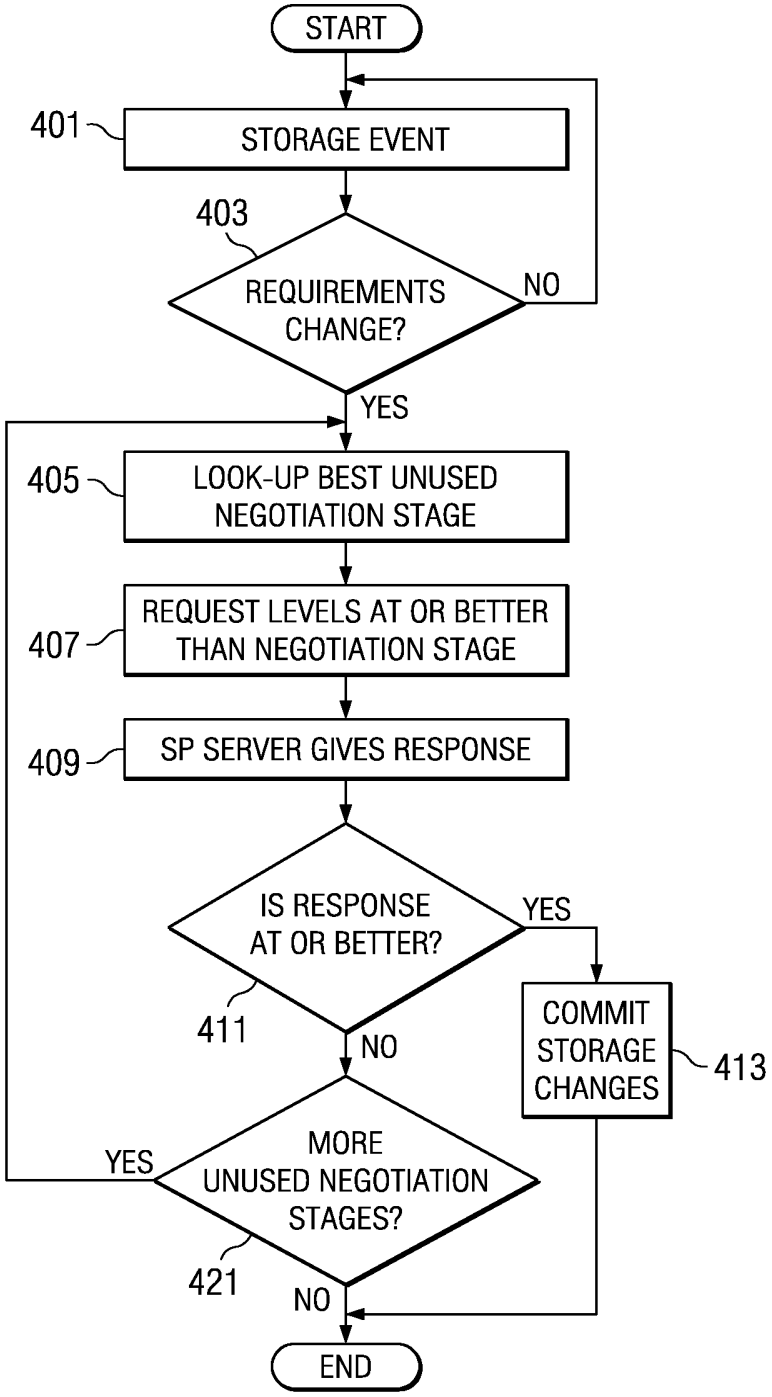
START
401
STORAGE EVENT
403
REQUIREMENTS CHANGE?
NO
YES
405
LOOK-UP BEST UNUSED NEGOTIATION STAGE
407
REQUEST LEVELS AT OR BETTER THAN NEGOTIATION STAGE
409
SP SERVER GIVES RESPONSE
IS RESPONSE AT OR BETTER?
YES
411
NO
COMMIT STORAGE CHANGES
413
MORE UNUSED NEGOTIATION STAGES?
YES
421
NO
END

FIG. 4

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2006/061357

A. CLASSIFICATION OF SUBJECT MATTER
INV. G06F9/46

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G06F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2004/064558 A1 (MIYAKE SHIGERU) 1 April 2004 (2004-04-01) abstract page 2, paragraph 22 page 5, paragraph 69 - page 6, paragraph 72 page 7, paragraph 86	1-14
A	US 2005/076154 A1 (CHAMBLISS DAVID DARDEN ET AL) 7 April 2005 (2005-04-07) the whole document	1-14
A	US 2004/064557 A1 (KARNIK NEERAN M ET AL) 1 April 2004 (2004-04-01) the whole document	1-14

-/--

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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"O" document referring to an oral disclosure, use, exhibition or other means

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
29 May 2006	08/06/2006

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Dewyn, T

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2006/061357

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2004/181476 A1 (SMITH WILLIAM R ET AL) 16 September 2004 (2004-09-16) the whole document	1-14
A	US 2003/110254 A1 (FUJITA TAKAHIRO ET AL) 12 June 2003 (2003-06-12) the whole document	1-14
A	WO 00/74337 A (AC PROPERTIES B.V; BOWMAN-AMUAH, MICHEL, K) 7 December 2000 (2000-12-07) the whole document	1-14

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2004064558 A1	01-04-2004	NONE	
US 2005076154 A1	07-04-2005	NONE	
US 2004064557 A1	01-04-2004	NONE	
US 2004181476 A1	16-09-2004	WO 2004081763 A2	23-09-2004
US 2003110254 A1	12-06-2003	JP 2003177963 A	27-06-2003
WO 0074337 A	07-12-2000	AU 5463000 A	18-12-2000