US 20060036790A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2006/0036790 A1**

Peterson et al. (43) **Pub. Date: Feb. 16, 2006**

(54) **METHOD, SYSTEM, AND PROGRAM FOR RETURNING ATTENTION TO A PROCESSING SYSTEM REQUESTING A LOCK**

(76) Inventors: **Beth Ann Peterson**, Tucson, AZ (US); **Juan Alonso Coronado**, Tucson, AZ (US); **Brian Dow Clark**, Tucson, AZ (US)

Correspondence Address:
KONRAD RAYNES & VICTOR, LLP.
ATTN: IBM37
315 SOUTH BEVERLY DRIVE, SUITE 210
BEVERLY HILLS, CA 90212 (US)

(21) Appl. No.: **10/916,171**

(22) Filed: **Aug. 10, 2004**

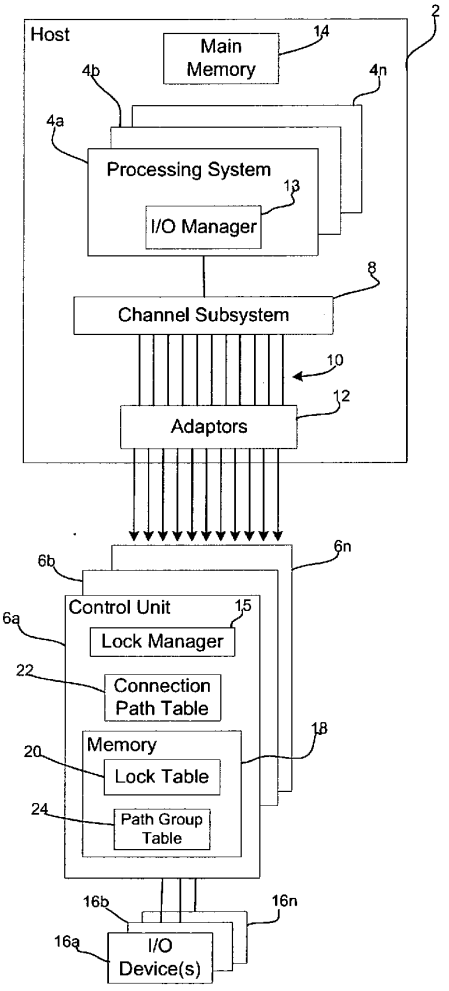
Publication Classification

(51) **Int. Cl.**
G06F 12/14 (2006.01)

(52) **U.S. Cl.** **710/200**

(57) **ABSTRACT**

Provided are method, system, and program for returning attention to a processing system requesting a lock. A lock request for a resource is received from the processing system. Indication is made of a connection path on which the processing system initially communicated an establish request to establish a connection. Attention is returned on the indicated connection path to the processing system to signal the processing system that the processing system may own the requested lock in response to the lock for the resource becoming available. Subsequent messages are received from and transmitted to the processing system concerning the resource on at least one additional path.



LzLabs GmbH. Ex. 1010-1

FIG. 1

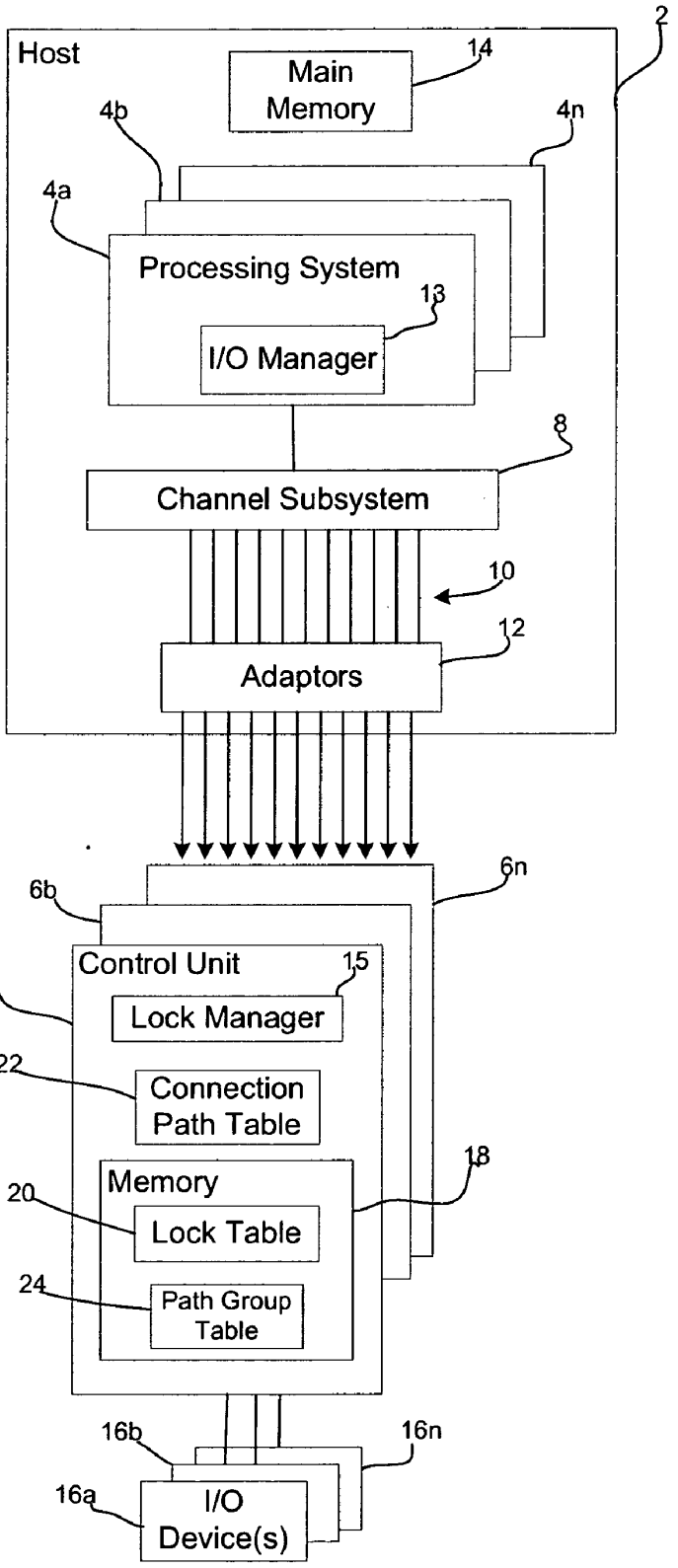
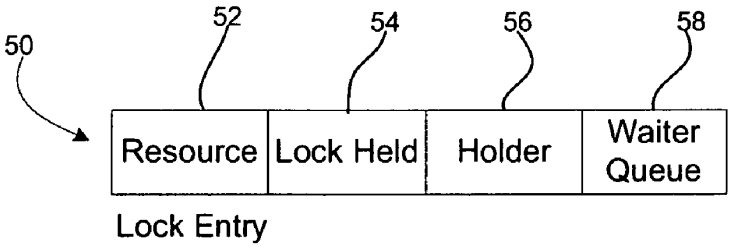
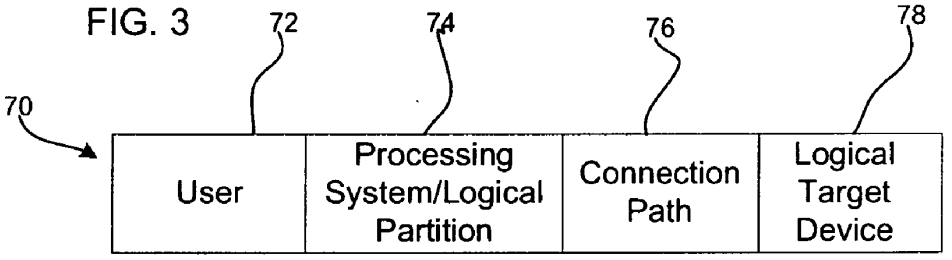

Host
2
Main Memory
14
4b
4n
4a
Processing System
13
I/O Manager
8
Channel Subsystem
10
12
Adaptors
6n
6b
Control Unit
15
6a
Lock Manager
22
Connection Path Table
18
Memory
20
Lock Table
24
Path Group Table
16b
16n
16a
I/O Device(s)

FIG. 2



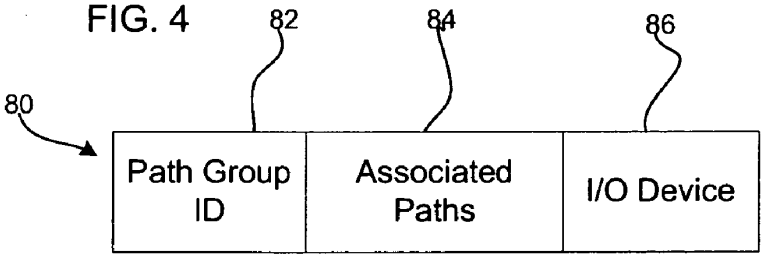
Lock Entry

FIG. 3



Connection Path Table Entry

FIG. 4



Path Group Table Entry

FIG. 5

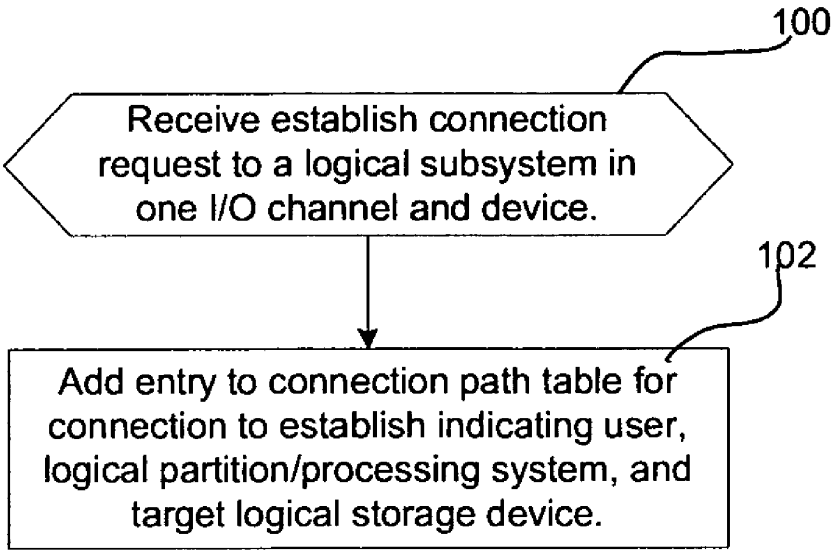

100
Receive establish connection request to a logical subsystem in one I/O channel and device.
102
Add entry to connection path table for connection to establish indicating user, logical partition/processing system, and target logical storage device.

FIG. 6

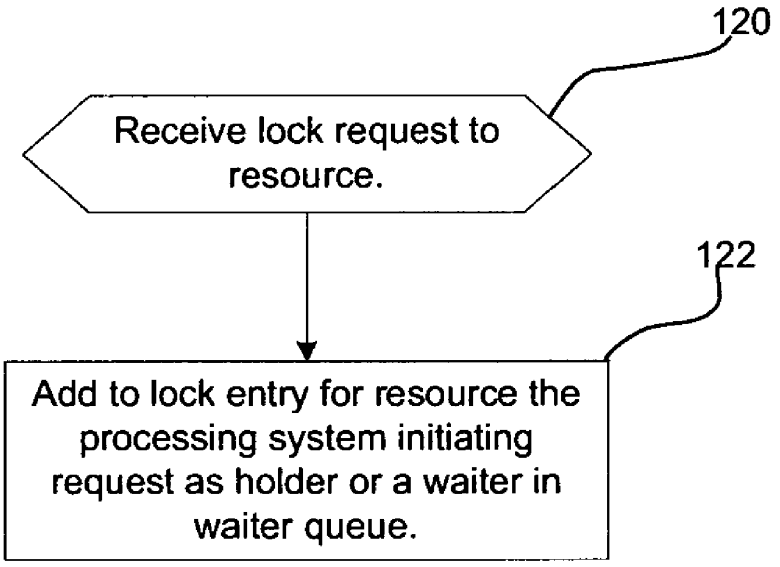

120
Receive lock request to resource.
122
Add to lock entry for resource the processing system initiating request as holder or a waiter in waiter queue.

FIG. 7

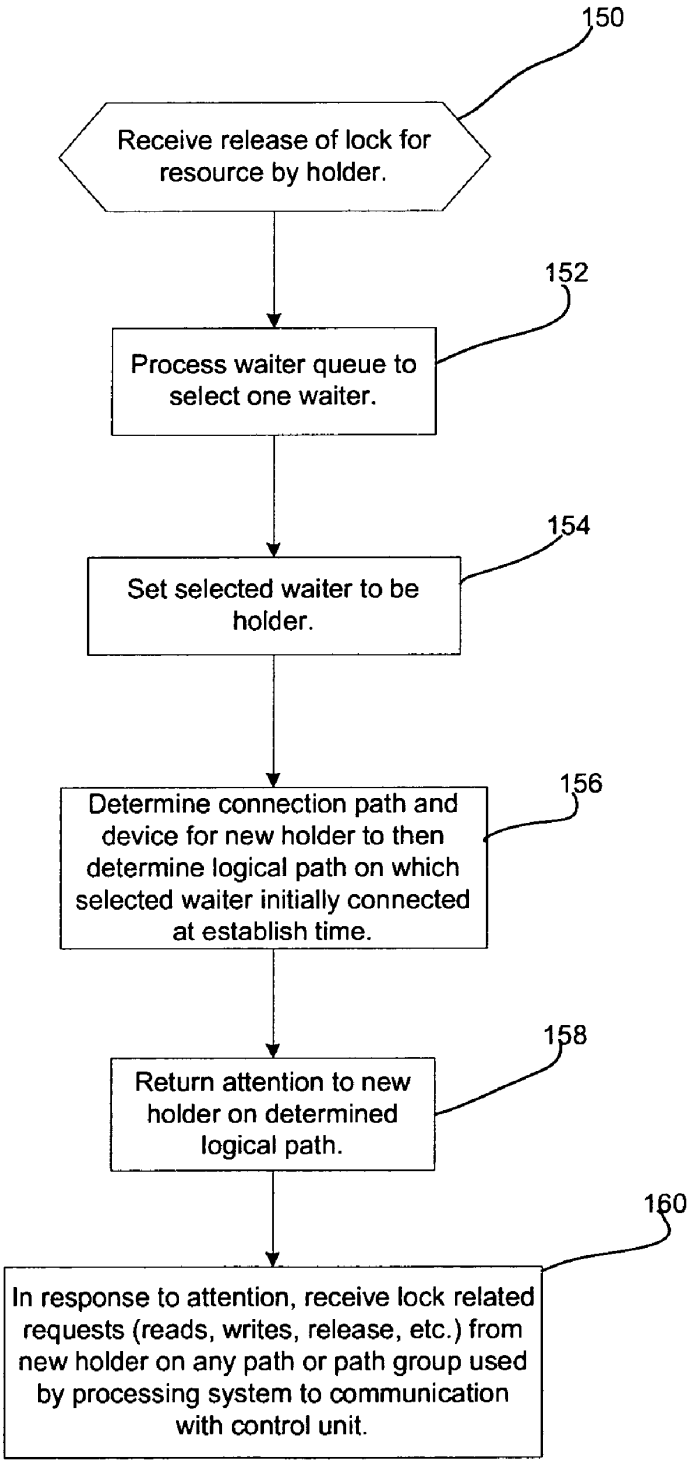

150
Receive release of lock for resource by holder.
152
Process waiter queue to select one waiter.
154
Set selected waiter to be holder.
156
Determine connection path and device for new holder to then determine logical path on which selected waiter initially connected at establish time.
158
Return attention to new holder on determined logical path.
160
In response to attention, receive lock related requests (reads, writes, release, etc.) from new holder on any path or path group used by processing system to communication with control unit.

FIG. 8

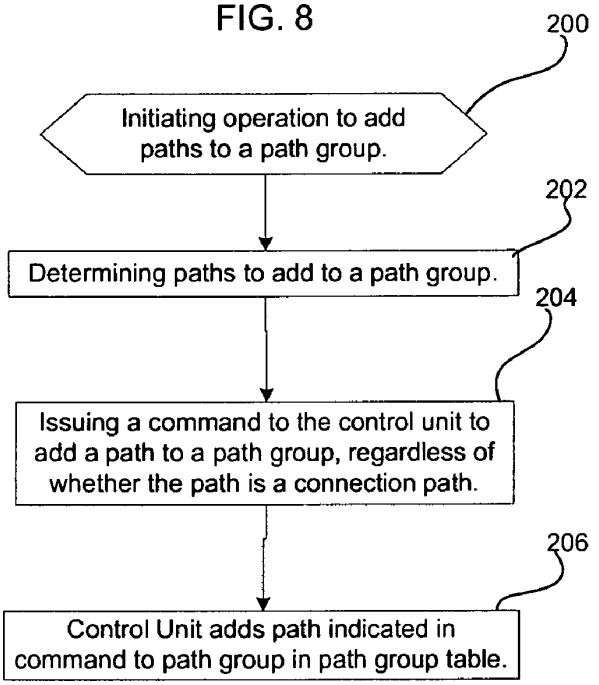
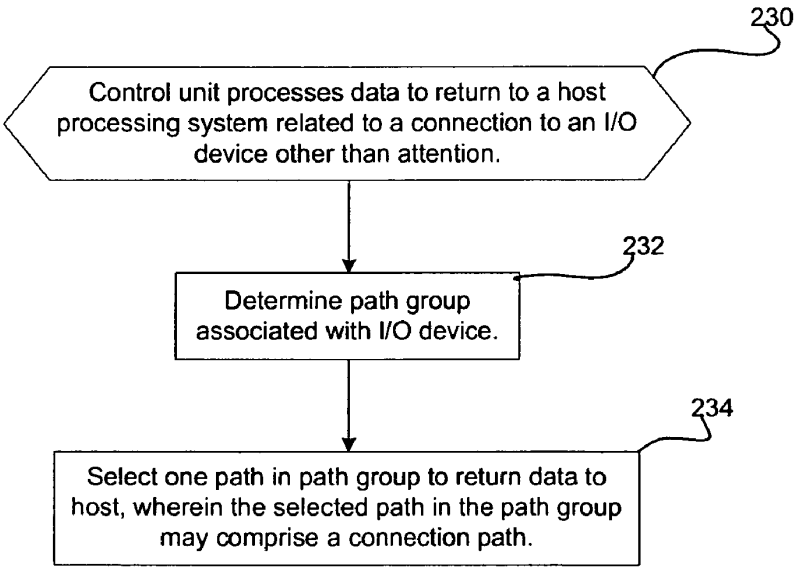

200
Initiating operation to add paths to a path group.
202
Determining paths to add to a path group.
204
Issuing a command to the control unit to add a path to a path group, regardless of whether the path is a connection path.
206
Control Unit adds path indicated in command to path group in path group table.

FIG. 9


230
Control unit processes data to return to a host processing system related to a connection to an I/O device other than attention.
232
Determine path group associated with I/O device.
234
Select one path in path group to return data to host, wherein the selected path in the path group may comprise a connection path.

METHOD, SYSTEM, AND PROGRAM FOR RETURNING ATTENTION TO A PROCESSING SYSTEM REQUESTING A LOCK

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates to a method, system, and program for returning attention to a processing system requesting a lock

[0003] 2. Description of the Related Art

[0004] In certain computing environments, multiple host systems may communicate with multiple control units providing access to storage devices, such as interconnected hard disk drives through one or more logical paths. The interconnected drives may be configured as a Direct Access Storage Device (DASD), Redundant Array of Independent Disks (RAID), Just a Bunch of Disks (JBOD), etc. For instance, the hosts may implement International Business Machines Corporation's (IBM®) Transaction Facility Processing (TPF) operating system in different processing systems in the hosts that issue Multi-Path Lock Facility (MPLF) locking requests to a control unit, such as an IBM Enterprise Storage Server (ESS)®, for data in a storage device managed by the ESS receiving the request. (IBM and ESS are registered trademarks of IBM). The ESS server microcode manages the locks for resources requested by the hosts using the TPF software.

[0005] A host granted a lock to a storage resource by the ESS lock manager may have exclusive or non-exclusive access to a track or data in the storage devices managed by the ESS. In this way, the ESS server manages locking for requests from many host systems.

[0006] In host systems implementing the IBM Enterprise Systems Architecture/390® (ESA/390), the processing systems executing in each host may comprise logical partitions of a processor, which divides a single processor into two or more logical independent processing systems. (IBM Enterprise Systems Architecture/390 is a registered trademark of IBM) Each logical partition communicates with one or more ESS servers, or other control units, over one or more logical paths.

[0007] Each TPF host connected to a logical partition in the ESS is a unique user of that partition. When a user connects to a logical partition, the path and device on which the host connects are retained as the connection path and connection device. This connection path and device may be associated with a particular path group comprising multiple logical paths to a control unit. However, the host TPF software may issue the disband path groups command for the intended connection path and device prior to connection. A user may connect on any logical path into the ESS.

[0008] In the current art, a user within a logical partition executing TPF software or other software capable of issuing the MPLF specific command set, may communicate a lock request to a control unit down a logical path. This path may or may not be the connection path and may or may not be in a path group. If the user cannot get the lock and the user has requested to be queued as a waiter, then once the lock becomes available for the user to hold, the ESS sends the user an attention interrupt and message to notify the user that the user is a holder of the lock. Until the user receives such attention, the user cannot process the user's I/O and the user's single threaded queues will increase while waiting to obtain the attention and the lock. The attention is required to go to the connection path/device. If this connection path/device is within a path group, then as per path group architecture, the attention may go to any path in the path group for the device. However, with the path group architecture, the attention may be sent on a path in the path group to a host/user other than the user host/user to which the attention is actually intended. In such case where the attention is sent to the wrong user, the user is unaware of holding the lock due to not receiving the attention and notification. As a result, the user will not process queued requests and the queue will increase. In addition, if the processing system requesting the lock does not get the attention, then the further waiters of the lock will not get processed because the current new holder did not respond to the attention message from the ESS locking facility.

SUMMARY

[0009] Provided are method, system, and program for returning attention to a processing system requesting a lock. A lock request for a resource is received from the processing system. Indication is made of a connection path on which the processing system initially communicated an establish request to establish a connection. Attention is returned on the indicated connection path to the processing system to signal the processing system that the processing system may own the requested lock in response to the lock for the resource becoming available. Subsequent messages are received from and transmitted to the processing system concerning the resource on at least one additional path.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] Referring now to the drawings in which like reference numbers represent corresponding parts throughout:

[0011] **FIG. 1** illustrates a computing environment in which embodiments are implemented;

[0012] **FIG. 2** illustrates information maintained in a lock table;

[0013] **FIG. 3** illustrates information maintained in a connection path table;

[0014] **FIG. 4** illustrates information maintained in a path group table;

[0015] **FIGS. 5, 6**, and **7** illustrate operations to manage establish connection and lock requests from host systems and attention processing to those hosts; and

[0016] **FIGS. 8 and 9** illustrate operations performed to add paths to a path group.

DETAILED DESCRIPTION

[0017] In the following description, reference is made to the accompanying drawings which form a part hereof and which illustrate several embodiments of the present invention. It is understood that other embodiments may be utilized and structural and operational changes may be made without departing from the scope of the present invention.

[0018] **FIG. 1** illustrates a computing environment in which aspects of the invention are implemented. One or more hosts **2** (only one is shown) include processing systems **4***a*, **4***b* . . . **4***n* that communicate Input/Output (I/O) requests to control units **6***a*, **6***b* . . . **6***n* through a channel subsystem **8** that provides a plurality of logical paths to the control units **6***a*, **6***b* . . . **6***n*. The channel subsystem **8** manages logical paths **10** extending through adaptors **12**. An adaptor provides the physical layer through which logical paths **10** extend to one control unit **6***a*, **6***b* . . . **6***n* or multiple control units through a switch (not shown). The channel subsystem **8** may further associate multiple logical paths **10** with a path group, where all the paths in a path group may be used to communicate with one or more control units **6***a*, **6***b* . . . **6***n*.

[0019] The processing systems **4***a*, **4***b* . . . **4***n* each include an I/O manager **13** that manages **110** requests to the control units **6***a*, **6***b* . . . **6***n*. A main memory **14** is a memory shared by the processing systems **4***a*, **4***b* . . . **4***n*. Each processing system **4***a*, **4***b* . . . **4***n* may comprise a central processing unit (CPU) executing programs, including I/O manager **13** code and channel subsystem **8** code. In further embodiments, each processing system may comprise a logical partition of a processor. In this way, one processor runs multiple logical partitions that each operate as independent systems, executing their own operating system, I/O manager **13** and channel subsystem **8** code. The I/O manager **13** may comprise an operating system or file system to manage I/O requests and handle locking, such as the TPF multi-path lock facility (MPLF). Further details of the TPF system are described in the publication "Transaction Processing Facility: Concepts and Structures", Version 4, Release 1, document no. GH31-0139-12 (Copyright IBM, June 2002), which publication is incorporated herein by reference in its entirety. Further details of a channel subsystem implementing logical paths is described in the publication "Enterprise System Architecture/390: Principles of Operation", document no. SA22-7201-08 (Copyright IBM, June 2003), which publication is incorporated herein by reference in its entirety.

[0020] The control units **6***a*, **6***b* . . . **6***n* include a lock manager **15** to manage requests from the processing systems **4***a*, **4***b* . . . **4***n* to access storage resources in the V/O devices **16***a*, **16***b* . . . **16***n*, such as tracks, partitions, logical devices, logical unit numbers (LUNs), or other logical or physical units of storage. The control units **6***a*, **6***b* . . . **6***n* have memory **18** in which they maintain a lock table **20**. The components shown in control unit **6***a*, such as the lock manager **15**, connection path table **22**, etc., would also be included in the other control units **6***b* . . . **6***n*. The lock manager **15** maintains a connection path table **22** providing information on hosts **2** connecting to the I/O devices **16***a*, **16***b* . . . **16***n* managed by that control unit. The control units **6***a*, **6***b* . . . **6***n* may comprise any type of server, such as an enterprise storage server, storage controller, etc., or other device used to manage I/O requests to attached I/O devices, where the I/O devices may comprise storage devices known in the art, such as interconnected hard disk drives (e.g., configured as a DASD, RAID, JBOD, etc.), magnetic tape, electronic memory, etc.

[0021] The control units **6***a*, **6***b* . . . **6***n* further maintain in memory **18** a path group table **24** providing information on the connection paths in each path group, where path groups may be maintained for the I/O devices **16***a*, **16***b* . . . **16***n* indicating the logical paths **10** connecting to I/O devices. Thus, the path group table **24** would associate path groups with I/O devices, and logical paths with the path groups.

[0022] In certain embodiments, logical paths **10** may connect the processing systems **4***a*, **4***b* . . . **4***n* in the host to one or more control units **6***a*, **6***b* . . . **6***n* through a physical layer, such as a cable, connecting directly to one control unit **6***a*, **6***b* . . . **6***n* or connecting through a switch. One processing system **4***a*, **4***b* . . . **4***n* may connect through logical paths implemented in different adaptors **12** to different control units. The host **2** may communicate with the control units **6***a*, **6***b* . . . **6***n* over the logical paths **10**, which may extend through a network, such as a Local Area Network (LAN), Storage Area Network (SAN), Wide Area Network (WAN), wireless network, etc. Alternatively, the host **2** may communicate with the storage controller **6** over a bus interface, such as a Peripheral Component Interconnect (PCI) bus or serial interface.

[0023] **FIG. 2** illustrates information included with a lock entry **50**, which comprises the entries in the lock table **20**, including: a resource **52** subject to the lock request, such as a track, partition, logical disk, etc. in one attached I/O device **16***a*, **16***b* . . . **16***n*; a lock held **54** field indicating the type of lock currently held against the resource, e.g., exclusive, non-exclusive, etc.; a holder **56** identifying the processing system **4***a*, **4***b* . . . **4***n* currently holding the lock, indicated in the lock held **54** field; and a waiter queue **58** comprising a pointer to a queue or an actual queue of requests by processing systems **4***a*, **4***b* . . . **4***n* for a lock to the resource **52** that is already held. The waiters in the wait queue **58** wait for the corresponding resource **52** indicated in the entry **50** in which the queue is indicated.

[0024] **FIG. 3** illustrates an entry **70** in the connection path table **22** that is added when a processing system **4***a*, **4***b* . . . **4***n* in one host **2** submits an establish request to establish a connection with an I/O device **16***a*, **16***b* . . . **16***n*. The connection path table entry **70** includes: a user **72** identifying the host submitting the request; a processing system/logical partition **74** identifying the processing system **4***a*, **4***b* . . . **4***n* or a logical partition therein initiating the establish connection lock request; a connection path **76** identifying a logical path **10** on which the connection was established; and a logical target device **78** identifying a logical device, e.g., logical storage, Logical Unit Number (LUN), etc., within one I/O device **16***a*, **16***b* . . . **16***n* to which the connection is established.

[0025] **FIG. 4** illustrates an example of an entry **80** in the path group table **24**, including a path group identifier (ID) **82**; associated logical paths **84** that are included in the path group; and an I/O device **86** to which the paths in the path group connect.

[0026] **FIG. 5** illustrates operations performed by the control unit **6***a*, **6***b* . . . **6***n* to process an establish request from one host **2**. Upon receiving (at block **100**) an establish connection request from one host **2** on a logical subsystem on one I/O channel and device, referred to as the connection path, the control unit **6***a*, **6***b* . . . **6***n* adds (at block **102**) an entry **70** to the connection path table **22** for the connection being established, indicating the user **72**, the logical partition/processing system **74** initiating the connection establish request, the connection path **76** on which the establish connection request was communicated, and the target logical storage device **78** with which the connection is being established.

LzLabs GmbH. Ex. 1010-8

[0027] **FIG. 6** illustrates operations performed by the lock manager **15** in the control units **6***a*, **6***b* . . . **6***n* to process a lock request to a storage resource. Upon receiving (at block **120**) a lock request from one processing system **4***a*, **4***b* . . . **4***n* in one connecting host, e.g., **2**, the lock manager **15** adds (at block **105**) to the lock entry **50** for the requested resource, indicated in field **52**, the processing system **4***a*, **4***b* . . . **4***n*, or logical partition if the processing system is divided into logical partitions, initiating the request. The processing system **4***a*, **4***b* . . . **4***n* initiating the request is indicated as a holder **56** or a waiter in the waiter queue **58**, depending on whether the lock for the requested resource is available.

[0028] At this point, the lock manager **15** may disconnect from the processing system **4***a*, **4***b* . . . **4***n* that initiated the request until the lock is available.

[0029] **FIG. 7** illustrates operations performed by the lock manager **15** to return attention to a waiter when the lock for a resource becomes available. Upon receiving (at block **150**) indication of the release of a lock for a resource by a holder, having a corresponding entry **50**, the lock manager **15** processes (at block **152**) the waiter queue **58** to select one waiter. The selected waiter is set (at block **154**) to the holder **56**. The lock manager **15** processes (at block **156**) the connection path table **22** to determine the connection path in field **76** for the new lock holder, i.e., logical path **10** on which the selected waiter initially connected with the establish request. The lock manager **15** then returns (at block **158**) attention to the new holder, i.e., selected waiter, on the determined connection path. In this way, the attention is returned on the same logical path, i.e., connection path, on which the processing system **4***a*, **4***b* . . . **4***n* initiating the lock originally connected. Thus, the lock manager **15** will not communicate the attention on any path in the path group, but only on the logical path **10** on which the processing system/waiter initially connected with the establish request, regardless of whether the connection path is in a path group. With the described embodiments, attention is returned on the specific logical path on which the waiter connected, not any logical path in a path group including logical paths that do not connect to the processing system **4***a*,**4***b* . . . **4***n* waiting for that attention, but instead that connect to other processing systems.

[0030] After attention is returned on the specified logical path, any other message between the host processing system **4***a*, **4***b* . . . **4***n* and control unit **6***a*, **6***b* . . . **6***n* related to the lock or resource may be transmitted on any logical path in the path group used to communicate with that control unit **4***a*, **4***b* . . . **4***n* holding and managing the locks (at block **160**), such as messages related to read, writes, lock releases, etc.

[0031] In described embodiments, the host **2** may submit requests to the control unit **6***a*, **6***b* . . . **6***n* to add paths to path groups without regard as to whether the path being added is a connection path (i.e., the logical path on which the connection was initially established) on which attention may be returned. The I/O manager **13** algorithm for determining paths to add to a path group may add connection paths to a path group because the lock manager **15** in the control unit **6***a*, **6***b* . . . **6***n* will use the connection path table **22** to return attention down the connection path on which a connection to an I/O device **16***a*, **16***b* . . . **16***n* was established regardless of whether the connection path is in a path group.

[0032] **FIG. 8** illustrates operations the host I/O manager **13** performs when adding paths to a path group. Upon initiating (at block **200**) an operation to add paths to a path group, the host I/O manager **13** determines (at block **202**) paths to add to a path group. This determination may involve executing a path group algorithm to determine logical paths **10** to add to a path group to increase the number of concurrent connections to an I/O device **16***a*, **16***b* . . . **16***n* or logical area therein. For instance, load balancing or other operations may be performed to determine optimal assignments of logical paths to path groups to provide redundancy of paths to improve bandwidth and handle failovers. The I/O manager **13** issues one or more commands (at block **204**) to the control unit **6***a*, **6***b* . . . **6***n* to add the determined one or more paths to one or more specified path groups, where the control units **6***a*, **6***b* . . . **6***n* maintain information on path groups in the path group table **24**. The control unit **6***a*, **6***b* . . . **6***n* adds (at block **206**) information on the paths indicated in the command to associated paths **84** (**FIG. 4**) in the path group table entry **80** for the identified path group **82** so the paths indicated in the command are associated with the path group indicated in the command.

[0033] In certain embodiments, the host I/O manager **13** may add connection paths to path groups and the control unit **6***a*, **6***b* . . . **6***n* may then add connection paths to a path group entry **80** defined in the path group table **24**. In the described embodiments, connection paths may be assigned to path groups.

[0034] **FIG. 9** illustrates operations performed by the control unit **6***a*, **6***b* . . . **6***n* to select a path to use to return data to a host processing system **4***a*, **4***b* . . . **4***n* related to a connection established with an I/O device **16***a*, **16***b* . . . **16***n*. Upon processing (at block **230**) data to return to a host processing system **4***a*, **4***b* . . . **4***n* related to a connection to an I/O device **16***a*, **16***b* . . . **16***n* other than attention for a lock request, the control unit **6***a*, **6***b* . . . **6***n* determines (at block **232**) the path group associated with the I/O device **16***a*, **16***b* . . . **16***n* involved in the communication from the path group table **24**, which identifies path groups, paths associated with the path groups and the target device to which the paths connect. The control unit **6***a*, **6***b* . . . **6***n* selects (at block **232**) one path in the determined path group to return data to the host processing system **4***a*, **4***b* . . . **4***n* initiating the request.

[0035] With described embodiments, assignment of paths to path groups does not prevent attention from being returned to a host because the control unit ensures that attention with respect to a lock request is returned down the connection path on which the connection was initially established. Moreover, connection paths may be added to a path group to use for communication between the host and I/O device after or before attention is transmitted down the connection path.

Additional Embodiment Details

[0036] The described embodiments for copying data between controllers may be implemented as a method, apparatus or article of manufacture using standard programming and/or engineering techniques to produce software, firmware, hardware, or any combination thereof. The term "article of manufacture" as used herein refers to code or logic implemented in hardware logic (e.g., an integrated circuit chip, Programmable Gate Array (PGA), Application Specific Integrated Circuit (ASIC), etc.) or a computer readable medium, such as magnetic storage medium (e.g.,

hard disk drives, floppy disks, tape, etc.), optical storage (CD-ROMs, optical disks, etc.), volatile and non-volatile memory devices (e.g., EEPROMs, ROMs, PROMs, RAMs, DRAMs, SRAMs, firmware, programmable logic, etc.). Code in the computer readable medium is accessed and executed by a processor. The code in which preferred embodiments are implemented may further be accessible through a transmission media or from a file server over a network. In such cases, the article of manufacture in which the code is implemented may comprise a transmission media, such as a network transmission line, wireless transmission media, signals propagating through space, radio waves, infrared signals, etc. Thus, the "article of manufacture" may comprise the medium in which the code is embodied. Additionally, the "article of manufacture" may comprise a combination of hardware and software components in which the code is embodied, processed, and executed. Of course, those skilled in the art will recognize that many modifications may be made to this configuration without departing from the scope of the present invention, and that the article of manufacture may comprise any information bearing medium known in the art.

[0037] The described operations may be performed by circuitry, where "circuitry" refers to either hardware or software or a combination thereof. The circuitry for performing the operations of the described embodiments may comprise a hardware device, such as an integrated circuit chip, Programmable Gate Array (PGA), Application Specific Integrated Circuit (ASIC), etc. The circuitry may also comprise a processor component, such as an integrated circuit, and code in a computer readable medium, such as memory, wherein the code is executed by the processor to perform the operations of the described embodiments.

[0038] In described embodiments, a host adds paths to a path group, where one path group provides paths for one host. In additional embodiments, multiple hosts may add their logical paths to a single path group, such that certain logical paths in the path group enable communication with different hosts.

[0039] In described embodiments, the lock manager maintained the logical path on which the processing system connected. In alternative embodiments having multiple physical connections to the control unit, the lock manager may indicate the physical connection on which to return status, as opposed to the logical connection.

[0040] **FIGS. 2, 3**, and **4** show certain information included in the lock table entry, connection path entry, and path group entry. In alternative embodiments, this information may be stored in different data structures having different formats and information than shown.

[0041] The illustrated operations of **FIGS. 5-9** show certain events occurring in a certain order. In alternative embodiments, certain operations may be performed in a different order, modified or removed. Moreover, steps may be added to the above described logic and still conform to the described embodiments. Further, operations described herein may occur sequentially or certain operations may be processed in parallel. Yet further, operations may be performed by a single processing unit or by distributed processing units.

[0042] The foregoing description of various embodiments of the invention has been presented for the purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise form disclosed. Many modifications and variations are possible in light of the above teaching. It is intended that the scope of the invention be limited not by this detailed description, but rather by the claims appended hereto. The above specification, examples and data provide a complete description of the manufacture and use of the composition of the invention. Since many embodiments of the invention can be made without departing from the spirit and scope of the invention, the invention resides in the claims hereinafter appended.

What is claimed is:

1. A method, comprising:

receiving a lock request for a resource from a processing system;

indicating a connection path on which the processing system initially communicated an establish request to establish a connection;

returning attention on the indicated connection path to the processing system to signal the processing system that the processing system may own the requested lock in response to the lock for the resource becoming available; and

receiving and transmitting subsequent messages from the processing system concerning the resource on at least one additional path.

2. The method of claim 1, wherein the connection path and at least one additional path are included in a path group associated with an I/O device including the requested resource.

3. The method of claim 1, wherein the paths on which the processing system communicates comprise logical paths.

4. The method of claim 1, further comprising:

receiving a plurality of lock requests from different processing systems including processing systems for storage resources in I/O devices, wherein the operations of indicating the path, returning attention and receiving and transmitting the subsequent messages are performed for each received lock request.

5. The method of claim 4, further comprising:

writing information indicating the connection path for the processing system submitting the lock request to a table having information on the connection paths used by the processing systems submitting the lock requests to enable the returning of attentions for the lock requests to the processing systems on the connection paths the processing systems used to establish the connection.

6. A system in communication with at least one processing system over paths and at least one Input/Output (I/O) device, comprising:

a computer readable medium;

circuitry in communication with the computer readable medium and enabled to perform:

(a) receiving a lock request for a resource in one I/O device from the processing system;

(b) indicating in the computer readable medium a connection path on which the processing system initially communicated an establish request to establish a connection;

(c) returning attention on the indicated connection path to the processing system to signal the processing system that the processing system may own the requested lock in response to the lock for the resource becoming available; and

(d) receiving and transmitting subsequent messages from the processing system concerning the resource on at least one additional path.

7. The system of claim 6, wherein the connection path and at least one additional path are included in a path group associated with the I/O device including the requested resource.

8. The system of claim 6, wherein the paths on which the processing system communicates comprise logical paths.

9. The system of claim 6, wherein the circuitry is further enabled to perform:

receiving a plurality of lock requests from different processing systems including processing systems for storage resources in the I/O devices, wherein the operations of indicating the path, returning attention and receiving and transmitting the subsequent messages are performed for each received lock request.

10. The system of claim 9, wherein the circuitry is further enabled to perform:

writing information indicating the connection path for the processing system submitting the lock request to a table in the computer readable medium having information on the connection paths used by the processing systems submitting the lock requests to enable the returning of attentions for the lock requests to the processing systems on the connection paths the processing systems used to establish the connection.

11. The system of claim 6, wherein the processing systems comprise logical partitions within a single processing device.

12. An article of manufacture in communication with a processing system and I/O devices, wherein the article of manufacture is enabled to perform operations, the operations comprising:

receiving a lock request for a resource in one I/O device from the processing system;

indicating a connection path on which the processing system initially communicated an establish request to establish a connection;

returning attention on the indicated connection path to the processing system to signal the processing system that the processing system may own the requested lock in response to the lock for the resource becoming available; and

receiving and transmitting subsequent messages from the processing system concerning the resource on at least one additional path.

13. The article of manufacture of claim 12, wherein the connection path and at least one additional path are included in a path group associated with an I/O device including the requested resource.

14. The article of manufacture of claim 12, wherein the paths on which the processing system communicates comprise logical paths.

15. The article of manufacture of claim 12, wherein the operations further comprise:

receiving a plurality of lock requests from different processing systems including processing systems for storage resources in I/O devices, wherein the operations of indicating the path, returning attention and receiving and transmitting the subsequent messages are performed for each received lock request.

16. The article of manufacture of claim 14, wherein the operations further comprise:

writing information indicating the connection path for the processing system submitting the lock request to a table having information on the connection paths used by the processing systems submitting the lock requests to enable the returning of attentions for the lock requests to the processing systems on the connection paths the processing systems used to establish the connection.

* * * * *