

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
13 November 2008 (13.11.2008)

PCT

(10) International Publication Number
WO 2008/137358 A1

(51) International Patent Classification:

G06F 3/06 (2006.01) G06F 13/10 (2006.01)

(21) International Application Number:

PCT/US2008/061615

(22) International Filing Date: 25 April 2008 (25.04.2008)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:

11/742,376 30 April 2007 (30.04.2007) US

(71) Applicant (for all designated States except US):
HEWLETT-PACKARD DEVELOPMENT COMPANY, L.P. [US/US]; 20555 S.H. 249, Houston, TX 77070 (US).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **THOMAS, Fred, C.** [US/US]; 3404 E. Harmony Road, Fort Collins, CO 80528 (US). **BOERGER, Paul** [US/US]; 3404 E. Harmony Road, Fort Collins, CO 80528 (US).

(74) Agents: **HARTNETT, Clare** et al.; Hewlett-Packard Company, Intellectual Property Administration, Mail Stop 35, P.O. Box 272400, Fort Collins, CO 80527-2400 (US).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM,

AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, NO, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

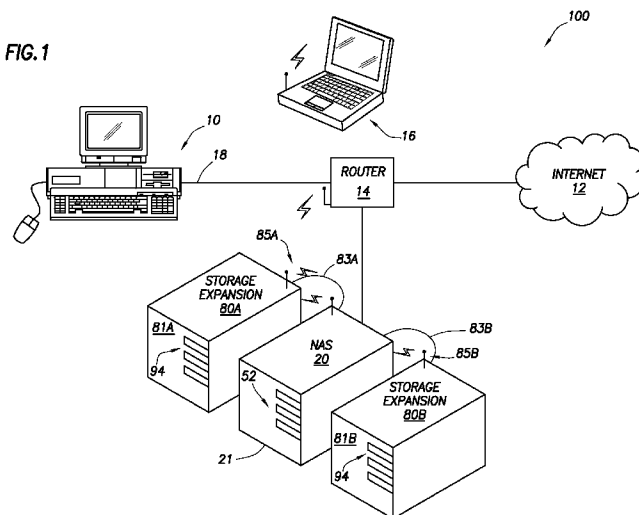
- as to the identity of the inventor (Rule 4.17(i))
- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))

Published:

- with international search report
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments

(54) Title: A SYSTEM AND METHOD OF A STORAGE EXPANSION UNIT FOR A NETWORK ATTACHED STORAGE DEVICE

FIG. 1



(57) Abstract: A system and method of a storage expansion unit for a network attached storage device. At least some of the illustrative embodiments are storage expander systems comprising an enclosure (81), a communications port (84) (the communication port (84) configured to operate under a communications protocol suitable for operatively accessing long term storage devices), and a port expander circuit (82) within the enclosure (81) and coupled to the communications port (84) (the port expander circuit (82) configured to have a plurality of secondary ports that operate under the communications protocol). The storage expansion system (80) is configured to couple to a network attached storage device (20) over the communications port (84), and the storage expansion system (80) is configured to facilitate external long-term storage for the network attached storage device (20).

WO 2008/137358 A1

A SYSTEM AND METHOD OF A STORAGE EXPANSION UNIT FOR A NETWORK ATTACHED STORAGE DEVICE

BACKGROUND

[0001] As home networks become more prevalent, so too does the need for centralized storage of data within the home. Home network attached storage devices are standalone devices which couple to all the computer systems of the home and provide the centralized data storage. However, increasing the centralized storage capacity of a home network attached storage device, if possible at all, is difficult and may require the user to disassemble the home network storage device and install additional long term storage devices.

BRIEF DESCRIPTION OF THE DRAWINGS

[0002] For a detailed description of exemplary embodiments, reference will now be made to the accompanying drawings in which:

[0003] Figure 1 shows a computer system in accordance with at least some embodiments;

[0004] Figure 2 shows a network attached storage device in accordance with at least some embodiments;

[0005] Figure 3 shows a storage expansion unit in accordance with at least some embodiments; and

[0006] Figure 4 shows a method in accordance with at least some embodiments.

NOTATION AND NOMENCLATURE

[0007] Certain terms are used throughout the following description and claims to refer to particular system components. As one skilled in the art will appreciate, computer companies may refer to a component by different names. This

document does not intend to distinguish between components that differ in name but not function. In the following discussion and in the claims, the terms “including” and “comprising” are used in an open-ended fashion, and thus should be interpreted to mean “including, but not limited to... .”

[0008] Also, the term “couple” or “couples” is intended to mean either an indirect, direct, optical or wireless electrical connection. Thus, if a first device couples to a second device, that connection may be through a direct electrical connection, through an indirect electrical connection via other devices and connections, through an optical electrical connection, or through a wireless electrical connection.

DETAILED DESCRIPTION

[0009] The following discussion is directed to various embodiments. Although one or more of these embodiments may be preferred, the embodiments disclosed should not be interpreted, or otherwise used, as limiting the scope of the disclosure, including the claims. In addition, one skilled in the art will understand that the following description has broad application, and the discussion of any embodiment is meant only to be exemplary of that embodiment, and not intended to intimate that the scope of the disclosure, including the claims, is limited to that embodiment.

[0010] Figure 1 illustrates a home networking system 100 in accordance with at least some embodiments. In particular, the home networking system 100 comprises an illustrative desktop computer system 10 coupled to the Internet 12 by way of a router 14. The home networking system 100 also comprises a second computer system, in this case a portable computer 16 coupled to the Internet 12 by way of the router 14. In the embodiments illustrated in Figure 1, desktop computer 10 couples to the router by way of a hardwired connection 18 (*e.g.*, an Ethernet connection) and illustrative portable computer 16 couples to the router 14 wirelessly (*e.g.*, IEEE 802.11, Bluetooth). However, computer systems may couple to the router in a hardwired fashion or wirelessly without regard to their portability. Further, while the system 100 of Figure 1 shows only one desktop computer 10 and one portable computer 16, any number of computers may be coupled to the router using any networking functionality.

[0011] The home networking system 100 of Figure 1 also comprises a network attached storage (NAS) device 20 within its own enclosure 21, the network attached storage device 20 coupled to the router 14. In accordance with at least some embodiments, the network attached storage device 20 is a storage device and/or server available to any computer system of the home networking system 100 (e.g., desktop computer 10 or portable computer 16). The network attached storage device 20 may be, for example, the central repository for data generated by computers of the home networking system 100. In the embodiments illustrated in Figure 1, the storage implemented by network attached storage device 20 is accessible to other computers of the home networking system by way of any suitable currently available networking communication protocol (e.g., Internet Protocol (IP), Transmission Control Protocol/Internet Protocol (TCP/IP)), or any after-developed networking protocol.

[0012] Because the network attached storage device 20 is designed to act as a server for the home networking system 100, and possibly to reduce cost, in accordance with at least some embodiments the network attached storage device 20 does not support direct coupling of a display device and/or keyboard. Thus, in some embodiments the network attached storage device 20 does not comprise a graphics controller that would couple to a display, and also does not comprise an input/output (I/O) controller that would couple to I/O devices such as a keyboard and mouse. To the extent administration is performed on the network storage device 20, the administration may be accomplished remotely using computer systems (e.g., desktop computer 10 or portable computer 16) in the home networking system 100.

[0013] Figure 2 illustrates in greater detail the network attached storage device 20. In particular, network attached storage device 20 comprises a processor 24 coupled to a main memory array 26, and various other components, through integrated host bridge 28 (sometimes referred to as a “north bridge” because of its location in computer system drawings). The processor 24 couples to the host bridge 28 by way of a host bus 30, or the host bridge 28 may be integrated into the processor 24. The processor 24 may be one of many available or after-developed processors, and thus the network attached storage

device 20 may implement bus configurations or bus-bridges in addition to, or in place of, those shown in Figure 2.

[0014] Main memory array 26 couples to the host bridge 28 through a memory bus 32. Host bridge 28 comprises a memory control unit that controls transactions to the main memory 26 by asserting control signals for memory accesses. The main memory array 26 functions as the working memory for the processor 10 and comprises a memory device or array of memory devices in which programs, instructions and data are stored. The main memory array 26 may comprise any suitable type of memory such as dynamic random access memory (DRAM) or any of the various types of DRAM devices such as synchronous DRAM (SDRAM), extended data output DRAM (EDODRAM), or Rambus DRAM (RDRAM).

[0015] Still referring to Figure 2, the network attached storage device also comprises a second bridge 34 that bridges the primary expansion bus 36 to various secondary expansion buses, such as the peripheral component interconnect (PCI) bus 38 and the universal serial bus (USB) 40. The second bridge 34 is sometimes referred to as the “south bridge” because of its location in computer system drawings. Read only memory (ROM) 42 couples to the south bridge 34, such as by a low pin count (LPC) bus 44. The ROM 42 contains software programs executable by the processor 10 to enable the system 20 to perform as a network attached storage device, and also to communicate with storage expansion units (discussed more below).

[0016] Network attached storage device 20 further comprises a hard drive controller 46 coupled to the south bridge 34 by way of the illustrative PCI bus 38. In alternative embodiments, the hard drive controller may couple to the primary expansion bus 36, or any other currently available or after-developed expansion bus. The drive controller 46 controls the non-volatile memory 48 of a long term storage device, such as a hard drive or optical drive. In some embodiments, the network attached storage device 20 implements a single long term storage device where computer systems of the home network can store and retrieve data and programs. In alternative embodiments, the network attached storage device implements a redundant array of independent (or inexpensive) drive (RAID)

system where the data and instructions written to the network attached storage 20 are duplicated across multiple long term storage devices to implement fault tolerance.

[0017] Also coupled to the illustrative PCI bus 38 is a network interface (NI) 50. The NI 50 enables the network attached storage device 20 to communication with computer systems on the home networking system 100 (through the router 14, both of Figure 1) such that the network attached storage device 20 may act as the central repository for data and programs of the home network system. In alternative embodiments, the functionality of the NI 50 is integrated onto the motherboard along with the bridges 28 and 34.

[0018] In order to convey information to the user regarding the state of the network attached storage device 20, and given that in at least some embodiments the network attached storage device 20 does not have a directly coupled display device, a plurality of light emitting devices 52 (here illustrated as light emitting diodes (LEDs)) couple to the enclosure 21 in such a way as to be visible to the user. The light emitting devices 52 are also illustrated in Figure 1. A driver circuit 54 provides control of the light emitting devices, which driver circuit may take commands from one or more general purpose input/output ports 56 of the south bridge 34. In alternative embodiments, the drivers may couple to, and receive commands from, any other suitable location, such as LPC bus 44.

[0019] The light emitting devices 52 may provide any suitable information. For example, there may be a light emitting device associated one each with each long term storage device in the network attached storage, and the light emitting device may visually convey to the user the status of the long term storage device. In some embodiments, the light emitting device associated with a particular long term storage device may emit blue light to indicate that the device is operational (whether being accessed or not), red to indicate device failure, and purple (combination of blue and red) to indicate that the device may be safely removed.

[0020] In accordance with some embodiments, the user may control attributes of the light emitting devices 52. For example, the user, through a software interface from the illustrative desktop system 10 or portable system 16, may change the intensity of the light emitted from the light emitting devices 52. The

change of intensity may range from making the light emitting devices 52 easier to see (increasing intensity) to turning the light emitting devices off completely.

[0021] Still referring to Figure 2, in addition to a communication port associated with NI 50 which couples to the router 14 (Figure 1), the network attached storage device may further comprise one or more communications ports, some of which are accessible through the enclosure 21 (Figure 1) for coupling to additional long term storage devices. Figure 2 illustrates two hardwired ports being a USB port 58 and a port 60 operated under the Serial Advanced Technology Attachment (SATA) standard (hereinafter just the SATA port 60). Other ports and operating protocols may be equivalently used, such as wireless ports and ports operated under the Serially Attached Small Computer System Interface (Serially Attached SCSI or SAS) protocol. Both the illustrative USB port 58 and SATA port 60 are suitable for operatively accessing long term storage devices coupled to those ports, but the SATA port 60 is particularly suited for such actions. While the USB port 58 may be driven directly from the south bridge 34, an additional drive controller 62 may provide the interface for the SATA port 62. In alternative embodiments, the interface for the SATA port 62 may be integral with the south bridge 34, or the interface for the SATA port 62 may be provided by the driver controller 46 associated with the long term storage device(s) 48. As for the SATA port 60, the port may operate under any currently available SATA standard (*e.g.*, the SATA 1.5 Giga bits per second (Gb/s) standard, the SATA 3.0 Gb/s standard, or the SATA 6.0 Gb/s) or any after-developed SATA standard.

[0022] Through the illustrative USB port 58 or SATA port 60 the storage capacity available to the user through the network attached storage device 20 may be increased. Figure 1 illustrates two storage expansion units 80A and 80B coupled to the network attached storage device 20, with each storage expansion unit 80 having its own enclosure 81 and its own power supply (not specifically shown). Figure 1 illustrates the storage expansion units 80 coupling to the network attached storage device 20 by way of hardwired connections 83 (*e.g.*, to the port 58 and 60 of the network attached storage device 20), and also by way of wireless connections 85; however, one need not have both types of coupling present in any one system. Moreover, while the antennas are shown external to

the enclosures 21 and 81, the antennas may be equivalently located internal to the enclosures.

[0023] Figure 3 illustrates a storage expansion unit 80 in greater detail. In particular, Figure 3 illustrates that a storage expansion unit 80 in accordance with some embodiments comprises a port expander circuit 82. The port expander circuit 82 couples to the network attached storage device 20 by way of primary communication port 84. The port expander 82 enables the network attached storage device 20 to communicate to a plurality of long term storage devices 86 (*e.g.*, hard drives or optical drives) through a plurality of secondary communication ports 88. While three such secondary communication ports are shown in Figure 3, two or more secondary communication ports may be used. In the illustrative case of the storage expansion unit 80 operating under SATA standard, the port expander circuit 82 may be a port expander circuit having part number Sil 4726 available from Silicon Image, Inc. of Las Vegas, Nevada.

[0024] Port expander circuits such as the Sil 4726 have certain predefined functionality. For example, each secondary communication port 88 may have associated therewith an activity output signal 90. The activity output signals are active when there is activity (*e.g.*, reading or writing) regarding the long term storage device to which the associated secondary communication port 88 is coupled. While it is possible to couple the activity output signals one each to light emitting devices associated with each long term storage device, presentation of mere activity of each long term storage device 86 may not be consistent with enclosure management philosophy of the network storage device 20. For example, as discussed above the light emitting devices 52 of the network attached storage device 20 do not necessarily convey mere device activity, and thus the light emitting devices 94 of the storage expansion units 80 may convey: whether their associated long term storage devices are operational (independent of whether accessed); whether their associated long term storage device has failed; or whether their associated long term storage device may be safely removed.

[0025] In order to present a consistent enclosure management operating philosophy as between the network attached storage device 20 and the storage

expansion unit 80, and in accordance with at least some embodiments, the storage expansion unit 80 further comprises a processor 92 that couples to the network attached storage device 20. In some embodiments, the processor 92 couples to the network attached storage device 20 through the primary communication port 84 of the port expander 82, although other coupling mechanisms (*e.g.*, independent communication pathway) may be equivalently used. In the illustrative case of Figure 3, the processor 92 couples to the port expander circuit 82 through general purpose input/output ports 93 of the port expander circuit 82, through a secondary communication bus protocol port 95 supported by the port expander circuit 82 (*e.g.*, Inter-Integrated Circuit (I²C) bus), or a combination of these.

[0026] The network attached storage device 20 communicates enclosure management commands to the processor 92. The processor 92, in turn, implements enclosure management functions based on the enclosure management commands. For example, processor 92 couples to light emitting devices 94 which are associated one each with long term storage device 86. The light emitting devices 94 are also illustrated in Figure 1. In accordance with some embodiments, the network attached storage device 20 sends enclosure management commands to the processor 92 regarding the how to drive the light emitting devices 94. The processor 92, in turn, decodes the commands and drives the light emitting devices accordingly. Thus, operation of the light emitting devices is consistent across the network attached storage device 20 and the storage expansion units 80 to which the network attached storage device 20 attaches (*e.g.*, blue light to indicate that the drive is operational (whether being accessed or not), red to indicate drive failure, and purple (combination of blue and red) to indicate that the device may be safely removed).

[0027] As yet another example of performing enclosure management functions by the storage expansion unit 80 based on enclosure management commands from the network attached storage device 20, consider the ability discussed above of a user to control the intensity or brightness of light emitted from the light emitting devices 52. In order to present a consistent operating philosophy, as the user commands changes to the intensity of the light emitted from the light emitting

devices 52, the network attached storage device 20 sends enclosure management commands to the storage expansion unit 80 (particularly the processor 92) to change the intensity of light emitting devices of the storage expansion unit 80. The processor 92, in turn, drives and/or controls at least some of the light emitting devices to change the intensity. In the illustrative case of the light emitting devices 94 associated with the long term storage devices 86, the processor 92 may pulse-width modulate the signals to the light emitting devices to control the intensity. In the case of the activity signals 90 coupled to the logical OR gate 96, the processor 92 may present a pulse-width modulated signal to the logical AND gate 98, which in turn pulse-width modulates the signal to the light emitting device 100 (illustrated as an LED) which shows activity of the long term storage devices as a whole. By pulse-width modulating the signal, the intensity of the light can be controlled, even to the point of turning off the light at a zero percent duty cycle. In the case of the connection signal 102 coupled to the logical AND gate 104, the processor 92 may present a pulse-width modulated signal to the logical AND gate 104, which in turn pulse-width modulates the signal to the light emitting device 106 (illustrated as an LED) which shows health of the connection of the primary port 84 to the network attached storage device 20. By pulse-width modulating the signal, the intensity of the light can be controlled, even to the point of turning off the light.

[0028] As yet another example of performing enclosure management functions by the storage expansion unit 80 based on enclosure management commands from the network attached storage device 20, consider temperature measurement and control. Because the storage expansion unit 80 is within a dedicated enclosure 81, the enclosure 81 may have one or more fans 108 to cool the interior components. The processor 92 drives the fans at particular speeds, such as through a fan driver circuit 110. The location where decisions are made regarding fan speeds vary. In some embodiments, the processor 92 is programmed to read temperatures, such as through temperature sensor 112, and control fan speed accordingly. In other embodiments, the network attached storage device 20 may request an indication of temperature using the enclosure management commands. The processor 92, in turn, reads the temperature and

sends an indication of the temperature over to the network attached storage device. The network attached storage device 20 may also command fan speed changes by sending enclosure management commands to the processor 92. The fan speed changes may be in response to the temperature values sent by the processor 92, or may be part of an overall control scheme (*e.g.*, having fans from all the storage expansion units 80 operate at the same speed to limit noise variability).

[0029] Figure 4 illustrates a method in accordance with at least some embodiments. In particular, the method starts (block 400) and then receives an enclosure management command by a storage expansion unit from a network attached storage device (block 404). The receiving could be over a dedicated connection between the storage expander unit and the network attached storage device, or embedded with other communication, such as communication over a SATA port. Thereafter, the network attached storage device performs the enclosure management function based on the enclosure management command (block 408), and the process ends (block 412). The enclosure management function can take many forms. In some embodiments, the enclosure management function is controlling a light emitting device on the storage expansion unit to mimic attributes of a light emitting device on the network attached storage device. In other embodiments, the enclosure management function is changing color emitted by a light emitting device on the storage expansion unit to indicate the operational state of a long term storage device. Yet still illustrative enclosure managements functions are: reading an internal temperature and sending the internal temperature to the network attached storage device by the storage expander unit; controlling an enclosure fan speed based the enclosure management command; or dimming a light emitting device based on the enclosure management command.

[0030] The above discussion is meant to be illustrative of the principles and various embodiments of the present invention. Numerous variations and modifications will become apparent to those skilled in the art once the above disclosure is fully appreciated. For example, the storage expansion units 80 may couple to network attached storage devices from different manufacturers, in

which case the consistent application of enclosure management philosophy may not be needed. In such circumstances, the storage expansion units 80 may operate standalone, performing enclosure management function without regard to the devices coupled to the primary expansion ports 84. Moreover, while hardwired connections between the network attached storage device 20 and the storage expansion units 80 are shown, wireless connections between these devices may be equivalently used. Further still, Figure 3 shows several logic operation gates (*i.e.*, AND and OR gates), but any electrical circuit which performs the logical operations may be equivalently used. Finally, Figure 2 illustrates the storage expansion units 80 as “computer-style” systems comprising various individual bridge devices and interconnected buses; however, the storage expansion units 80 may equivalently comprise Systems-on-Chip (SoC) devices such that most if not all the functionality is implemented in the form of single integrated circuit. It is intended that the following claims be interpreted to embrace all such variations and modifications.

CLAIMS

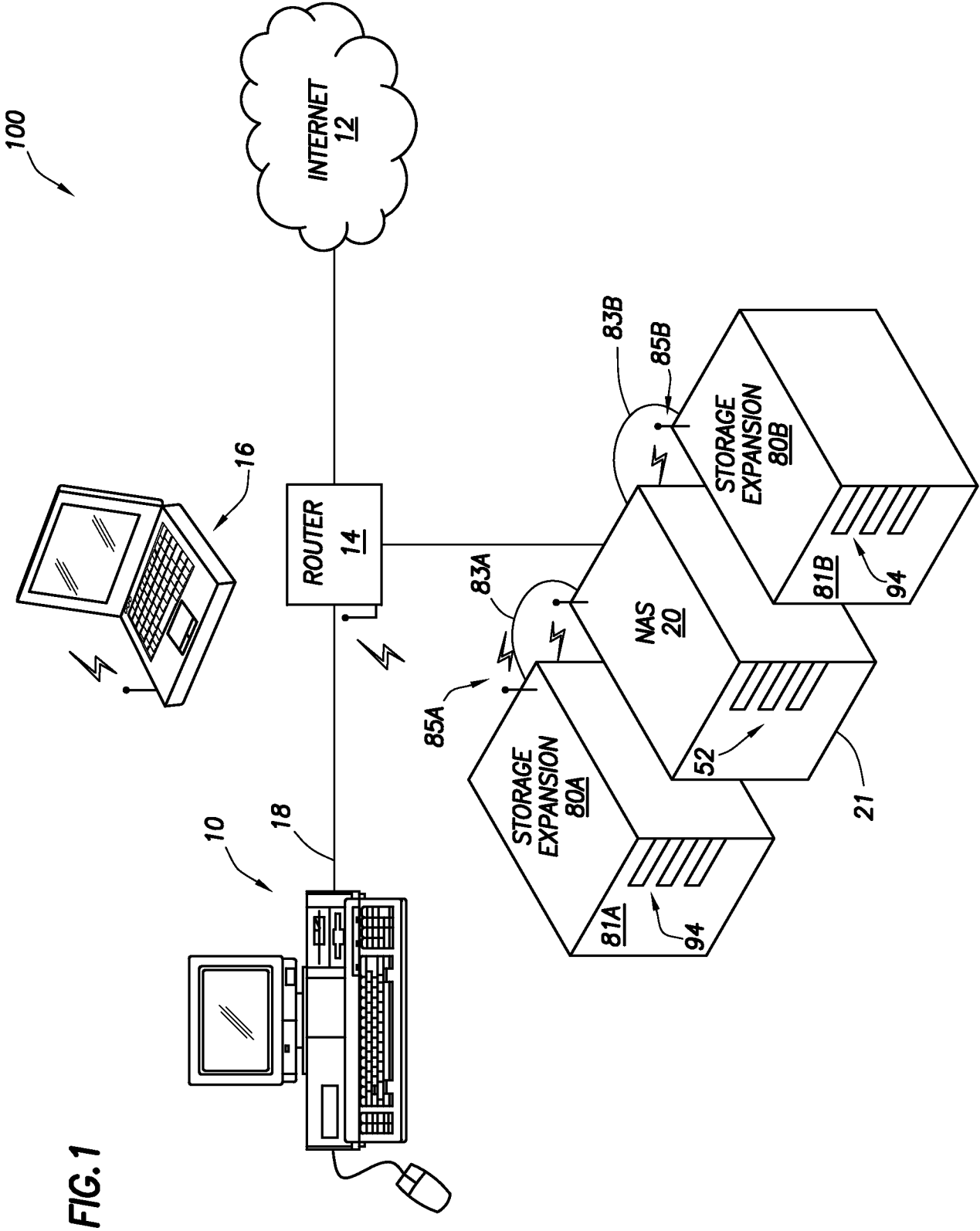
What is claimed is:

1. A storage expander system (80)comprising:
an enclosure (81);
a communications port (84), the communication port (84) configured to operate under a communications protocol suitable for operatively accessing long term storage devices; and
a port expander circuit (82) within the enclosure (81) and coupled to the communications port (84), the port expander circuit (82) configured to have a plurality of secondary ports that operate under the communications protocol;
wherein the storage expansion system (80) is configured to couple to a network attached storage device (20) over the communications port (84), and wherein the storage expansion system (80) is configured to facilitate external long-term storage for the network attached storage device (20).
2. The storage expander system as defined in claim 1 wherein the communications protocol is the Serial Advanced Technology Attachment (SATA) standard.
3. The storage expander system as defined in claim 1 wherein the communications protocol is the Serially Attached Small Computer System Interface (Serially Attached SCSI or SAS).
4. The storage expander system as defined in claim 1 further comprising a plurality of long term storage devices (86) coupled one each to each of the plurality of secondary ports of the port expander circuit (82).
5. The storage expander system as defined in claim 1 further comprising a processor (92) coupled to the communications port (84), the processor (92) configured to receive an enclosure management command from the network

attached storage device (20) over the communications port (84) and to perform at least one enclosure management function based on the enclosure management command.

6. The storage expander system as defined in claim 1 further comprising:
a processor (92) coupled to the communications port (84); and
a light emitting device (94, 100, 106) coupled to the processor (92);
wherein the processor (92) is configured to selectively control the light emitting device (94, 100, 106) based on enclosure management commands received from the network attached storage device (20) over the communications port (84).
7. A method comprising:
receiving (404) an enclosure management command by a storage expander unit (80) from a network attached storage device (20) to which the storage expander unit (80) is coupled;
performing (408) an enclosure management function by the storage expander unit (80) based on the enclosure management command.
8. The method as defined in claim 7 wherein performing the enclosure management function further comprises controlling a light emitting device (94, 100, 106) to mimic attributes of a light emitting device on the network attached storage device (20).
9. The method as defined in claim 7 wherein performing the enclosure management function further comprises changing color emitted by a light emitting device (94, 100, 106) to indicate the operational state of a long term storage device.
10. The method as defined in claim 9 wherein performing the enclosure management function further comprises at least one selected from group consisting of: reading an internal temperature and sending the internal

temperature to the network attached storage device (20) by the storage expander unit (80); controlling an enclosure fan (108) speed based the enclosure management command; and dimming a light emitting device (94, 100, 106) based on the enclosure management command.



2/4

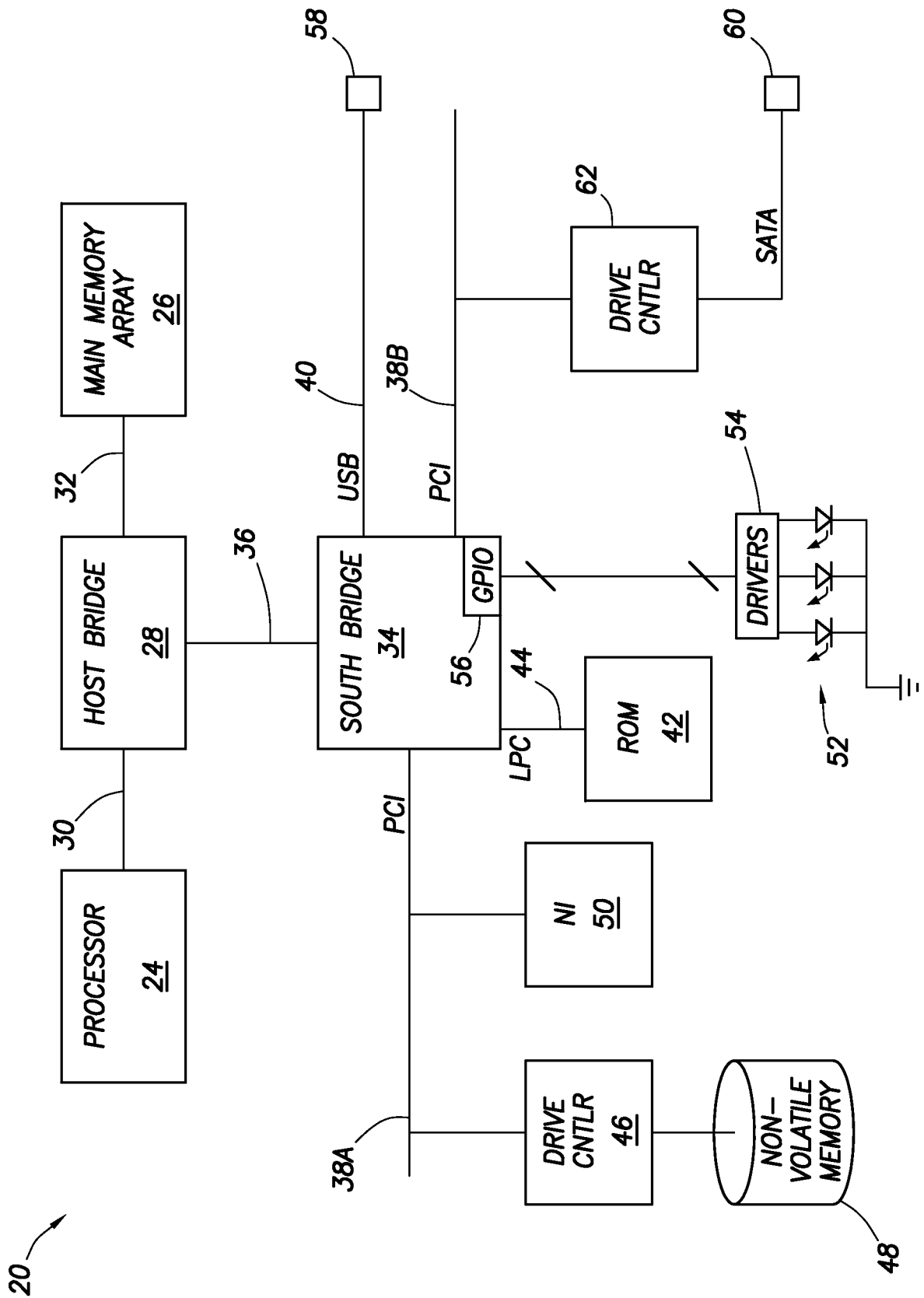
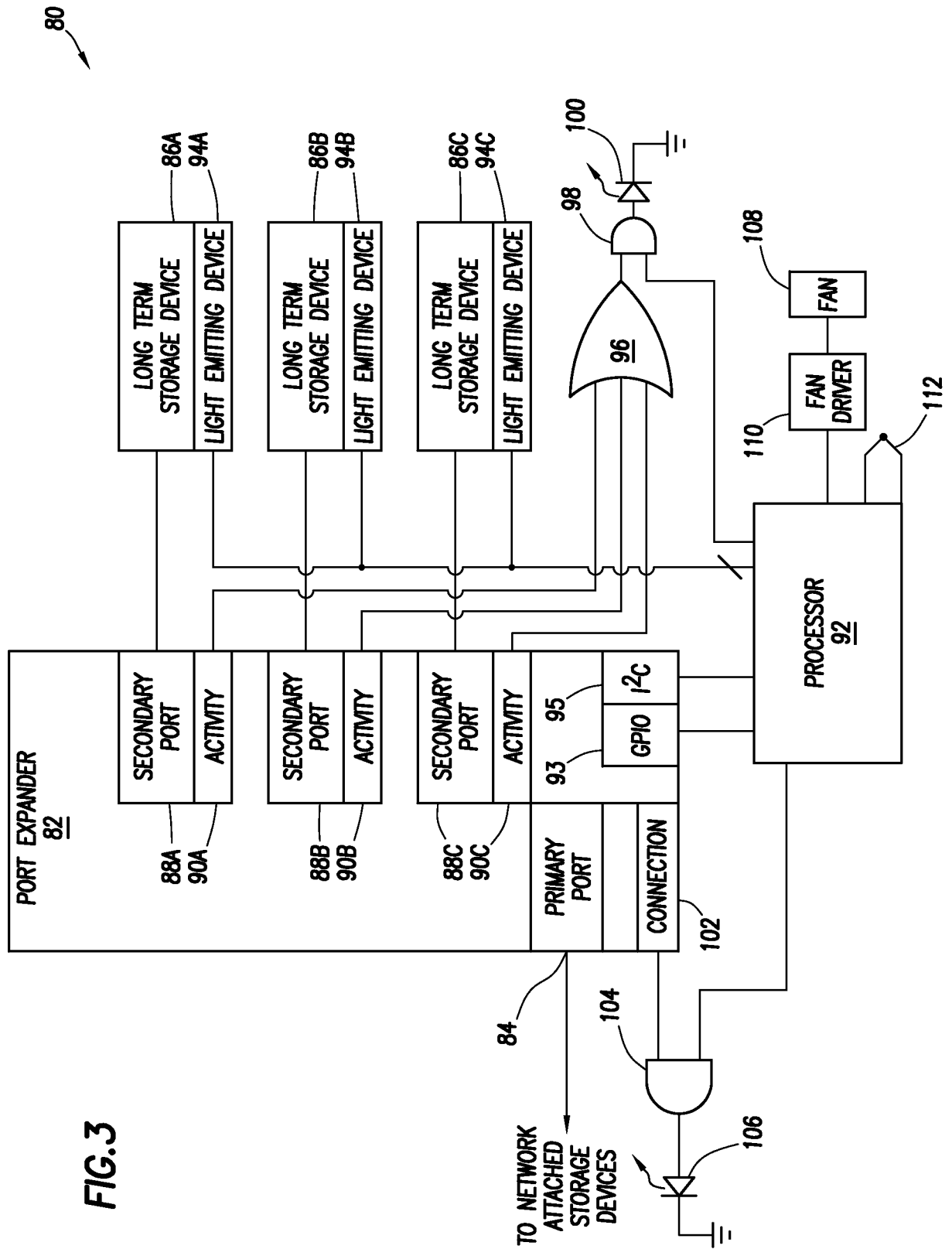
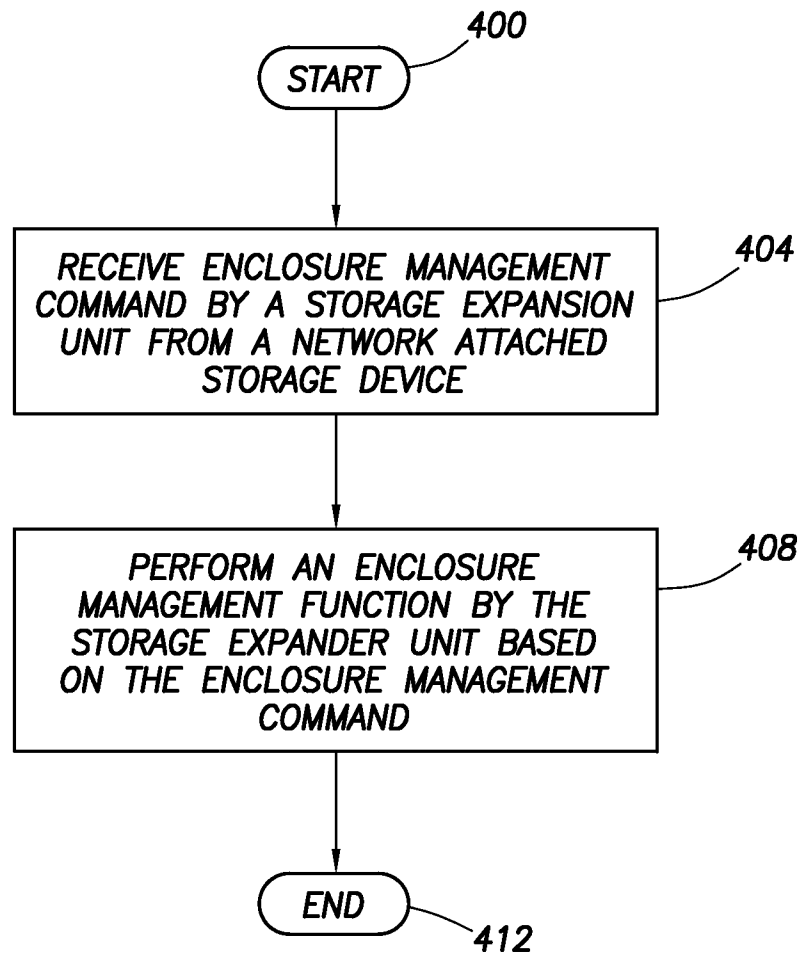


FIG. 2

3/4



4/4

**FIG.4**

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2008/061615**A. CLASSIFICATION OF SUBJECT MATTER****G06F 3/06(2006.01)i, G06F 13/10(2006.01)i**

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)

IPC8 G06F, G11B, H04L

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

Korean Utility models and applications for Utility Models since 1975

Japanese Utility models and applications for Utility Models since 1975

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKIPASS(KIPO internal) "storage, expansion, communication, network, and similar terms"

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 7191287 B2 (YUSUKE NONAKA et al.) 13 Mar. 2007 See Summary of the invention, Figure 1, Column 4 Line 23 - Column 5 Line 42	1 - 10
A	US 6606690 B2 (MICHAEL PADOVANO) 12 Aug. 2003 See Summary of the invention, Figures 4-5, Column 16 Line 66 - Column 19 Line 42	1 - 10
A	US 20040030668 A1 (BRIAN PAWLOWSKI et al.) 12 Feb. 2004 See Summary of the invention, Figures 3-4, Paragraphs 38-59	1 - 10
A	US 20060206671 A1 (ANTHONY AIELLO et al.) 14 Sep. 2006 See Summary of the invention, Figures 6-9, Paragraphs 58-64	1 - 10



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason (as specified)

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

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"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

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

15 OCTOBER 2008 (15.10.2008)

Date of mailing of the international search report

15 OCTOBER 2008 (15.10.2008)

Name and mailing address of the ISA/KR

Korean Intellectual Property Office
Government Complex-Daejeon, 139 Seonsa-ro, Seo-gu,
Daejeon 302-701, Republic of Korea

Facsimile No. 82-42-472-7140

Authorized officer

JEONG, Jae Woo

Telephone No. 82-42-481-5718



INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2008/061615

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 7191287 B2	13.03.2007	CN 1648842 A GB 2411020 B2 JP 2005215947 A2	03.08.2005 28.12.2005 11.08.2005
US 6606690 B2	12.08.2003	AU 4158801 A EP 1382176 A2 WO 02067529 A3	04.09.2002 21.01.2004 16.10.2003
US 20040030668 A1	12.02.2004	AU 2003-254238 A1 CA 2495180 A1 CN 1688982 A EP 1543399 A2 JP 2005535961 A WO 04015521 A3	25.02.2004 19.02.2004 26.10.2005 22.06.2005 24.11.2005 01.07.2004
US 20060206671 A1	14.09.2006	EP 1849055 A2 JP 2008529167 A	31.10.2007 31.07.2008