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MULTI-PROTOCOL STORAGE CONTROLLER

CROSS REFERENCE TO RELATED APPLICATIONS

This document claims priority to and thus the benefit of an earlier filing date from U.S. Provisional Patent Application No. 61/862,361 (filed on Aug. 5, 2013, entitled "Multi-Protocol Storage Controller"), which is hereby incorporated by reference.

FIELD OF THE INVENTION

The invention generally relates to field of storage controllers.

BACKGROUND

Numerous storage device interfaces exist and continually challenge storage domains. For example, Peripheral Component Interconnect Express protocol (PCIe) based storage devices are now being used in association with Serial Attached Small Computer System Interface (SAS) storage domains. And, in some instances, PCIe storage devices are "hot-swapped" in place of SAS storage devices. But, PCIe is a packet based, connectionless transfer protocol and SAS is an end-to-end, connection based protocol that does not provide for connectionless transfers, making interoperability particularly challenging. More particularly though, storage controllers employing one protocol are incapable of detecting storage devices of another protocol when hot swapped into the domain.

SUMMARY

Systems and methods presented herein provide for coupling a storage controller to a plurality of different storage device types. In one embodiment, a storage controller includes an interface operable to communicatively couple to a storage device. The storage controller also includes a processor operable to select between hardware protocol detection of the storage device and firmware protocol detection of the storage device, and to detect a protocol of the storage device when the storage device communicatively couples to the interface according to the selected protocol detection. The storage controller then selects a protocol to process input/output requests from a host based on the detected protocol of the storage device.

The various embodiments disclosed herein may be implemented in a variety of ways as a matter of design choice. For example, the embodiments may take the form of computer hardware, software, firmware, or combinations thereof. Other exemplary embodiments are described below.

BRIEF DESCRIPTION OF THE FIGURES

Some embodiments of the present invention are now described, by way of example only, and with reference to the accompanying drawings. The same reference number represents the same element or the same type of element on all drawings.

FIG. 1 is a block diagram of an exemplary storage controller operable with devices of differing protocols.

FIG. 2 is a flowchart of an exemplary process of the storage controller of FIG. 1.

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FIG. 3 is a block diagram of another exemplary storage controller.

FIG. 4 is a flowchart of an exemplary process of the storage controller of FIG. 3.

5 FIG. 5 is a graph of an exemplary hardware protocol detection scheme of the storage controllers of FIGS. 1 and 3.

FIG. 6 is a flowchart of another exemplary process of the storage controller of FIG. 3.

10 FIG. 7 is a block diagram of an exemplary computing system in which a computer readable medium provides instructions for performing methods herein.

DETAILED DESCRIPTION OF THE FIGURES

15 The figures and the following description illustrate specific exemplary embodiments of the invention. It will thus be appreciated that those skilled in the art will be able to devise various arrangements that, although not explicitly described or shown herein, embody the principles of the invention and are included within the scope of the invention. Furthermore, any examples described herein are intended to aid in understanding the principles of the invention and are to be construed as being without limitation to such specifically recited examples and conditions. As a result, the invention is not limited to the specific embodiments or examples described below.

20 FIG. 1 is a block diagram of an exemplary storage controller **104** operable with devices of differing protocols. The storage controller **104** is operable to process I/O requests of a host system **105** and direct those I/O requests to various target devices **110**, **111**, and **112** according to their respective storage protocols. For example, in this embodiment, the target devices **110** are SAS storage devices, the target devices **111** are PCIe storage devices, and the target device **112** is a storage device using some other protocol (e.g., a Serial Attached AT Attachment (SATA) protocol, a Fibre Channel over Internet Protocol protocol, an Enterprise Systems Connection, a Fibre Channel protocol, a Universal Serial Bus (USB) protocol, an Internet Serial Attached Small Computer System Interface (iSCSI) protocol, etc.). The storage controller **104** is operable to discover, via hardware and/or firmware, the type of storage device it connects to when one of the target devices **110**, **111**, **112** is coupled to the storage controller **104**. Once discovered, the storage controller **104** can process I/O requests from the host system **105** to any of the target devices **110**, **111**, **112** via their respective storage protocols.

25 The target devices **110**, **111**, **112** may be directly attached the storage controller **104** or they may be coupled through a storage system expansion component, such as the expander **103**. For example, one or more expanders may be operable to directly attach to other target devices **110**, **111**, **112** as well as other expanders to provide a "switched fabric" that switches I/O request to appropriate devices as determined by the storage controller **104**. An example of the expander **103** includes a wide port expander operable with multiple protocols, such as those mentioned (e.g., SAS, PCIe, USB, SATA, etc.).

30 Examples of the target devices **110**, **111**, **112** include storage devices, such as disk drives and solid state drives (SSDs). In this regard, the target devices **110**, **111**, **112** may provide data storage on behalf of the host system **105**. And, the host system **105** may configure read/write requests for input/output (I/O) operations with any of the target devices **110**, **111**, **112**. The host system **105** may be any suitable computing device or system operable to perform I/O operations, for example, servers, workstations, personal computers, etc.

35 The storage controller **104** is any device, system, software, or combination thereof operable to perform device discovery,