Technical Brief

MediaShield Storage Technology Confidently Storing Your Digital Assets

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Overview

The massive growth in broadband connections is enabling consumers to turn to legal music download services to obtain the latest MP3. Hear the song, buy the song. It's that simple. At the same time, digital cameras are now so common that snapping family pictures and quickly sharing them with relatives and friends is only a quick e-mail away.

Businesses are now storing an unprecedented amount of critical business information. Perhaps the "paperless" office has not completely materialized, but the advantages of storing and archiving digital business assets certainly are apparent. A common concern of PC users is the safety of their stored assets. What do you do if your computer disk crashes? This can be devastating to a business, and for consumers it is remarkable to think that the cost of the MP3s stored on a hard disk is now greater than the cost of the hard disk itself.

The NVIDIA® MediaShield™ storage technology addresses these problems. Want your storage assets protected? Use MediaShield to set it up. MediaShield makes these solutions possible by bringing technology that the world's largest businesses use to quickly access and protect their most important data—a technology known as Redundant Array of Independent Disks (RAID)—to the common PC desktop.

MediaShield technology uniquely offers a management interface that lets you easily configure or change your multidisk arrays.

❑ Do you want data protection? Just set up one disk as a mirrored copy of the first. Plus, provide further protection by assigning dedicated spare disks that are ready to be automatically used as backups if one of the mirrored disks fails.

❑ Another MediaShield storage innovation alerts you when a disk fails, and shows you which one to replace.

❑ Do you want faster access to your stored assets? Set up two disks to operate in parallel (known as "striping") by clicking a button on the storage management user interface.

This technical brief discusses the advantages and specifics of NVIDIA MediaShield technology and describes the applications and computing environments that will benefit from using it.

Industry-Defined Multidisk Techniques

Multidisk techniques were first published in 1988 by a multivendor consortium—the RAID (Redundant Array of Independent Disks) Advisory Board. Each multidisk technique was divided into different categories or levels. Originally, multidisk techniques focused on improving resiliency or data availability. As additional techniques were defined, one was introduced for improving performance.

For all levels, multidisk techniques optimize storage solutions by grouping disks together and treating them as a single storage resource. NVIDIA nForce® solutions support RAID 0, RAID 1, and RAID 0+1, and RAID 5 configurations.

RAID 0: Disk Striping Delivers Unmatched Storage Performance and Scalability

Disk striping, also known as RAID 0, is a multidisk scheme that decreases the disk read and write times for many applications, improving overall storage performance in a system. Data is "striped" across multiple disks in an array. In this manner, reads and writes to multiple drives can be carried out in parallel, accelerating the overall access time for disk operations (Figure 1).
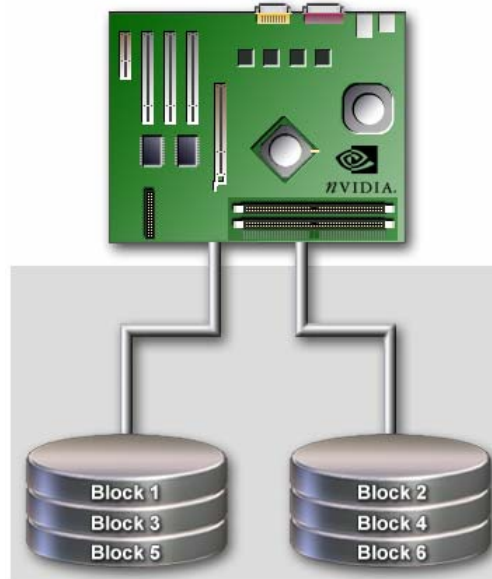
Figure 1.   Disk Striping (RAID 0)

RAID 1: Disk Mirroring Protects Important Digital Assets

Disk mirroring, also known as RAID 1 (Figure 2), is a multidisk scheme for users who want to easily back up their important assets. Every write is carried out twice, in parallel. The mirrored, or backup, copy of the data can reside on the same disk or on a second redundant drive in the multidisk configuration.

Disk mirroring provides a hot-standby copy of data if the active volume or drive is corrupted or becomes unavailable because of a hardware failure. Disk mirroring techniques can be applied for high-availability solutions, or as a form of automatic backup that eliminates tedious manual backups to more expensive and less reliable media.
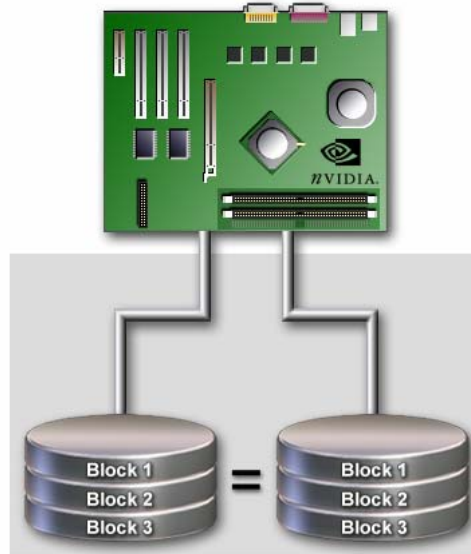
Figure 2.   Disk Mirroring (RAID 1)

RAID 0+1: Disk Striping and Mirroring Gives Performance and Protection

Striped disks (RAID 0) can be mirrored using disk mirroring (RAID 1) techniques. A disk striping and mirroring configuration (RAID 0+1) improves performance and protection (Figure 3).
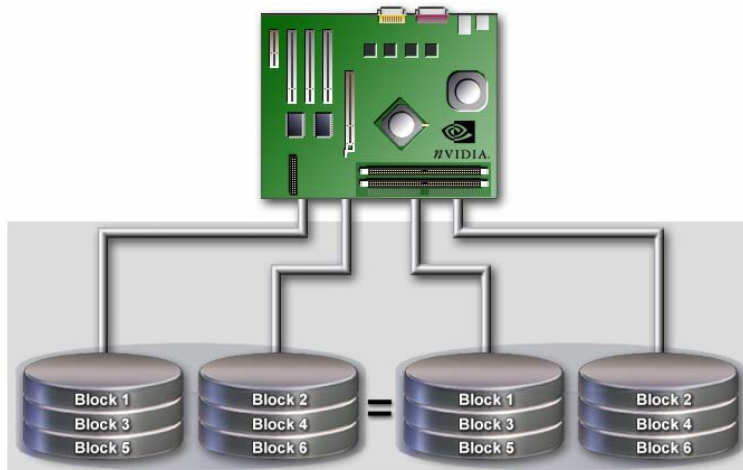

Figure 3.   Disk Striping and Mirroring (RAID 0+1)

RAID 5: Provides Smart Protection and Optimal Data Access

RAID 5 (Figure 4), one of the most popular RAID levels in the industry, stripes data and distributes parity information across three or more drives. This capability improves disk performance and provides fault tolerance.
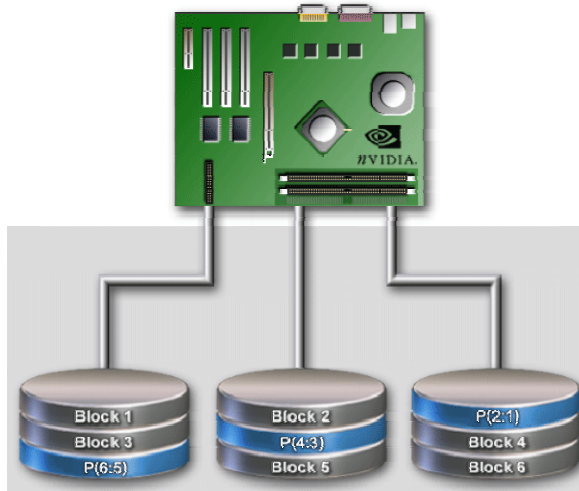

Figure 4. Smart Protection and Improved Data Access (RAID 5)

Features of MediaShield Storage

NVIDIA's MediaShield storage technology implements standard disk striping, disk mirroring, and disk stripe/mirroring techniques to improve the use of your storage assets. In addition, MediaShield storage introduces many innovations that simplify and optimize the management of multidisk features and disk resources.

RAID 5

RAID 5 (Figure 5) is a multidisk scheme that provides full protection and fast access of digital media content. Users have peace of mind storing pictures, music, videos, and other important documents on their PC without worrying about losing data.

RAID 5 offers the fault-tolerant capability to automatically back up your most important files, while also providing faster disk access and adding storage capacity.

With the introduction of NVIDIA nForce® 590 SLI, 570 SLI, and 570 MCPs, MediaShield offers support for a six-disk RAID 5 array. Since RAID 5 requires a minimum of three disks, MediaShield also supports a dual RAID 5 array with this new generation.
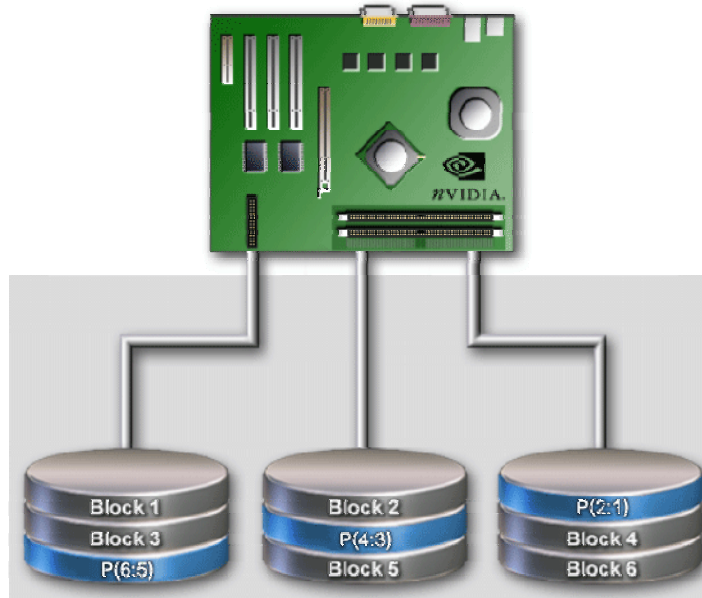
Figure 5.   RAID 5

Serial ATA 3Gb/s

SATA 3Gb/s is the next-generation storage technology, offering greater disk bandwidth that overcomes the growing limitations of the older Ultra ATA and SATA 1.50Gb/s technologies. SATA 3Gb/s doubles the speed of current SATA technology, uses the bus more efficiently, backs up and retrieves data faster, and recovers faster from signal drop/failure (asynchronous signal recovery). Plus, it improves overall system responsiveness.

The MediaShield storage SATA 3Gb/s is the industry's most advanced storage solution, incorporating the following features:

❑ Support for up to six native SATA 3Gb/s devices.
❑ Hot-swap capability, allowing disks to be changed without powering down the system.
❑ Optimization for the high-performance MediaShield storage RAID technology.

Native Command Queuing (NCQ)

Unlike devices that are completely electronic, hard drives have a mechanical element that can suffer from the laws of physics. This characteristic limits how fast a hard drive can access media and retrieve data. Mechanical limitations can only be optimized to a certain degree, but the efficiency of the internal workflow can be dramatically increased by intelligently managing the workflow. For example, workflow can be managed by using Native Command Queuing (NCQ), a command protocol in Serial ATA that allows multiple commands to be simultaneously outstanding within a drive (Figure 6).

The best example of workflow management is the expedient transportation of elevator passengers. Imagine four people entering an elevator and successively pushing a button for one of the following floors: 4, 2, 6, and 3. In a non-NCQ environment, the elevator stops at the fourth floor (bypassing the second and third floors), goes down to the second floor, goes up to the sixth floor (again bypassing the third floor), and finally descends and stops at the third floor. This is not an efficient way of transporting passengers. In an NCQ environment, however, the elevator stops at the second, third, fourth, and sixth floors, in that order.

And for hard drives, NCQ can help overcome mechanical limitations and increase storage performance on random workloads by allowing the drive to internally optimize the order of the commands.

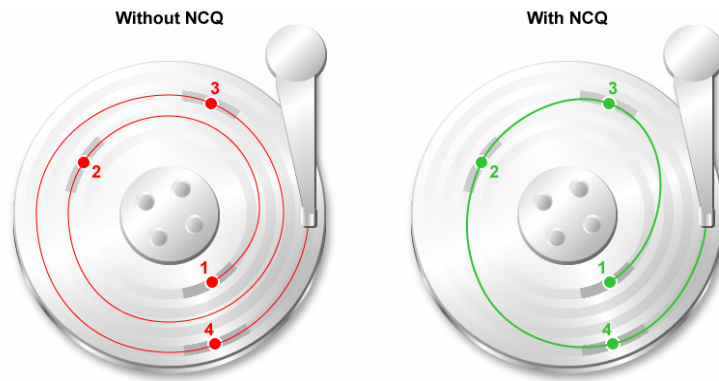Native Command Queuing is featured in some versions of NVIDIA nForce MCPs.

Figure 6.   MediaShield Storage Native Command Queuing

Disk Alert System

Most multidisk users purchase several identical hard drives to take full advantage of their disk array. If an array fails, the only way users can identify their failed drive is by locating a serial number, thereby limiting their ability to correctly identify a failed drive.

The MediaShield Disk Alert system facilitates identification by going a step further. An alert displays an image of the system motherboard and highlights the failing port, providing a visual indication so you know exactly which hard drive to replace (Figure 7).
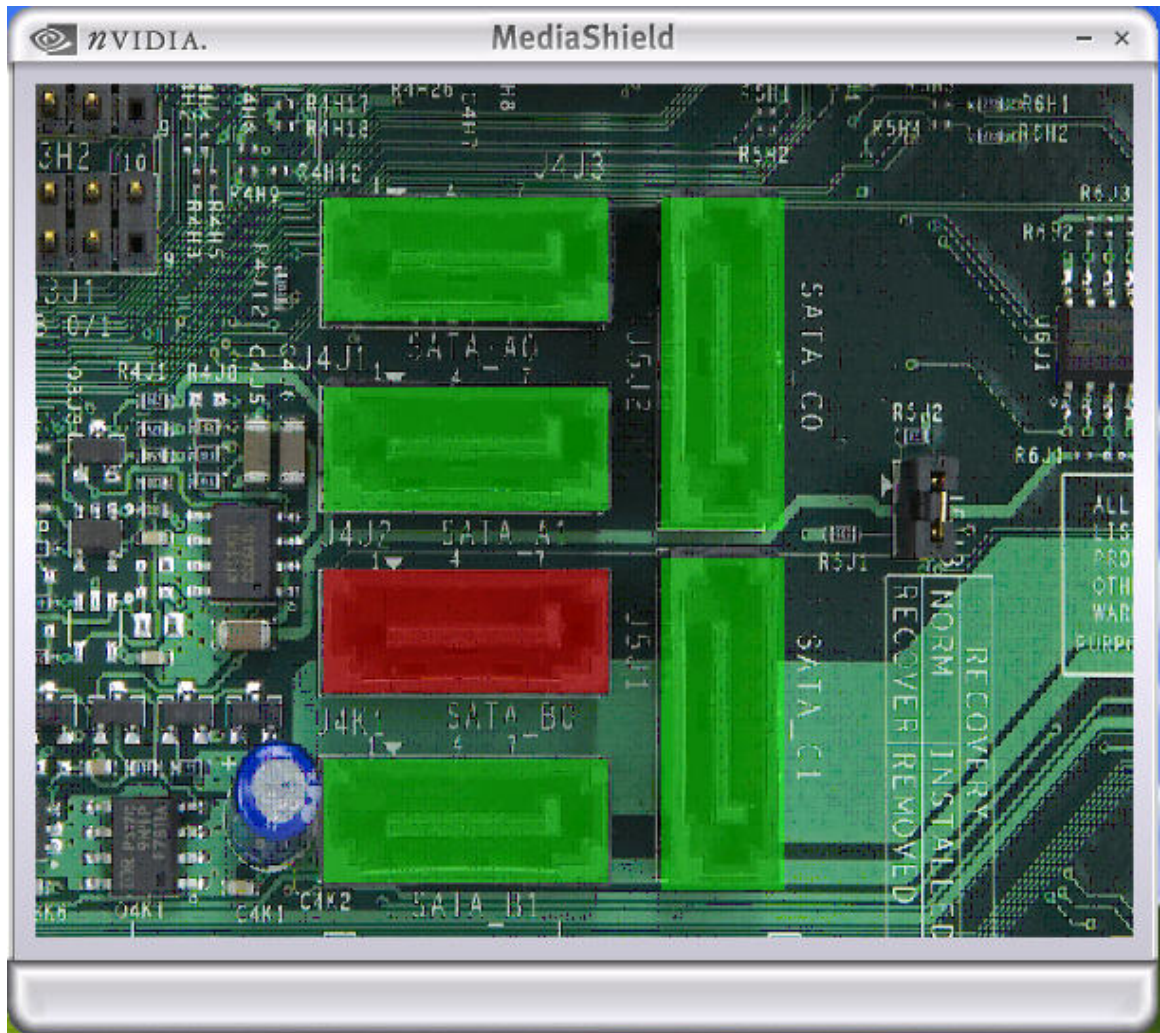
Figure 7.   Disk Alert Shows Which SATA Connector the Failed Drive
Is Connected To

Spare Disk Allocation

Disk mirroring techniques let users designate spare drives that can be configured as hot standbys, protecting the disk array if a disk fails. A *shared spare* can protect multiple arrays of drives, or a *dedicated spare* can serve as a hot standby for a particular drive array.

The spare disk feature, available with MediaShield RAID 5, offers protection that goes beyond mirroring data, which has traditionally been limited to high-end multidisk systems. With MediaShield storage, NVIDIA brings this high-end capability to the PC. A dedicated spare can take over for a failed disk until the repair is completed—giving support teams the flexibility to choose convenient repair times.

Morphing

In a traditional multidisk user environment, users who want to change the current state of a disk or the current multidisk array must back up the data, delete the array, reboot the PC, and then reconfigure the new array. During this process, the user has to go through multiple steps just to configure a new array.

However, MediaShield allows users to change the current state of the disk or array to another with a one-step process called "morphing." Morphing lets users upgrade their current disk or array for more performance, higher security, and higher capacity. More importantly, the upgrade is accomplished without going through multiple steps. The morphing feature offers an upgradeable option to easily manage storage.

Booting from a Multidisk Array

MediaShield storage fully supports the use of a multidisk array for loading the operating system at power-up. This means that all available disk drives can be included in the array for optimal performance and protection of all storage.

On-the-Fly Rebuilds

If a disk fails, disk mirroring techniques allow continuous operation by taking advantage of the mirrored data copy in the array. MediaShield storage offers more— it lets a user rebuild a new mirrored copy for the data while the system is up and running, without disrupting user and application access to the data set.

Rebuilding on the fly eliminates downtime and maximizes protection for critical storage resources.

Hot-Plug

MediaShield storage includes hot-plug support for SATA drives. If a drive fails, the "hot-plug" feature lets users swap out the failed hard drive without powering down the system, and replace it with a new one.

Intuitive User Interface

Using the intuitive user interface, anyone—including users without experience setting up multidisk arrays—can apply and manage the MediaShield storage technology.

Point-and-click operations lead users through the steps to specify which disks to configure in an array, turn on striping, and build mirroring volumes. Configuration changes can be quickly and easily carried out at any time, using the same interface (Figure 8).
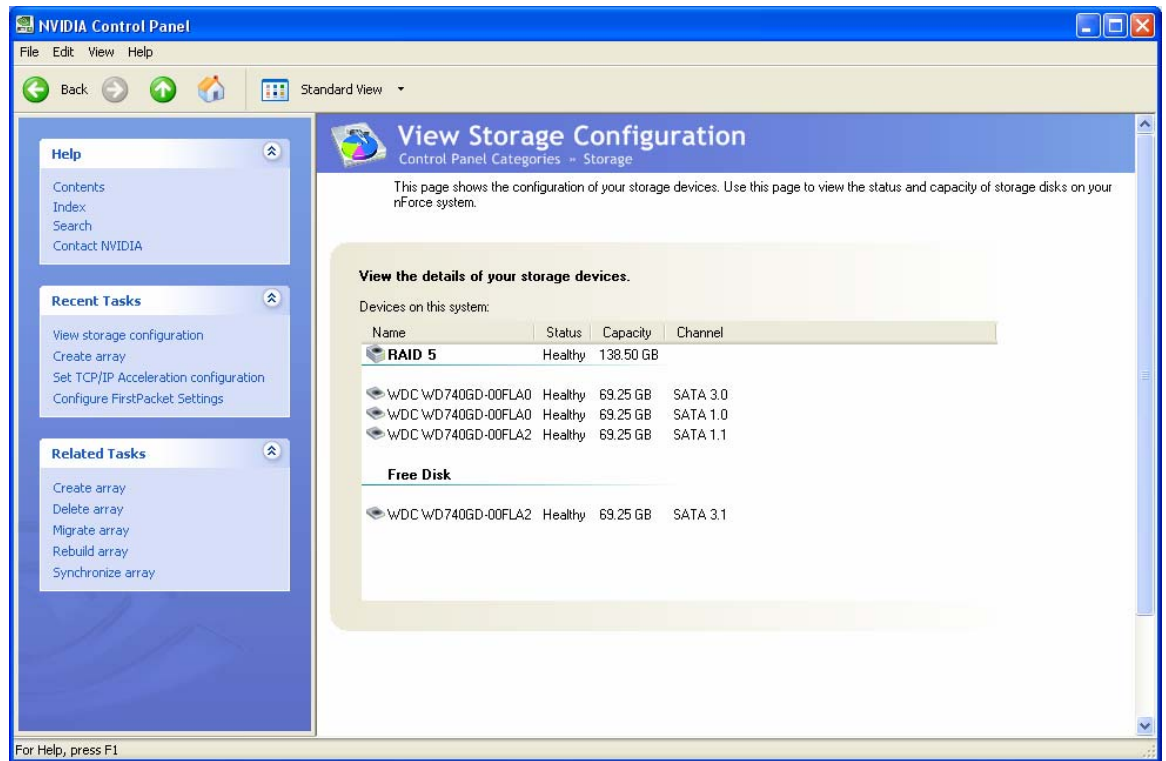

Figure 8.   MediaShield Interface: Easy Setup and Management of Disk Storage Resources (Mirroring)

Applications

Multidisk solutions deliver several categories of benefits to various applications:

❑ Performance optimization
Disk striping techniques result in higher throughput to and from an array of disk drives.

❑ Data protection
Data is mirrored to a second drive, so the probability of data loss because of drive failures is zero.

❑ Data availability
MediaShield storage technology implements multidisk techniques in a manner that minimizes downtime for individual drives and the entire array.

❑ Automated backups
Multidisk techniques offer a cost-effective alternative to users who do not have the staff or expertise to perform regular backups and manage data restores in the event of failures. MediaShield storage uniquely simplifies the process with an intuitive interface for setting up and managing multidisk arrays.

Many applications and users can benefit from using MediaShield storage.

Personal Archiving: Performance, Data Protection

Personal archiving of family videos and photos is a growing application area for home computing. As families opt for the convenience of online storage, editing, and file sharing with friends and relatives, the storage requirements have expanded. The requirements now include adequate performance when sharing large files, and protection (backup) for priceless family history. MediaShield storage technology addresses all these requirements, without requiring the home user to become a storage expert.

Users can easily configure multiple drives to mirror (or back up) critical data and to support striping for enhanced performance, which prevents dropped frames during video editing operations. As disk storage continues to drop in price, this alternative has become a very practical solution within home computing environments.

Engineering: Data Protection, Automated Backups

Small engineering firms typically cannot afford a dedicated IT support team, but must somehow ensure the availability and protection of valuable engineering drawings and project files. MediaShield storage technology provides an affordable and easy-to-use solution with immediate benefits to these types of small businesses.

❑ RAID 5 offers *advanced protection* and optimizes data access. RAID 5 also provides an additional "spare disk" in a failure case so data will always be protected.

❑ RAID 1 (disk mirroring) ensures the *availability* of stored files. RAID 1 also provides an *automatic backup* copy, eliminating the need for time-consuming copying of files to expensive tapes or other media.

❑ RAID 0 (disk striping) can be implemented to *shorten the access times* for large engineering files and to improve productivity, especially for projects that require collaborative efforts and file sharing.

Manufacturing: Data Availability

Any production line incurs a cost (lost revenue) when operation is disrupted. The PCs controlling the line must have constant access to critical programs and data files to avoid downtime.

Disk mirroring techniques can be applied in these types of mission-critical situations to affordably gain high availability and protection for critical storage resources.

Multithreaded Client/Servers: Performance

Multithreading, a popular programming technique for large software applications, puts an increased burden on a storage system. Multiple active program paths generate additional disk accesses and can quickly bog down a single drive. Similarly, the use of many server applications results in overly taxed PC clients, plus increased loads on the desktop storage devices.

Multidisk techniques, by striping data across multiple drives, can increase the throughput of a desktop storage solution and ensure the performance required for today's complex applications.

Conclusion

NVIDIA's MediaShield storage technology, a standard feature in the latest NVIDIA nForce MCPs, provides a cost-effective foundation for reliable, highly available, and optimized data storage solutions. With an easy-to-use interface, MediaShield removes the barriers associated with multidisk management in the past.

The advanced capabilities of NVIDIA's MediaShield storage—including support for a six-disk RAID 5, SATA 3Gb/s, and native command queuing (NCQ)—continue the NVIDIA tradition of building in functionality that lets users get the most out of systems.

These features of NVIDIA's MediaShield storage distinguish it as delivering industry-leading value to today's PCs and workstations:

❑ High-demand functionality
❑ Adherence to popular and emerging standards
❑ Ease of use

Plus, NVIDIA's proven record for optimizing the flow of data throughout the system now extends to MediaShield's subsystem—a critical component for today's applications that handle increasingly large files, models, data sets, and digital media content. NVIDIA's MediaShield storage is a vital technology that ensures optimized, balanced, system performance for dynamic computing environments.

With MediaShield storage, NVIDIA shifts the scale back in the direction of reliability and stability, and lowers the total cost of ownership for optimized, highly available data storage solutions.

NVIDIA Corporation
2701 San Tomas Expressway
Santa Clara, CA 95050
www.nvidia.com