IRONWOLF NAS

SEAGATE

TECHNOLOGY PAPER

Discovering a Better NAS Experience With AgileArray™

AGILEARRAY

Built into every IronWolf™ NAS drive is Seagate's groundbreaking AgileArray™ technology—a combination of powerful hardware, firmware and software features that deliver enhanced NAS performance and reliability. AgileArray is an essential ingredient for demanding, multi-user environments where 24×7 accessibility and snappy performance are mandatory.

Efficient Error Recovery Control

A standard desktop HDD simply isn't designed to accommodate the rigors and logic of the NAS environment. For example, a standard desktop HDD will appear to go offline for a relatively long time when it attempts to recover from a suspected read or write error. During this time, the desktop HDD is attempting multiple retry operations to complete the task at hand. This is a normal and desirable behavior for a standalone drive in a PC environment and usually goes unnoticed by the single user. In a NAS, however, the RAID controller leverages data redundancy across multiple disks to recover from errors much more quickly. Therefore, a standard desktop HDD and RAID controller are essentially in conflict during error recovery which can confuse the system into believing the RAID set has been compromised with an unresponsive drive.

For example, data recovery can take as long as 2 minutes assuming 30-second data retry timer is found in a typical desktop HDD (Figure 1). As HDD 0 exhausts, retries and returns with an unrecoverable data error, the host tries to read data from another drive in the RAID volume. If every drive tries to recover data within a given data-retry limit, the system can spend as much as 2 minutes until the host gives the last HDD (HDD 4) chance to read the data.

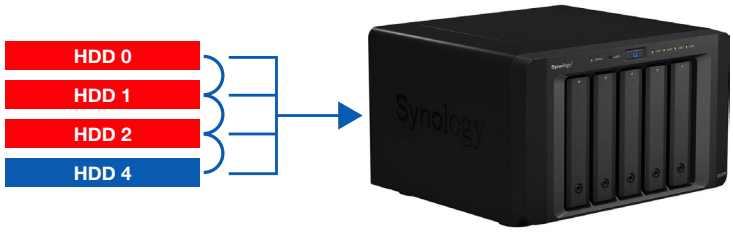

Figure 1. Reading data can be time consuming (read from a bad sector—30-second recovery time per HDD)

With a shorter default error recovery timer, the NAS system can recover data from each drive faster. Default setting for error recovery timer, the same data from the previous example can be recovered in less than 28 seconds. In fact, the timer can be customized for each volume or drive as needed. In many RAID systems, an extremely long recover time can result in the RAID volume dropping an HDD from the volume.

Seagate's AgileArray Technology helps to solve this problem with an adjustable time limit for the drive's built-in error recovery process thereby allowing the drive to remain available and to work in concert with the RAID controller to solve problems.

Robust RAID Optimization Firmware

NAS firmware is optimized for RAID configurations while a desktop HDD is optimized for standalone HDD configuration. This is important because unlike a single HDD volume, a RAID volume generally has data distributed over multiple HDDs. Therefore, large datasets such as video files reside over many drives and can pose inconsistent performance issues.

In a desktop system with a single HDD volume, large files are generally written sequentially as shown in Figure 2. A caching algorithm is based on desktop computer usage.

Figure 2. Single HDD Volume

In a RAID 5-configured NAS, the same dataset, as in Figure 2, is now written among all drives as well as a parity data for each stripe (Figure 3). Due to noncontinuous write and read on each drive, caching algorithms must be optimized for such operation. Seagate AgileArray is optimized and tested for many RAID configurations.

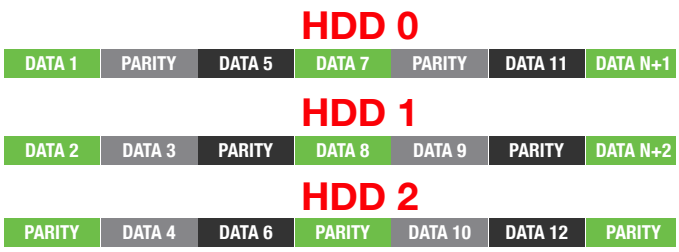

Figure 3. Three HDDs with RAID 5-configured

Advanced AcuTrac™ Technology

Under extreme vibration condition present in a NAS chassis, any drive in the system must be able to tolerate vibration caused by other drives and chassis fan(s). Vibration from a neighboring HDD or chassis fan can negatively impact individual drive performance resulting in overall system performance degradation. In a mild vibration condition, a desktop drive may simply degrade in performance. However, in an extreme vibration condition, a desktop drive may stop functioning altogether as the servo system cannot lock on a data track.

AcuTrac allows Seagate IronWolf HDDs to function even under an extreme vibration condition with minimal performance degradation. AcuTrac consists of two components (Figure 4), dual-stage microactuator and advanced format servo.

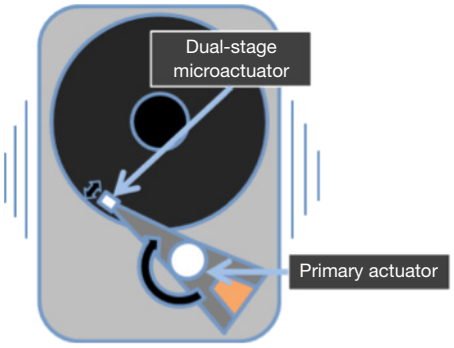

Figure 4. AcuTrac components

While the primary actuator is responsible for fast track-to-track movement, the microactuator is a secondary actuator responsible for inner-track movements in the servo system. Both technologies enable the servo system to react quickly to any vibration that can disturb the servo system and keep it on track for optimum performance.

Dual Plane Balance Means Quiet Operation

As the number of disks increase, the effect of motor imbalance becomes more pronounced with vibration and noise. Multiple HDDs in a NAS chassis and system fans further amplify the vibration. With dual plane balancing, however, both vibration and noise caused by the drive are addressed by balancing the disk pack in all axes using the latest technology. IronWolf utilizes the tightest dual plane balance specification to help ensure the drive is vibration-free and quiet during operation. The result is a consistent and reliable drive that provides consistent NAS system performance.

RV Sensors Detect Vibration

Rotational Vibration (RV) sensors are used to detect vibration about an axis which can affect servo tracking capability and overall drive performance. The level of vibration and the frequency are processed in a closed feedback loop system to compensate for the head position and to minimize performance degradation.

RV sensors are usually found only in expensive enterprise class drives where drives are under constant vibration due to chassis fans and numerous drives present in a system. Select IronWolf and all Seagate Enterprise NAS drives are equipped with RV sensors.

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Supports a Streaming Command Set

Every Seagate IronWolf HDD supports ATA-8 streaming command set. In addition, the firmware is optimized to handle large sequential block transfers that are found in most video files. Desktop HDD can handle limited number of streams as it is intended for a single user PC. AgileArray can handle up to 64 streams simultaneously.

AgileArray firmware detects a stream based on incoming command sequence and configures a data buffer to queue up data in sequence. Such queuing of data during write reduces seeks which allows IronWolf HDD additional capability to write scores of streams even in a highly random operation.

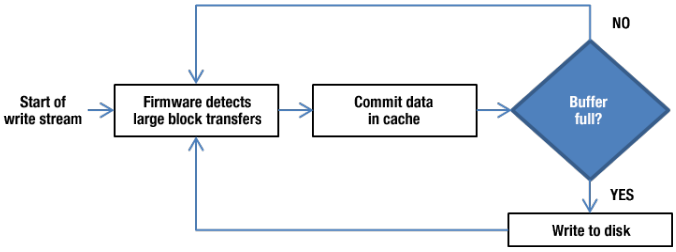

Figure 5. How command streaming works

Advanced Power Management

AgileArray's power management is optimized for NAS applications, and the firmware strikes a perfect balance to achieve industry-leading seek performance while offering the lowest possible power consumption.

While an aggressive power saving mode can benefit notebook or desktop systems, it may not work well in a NAS application. Power saving modes involve heads unloading from disk to ramp followed by the disk spinning down. Each level in a power saving mode saves power at the expense of the drive coming back-to-ready when the host needs to access data. In addition, coming out of each power saving mode consumes additional power. AgileArray power management balances power saving and time-to-ready specifically for NAS applications by minimizing head unloads and spin downs. The result is a quick response time for the NAS applications, providing excellent overall power consumption.

AgileArray vs. NASWorks

AgileArray works with all NAS systems, and is especially important for large capacity drives operating in high performance NAS systems. And because system reliability is a primary concern for most users, AgileArray is beginning to lead the competition with Seagate APIs. While NASWorks is a comprehensive set of features for the NAS environment, AgileArray takes one step further with APIs that work under Linux-based NAS OS, thereby enhancing the user experience.

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