RAID Certification Testing Process

Drive Quality Screening for the Next Generation of Storage Systems

Executive Summary

To increase the reliabilty of commodity disk drives, DNF Storage has develped an extensive RAID Certification testing procedure. Each drive used by DNF goes through a sophisticated and grueling 120 hour testing process, weeding out units that exhibit signal quality problems, data mismatch errors, temperature and power regulation issues, or other conditions that escaped the manufacturer's testing process. The survivors receive our "RAID Certified" seal of approval.

As drives became commodity products, the overall quality and reliability have suffered. While this is not a critical problem for consumer applications, even low-cost RAID systems need to be protected from the threat of drive failure. To separate "gold-standard" drives from inferior units destined for the consumer market, the RAID Drive Certification process puts drives through a sophisticated and grueling artificial testing process that lasts up to 120 hours. Further, application-specific hardware RAID tests to ensure that they perform well in their destined systems. This weeds out units that exhibit signal quality problems, data mismatch errors, high media error rates, temperature and power regulation issues, or other marginal issues that escaped the manufacturer's testing process. The significance of these conditions is ill-understood or ignored by many storage manufacturers. While such defects do not pose an immediate problem in single-drive servers or personal computers, inferior drives are unacceptable in high availability, mission-critical RAID solutions. After enduring our testing process, only the best receive a "RAID Certified" seal of approval.

The Problem

As drive manufacturers strive to meet growing storage needs in a limited physical form factor, using fixed-size magnetic media, reliability becomes a significant issue. Platter sizes increase to yield large drive capacities, but current read and write speeds must be maintained. This requires tighter and tighter tolerances on the mechanically positioned read/write heads, powerful actuator motors. With platter density as it is, even small media imperfections can damage a large number of sectors. The sheer amount of data being processed demands high-quality drive logic boards. Fast drives also have high power consumption, which stresses power regulation systems and produces large amounts of heat—a major enemy for electronic components. Defects in the manufacturing process can manifest themselves in any of these areas, afflicting SCSI, PATA/SATA, and fibre drives.

Factors in Drive Failure

Overall, most drives are capable and satisfactory, but a significant number will fail within the early days of their operation due to manufacturing defects. Manufacturers try to weed out the substandard units, but they frequently do not evaluate drives in sufficient detail. Moreover, a drive may function well enough from the end-user perspective and still exhibit marginal internal issues.

A list of common drive technology issues:

Type	Symptom	Cause
On Time Spin-Up	Drive Not Ready	Stiction Problems
Signal Integrity	Signal to Noise Ratios (SNR)	Media Errors
Remaps	Data Mismatch	Read/write Errors
Random Seeks	Data and Track-Following Problems	Zone Boundary Issues
Reset	Power Spike	Data & Control Crosstalk
Random Power-Down/Snoozing/Low Activity State	Out of Tolerance (for use in RAID)	Temperate Tolerance Issues

Any number of these problems can plague a fresh drive without causing immediate failure or major problems, but these issues will ultimately reduce drive lifetimes. Far from being a necessary reality of mass storage, drives exhibiting these conditions can be identified and eliminated through our sophisticated RAID Drive Certification process.

DNF's RAID certification strategy ensures drives are ready for implementation in array systems by eliminating substandard units, and normalizing initial build quality. This is crucial in mission-critical, high-availability systems, which require predictability above all else. Performance must stay within expected boundaries and the protection offered by RAID mirroring and parity cannot be used as a constant crutch. In short, DNF aims to make superior drive quality the front line of data protection.

RAID Drive Certification Testing Method

DNF's RAID Drive Certification process can be broken down into three basic procedural components.

First is "functional testing," more commonly known as stress testing or "burn-in." This type of testing places units in an artificial environment and forces them to perform as fast as possible for an extended period of time. In many cases, this would amount to nothing more than a ritual.

At DNF, however, we put drives through a range of read/write situations, including worst-case scenario alternating fast 0/1 writes on the dense inner tracks of a drive. However, functional testing is not comprehensive, and only eliminates the stragglers or drives which obviously do not perform consistently within a specified range.

The second component of the RAID Drive Certification process is parametric testing. Using a real-time RTOSS operating system, DNF engineers view and log raw drive behavior at the hardware/interface level. A drive may still pass a functional test, but anomalies in seek time, read error rate, voltage, or other parameters will make it unfit for enterprise use.

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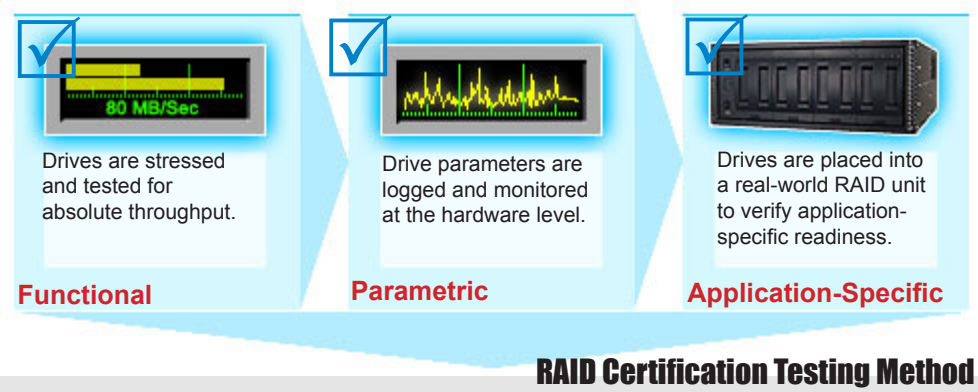

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The third, and most crucial feature of DNF's certification procedure is application testing. Taken individually, drives will often behave within the manufacturer's specifications, but variations in the building process can cause problems in RAID situations. As data is striped across a high-performance RAID array, each drive accepts an exact percentage of the write load. When the next write is striped on the array, each drive must have completed its previous write task for the RAID to work at full speed. Should a single drive fail to complete its previous write in time, the whole array will slow down to accommodate it. If the performance anomalies are serious enough, drives may flicker offline and threaten the array's integrity. This is why DNF takes drives that has passed all previous tests and runs them in unison, under a variety of real-world RAID conditions. This verifies that drives will perform as expected when used for actual high-performance applications, be it streaming media, high I/O database storage, or even large-capacity arrays.

Through this process, DNF can eliminate marginal units that would otherwise reach end-users, and ensure that only gold-standard drives remain. These alone receive our "RAID Certified" seal of approval.

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