Seagate

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Technology Paper

Maximize Fibre Channel Value With 15K-RPM Disc Drives

Introduction

Each passing year has seen Fibre Channel (FC) strengthen its position as the premier storage interface in the enterprise, despite the relatively high cost of an FC storage area network (SAN). Requiring significant investment in both the Fibre Channel network (or fabric) itself and training for support staff, deployment of an FC SAN is not undertaken lightly. Businesses conduct thorough cost-benefit analyses to ensure their new FC SANs will deliver maximum performance and optimal total cost of ownership (TCO).

Yet these analyses often overlook one critical factor in determining an FC SAN's speed and efficiency: the Fibre Channel disc drive. Given the substantial investment an FC SAN represents, it's ironic that so many enterprises undercut the value of their FC SANs by hobbling them with 3.5-inch 10K-RPM disc drives. The continued popularity of these drives stems from the erroneous belief that they offer the best available combination of performance and economy in an FC SAN environment.

Fortunately, this misconception is rapidly fading as the superiority of 3.5-inch 15K-RPM FC disc drives becomes more widely known. It comes as no surprise that 15K-RPM drives provide significantly faster throughput than their 10K-RPM ancestors; but what delights many IT managers is the fact that 15K-RPM drives are more cost-effective as well, enabling **lower total cost of ownership**.

Access Time Is Key

By its very nature, an FC SAN places a premium on disc drive performance. Combining a 4.0 Gbits/sec transfer rate (8.0 Gbits/sec in full-duplex mode), support for 16 million addresses and a maximum cabling distance of ten kilometers, Fibre Channel networks are capable of unprecedented data accessibility. But to deliver such accessibility in demanding online applications, an FC SAN must employ disc drives that can rapidly respond to many simultaneous read/write requests from a multitude of servers.

An FC drive's **access time** is an essential factor in meeting the rigors of FC SAN duty. Access time is defined as the time needed for the read/write head to reach the disc location where the desired data resides. The two major components of a drive's access time are **seek time** and **latency**:

- **Seek Time:** When the drive receives a request, the head moves, or seeks, across the disc to the track containing the desired data. The time it takes for the head to move from its initial position to the data's track is called *seek time*. Smaller-diameter discs shorten the distance the head must travel, thus reducing seek times.
- **Latency:** After the head is positioned on the appropriate track of the disc, the head must wait on that track until the rotating disc brings the desired sector of data underneath the head. The time it takes for the data to reach the head is called *latency time*. Of course, the faster the disc is spinning the shorter the latency time.

When a seeking head reaches the target track, the data may already be immediately under the head, resulting in an effective latency of 0 msec. In other cases, where the data has just passed beneath the head, the head must wait a full revolution before reading the data. Thus latency on any drive averages out to be one-half of its full revolution latency time ([full-rev latency + zero]/2).

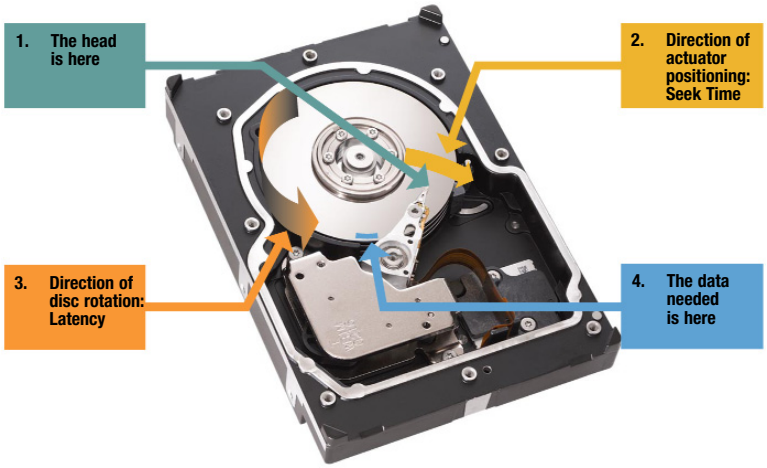

Figure 1. Seek time and latency determine a drive's access time

Costly Compromises

Some IT departments address their FC SAN performance needs by purchasing lower-capacity 10K-RPM disc drives. While selecting smaller (36GB or 73GB) drives requires more drives to meet a given capacity goal, it ensures each drive accesses less data and thus lowers drive access times. In effect, these departments are purchasing more actuators to simultaneously access their data. This approach increases overall performance of the drives, but substantially raises cost/GB.

Other IT professionals choose to increase their 10K-RPM drives' performance by storing data only on the outer diameter of the disc, a practice referred to as *short-stroking* (or *destroking*). Short-stroking a drive reduces the distance the actuator must move to access the data, and thus improves disc seek time. Of course, such an approach greatly reduces effective disc capacity, escalating the cost/GB of the drive. (For example, a 10K-RPM 146GB drive short-stroked to yield 73GB capacity costs significantly more per GB than a 10K-RPM 73GB drive.)

Whether in conventional (full-stroked) or short-stroked configurations, it's clear that 10K-RPM drives often require ingenuity and unorthodox techniques to wrest acceptable performance and capacity from them. Such techniques obviously inflate storage costs by the sheer number of drives needed, but they also drive up associated costs, such as FC infrastructure, required space (data center ft^3 and rack U), power consumption and cooling, and storage maintenance. Surely there must be a better way….

Performance First

The most obvious benefit of 15K-RPM drives is their ability to significantly boost server and storage performance. For a typical workload, 15K-RPM drives deliver 33 percent more input/output per second (IOPS), 33 percent faster latency and 26 percent faster seek time than the same server configured with 10K-RPM drives (see Figure 2). These performance advantages are maintained whether testing 14 drives (as shown) or a single drive.

15K RPM: Higher Performance With Same Number of Drives			
Metric	**10K RPM**	**15K RPM**	**15K Advantage**
Performance (IOPS)	**579** (146GB, 14 drives)	**772** (146GB, 14 drives)	**33% Faster**
Latency (msec)	**2.99**	**2.00**	**33% Faster**
Seek Avg R (msec)	**4.7**	**3.5**	**26% Faster**
Test results from IBM xSeries 336 with EXP 400, general transactional workload, RAID 5.			

Figure 2. Performance advantage of 15K-RPM drives

15K-RPM drives achieve this superior performance by providing quicker access to data. 15K-RPM drives, naturally, spin their internal discs faster, which reduces latency. Furthermore, the discs' smaller diameter (approximately 2.6 inches vs. 3.0 inches for many 10K-RPM drives) shortens the distance an actuator must move, decreasing seek time.

Economies of Speed

But while the raw performance of 15K-RPM drives is impressive, the *economies enabled by this speed* are what make 15K-RPM drives so compelling. For example, as shown in Figure 3, eleven (11) 15K-RPM 146GB drives will give the same performance as seventeen (17) 10K-RPM 73GB units, but with 29 percent more capacity and 35 percent fewer drives purchased.

15K RPM: Same Performance With Fewer Drives				
Drive Comparison	**# of Drives**	**Capacity (GB)**	**Performance (IOPS)**	**15K Advantage**
10K 146GB	**17**	**2482**	**700**	
15K 146GB	**11**	**1606**	**700**	**35% Fewer Drives**
10K 73GB	**17**	**1241**	**700**	
15K 146GB	**11**	**1606**	**700**	**29% More Capacity, 35% Fewer Drives**
Test results from IBM xSeries 336 with EXP 400, general transactional workload, RAID 5.				

Figure 3. 15K-RPM drives meet performance requirements with 35 percent fewer drives

Similarly, a multitude of short-stroked 10K-RPM drives can be replaced by fewer 15K-RPM drives to attain a given level of performance and capacity, significantly reducing TCO. For example, an IT manager might typically buy 10K-RPM 73GB drives, but elect to purchase 10K-RPM 146GB drives and short-stroke them to increase performance. But even when 10K-RPM drives are short-stroked, fewer 15K-RPM drives than 10K-RPM drives are required (see Figure 4).

15K RPM: Same Performance and Capacity With Fewer Drives					
Drive Comparison	**Short-Stroked to (GB)**	**# of Drives**	**Capacity (GB)**	**Performance (IOPS)**	**15K Advantage**
10K 300GB	**129GB**	**16**	**2064**	**763**	
15K 146GB	**Full-stroked**	**14**	**2044**	**772**	**12% Fewer Drives**
10K 146GB	**120GB**	**17**	**2040**	**745**	
15K 146GB	**Full-stroked**	**14**	**2044**	**772**	**18% Fewer Drives**
Test results from IBM xSeries 336 with EXP 400, general transactional workload, RAID 5.					

Figure 4. Lower total cost of ownership with 15K-RPM drives

Simply put, 15K-RPM disc drives were purpose-built to address the performance deficiencies of 10K-RPM drives, and in so doing enable greater cost-effectiveness to be achieved. Deploying fewer drives delivers lower TCO by ensuring:

- Less supporting Fibre Channel infrastructure
- Less space required for that infrastructure
- Lower maintenance and storage-management costs
- Greater reliability due to fewer potential points of failure
- Higher IOPS/U

Furthermore, 15K-RPM drives have three field-proven generations of reliability, decrease RAID rebuild times, and have similar or lower power and cooling requirements, acoustics, and rotational vibration compared to 10K-RPM drives.

Conclusion

Now more than ever, IT professionals are under intense pressure to squeeze maximum value from every asset. Fibre Channel SANs represent a substantial outlay, and their return on investment (ROI) can be significantly boosted when optimal performance and efficiency are achieved. Transitioning from 10K-RPM to 15K-RPM disc drives enables FC SANs to deliver 30 percent more performance, while needing fewer 15K-RPM drives to meet throughput and capacity requirements. The bottom line: 15K-RPM disc drives deliver higher performance and reduced TCO, fundamental goals for every FC SAN.

AMERICAS **Seagate Technology LLC** 920 Disc Drive, Scotts Valley, California 95066, United States, 831-438-6550
ASIA/PACIFIC **Seagate Technology International Ltd.** 7000 Ang Mo Kio Avenue 5, Singapore 569877, 65-6485-3888
EUROPE, MIDDLE EAST AND AFRICA **Seagate Technology SA** 130-136, rue de Silly, 92773 Boulogne-Billancourt Cedex, France, 33 1-41 86 10 00