



## HP meets challenge with the 15K Universal Disk Drive for improved, state-of-the-art storage solutions

### Scope of this paper

This document illustrates how the improvements inherent in the 15K can benefit customers' enterprises while running a variety of applications. This brief also outlines the quality assurance that HP gives to customers regarding hard disk drive (HDD) substitutions.

### Overview

Sound IT investments must take into consideration the different dimensions of performance. Often the factor of disk drive spindle speed is overlooked, despite the significant impact that disk drive parameters, such as spindle speed, can have on storage system performance.

HP is meeting the challenge of providing state-of-the-art storage solutions with award-winning products like the Smart Array Family of intelligent controllers. Continuing its commitment, HP provides innovation in the storage component of the solution, the disk drive, with the Universal Disk Drive product line. The HP 15K Universal Disk Drive (15K) is the latest member of this product line.

The 15K can be integrated into the current *AlphaServer™*, *ProLiant™*, and *StorageWorks* enterprise product lines. The 15K has the same form factor and the same power and cooling requirements as the 10K Universal Disk Drive (10K), but with significantly faster performance – up to a 32 percent improvement. Performance improvement was measured using the ProLiant DL380 G2, running dual 1.4GHz processors and 256MB RAM driven by a 64-bit/133MHz dual-channel, Ultra320 SCSI host bus adapter.

## 15K Features and Benefits

### performance

The 15K is another HP industry-leading product without compromise. HP engineers conducted independent testing to determine the real performance benefit of 15K over their 10K brethren, using the same HP systems that are hard at work in enterprises all over the world today. A ProLiant DL380 G2 utilizing 15K drives demonstrates a performance increase of approximately 32 percent over the same system using 10K-RPM drives.

Additionally, the 15K includes the power of the Ultra320 SCSI interface (Ultra4), which doubles the data rate over the previous-generation SCSI interface to 320MB/s, while still being backward-compatible with older SCSI interfaces such as Ultra3 and Ultra2. Combining the performance of the 15K with increased bus bandwidth offered by the 320-MB/s interface, improves system performance, reducing the likelihood that the interface will become a bottleneck.

Table 1 compares the 15K with the 10K. While the physical and electrical characteristics are equivalent to the 10K, the 15K improves response time via progress in rotational latency and seek times. These improvements, (which are later explained in more detail), directly enhance the ability of the storage system to keep up with demanding user workloads.

**Table 1 – Universal Disk Drive Comparison**

	<b>15K Universal Disk Drive</b>	<b>10K Universal Disk Drive</b>
<b>Capacity (GB)</b>	18, 36, or 73	36, 73, or 146
<b>Height</b>	1.0 in (25.4 mm)	
<b>Width</b>	4.0 in (101.6 mm)	
<b>Depth</b>	5.75 in (146 mm)	
<b>Interface</b>	Ultra320 SCSI, 2 GB/sec FC-AL	
<b>Reliability</b>	0.58% AFR	
<b>Seek Time (average) (ms)</b>	3.6	5.2
<b>Latency (ms)</b>	2.0	2.99

The HP Universal Disk Drive family also provides:

- **Reliability**—The 0.58 percent annual failure rate (AFR) meets the demands of the enterprise environment for high availability.
- **Investment Protection**—Drives are easily deployed within existing Ultra2 and Ultra3 solutions.
- **Flexibility**—Drives merge seamlessly into any HP server supporting the Universal Disk Drive family.
- **Easy Data Migration**—When combined with the HP Smart Array Family of products, data can be safely migrated using a planned deployment.

### Evolutionary Improvement Trends in HP's Disk Drives

The hard disk drive industry has shown amazing technological improvements over the years. The growth of the aerial density of disk drive media, and the improvements in the components and systems that support that data density, have led to a doubling of capacity year after year — surpassing the expectations of skeptics, both within and outside the industry. However, in terms of drive *performance*, the generational improvements of disk drives have not been as impressive, especially compared to the performance growth of other components in a system.

As the 15K RPM disk drives were qualified by HP and subsequently offered to our customers, they offered a chance to increase performance, bucking the slow trend of disk drive performance improvement. This increase in performance is due to the mechanical improvements of 15K designs.

#### mechanical performance

Due to mechanical performance limitations, disk arrays were born so as to maximize the number of operations that could be performed such as distributing the workload among as many disks as possible and hoping to eliminate the disk drive as a bottleneck for the whole system. The 15K further develops the power of arrayed disk drives by adding more I/Os per second (IOPS) to each unit, enabling multiplicative improvement in system performance. Furthermore, IOPS-hungry software applications like Microsoft Exchange server will benefit from newly announced disk drive technology — 2.5-inch enterprise drives, by creating hardware platforms resulting in the highest IOPS per cubic foot of data center space.

#### spindle speed

Unfortunately, the infrastructure to support multiple drives adds significant cost to the overall system, and additional arrays of drives incur significant marginal costs. In order to avoid the high costs of adding arrays of more and more drives to meet system performance requirements, IT departments can take advantage of the newest drives featuring spindle speeds of 15K RPM. The newest 15Ks have the potential to reduce the aggregate number of drives deployed and reduce the amount of cache used—allowing administrators to meet system-level performance requirements while saving money.

Figure 1 shows the significant improvement in random write performance, up to a 32 percent performance increase on 15K over a similar 10K implementation.

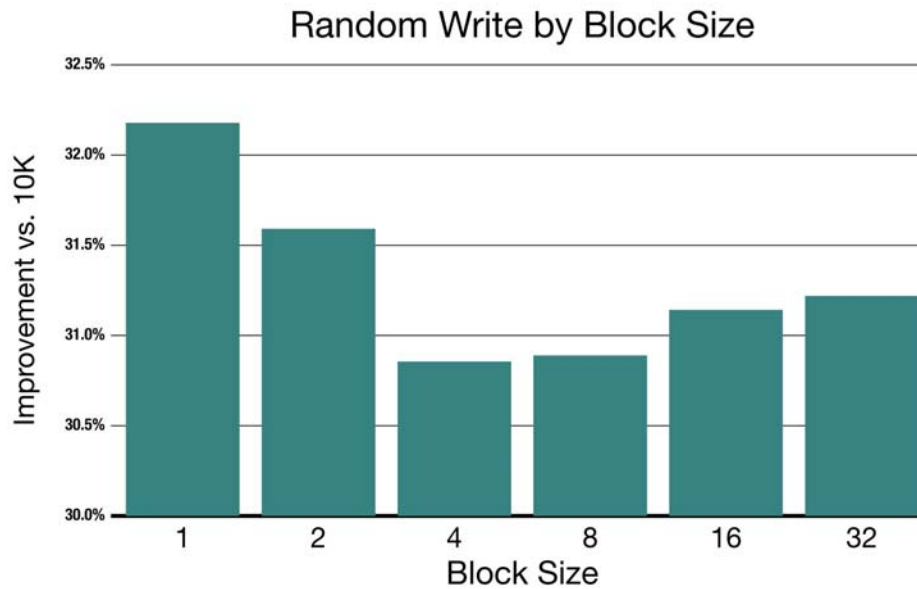
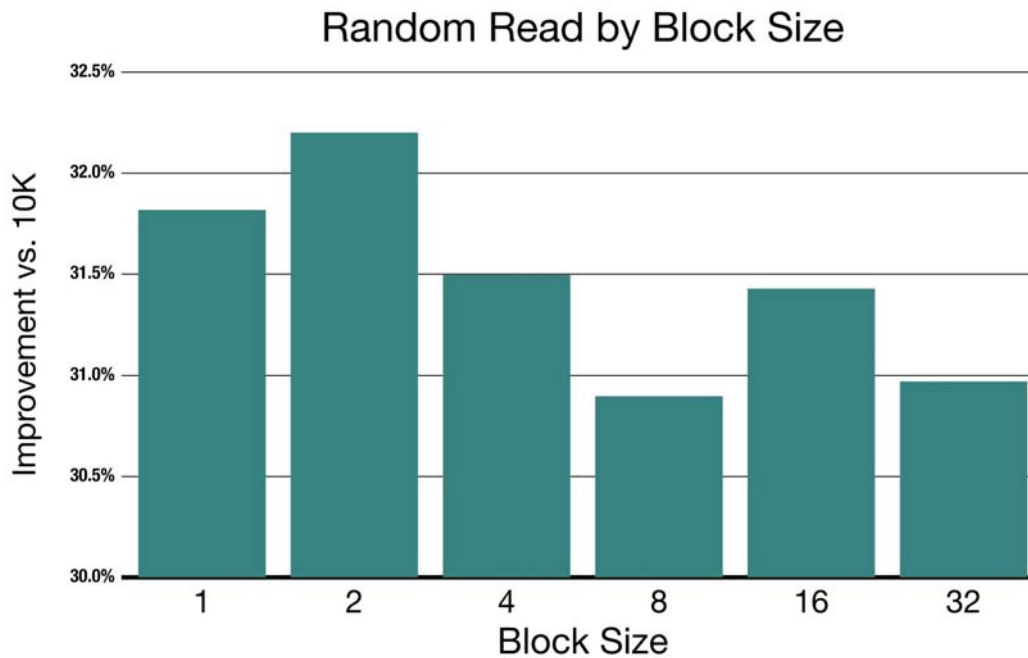


Figure 2 shows a similar performance delta on random reads. Because of the significant performance advantage of the 15K.



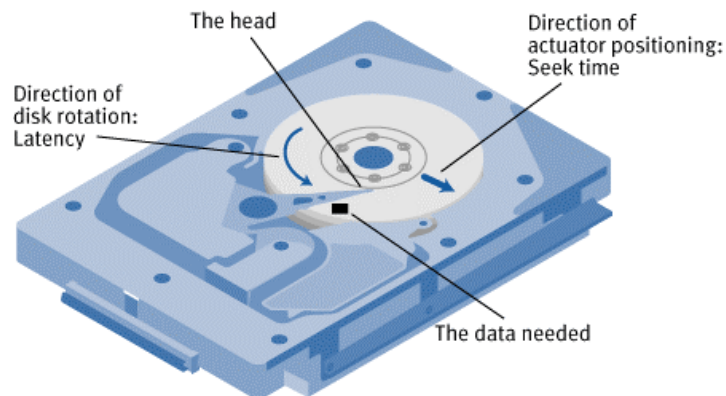
## The Mechanics Behind 15K Speed

### access time

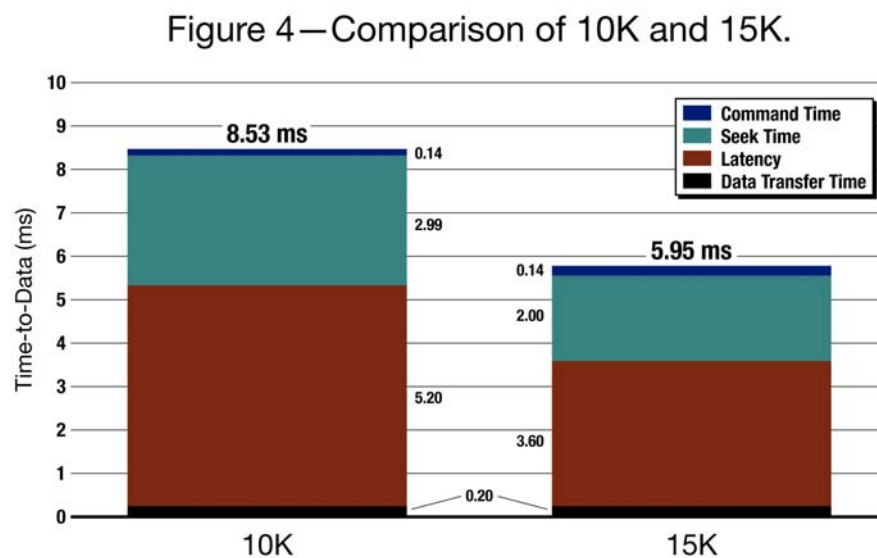
Most performance applications benefit more from faster access time than from faster transfer rates. These applications transfer small blocks of data that are located at various physical locations within the drive. Transaction processing is a classic example of these application types. A specific example of transaction processing is online transaction processing, for which a typical pattern consists of two-thirds random reads and one-third random writes that transfer data of 8-KB in length, on average.

Disk-drive access time is the time required for the drive's head to move to the disk location from where it will transfer the data. In performance-dependent applications, access time is much greater than data transfer time — the time that the drive uses to actually read or write the data. The major components of access time are seek time and latency (see **Figure 3**), which play a large role in determining drive performance. **Figure 4** graphically compares the time-to-data of the 10K and 15K.

**Figure 3. Components of a hard drive that contribute to seek time and latency**



**Figure 4. Time-to-data comparison of 10K and 15K**



**seek time**

After the drive receives the command, the head moves across the disk to the track that contains the relevant data. The time required to perform this action is called the *seek time*. Because of the small, 65-mm disk diameter of the 15K, its total seek distance is short, resulting in a fast seek time of 3.6 ms. In comparison, the disk size for the 10K drive is 84 mm, resulting in a longer radius, therefore a slower seek time, due to the physics of having to travel a greater distance than the 65-mm equipped 15K drive.

**latency**

After the head locates the right track on the disk, the head waits on that track until the desired sector (section of the disk for the data transfer) of the track reaches the head. The time the data takes to reach the head is known as *latency*.

Latency is determined by the spin speed of the disk. The faster the disk spins, the shorter the latency time, because the data will reach the head faster. For a 15K, the total time the disk takes to make one revolution is 4 ms. For a 10K, this total time is 6 ms.

The data could be under the head as soon as the head reaches the track, resulting in a latency of 0 ms. Alternatively, the data could have just passed the head, in which case the head must wait a full revolution, which takes 4.0 ms. Therefore, the latency of a 15K rpm drive is 2.0 ms, on average. The seek time plus latency of the 15K is 5.6 ms, 2.6 ms faster than that of the 10K.

**data transfer time**

The remaining time the drive takes to transfer the data is called *data transfer time*, and it is determined by the data transfer rate. For most performance applications, data transfer time is very small compared to the access time, and therefore has relatively little impact on the drive's performance. Nonetheless, the 15K's data transfer time is faster than the 10K's data transfer time.

**HP's Quality System—Backing Up Performance with Reliability**

In addition to offering groundbreaking performance, the latest generation of the 15K is procured through an industry-renowned qualification process. This process ensures that only the best drives are approved to ship in HP systems, and we've been utilizing this process since the first 15K drive qualification in 2000.

HP's qualification process selects the best Hard Disk Drives (HDD) through a rigorous process involving the following four steps:

**1. Selection Evaluation**

Early in the life cycle of an HDD product, early samples are evaluated and a number of standardized characterizations and tests are run on HDDs from a number of vendors. This evaluation is done with a team consisting of several different disciplines within HP, so that a broad range of factors are considered.

The development process at the HDD suppliers is frequently monitored and reviewed so that enhancements to new products are ensured to cause no compatibility issues and no interruption of the quality that HP customers have come to expect.

**2. Development Validation**

Throughout the course of the product life cycle, HP and the HDD suppliers perform a number of standardized tests that ensure compliance with HP and industry specifications. Any exceptions are carefully reviewed collaboratively between HP and the supplier, and any necessary corrective actions are tracked to close.

### 3. Supplier Production Qualification

Early in the HDD product life, HP works with each supplier to understand and develop product and process capabilities. This includes reviewing corrective action processes and the greater quality system. Factory audits and analysis of manufacturing parametric data are also a part of this process.

HP also conducts a configuration pilot to ensure that both HP and the supplier are ready for full volume production.

### 4. Continuous Improvement and Performance Monitoring

Through methods such as ongoing reliability testing, factory monitoring, and rigorous closed-loop corrective action tracking, HP ensures quality product after the HDD has been qualified and volume shipments have commenced.

The sophistication of the HP qualification process and the collaborative relationship that it builds with HDD suppliers leads to better products being created in a smoother manner — ultimately ensuring that the best possible system reaches HP's customers.

#### Meeting the need for speed in today's demanding applications

Due to the faster time-to-data that the 15K can provide, each drive is able to deliver up to 32 percent more IOPS than the traditional 10K. Almost any application can benefit from the increased performance of the 15K. Four of the most common applications are:

- File and print
- Database
- E-mail
- Web or media servers

When deployed properly, the workload on a server running any of these applications can operate predictably with just about any disk drive. However, under periods of heavy load, the increased performance of the 15K can help make the difference and support the heavy load, potentially eliminating the need to invest in additional processing power or additional cache memory — ultimately saving customers money.

#### management

HP systems feature sophisticated management tools such as *HP Insight Manager™* to help manage requests, so that the power of the 15K's increased performance can be exploited and server performance can be sustained, even under heavy file and print loads.

#### database

The demands of database queries and transaction updates often require transfer of significant amounts of data in a very short time. To support these computation speeds, the functional storage structures of traditional database applications must be distributed among multiple drives to support the large number of IOPS in these instances. The increased maximum IOPS of the 15K help minimize the impact of these activity bursts. Customers will find that SAP, Oracle, PeopleSoft, and other database applications running the enterprise operate more efficiently, delivering better performance results when utilizing the 15K.

**e-mail**

Although e-mail messages take time to proliferate through the Internet and internal networks, the need for copied e-mails to fan out to multiple recipients puts demands on the time that it takes to copy and update individual messages. Since it is difficult to predict e-mail workload at any point in time, the improved response time of the 15K can help to reduce the need to over-design e-mail systems for peak periods. As hardware consolidation accelerates and more end users access fewer systems, increased performance per system is mandatory. The 15K offers IT administrators a productivity enabler for peak activity periods.

**web or media**

World Wide Web applications demand significant network bandwidth and processing power. Redundancy and data propagation are commonplace. However, the Web also forces powerful back-end systems to concentrate and process a growing number of e-business transactions. In essence, the Web has all the requirements of a traditional database environment on the back end, with the inability to schedule when the peaks occur. Again, the 15K can help compensate for these unpredictable peaks

**Summary**

The need for speed is more significant than ever amid the applications of today's challenging IT industry. The huge investments in processing power and network bandwidth are testaments to that fact. HP balances the significant advances in computational power with storage systems that provide state-of-the-art performance. The 15K is a crucial component in optimizing customers' storage systems to provide that performance while utilizing the highest reliability components assured through rigorous testing procedures. The 15K is an evolutionary product that, in addition to new standards of command performance, provides all the existing benefits of the Universal Disk Drive family without compromise.

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5982-1719EN, 09/2003