

April 2001  
14ME-0301A-WWEN  
Prepared by:  
Industry Standard Server Group  
Compaq Computer Corporation

**Contents**

**Introduction**.....3  
**Features and Benefits**.....3  
**Performance and the Disk Drive** .....4  
    Disk Drive Performance .....4  
    Mechanics.....6  
**Applications**.....7  
    File and Print.....7  
    Database .....7  
    Email.....8  
    Web or Media.....8  
**Conclusion**.....8  
**Contact Us** .....9  
**Appendix A: Photographs and Descriptions** .....10  
    Universal Disk Drive.....10  
    Compaq 15K Universal Disk Drive .....10

## 15K: The Need for Speed

**Abstract:** The Compaq 15K Universal Hard Drive (15K UDD) provides the evolutionary performance necessary to complement Compaq's portfolio of high performance *AlphaServer*<sup>™</sup> and *ProLiant*<sup>™</sup> servers. In businesses where every second counts, these drives can dramatically improve response times. This paper details when, where, and why to deploy these drives.

## Notice

14ME-0301A-WWEN © 2001 Compaq Computer Corporation

Compaq, AlphaServer, ProLiant, Compaq Insight Manager, and the Compaq logo Registered in U.S. Patent and Trademark Office. Intel, Xeon, and Pentium are registered trademarks of Intel Corporation in the United States and other countries. All other product names mentioned herein may be trademarks and/or registered trademarks of their respective companies.

Compaq shall not be liable for technical or editorial errors or omissions contained herein. The information in this document is provided "as is" and is subject to change without notice. The warranties for Compaq products are set forth in the express limited warranty statements accompanying such products. Nothing herein should be construed as constituting an additional warranty.

## Introduction

As businesses push an ever-increasing amount of information onto intranets and the Internet, the need to improve the response times is critical. Customers do not like to wait. The obvious investment in network bandwidth and processor technology must be complemented by improvements in storage solutions.

Compaq is meeting the challenge of providing state of the art storage solutions with award winning products like the Smart Array family of intelligent controllers. Compaq has also provided innovation in the storage component of the solution, the disk drive itself, with the Universal Disk Drive product line. The Compaq 15K Universal Disk Drive (15K UDD) is the latest member of this product line.

The 15K UDD continues Compaq's commitment to affordable, state of the art storage components. The 15K UDD can be integrated into the current *AlphaServer*<sup>™</sup> and *ProLiant*<sup>™</sup> server product lines. The 15K UDD has the same form factor, power requirements, and cooling requirements as its predecessor, the 10K Universal Disk Drive (10K UDD), but with significantly faster access times.

The remainder of this document illustrates how the improvements inherent in the 15K UDD can benefit a variety of applications.

## Features and Benefits

The 15K UDD maintains the Compaq commitment to provide industry-leading products without compromise. Table 1 compares the 15K UDD with its predecessor the 10K UDD. While the physical and electrical characteristics are equivalent to the 10K UDD, the 15K UDD significantly improves two of the major contributors to response time—rotational latency and seek time. These two critical factors directly impact how well a disk drive can keep up with demanding workloads.

**Table 1. Universal Disk Drive Comparison**

	15K Universal Disk Drive	10K Universal Disk Drive
<b>Capacity (GB)</b>	9 or 18	9, 18 or 36
<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>	Wide Ultra3 SCSI	
<b>Reliability</b>	0.73% AFR	
<b>Seek Time (average)</b>	3.9 ms	5.5 ms
<b>Latency</b>	2.0 ms	2.99 ms

The Compaq Universal Disk Drive family also provides:

- **Reliability**—The 0.73 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 Compaq server supporting the Universal Disk Drive family.
- **Easy Data Migration**—When combined with the Compaq Smart Array family of products, data can be safely migrated using a planned deployment.

## Performance and the Disk Drive

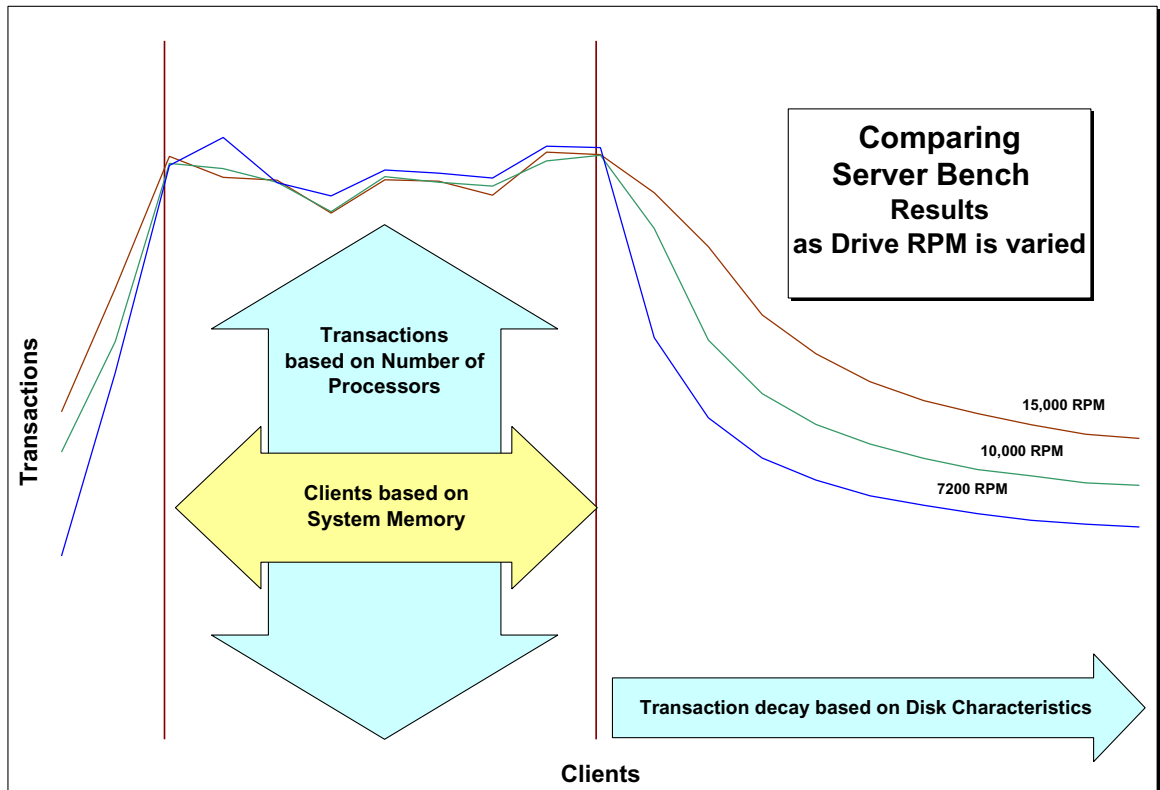
### Disk Drive Performance

When compared to processor and memory technology, disk drives are slow devices. Even the most advanced disk drives are orders of magnitude slower than their silicon counterparts. Unfortunately, the computer industry has been unable to find a more affordable or dependable method for saving and retrieving all of the information that those speedy processor and memory systems can generate. With that said, how can performance matter when discussing disk drive technology? The simple answer is that it does.

Performance matters because without fast access to large amounts of data, that state of the art, multiprocessor server in the data center is left waiting for the disk to spin and for the actuator to move before it finds the data it needs to satisfy the customer at the other end of the wire.

Systems designers compensate for some of the waiting by using memory, and lots of it, to cache as much of the data as possible close to the processor. The storage system controller itself maintains a cache to offset the normal delays caused by waiting on the slower disk drives. By using expensive techniques to fool the system into believing the data has been written, such as battery-backed write caches, the storage system controller can help keep the data flowing under reasonable loads. However, what happens when the demands on the system exceed the capabilities of the caching algorithms? The performance of the system drops to the level of its slowest component, the disk drive.

ServerBench is an industry standard benchmark provided by Ziff Davis Publishing Inc. It can be used to compare the capabilities of file servers in transaction-based environments. Typically, a system is optimized for the performance region of the curve to maintain reasonable response times. A good deployment strategy would follow these guidelines.



**Figure 1: Typical ServerBench results**

Figure 1 illustrates what happens in a transaction-based server when the caching algorithms break down and the processors are starved for data. Notice that the number of transactions that the system can handle under a heavy load is directly related to the performance capabilities of the disk drives.

## Mechanics

How does spinning a drive faster improve its performance? Figure 2 shows a 15K UDD with some annotations indicating how the spin rate can affect performance. In this example, the user would have to wait almost a full rotation of the disk before the data could be read. This measure of a disk drive's performance is referred to as its rotational latency. Typically, it is specified in times that are equivalent to one-half the time for a full rotation. On a 10K UDD the wait would be about 6 milliseconds, but on the 15K UDD the wait is reduced to 4 milliseconds, or a 30 percent reduction for a full rotation.

To understand the significance of the time reduction, an Intel Pentium III Xeon processor running at 1 GHz could complete 2 million additional machine cycles in that period without having to wait on the drive.

In addition to spinning the drive faster, the 15K UDD also dramatically improves the mechanical position of the disk actuator. The disk actuator is the moveable arm on the disk drive that must be positioned to read or write data.

Again, referring to Figure 2, the user in this example would also have to wait for the disk actuator to position itself from the inner diameter of the disk to the outer diameter. This positioning time is referred to as the seek time. It is typically measured as a weighted average since it is possible for the drive to minimize this time through sophisticated command reordering algorithms.

The 15K UDD trims 1.5 milliseconds off the seek time when compared against its 10K UDD predecessors. Fortunately, the rotational latency and seek times are not added together. While a drive is waiting for the disk to rotate into position, it can be simultaneously moving the actuator, so the rotational latency will typically be the gating factor.

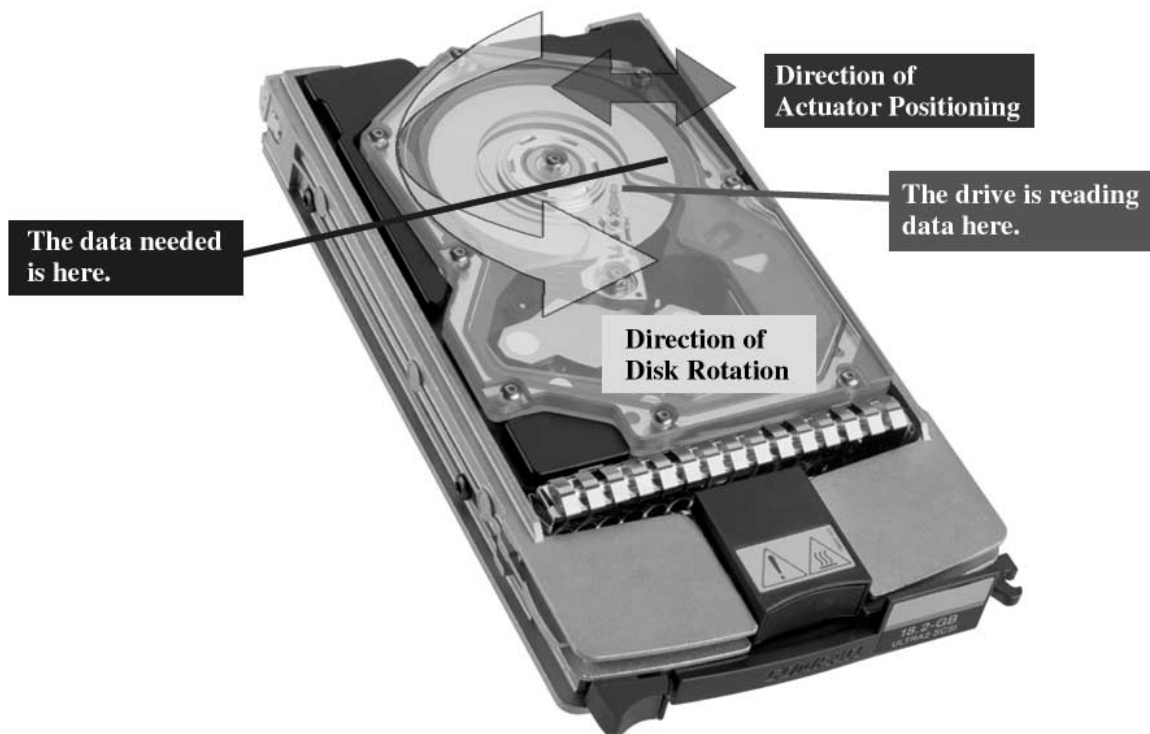


Figure 2: Disk mechanics example

## Applications

Most applications can benefit from using the 15K UDD. Four of the most common applications are:

- File and Print
- Database
- Email
- 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 15K UDD can help make the difference between supporting the load and needing to invest in additional processing power.

### File and Print

Figure 1 illustrates how file and print applications can benefit from the 15K UDD. The ServerBench results show that as more clients are added to a file server, its performance can be reduced to the speed of the slowest component, the disk drive.

Compaq supplies sophisticated management tools such as *Compaq Insight Manager*<sup>™</sup> to help when the client load has increased enough to affect file server performance. In some cases, it may be easier to use the Drive Activity Light on the Universal Disk Drive Carrier to determine whether the drive is a serious bottleneck. If the light is on constantly for any significant amount of time, especially during peak usage, then the system is probably waiting on the drive. Upgrading to a 15K UDD can help.

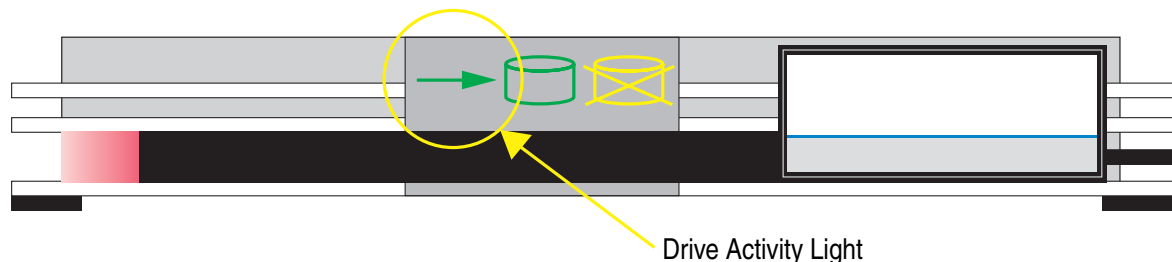


Figure 3: Universal Disk Drive carrier

### Database

The demands of database queries and transaction updates make the transfer of significant amounts of data in a very short period of time commonplace. To support the computation speeds, the functional storage structures of traditional database applications must be distributed among multiple drives and for optimum performance, lots of drives. To illustrate how the number of drives affects system performance and cost, consider a lesson relearned by the Compaq System Performance Team in preparing a new system for market.

The Transaction Processing Performance Council provides a standardized benchmark, called TPC-C, to grade the responsiveness of database solutions with transactions per second per dollar metric, referred to as tpmC and Price/tpmC.

The TPC-C brings together all of the components of a database solution and requires a significant investment in configuration and tuning. Since the total cost of the solution must be included as part of the TPC-C metric, a configuration that meets a transaction goal with the fewest number of components has an advantage. Because of the slow speed of disk drives, relative to the other components in the system, most enterprise solutions require large numbers of disk drives. The infrastructure to support those disks is a significant cost of the system.

The Compaq System Performance team was asked to use the 15K UDD as part of the TPC-C system configuration. They discovered that by moving from the 10K UDD to the 15K UDD, the transaction goal could be reached with a significant reduction in the number of drives and the associated infrastructure required to support those drives. This reduced the total cost of the solution, even though the cost of the 15K UDD is greater than its 10K UDD predecessor. The complete audited results of the 15K UDD based solution can be found on the Transaction Processing Performance Council website at:

[www.tpc.org](http://www.tpc.org)

## Email

Although email has time to proliferate through an intranet or the Internet, the potential for copied emails to fan-out to multiple receivers makes the time to copy and update individual messages challenging. Since it is difficult to predict email workload at any point in time, the improved response time of the 15K UDD can help to reduce the need to over-design email systems for peak periods.

## Web or Media

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

## Conclusion

In today's competitive business market, speed matters. The huge investments in processing power and network bandwidth are testaments to that fact. Compaq balances the significant advances in computational power with storage systems that provide state of the art performance. The 15K UDD is the latest member of that effort. It is an evolutionary product that provides all the benefits of the Universal Disk Drive family without compromise.



## Contact Us

For additional information about UDDs:

[www.compaq.com](http://www.compaq.com)

For additional information about 15K Universal Disk Drives:

[www.compaq.com](http://www.compaq.com)

**Table 2. Departments and Telephone Numbers for the United States and Canada**

Department	Telephone Numbers
Consumer Direct	1-800-888-0220
Compaq DirectPlus	1-800-888-5858 (U.S.)
Compaq Partner Direct	1-800-888-5874
Compaq Reseller Locator	1-800-345-1518 (Option 3)
Compaq Canadian Reseller Locator and Product Literature	1-800-567-1616
Diskette Fulfillment (backup diskettes for preinstalled software)	1-800-952-7689 (U.S.) 1-800-349-8498 (Canada)
Compaq Product Information	1-800-345-1518 (U.S.) 1-800-567-1616 (Canada)
Compaq Technical Support	1-800-OK-COMPAQ (U.S. and Canada) 1-800-652-6672

## Appendix A: Photographs and Descriptions

### Universal Disk Drive

Compaq Universal Disk Drives provide investment protection and simplification. With compatibility across many enterprise platforms, you are free to deploy and redeploy these drives to quickly deliver increased performance and storage capacity.



Figure 4: Universal Disk Drive

### Compaq 15K Universal Disk Drive

The new Compaq 15K UDD provides the highest performance device in the enterprise storage market. Compaq has added this hard drive to stay aligned with future drive technology demands.



Figure 5: Compaq 15K Universal Disk Drive