

SCSI Remains the I/O
Interface of Choice for Workstations:
An analysis comparing
SCSI and Ultra DMA

A White Paper Prepared by The SCSI Trade Association

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SCSI Parallel Interface Technology -
a path to the future!

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Summary

The new Ultra DMA claims to double drive performance, yet benchmark tests demonstrate a performance gain of less than five percent over older EIDE drives.

Introduction

Users performing data-intensive tasks such as CAD/CAM, desktop publishing, and digital media content creation continue to use high-performance workstations as their computing workhorses. These applications test the workstation's I/O power. Now SCSI, the traditional I/O powerhouse, is facing challenges from the recently released Ultra DMA interface standard. Yet, benchmark tests on Ultra DMA drives show limited performance improvements over previous generation ATA drives, while similar benchmark tests on Ultra SCSI drives reveal significant performance improvements over Ultra DMA. Further, the performance gap widens with the next generation Ultra2 SCSI drives.

Introduction To The Technical Aspects

Major innovations in parallel SCSI technology, built on a foundation of proven technology, promise to meet the needs of the marketplace both now and for the foreseeable future. This white paper describes the changes and how they will improve price-performance while protecting the customer's investment in hardware, software and training.

EIDE's Ultra DMA: Little More Than a Name Change

EIDE's latest-generation Ultra DMA hard disk drives claim to double the maximum interface burst transfer rate from 16.7 to 33 MByte/sec. However, empirical analysis reveals quite a different story. Under Windows NT®, Workstation 4.01¹, the best Ultra DMA hard drives are only 2.7% faster than the best of the previous-generation ATA DMA Mode 2 drives.

	Best Ultra DMA	Best ATA DMA Mode 2	Improvement
ThreadMark v2.0	5.71 MB/sec	5.56 MB/sec	2.7%
WinBench 97 v1.1 Business Disk WinMark	1,240 KB/sec	1,230 KB/sec	.81%
WinBench 97 v1.1 High-End Disk WinMark	3,440 KB/sec	3,400 KB/sec	1.18%

Chart 1: In three separate benchmark tests, the best Ultra DMA hard drives outperformed the best of the previous-generation ATA DMA Mode 2 drives by just 2.7%, 0.81%, and 1.18% respectively.

Why does ATA's doubling of the interface's maximum burst rate provide such limited performance gains?

ATA's One-Lane Highway

ATA remains a single-threaded I/O interface with the ability to execute only one I/O request at a time, which restricts total data throughput speeds. Further, the drives are the bottleneck, not allowing ATA to perform at its theoretical transfer rates. Therefore, doubling the maximum transfer rate to 33 MByte/sec buys little as the limitation still remains the drive.

Any Ultra DMA performance benefits do not come from improvements in the interface. Instead, performance improvements come from the improved data rate of the drives themselves.

SCSI's Multi-Lane Highway

SCSI is a multi-threaded I/O interface. It can process multiple I/O requests at a time. The SCSI bus remains free until a device has information – command, data, or status – to send on the bus, orchestrated by the SCSI host adapter. Devices with outstanding requests disconnect from the SCSI bus until they have information to send. The technology allows multiple devices to process requests simultaneously, an effective way to overlap the mechanical drive delays required to locate data. It is also an effective way to share the bus bandwidth among all connected devices. With SCSI, the throughput of all drives can be combined for data throughput of up to 80 MByte/sec.

But SCSI's multi-threading does not just provide benefits in multiple peripheral environments. SCSI's multi-threading also allows multiple requests to be processed simultaneously by one device in a single application automatically. This queuing of commands allows the drive to re-order the requests to minimize the total time required to service them. Command queuing can be especially valuable in workstations with a single hard disk drive.

Ultra DMA does not support overlapped seeks, bus bandwidth sharing, or command queuing because of its single-threaded nature.

SCSI's Hard Disk Drives are "Best of Class"

Not only is the SCSI interface with its multi-threaded capabilities an intelligent interface, SCSI drives also have the best performing mechanics behind the interface. SCSI drives spin up to 10,000 RPM.

	Best 10,000 RPM Wide Ultra SCSI	Best Ultra DMA	Improvement
ThreadMark 2.0	9.61 MB/sec	5.71 MB/sec	68.3%
WinBench 97 v1.1 Business Disk WinMark	1,920 KB/sec	1,240 KB/sec	54.84%
WinBench 97 v1.1 High-End Disk WinMark	5,180 KB/sec	3,440 KB/sec	50.58%

Chart 2: The best 10,000 RPM Wide Ultra SCSI hard drives outperformed the best Ultra DMA drives by a commanding 68.3%, 54.84%, and 50.58% respectively.

And the best 10,000 RPM SCSI drive is significantly faster than the best Ultra DMA drive. In absolute terms, a 10,000 RPM Wide Ultra SCSI Seagate Cheetah drive can sustain transfers at 9.61 MByte/sec.² SCSI drives spinning at up to 10,000 RPM have the most advanced mechanics, providing data fastest off the drive and across the bus.

While EIDE provides the minimum functionality and performance at the lowest cost to meet the I/O requirements of the non-demanding desktop PC user, SCSI is built for the performance I/O requirements of workstations, file servers, and sophisticated applications.

Ultra2 SCSI: Much More Than a Name Change

Ultra2 SCSI is the next generation of SCSI. It doubles the data burst rate of Ultra SCSI to 80 MByte/sec, providing greater system throughput. Also, it quadruples the maximum cable length of Ultra SCSI to 12 meters, allowing increased flexibility in adding external storage or configuring clustered servers. To date, only 7200 RPM Ultra2 drives are available and benchmarks show significant performance improvement over the best Ultra DMA drives³ — 10,000 RPM drives will be available soon (Q1 of 1998) and performance will only improve.

	Best 7,200 RPM Wide Ultra2 SCSI	Best Ultra DMA	Improvement
ThreadMark v2.0	8.78 MB/sec	5.71 MB/sec	53.77%
WinBench 97 v1.1 Business Disk WinMark	1,500 KB/sec	1,240 KB/sec	20.97%
WinBench 97 v1.1 High-End Disk WinMark	4,250 KB/sec	3,440 KB/sec	23.55%

Chart 3: The best 7,200 RPM Ultra2 SCSI outperformed the best Ultra DMA by an impressive 53.77%, 20.97%, and 23.55% respectively.

Conclusion

SCSI remains the interface of choice for workstations, but don't just take Adaptec's word. Intel and Microsoft®, in the *Workstation 98* specification recommend SCSI because "SCSI is a flexible I/O bus that supports good performance for access and throughput to meet a workstation's intensive data transfer needs."⁴

References

- 1 Windows NT Workstation 4.0 running on a 266 MHz Pentium II 440LX-based motherboard with 64 megabytes of RAM. The complete system configuration can be found at:
www.adaptec.com/technology/benchmark/UDMAconfig.html. Complete details of the results can be found at:
www.adaptec.com/technology/benchmark/UDMAresult.html
- 2 Measurements taken with the Adaptec AHA®-2940UW Wide Ultra SCSI host adapter in same system used for Ultra DMA measurements.
- 3 Measurements taken with the Adaptec AHA-2940U2W Wide Ultra2 SCSI host adapter in same system used for Ultra DMA measurements.
- 4 "PC 98 System Design Guide: A Technical Reference for Designing PCs and Peripherals for the Microsoft Windows® Family of Operating Systems", Version 1.0, September 5, 1997, Intel Corporation and Microsoft Corporation, Page 73.

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Additional Information

The SCSI Trade Association has a wide variety of documents and information on SCSI Parallel Interface Technology, including presentations, articles in periodicals, seminar material and white papers. Please contact Association offices at:

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