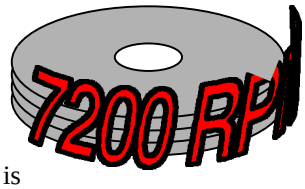
March 2, 1999

Benefits of 7200 RPM



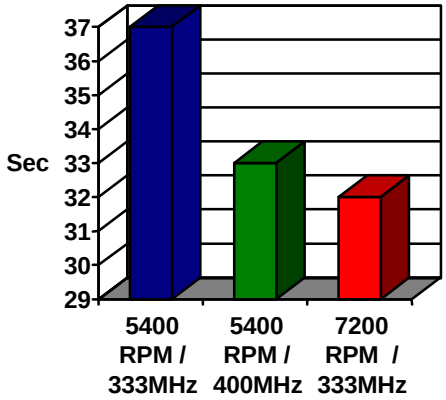
Introduction

Many computer buyers tend to consider only one metric when judging how their hard drive measures up: Capacity. This seems a little odd considering that virtually every other component in the system is characterized by the performance it delivers – the processor is known by its clock speed, the modem and CD ROM by their transfer rates, the motherboard by its bus rate. Even the SRAM, also known for its capacity, is thought of as a performance element: more SRAM implies better system throughput.

But the hard drive is just as critical an element in system speed. Any operation that involves moving large amounts of information on or off the disk will reveal the importance of a high-performance hard-drive. To a large extent, the hard drive influences how fast Windows or Mac OS boots, how quickly applications launch, and the speed of loading large data or graphics files.

The performance benefits of a faster hard drive are actually comparable to the benefits of a faster processor. In system-level testing at Maxtor, two upgrades to a 333MHz Pentium II system were compared. In one upgrade, the processor speed was increased to 400 MHz. In the other upgrade, the 10GB 5400 RPM drive was replaced with a 10GB 7200 RPM drive. Comparing system responsiveness in real-world applications, such as launching PowerPoint and loading a file, the 7200RPM-equipped system performed significantly better. If the speed of your system is important to you, the speed of your hard drive should be as well.

Time Required to Launch PowerPoint and Open 1MB File



In real-world applications, the speed of the hard drive has just as much impact on overall system performance as the processor. When comparing the benefit of a processor upgrade verses a 7200 RPM drive upgrade, the faster drive will often provide superior results… and at lower cost.

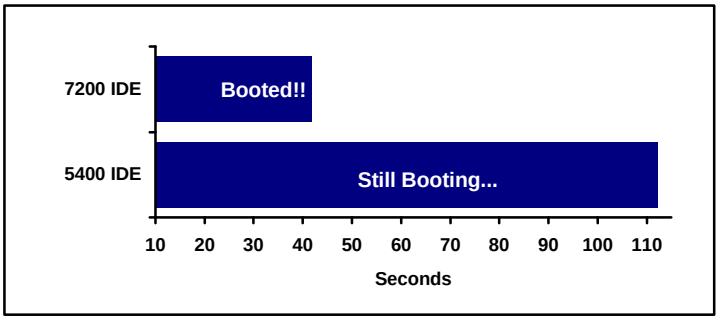
The Value of System Performance

It may seem obvious to say that system performance does matter. More speed, after all, translates to a more responsive system. This means less waiting time, and greater productivity. But there are other reasons to be concerned about performance, reasons which are evolving as system capabilities evolve.

Certainly one element is the increasing size and complexity of software: Windows 98 occupies over 2.5GB of disk space vs. 700 MB for Windows 97. Windows 2000 is expected to be significantly larger. As the operating system and associated applications packages grow, more speed is needed just to remain at a given system performance level. For system integrators concerned about Total Cost of Ownership, a higher performance system will ultimately pay dividends by enjoying a longer useful life.

In addition to larger OS and applications packages, we are seeing the overall demands on PC bandwidth increasing. More background

Time to Boot Windows 98

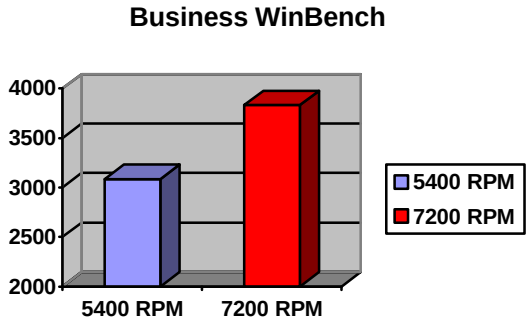


In booting Windows 98, the DiamondMax Plus 7200 RPM drive executes significantly faster than equivalent-capacity 5400 RPM drives.

operations including e-mail, virus protection, and entertainment are demanding more from the PC. Intel has proposed a model called "Constant Computing" wherein increasing the system bandwidth is a mechanism to boost the system's utility, increase reliability, and reduce the overall maintenance costs. As we go forward every part of the system will be called upon to improve throughput.

Measuring Performance

High-performance drives improve performance in several ways. The first is evident in the WinBench measurement, a popular means of evaluating system performance. In WinBench, a variety of popular applications are simulated and overall execution time measured. A weighting factor is applied to the execution time for each application package. Measurements have shown that 7200 RPM drives improve WinBench scores approximately 20% over equivalent capacity 5400 RPM drives[1]. Considering that WinBench is a measure of overall system throughput, as opposed to just drive throughput, this is an impressive result.



7200 RPM drives provide more than 20% performance enhancement in the system-level WinBench test.

WinBench is a good tool for arriving at a summary number, but that number is just that: a summary. In evaluating the WinBench result it's important to keep the actual *intended application* in mind. In particular, consider how a drive's basic performance elements will contribute to system performance in the application. These basic elements are seek time, rotational speed, channel rate, and caching capability.

These basic elements ultimately translate to two measures of drive performance: Random throughput and sequential throughput. Random throughput is the speed of processing a string of small transfer commands where the data locations are randomly distributed over the disk. Sequential throughput measures the time to process a string of commands where the requests are contiguous on the disk.

Random Throughput

Random throughput, especially important in database or server applications, is largely determined by seek time and rotational speed. In its roughest terms, random throughput, in operations per second, is the inverse of the "time to data". Time to data is the sum of seek time and rotational latency. 7200 RPM drives significantly improve time to data: a 7200 RPM drive has 25% less average rotational latency than a 5400 RPM drive. In server-class SCSI drives, where random throughput is required for server applications, users adopted 7200 RPM as the required spin speed about seven years ago. They found then, as desktop users are finding now, that spin speed plays a major role in system performance.

Intel's "Still Rendering" campaign highlighted the value of system performance, particularly in A/V and gaming applications.

Sequential Throughput

Sequential throughput, critical in graphics, video, and entertainment applications, is ultimately determined by the drive's internal data rate, or the rate at which the recording head transfers data to and from the disk. It is not possible to transfer data to the host, on a sustained basis, at a higher rate than it's being read from the disk. (Some people confuse the internal data rate with the interface data rate, or the maximum *burst transfer rate* between

[1] **System configuration:** 400 MHz, Pentium II, Phoenix BIOS ver. 4A4LL0X0.10A.0017.P06, 64 MB Ram
STB 128 Velocity AGP video, AL440BX Intel "Atlanta" PIIX4 Chipset, 16x CD ROM, Intel UDMA Drivers Loaded for UDMA Testing

the drive and the host.) While it is critical that the interface rate not be a throughput bottleneck, all Maxtor drives are designed with an interface rate sufficiently high that the interface will not limit throughput.

The factor that determines sustained throughput, the internal data rate, is indirectly determined by the drive's rotational rate. Simply stated, a faster-spinning drive will tend to read data from the disk faster. If two drives, one 5400 and one 7200 RPM have the same capacity and the same number of disks, the 7200 RPM drive will read the same amount of data in a shorter period. Files therefore load faster, the OS boots in less time, and the computer responds more quickly.

Additional Performance Boost

The drive's onboard cache provides a staging area for data. Since the interface data rate and the internal data rate are not the same, the cache acts as a speed-matching device. But it can also do a lot more and does have a significant effect on performance. The cache is used in two basic ways: First, the cache may be used to read-ahead data that the drive suspects the host will request next. If the guess is correct and the data can be read from cache, significant time is saved. Second, the cache may act as a staging area for data being written to the disk. Once the data is written to the cache, the host can move on to other tasks without waiting for the write to the disk to complete.

Beyond these basic cache operations there are significantly more subtleties, factors that ultimately determine how well the cache boosts performance. Cache size in itself is not a direct determinant of performance. Maxtor is a leader in caching technology, employing sophisticated algorithms similar to those found in high-end SCSI drives. But it is important to remember that caching, while it has a large impact on performance, can only improve on the drive's raw throughput. A good caching scheme will produce better results if the underlying mechanics have better performance.

The Performance Solution: DiamondMax Plus 5120

Maxtor's new DiamondMax Plus 5120 provides a unique combination of these performance elements.

- Highest data rate: DiamondMax Plus 5120 has the highest internal data rate of any desktop drive, either shipping or announced. Higher, even, than most SCSI drives shipping today. This allows the DiamondMax Plus 5120 to be a significant contributor to overall system performance.

- 7200 RPM Rotational Speed: With 7200 RPM rotational speed, DiamondMax Plus 5120 reduces rotational latency by 25% relative to 5400 RPM drives. This results in a substantial improvement in the drive's random throughput.

- Advanced Caching: With a highly advanced set of caching algorithms, DiamondMax Plus offers caching sophistication equivalent to many high-end SCSI drives.

As the new performance standard in desktop drives, DiamondMax Plus 5120 offers an easy and economical path to upgrading both the responsiveness and capacity of your system. Try one and you'll see: it's that fast!