



# An in-depth **look** at the **SCSI** *environment*

SCSI is best used in multitasking operating systems, such as Windows NT 4.0, UNIX and OS/2, in part, because of its outstanding ability to compartmentalize diverse operations. SCSI also enhances critical performance in situations where more than one disc drive is used, such as in a workstation/server or RAID environment. At higher capacity-points (4 Gbytes and higher), SCSI hard drives are typically available with faster seek times, lower latencies and much higher transfer rates than an equivalent-capacity ATA drive.

Mainstream SCSI drives today have spindle speeds of 7,200 RPM and capacities from 4.55 to 18.2 Gbytes. Seagate set a new 10,000-RPM standard with the introduction of the Cheetah drive family. With its combination of 10,000 RPM, fast sustained data rates, low seek times and the Ultra2 SCSI and Fibre Channel interfaces, Cheetah is the fastest drive available today. Seagate now offers SCSI drives with a 47-Gbyte capacity point, as well as value SCSI drives for desktop computers.

**I/O.** One of the performance bottlenecks for a system is the system's I/O speed. Ultra2 SCSI opens up the SCSI bus to a burst data rate of 80 Mbytes per second. Ultra2 also provides differential data integrity, bus cable lengths of 12 meters and the flexibility to connect up to 15 peripherals on the SCSI bus, all at the same cost as today's single-ended solution.

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Ultra2 SCSI is backward-compatible to previous versions of SCSI, taking advantage of today's multibillion-dollar installed SCSI base. For solutions that require the highest performance, Fibre Channel-Arbitrated Loop provides even more connectability, up to 126 devices, data rates as fast as 200 Mbytes per second and cable lengths up to 10,000 meters.

## What are the Key Features of SCSI and Drives Designed for the SCSI Interface?

Disconnect/reconnect, ASA II,  
Tagged command queuing, drive design

**Disconnect/reconnect** provides SCSI the ability to accept commands (or data) and release the bus until it is ready for the next phase. Data transfers can be *interleaved*, making the most efficient use of bus bandwidth. For example, in a two-drive system, the first drive accepts a command to read data and disconnects from the bus. The drive then positions the heads over the relevant sectors and reads them into the cache buffer. Because the first drive has dropped off the bus, the system is free to request data from the second drive, which in turn drops off the bus after it receives a command. After the first drive is ready to transfer the data, it can reconnect to the bus as soon as it's free. It then disconnects after the transfer, leaving the bus free for the second drive to use as soon as it's ready.



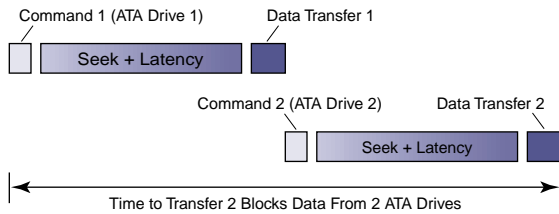
Seagate's exclusive second-generation ASA II technology streamlines the internal architecture of the disc drive, dramatically increasing drive performance for high-end environments, such as RAID, technical workstations, digital A/V and LAN/WAN. Fully compatible with all industry-standard SCSI implementations and common across all Seagate Hawk™, Barracuda™, Cheetah™ and Elite® families, ASA II facilitates easy product and cross-platform migration.

**Tagged command queuing** provides significant performance improvements in a multitasking or multiprocessing environment. Tagged command queuing provides the capability to reorder up to 64 SCSI commands to improve I/O efficiency. Disc drive read or write commands are reordered to reduce the number of seeks, the length of the seek and the latency required to position the data under the read/write heads.

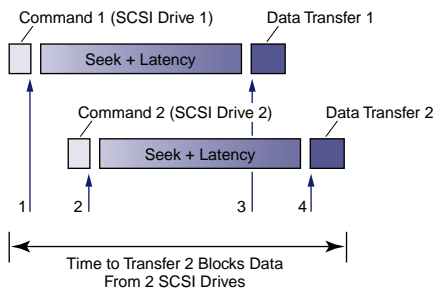
**Rotational-position seek/sort** allows the disc drive to accept multiple commands for data transfers, which can then be reordered into the most efficient sequence, taking into account the physical location of the data on the disc media. The more sophisticated SCSI drives provide command reordering based on rotational position and radial position. This SCSI feature, coupled with Seagate's tagged command queuing, provides dramatic improvements in disc I/O performance in applications such as servers, disc arrays, professional A/V and data mining.

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### Single-Threaded Operations (ATA Disc Drive)



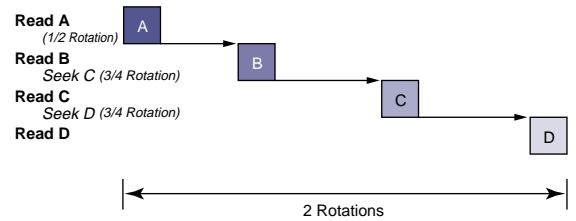
### Multithreaded Operations (SCSI Disc Drive)



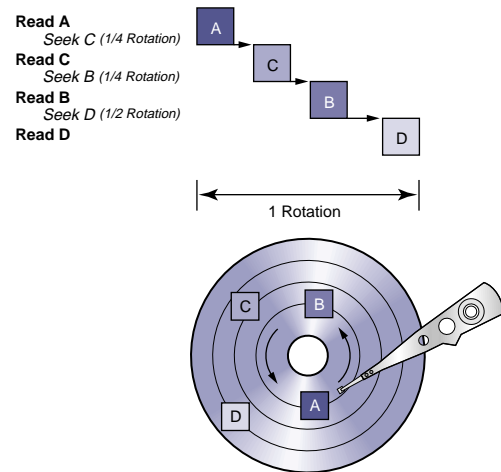
**Figure 1.**

Figure 1 illustrates the difference between the type of single-threaded operations (ATA) and multithreaded operations (SCSI) that the two interfaces support. This is a very simplistic representation and shows only two read commands being sent to two drives. As the next feature shows, it is possible to send multiple commands to a number of devices (Seagate SCSI drives support up to 64 commands at one time). These commands are then executed in the most efficient way possible.

### Without Command Reordering



### With Command Reordering



**Figure 2.**

In Figure 2, if the drive were simply to accept and execute the commands in the sequence received, it would take two revolutions of the disc to access and transfer the data. Using the rotational-position seek/sort feature allows the drive to “look” at all the commands received from the host and to decide in which order to execute them to provide the shortest time for the overall sequence.

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## Drives Designed for SCSI

The SCSI interface is used on systems designed for high performance in a multiuser, multitasking and multiprocessor environment. Each component of these systems is design-optimized for speed and reliability. In environments such as this, the I/O and its components are very important to overall system performance. Disc drives designed for the SCSI environment have the highest performance and reliability specifications available. Disc drive performance features to look for when selecting a SCSI drive are seek time, sustained data rate and rotational speed. Reliability features such as MTBF, shock and vibration specifications and drive error rates are very important when your environment requires maximum data availability. Today's high-performance SCSI drives, such as Seagate's Barracuda or Cheetah families, have seek times as low as 7 msec, sustained data rates greater than 20 Mbytes per second and rotational latency as low as 2.99 msec. These drives also incorporate SCSI performance enhancements such as ASA II, rotational-position seek/sort, write-back cache and dual micro-processors. Reliability specifications for SCSI drives are typically 1,000,000 hours. Seagate's high-volume manufacturing and test process, coupled with mature design and development, provide high-performance SCSI drives with industry-leading, built-in reliability.

## How Does SCSI Help When Running Concurrent Applications?

### Running concurrent applications

The following actions can stress the I/O bandwidth of a system:

- Loading graphic files, video files or photo images
- Spooling large print files
- Cutting and pasting between documents
- Using the latest multimedia bells and whistles
- Copying data between a CD, disc or tape
- Playing audio CDs

Windows NT 4.0 and SCSI improve throughput by allowing the hardware to run tasks in parallel and in the most efficient manner possible.

If moving large amounts of data at the fastest possible speed is important, then SCSI can help. If achieving the highest possible transactions per second is critical, then SCSI can help.

## What Is the Future of the SCSI Interface?

A revolution is occurring in the way the computing world demands data. Dramatic improvements in system I/O architecture provide today's systems and applications with rapid access to vast data files. The parallel SCSI interface evolved from a bus data rate capability of 3 Mbytes per second to the backward-compatible

Ultra2 specification of 80 Mbytes per second. Ultra2 SCSI also provides the capability of connecting 15 SCSI devices on a single bus with cable lengths of 12 meters. The latest serial SCSI interface, Fibre Channel-Arbitrated Loop, provides system level bus data rates of 200 Mbytes per second. For applications that require maximum connectability and cable length, Fibre Channel allows 126 devices and cable lengths of 10,000 meters.

Today's SCSI interface gives system designers a choice of high-performance solutions to fit their cost and performance requirements. With the release of the newest Barracuda, Cheetah and Elite drives, Seagate maintains its leadership in state-of-the-art SCSI I/O solutions. Ultra2 SCSI Low Voltage Differential (LVD) provides the I/O bandwidth, design flexibility and data integrity for high-performance mainstream workstation, server and array applications. Fibre Channel-Arbitrated Loop provides the device connectability and superior bus data rates required for leading-edge applications such as Storage Area Networking, data mining and data warehousing.

The single-connector attachment II (SCA II) is another new feature available when using the SCSI interface. SCA II provides a single-point connection for all disc drive power, I/O and configurations. The SCA II 80-pin connection is used for many new multidrive parallel SCSI designs, and all Fibre Channel drives use the 40-pin version of the same connector. The single-connector attachment makes hot drive insertions and removals (hot plugging) practical with minimum impact on the devices or the operating system.

Overall drive performance doubles about every three years. The system I/O architecture must maintain corresponding performance increases to avoid performance bottlenecks. New designs are in place to ensure that both parallel and serial SCSI will have the performance/ cost features to ensure growth well into the 21st century.

## How Do Seagate Drives Benefit RAID Performance?

RAID systems require various interfaces and connectivity solutions. Seagate constantly refines its technologies specifically for RAID applications. Moreover, Seagate is one of the pioneers in the development of the single-connector attachment (SCA), easing drive integration and maintenance for arrays and servers.

Seagate's latest Barracuda, Cheetah and Elite drives have a built-in hardware XOR function. This hardware capability dramatically increases performance in a RAID application.

Seagate's leadership position within the RAID Advisory Board (RAB) is helping to define characteristics of disc drives for RAID systems.