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Adaptec® **Ultra320 SCSI and RAID** for data-hungry server applications

Introduction

Ultra320 SCSI is the next step in the evolution of the parallel SCSI protocol designed to address the continuing growth in the demand placed on storage connectivity bandwidth. It doubles the bandwidth of its predecessor – Ultra160 SCSI at 160 MByte/sec – to 320 MByte/sec by doubling the clock frequency from 40 MHz to 80 MHz while transferring data over a 16-bit bus on both the rising and falling edges of the clock. Furthermore, Ultra320 SCSI enhances the efficiency of information flow by incorporating the *"Packetized SCSI"* protocol. This protocol consolidates the *command*, *data*, *status* and *message* phases of non-Packetized SCSI into two data phases – one for each direction – whose contents are transmitted at data rate speeds, and decouples device selection/reselection from the subsequent phases of non-Packetized SCSI. This reduces data transfer overhead by permitting multiple commands, status and associated data to be merged and transferred between an initiator and a target device in two bursts – one with commands and data for write operations from the initiator to the target, and the other in the reverse direction containing statuses and data derived from read operations.

This enhanced bandwidth and transfer efficiency of Ultra320 SCSI ostensibly offers client applications the potential for increased throughput and improved performance. However, to truly comprehend the benefits of Ultra320 SCSI to various applications, let us inspect the broad spaces in which applications reside.

The Application Spaces

Applications may be partitioned into two non-intersecting spaces – those generating random I/Os such as database, file, web and mail servers, and those generating sequential I/Os such as audio and video servers. Let us now take a closer look at the factors that govern the performance of applications in these two spaces and Ultra320 SCSI's ramifications.

Applications Generating Random I/Os

Consider an application generating random I/Os with a mean size of 16 KByte. The fastest 15K rpm SCSI drives require over three milliseconds on average to seek the appropriate target address for an I/O. On the other hand, the time to read or write a 16 KByte block of data is well under half a millisecond assuming a conservative average formatted transfer rate of 40 MByte/sec for the drives. Clearly, the throughput of the drives are compromised under the circumstances by the disproportionate amount of time consumed in seeking appropriate addresses on the disks as opposed to reading from or writing to them. In addition, since the I/Os are small and random, I/O coalescing cannot be utilized and the throughput therefore limited to the finite number of I/Os that can be processed and churned out individually by the controller's CPU. Therefore, the bandwidth of the SCSI bus is not a significant factor affecting the throughput of such applications.

Applications Generating Sequential I/Os

In contrast, sequential I/Os are large in size – 64 KByte or greater – and permit the controller to use techniques such as I/O coalescing (and read-ahead when applicable) to saturate the SCSI bus. Furthermore, since sequential I/Os typically do not induce drive head transitions to seek random addresses on the disk (other than transitions to contiguous tracks and/or cylinders), individual drives spend most of their time reading or writing to the disk. In fact drives generally provide throughputs equal to their average formatted transfer rate in response to sequential I/O streams. Thus, assuming an average formatted transfer rate of 40 MByte/sec for a drive, at most four drives can be theoretically supported on an Ultra160 SCSI bus when serving applications generating sequential I/Os. Clearly, the bandwidth of the SCSI bus is a prominent factor that affects the throughput of applications in the sequential I/O space such as audio and video servers.

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The Benefits of Ultra320 SCSI

The most significant impact of Ultra320 SCSI is on applications in the sequential I/O space. Note that, initial offerings of Ultra320 SCSI drives are identical to their Ultra160 SCSI predecessors in every respect other than their external interface (which is Ultra320). Consequently, their formatted internal transfer rate – which is the gating factor in a drives sustained throughput capability – is identical to their Ultra160 SCSI counterparts. Thus, applications in the sequential I/O space using Ultra320 SCSI backends can theoretically expect to harness up to twice the number of drives to utilize the additional bandwidth offered by Ultra320 compared to Ultra160. In practice the number may be tempered by the bandwidth of the internal PCI bus when using multi-channel controllers since PCI's bandwidth of 528 MByte/sec (decimal) would be a little below the cumulative bandwidth of multiple Ultra320 SCSI channels on a controller.

What about Ultra320's impact on the random I/O space? Though mechanical drive metrics consume a disproportionate amount of time compared to the actual task of reading data from or writing data to the physical medium, Ultra320 increases the rate at which that data that can be funneled back to the host. This translates to small reduction in the overall time required to complete requests. Hence, this should improve the throughput of applications in the random I/O space as well, albeit very modestly compared to the sequential I/O space.

The Adaptec Advantage

Adaptec has been synonymous with SCSI products that are globally recognized for their reliability, performance, innovation and support, and Adaptec is extending this record of excellence to the latest SCSI generation – Ultra320 SCSI. Toward that end, for the first time in SCSI's 20-year history, Adaptec is offering integrated RAID capabilities with its entire family of Ultra320 SCSI controllers, recognizing that data – and ability to protect it – is the heartbeat of many businesses. Using the controllers, IT managers now can protect all their workstation and server data.

Adaptec is the only company to offer an Ultra320 SCSI controller family featuring integrated RAID striping, mirroring and hot spare support to bolster data protection and maximize system performance and uptime. In addition, with the integrated RAID feature – called HostRAID™ – only Adaptec's Ultra320 SCSI controllers support four hard disk drives and two arrays per channel, providing the most integrated RAID storage capacity.

Adaptec's Ultra320 products also include a family of low-profile Ultra320 SCSI RAID cards: a one- and two-channel RAID controller and two zero-channel RAID cards. The form factor of Adaptec's Ultra320 SCSI RAID cards makes them ideal for high-density storage environments, while their advanced RAID features allow system integrators to maximize system uptime.

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