



IBM Netfinity Server Ultra2 SCSI Directions

Bringing proven leadership in high availability and performance to industry-standard, business-critical solutions

Executive Summary

The Small Computer System Interface (SCSI) is the most popular interface for attaching high-performance disk drives to network server systems. SCSI became an American National Standards Institute (ANSI) standard in 1986 and since then has evolved continuously. The data path has increased from 8 to 16 bits (Wide SCSI), and data transfer speeds have increased from 5 to 40 MBps (Ultra SCSI). The next generation of SCSI will further increase the transfer speed to 80 MBps. The maximum cable length of standard SCSI has been reduced from 6 m (20 ft) to 3 m (10 ft) and then further reduced to 1.5 m (5 ft) as data transfer speeds have increased with the announcement of Fast SCSI and Ultra SCSI. Ultra2 SCSI, sometimes called low-voltage differential SCSI (LVDS), is the next generation in SCSI technology; it will allow the maximum cable length to increase to up to 12 m (40 ft), which will enable inter-rack connections, thereby overcoming the current limitations of intra-rack solutions. Over time, Ultra2 SCSI hardware will become available that will allow data transfer rates to increase from 40 to 80 MBps, although system-level performance improvements will be minor for typical file/print and database server applications. Greater distance and flexibility will be the major benefits. Ultra2 technology will be compatible with existing SCSI devices to allow older, non-Ultra2-capable controllers to be used with newer, Ultra2-capable devices and vice versa. This will foster a smooth and rapid transition to Ultra2 technology.

Ultra2 SCSI technology supports increased performance, scalability and distance for attaching storage subsystems to network servers. IBM's Ultra2 SCSI products will provide this technology and the benefits it offers to businesses requiring enterprise server solutions.

IBM is adapting decades of experience of large- and midrange-system leadership experience to its product line of SCSI RAID controllers, adapters, hard-disk drives and external storage enclosures to provide complete application solutions for today's industry-standard server marketplace. IBM intends to begin making these products available in the second half of 1998. Looking to 1999 and beyond, IBM will continue to enhance the Netfinity server product line, focusing on all aspects of computing to further improve performance and help you reduce the cost of ownership.

This paper offers a brief tutorial on Ultra2 SCSI technology and discusses the current directions for IBM Netfinity Ultra2 SCSI products. Because of the dynamic nature of the computer industry, changes may occur in IBM's actual implementations and timing of product announcements.

What is Ultra2 SCSI?

Ultra2 SCSI, also known as low-voltage differential SCSI (LVDS), is the next-generation parallel SCSI interface, and IBM Netfinity products will once again play a leadership role in offering a new technology and its benefits to our customers. Beginning as an ANSI standard intended as an I/O device attachment interface for microcomputers, SCSI has evolved to support today's faster, more complex peripherals and their demands for ever-increasing flexibility, distance and bandwidth. Today SCSI encompasses not only magnetic disk drives but magnetic tape drives, optical disk drives, processors, communications devices, disk array subsystems and other devices. It is used in systems of all sizes, from small systems up to and beyond high-end UNIX systems.

The SCSI standard has also evolved to use more intelligent hardware and a more sophisticated command protocol. Since SCSI became a standard in 1986, the data path width has increased from 8 to 16 bits, and the data transfer speed has increased from 5 MBps to a maximum of 40 MBps. Ultra2 SCSI technology also increases cable distances to 12 m (40 ft). Initially Ultra2 SCSI technology will support transfer speeds of 40 MBps. Over time, speeds will increase to 80 MBps, although system-level performance improvements will be small, because SCSI bus data transfer rates typically do not limit a system's performance.

SCSI became popular for many reasons, among which are those listed here:

- New types of peripheral devices can be added to a system without hardware changes; only a new I/O device driver is needed.
- SCSI satisfies the high-performance requirements of medium and large systems.
- Intelligence can be moved from the host to a peripheral device, thereby off-loading the system's or controller's processor.
- SCSI's ability to logically disconnect and reconnect devices from the bus means that slow operations can be performed offline, thus allowing several operations in a system to run concurrently.
- The parallel SCSI interface enables systems to perform at a higher potential because the I/O bus is not the system bottleneck.
- SCSI and the enhanced versions that have followed it have all offered backward compatibility, thus protecting existing investment in both hardware and software.

SCSI originally offered two electrical interfaces: "single-ended" for devices up to 6 m (20 ft) apart, and "differential" for devices up to 25 m (82 ft) apart. Differential provides better protection against noise from an adjacent circuit, and thus much-improved signal quality, than does single-ended SCSI. However, the increased power required for differential drivers means that they cannot be built into a single CMOS SCSI controller chip. Therefore, differential is significantly more expensive and requires more circuit board space and power than does single-ended SCSI. As the speed of the SCSI bus has increased with the adoption of Fast and Ultra SCSI technology, the cable lengths of the bus have steadily decreased to 1.5 m (5 ft), which has created a significant problem when trying to connect large numbers of devices to a SCSI bus.

Leadership in Ultra2 SCSI technology

Ultra2 SCSI has been developed to solve these problems. Because it uses low-voltage differential signals, it increases the maximum cable length to 12 m (40 ft), which is eight times the length allowed by single-ended Ultra SCSI. Low-voltage differential circuits consume much less power than conventional differential SCSI drivers, which allows the circuits to be built into standard CMOS SCSI controller chips.

Ultra2 SCSI technology also offers greater flexibility in peripheral configuration and the ability of current SCSI users to upgrade their systems easily.

What Are the Advantages of Ultra2 SCSI?

Ultra2 SCSI is a low-voltage interface that takes advantage of the benefits of differential signaling. The high signal quality provided by Ultra2 SCSI will support the reliable, sustained data transfer rate required by storage subsystems attached to network servers. As a low-voltage interface, it will enable bus drivers to be built inside controller chips, thus making its cost closer to that for single-ended SCSI.

Integration of low-power drivers in the standard CMOS SCSI chip will reduce the power dissipated by the chip, lower the amplitude of noise reflections and provide higher transmission rates.

IBM Netfinity's leadership implementation of Ultra2 SCSI technology will provide an easy migration path from Ultra/Wide SCSI. The backward compatibility with legacy SCSI buses will extend the life of existing SCSI designs and peripherals, thus protecting current SCSI hardware and software investments. Reduced integration and support costs will follow because it will not be necessary to adopt an entirely new I/O interface.

The enhancements of Ultra2 SCSI will support both intra- and inter-rack connectivity between a CPU, an Ultra2 SCSI RAID adapter, an external storage enclosure supporting Ultra2 SCSI, and Ultra2 SCSI hard-disk drives.

Customers running applications that manipulate large amounts of data, such as Lotus Notes or data-mining applications, may see modest system-level performance improvements due to the 80-Mbps data transfer rate capability of Ultra2 SCSI technology.

Because Ultra2 SCSI is based on the single-ended SCSI bus, it supports both single-ended traditional SCSI devices and newer, Ultra2 SCSI devices. When both are attached, a signal in the bus called Differential Sense (DiffSens) automatically detects the presence of a single-ended device and switches all devices in the system to single-ended. This means that all devices run at a maximum speed of 40 MBps with the same cable length limitations as supported by non-Ultra2 SCSI products, but it also means that systems continue to operate, as long as the cable length restrictions have been followed, instead of failing because of mismatched transmission speeds.

And, combining Ultra2 SCSI technology with Netfinity systems can increase the performance and scalability of Netfinity-based server solutions. See the following table for examples of the increased speed and distance that Ultra2 SCSI offers in comparison with older SCSI interface technologies.

Ultra2 SCSI compared with other SCSI interface technologies:

	SCSI	Fast/Wide SCSI	Ultra/Wide SCSI	Ultra2 SCSI (LVDS)
Distance	Up to 6 m (20 ft)	Up to 3 m (10 ft)	Up to 1.5 m (5 ft)	Up to 12 m (40 ft)
Speed (data transfer rate)	5 MBps	20 MBps	40 MBps	80 MBps
Host systems per connection	1-8	1-8	1-8	1-8
Devices per connection	7	15	15	15

The advantages of Netfinity Ultra2 SCSI include distance, performance, availability and scalability.

- **Distance and Performance.** Ultra2 SCSI increases the length of cables supported in Ultra/Wide SCSI from 1.5 m (5 ft) to 12 m (40 ft). This means that you are no longer limited to connections within a rack; instead, you have inter-rack connectivity between, for example, several disk enclosures and two servers in a cluster configuration. And Ultra2 SCSI can also transfer data at twice the speed of Ultra/Wide SCSI: at 80 MBps instead of 40 MBps, although 40 MBps does not typically limit system-level performance.
- **Availability.** Systems that require the high performance and reliability of SCSI need the quickest recovery from application or operating system failure. IBM's Netfinity Ultra2 SCSI products, combined with the appropriate software, will offer redundant power supplies, fans and failover recovery capability in clustered environments. A graphical user interface makes installation, configuration and management easy. Maintenance and upgrades can be performed without interruption of business-critical operations.
- **Scalability.** As businesses grow and become more complex, so do systems. The flexibility and scalability of Ultra2 SCSI technology enable you to manage this increased complexity and expand your current system while protecting your base investment. A data transmission rate of 80 MBps will provide no measurable benefit for most typical file/print or database server applications, but will be helpful in cases where large blocks of data are moved to and from disks frequently, such as some image and Web servers and data-mining servers.

IBM Netfinity Server Ultra2 SCSI Strategy

Today's networked business solutions must be able to grow horizontally through scalable I/O devices. Today, IBM's Netfinity I/O subsystem strategy and products support this growth requirement. Some of the IBM products currently supporting horizontal growth are the ServeRAID II Ultra SCSI adapter, SSA adapters, the EXP10 external SCSI expansion enclosure and hard-disk drives.

IBM's Netfinity servers support scalable I/O using intelligent I/O processors in ServeRAID II and SSA adapters. In addition, with the EXP10 external storage enclosure, a single rack can accommodate up to 2.5 terabytes of data using 18.2-gigabyte hard files.¹

But tomorrow's computing environments will demand more than this, and IBM's Ultra2 SCSI strategy is to provide highly flexible, leadership products that meet these increasing demands. IBM's Ultra2 SCSI technology being developed today is expected to allow the introduction of Ultra2 SCSI-compatible products in the second half of 1998.

Initially, IBM intends to make Ultra2 SCSI-compatible adapters and external disk expansion enclosures available that will allow use of standard Ultra SCSI disk drives. These products will provide transmission at 40 MBps over 12 m (40 ft). Increased distance, rather than increased speed, is the greatest benefit while allowing the use of widely available Ultra SCSI disk drives. The speed of the interface is not generally a bottleneck in most file, print and database applications, but there has always been a need to increase the distance between devices. A cable length of 12 m (40 ft) will end the intra-rack limitations of today's SCSI and enable inter-rack connectivity in the future.

In offering these products, IBM will continue to provide technology leadership with investment protection and a smooth, cost-effective transition to Netfinity-based solutions for business-critical applications.

"With their Netfinity product, IBM is leveraging the new Ultra2 LVD capabilities of the SCSI standards to enable their customers to take advantage of increased I/O performance and scalability inherent in SCSI products," said Harry Mason, Chairman of the SCSI Trade Association (STA) and director of host marketing with Symbios, Inc. "As a market leader, IBM's adoption of Ultra2 underscores the value of SCSI to support increasingly demanding applications in workstation and server environments," Mason added.

¹ A terabyte is 1000 million bytes, when referring to hard-disk capacity. Actual capacity may vary.

Conclusion

Ultra2 SCSI is an emerging, powerful technology for businesses that need available, reliable, high-speed storage interconnected over longer distances than are currently possible. It is the next generation of SCSI and will benefit customers by allowing cable lengths of up to 12 m (40 ft) and supporting flexible, inter-rack versus intra-rack storage solutions. Initially, it will support data transfer rates of 40 MBps; over time, rates will increase to 80 MBps, although the actual system-level performance gain will be small for most typical servers because data transfer rates do not normally limit performance.

IBM will once again play a leadership role in storage technology by implementing Ultra2 SCSI across its line of storage expansion enclosures, RAID adapters and hard-disk drives. IBM's strategy for implementing this technology has received the endorsement of prominent leaders within the industry as a whole. IBM's strategy is to protect customer investments in today's SCSI while allowing them to gradually adopt this new, backward-compatible technology and realize its benefits over time. Furthermore, by delivering Ultra2 SCSI software and hardware products in 1998, IBM will continue to be the vendor you can rely on to offer a complete range of solutions for your business-critical needs.

IBM's heritage with campus and enterprise computing, our leadership role in the development and implementation of new technologies and industry standards, and IBM Netfinity products give you the confidence to run your business-critical systems today and in the future. And with our worldwide service and support, we'll help you keep your business up and running to meet your requirements 7 days a week, 24 hours a day, 365 days a year.

Additional Information

For more information on IBM Netfinity directions, products and services, refer to the following white papers, available from our Web site at www.pc.ibm.com/us/netfinity.

IBM Netfinity Technology Directions

IBM Netfinity 8-Way SMP Directions

IBM Netfinity Cluster Directions

IBM Netfinity Fibre Channel Directions

System Management for Servers

At Your Service...Differentiation beyond technology

Leadership in Ultra2 SCSI technology



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