Ultra 160 SCSI

The SCSI technology continues to evolve and its evolution is successfully meeting the increasing demand for I/O bandwidth. The SCSI interface has the stability, ease of connectivity; large installed base and a 15-year heritage offering full backward compatibility. The new implementation of SCSI, Ultra 160 SCSI, boosts performance, reliability, and manageability even more.

Ultra160 SCSI doubles transfer rates from 80 to 160 Megabytes per second, improves manageability by automatically testing the interface's performance level and increases reliability by adding Cyclical Redundancy Checks (CRC). When Ultra 160 SCSI is used with low-voltage differential (LVD) signaling, cable lengths of 12 meters are maintained providing full backward compatibility.

The SCSI Evolution

SCSI data rates have increased over time, doubling about every five years.

SCSI Terms	Bus Speed (MBps)	Bus Width (Bits)	Maximum Bus length (M)			Max. Dev. Support
			SE	Diff	LVD	
SCSI	5	8	6	25	-	8
Fast SCSI	10	8	3	25	-	8
FW SCSI	20	16	3	25	-	16
Ultra SCSI	20	8	1.5	25	-	8
Ultra SCSI	20	8	3	25	-	4
UW SCSI	40	16	-	25	-	16
UW SCSI	40	16	1.5	-	-	8
UW SCSI	40	16	3	-	-	4
Ultra-2 SCSI	40	8	-	-	12	8
WU-2 SCSI	80	16	-	-	12	16
WU-3 SCSI	160	16	-	-	12	16

What is Ultra160 SCSI?

The ANSI standards T10 committee is revising the SCSI Parallel Interface (SPI-3). This document is the basis of the Ultra160 SCSI technology. Evolutionary changes have been made to the existing SCSI protocol (SPI-2) to increase performance, manageability, and reliability. All changes are incremental, and existing SCSI protocols are maintained for backward compatibility. Three new underlying components of Ultra160 SCSI are,

- Double Transition Clocking
- Cyclical Redundancy Checks (CRC) and
- Domain Validation.

What technology Enables Ultra160 SCSI?

Ultra160 SCSI doubles transfer rates to 160 Megabytes per second by using both edges of the request/acknowledge signal to clock data. This creative solution provides designers with the choice of improving speed, reliability or connectivity. It allows system designers to choose bus bandwidths up to 160 MB per second using existing Ultra2 SCSI cable plants. Alternatively, this technology lets designers maintain Ultra2 SCSI speeds (80 MB/second) and improve reliability by lowering clock speed, allowing more margin for ASICs and cables. Other Ultra160 SCSI improvements include automatic tests of the interface's performance level for increased manageability and the addition of CRC for reliable data transmission. When Ultra160 SCSI is used with LVD signaling, cable lengths of 12 meters are maintained providing full backward compatibility.

- **Double Transition Clocking (DT Clocking)**

Double transition clocking changes the digital protocol to use both edges of the SCSI request/acknowledge signal to clock data. Data transfer rates can be doubled simply by increasing the speed of only the data lines. For example, request/acknowledge signal on Ultra2 SCSI runs at 80 MHz, while data runs at only 40 MHz, or 80 MB/second on a 16-bit wide bus. By using both edges of the same 80 MHz request/acknowledge signal, the data rate can be increased to 80 MHz, or 160 MB/second on a 16-bit wide bus.

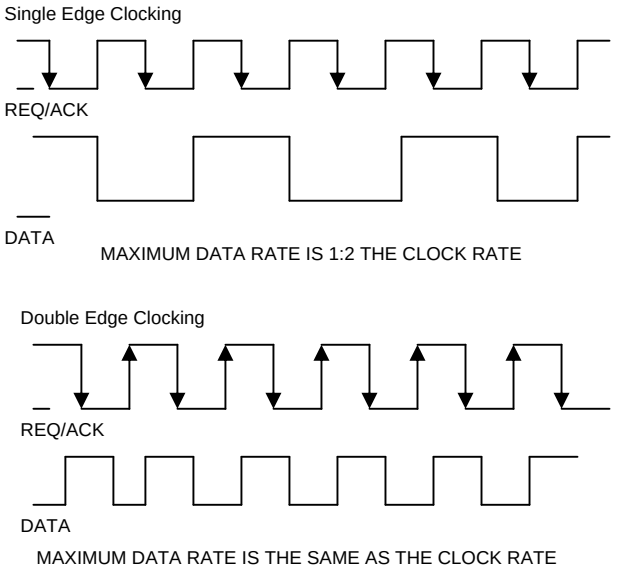

Figure 1. Double Edge Clocking – Increasing Speed

Speed Advantage with DT Clocking

Double Transition Clocking doubles the Ultra2 SCSI data transfer rates from 80 MB/second to 160 MB/second. Interface bandwidth is an essential ingredient for Windows NT and UNIX workstations, video and web servers, and storage area networks (SANs).

Reliability Advantage with DT Clocking

For a given transfer rate Double Transition Clocking keeps the maximum clock rate at half the rate of single edge clocking *(see Fig2)*. This provides more timing margin for ASICs, cables, and motherboard traces, high capacitance devices, extra connectors, etc. Longer pulses reduce the likelihood of problems by increasing timing margins and tolerance to noise. Double Transition Clocking reduces the maximum frequency of the clock lines (REQ/ACK) without slowing the data rate. Slower clocks should also reduce EMI issues for system designers.

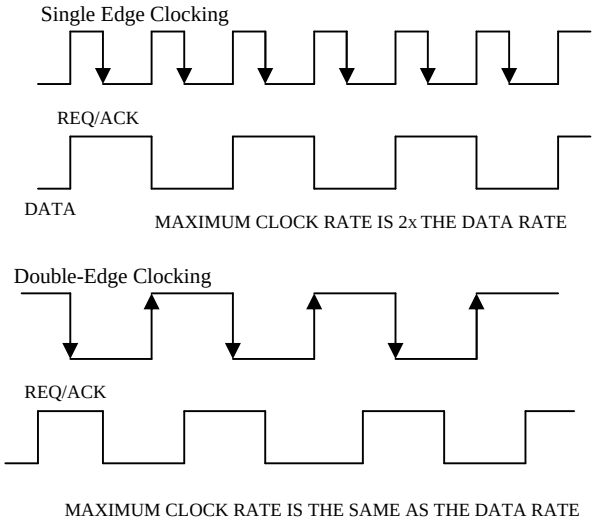

Figure2. Double Edge Clocking - Increasing Reliability

? **Cyclical Redundancy Checks (CRC)**

The Ultra160 SCSI reliability enhancements include the addition of a Cyclical Redundancy Check on customer data. CRC provides extra data protection for marginal cable plants, external devices, and is one of the best ways to assure data protection during hot plugging. CRC offers higher levels of data reliability by ensuring complete integrity of transferred data. It dramatically reduces undetected error rates by using the same proven CRC that is utilized by FDDI, Enet, & Fibre Channel interface.

The Ultra3 SCSI CRC detects: All single bit errors, All double bit errors, All odd number of errors, All burst errors up to 32-bits long, And has a ~2-32 rate of undetected random error patterns

? **Domain Validation**

This technology intelligently tests storage networks including cables, backplanes, terminators, bridges

expanders, etc. Domain Validation ensures that the network is operating at the required specifications. If reliability is at risk, the transfer proceeds without a hitch at a lower speed—much the way today's modem and fax transmissions connect despite variations in equipment. Domain Validation should increase end-user satisfaction and decreases total cost of ownership by reducing service calls for under performing systems. In addition these tests could save on call center support resources and help alleviate end-user frustration. In the past new devices such as HBAs (host bus adapters) and HDDs (hard disk drives) did not always work smoothly with legacy configurations. Domain Validation helps assure that Ultra160 SCSI devices operate smoothly in existing legacy systems. This testing is done automatically without changing controller settings, setting BIOS parameters, or fumbling with manuals.

Packetized Protocol and QA

Packetized Protocol and Quick Arbitrate (QA) are two features that offer improvements in the efficiency of the bus –how much of the theoretical bandwidth is available for data transfers.

In SCSI, the command has always been transferred to the target device in “Asynchronous Mode”, which operates at a much slower frequency than the data transfer. Packetized Protocol allows the command to be bundled into a data packet that can be transferred at full speed. The packet can also contain other things – multiple data transfers, messages, & additional commands. Combining multiple items into a single packet can also save time on the bus usually reserved for settling delays between separate phases.

The overhead reduction from Packetized Protocol is most noticeable when the command overhead is the highest, which is during smaller data transfers. Workloads such as transaction processing typically fall into this category.

QA reduces overhead by redefining how a device completes an operation on the bus. QA-aware devices can

“hand off” the bus to a second QA device waiting for bus time without going into a new arbitration phase. This allows quicker transitions and less wasted time between commands.

While the overall savings from these two parameters may be small in average workloads today, Packetized Protocol and QA will be added to the list of improvements as speeds increase even further.

Ultra160 SCSI: The Need for Speed

The rule of thumb for the past 15 years has been that bus bandwidth should be at least 4 times the maximum throughput of a drive. The Ultra160 SCSI bus bandwidth should stay comfortably ahead of the internal transfer rates of the next generation 10K rpm HDDs. These HDDs can saturate the Ultra2 SCSI bus with as few as three drives.