

SCSI Primer (for IBM RS/6000 and pSeries)

The following is intended as a very rudimentary SCSI primer, defining SCSI terminology and providing an overview of SCSI in the RS/6000 and pSeries environment.

SCSI stands for Small Computer Systems Interface. SCSI is an evolving spec that has seen significant changes since its introduction. SCSI devices can be Hard Disk Drives, Tape Drives, CD-ROM, DVD-RAM, Scanners and so on.

SCSI Devices on the SCSI Bus are controlled by a SCSI Adapter (either integrated on the system board or a separate physical adapter).

The SCSI Bus is a discrete signal pathway. Devices on the Bus are numbered with an ID beginning at zero. The number of Devices allowed on a bus is dictated by the type of SCSI controller and devices attached. Multiple SCSI Busses (when more than one controller is present) are referred to as LUNs.

Command Specs and Types of SCSI.

SCSI-1

The original SCSI implementation became known retroactively as SCSI-1.

SCSI-1 defined a Bus Width of 8-bit, running at a Data Transfer Rate of 5MB/s. It may help to think of the Bus Width as an eight lane highway, and the Data Rate as the number of vehicles passing by in a second.

Additionally, SCSI-1 defined two different flavors, known as Single Ended and (High Voltage) Differential.

Single Ended SCSI-1 typically had cabling length restrictions of 6 meters. Differential SCSI-1 allowed cabling lengths of up to 25 meters, using different Pin outs and a higher voltage (5V) than Single Ended. Single Ended and Differential devices could not be mixed on the same SCSI bus.

For most industry standard implementations, SCSI-1 resulted in adapters and devices using a 50 pin ribbon cable and 50 pin Centronics connector. Although IBM used the Centronics connector on its devices, two distinctions were made in order to create a proprietary interface. First, the original SCSI-1 adapter used a 60 Position connector and, secondly, devices had only a single interface which required a proprietary 'piggy back' cable with on-board electronics for correct termination.

SCSI-2

SCSI-2 refers to the second version of the official SCSI spec. Unlike SCSI-1, SCSI-2 implemented standards for connectors as well as speeds. Under SCSI-2, the 50 pin High Density (HD) adapter interface was introduced - although this was not the only allowed interface. IBM implemented this interface with its FC 2410 and 2420 adapters.

The SCSI-2 implementation also improved on SCSI-1 by facilitating a Data Transfer Rate of 10MB/s (double the previous standard). However, the maximum cable length for Single Ended SCSI-2 was lowered to 3 meters.

SCSI-2 Fast/Wide

Fast:

The original SCSI spec (SCSI-1) stipulated a 5mb/sec data transfer rate. SCSI-2 merely doubled this to 10mb/sec. Consequently, it became known as 'Fast SCSI'. Fast SCSI merely refers to a faster data transfer. The bus width is still 8 bit. It is also referred to as Fast-10.

Wide:

SCSI-2 encompasses two bus widths. The original implementation of 8-bit (which became known as Narrow) and 16 bit, which became known as Wide. Since the bus width was wider, the transfer rate doubled from 10mb/ to 20mb/sec.

SCSI-2 devices and controllers therefore came in several flavors.

Fast/Narrow 8-bit 10MB/s Single Ended or Differential

Fast/Wide 16-bit 20MB/s Single Ended or Differential

Ultra SCSI

Ultra SCSI is an 8 bit reference. Instead of going from 'SCSI' to 'Fast SCSI' to 'Faster SCSI', a new term was coined. Ultra refers to an 8 bit bus running at 20mb/sec. (Compared to the 16 bit 'Wide' which also ran at 20mb/sec). Ultra is also known as Fast-20.

Ultra Wide

Refers to the 16 bit version of Ultra. The doubled bus allows for twice the speed. Ultra Wide implementations boast 40mb/sec data transfer across the bus.

Ultra2

Ultra2 is a 16 bit only designation and represents a bus rate of 80MB/Sec. It is also known as Fast-40.

All Ultra2 busses are LVD (Low Voltage Differential) Single Ended.

Ultra160

Ultra160 again doubled the bus rate from 80MB/s to 160MB/s. It is also referred to as U3, Ultra3 and Fast-80. It is not SCSI-4.

As noted earlier, SCSI-3 is an unfinished spec. Ultra3 implemented five new features for SCSI but this was inconsistent with the Adaptec implementation - which only accepted three of the five attributes. Consequently (and since Adaptec pretty much determines the SCSI market) the U160 interface was born as an alternative to Ultra3.

Although Ultra3 and U160 both incorporate a 160mb/sec 16 bit LVD bus with the same cabling, they are actually different in technical spec.

Ultra320

Ultra320 is the current standard. The bus rate is 320MB/s. It is also referred to as U320, U4 and Fast-160. It is not SCSI-5.

SCSI-3

SCSI-3 refers to the current (as of 07/2002) implementation. It is an unfinished spec and includes everything from Fast/Wide 20mb/s through the current 320mb/s Ultra320 implementation.

Because the SCSI-3 specification includes such a wide range of modifications, there has been some confusion over the correct naming of SCSI-3 devices - with Ultra320 sometimes being referred to as SCSI-5. In fact, Ultra320 is still SCSI-3.

SCSI-3 did, however, exclude any of the IBM proprietary 68 Position connectors as found on the Micro Channel adapters (FC 2415, 2412, 2416).

Although there is no official SCSI-3 interface, IBM switched from the 68 pos connector to the 68 pin HD connector (for the PCI bus cards), in order to satisfy the open architecture mandates of the spec.

Summary of Terminology

8-bit:	Narrow SCSI Bus
16-bit:	Wide SCSI Bus
Single Ended:	Single ground wire, shorter SCSI bus cabling lengths (3m typical). Not compatible with Differential.
Differential	Dual ground wire, longer SCSI bus cabling lengths (up to 25m). Not compatible with Single Ended.
HVD (High Voltage Differential)	Retro term meaning 5V Differential
LVD (Low Voltage Differential)	Newer spec (Ultra2 and above) using 3 volt logic. Cable lengths vary depending upon the type of device attached (LVD or SE). HVD devices are not compatible with LVD adapters. Single Ended devices are allowed with LVD/Multi-mode adapters but will revert the whole SCSI bus to Single Ended.

SCSI-4/SCSI-5:

These terms are often used to describe SCA-80 pin and VHDCI 0.8mm connections.

However, there is no such thing as SCSI-4 or SCSI-5.

Both interfaces are part of the SCSI-3 (unfinished) spec.

IBM SCSI Versioning at a glance:

SCSI-1	5mb/s	8-bit	HVD and SE	
SCSI-2	10mb/s	8-bit	HVD and SE	(Fast)
SCSI-2 F/W	20mb/s	16-bit	HVD and SE	(Fast/Wide)
Ultra SCSI	20mb/s	8-bit	HVD and SE	(Fast-20)
Ultra Wide	40mb/s	16-bit	HVD and SE	(Fast-20)
Ultra2	80mb/s	16-bit	LVD	(Fast-40)
Ultra3	160mb/s	16-bit	LVD	(Fast-80)
U160	160mb/s	16-bit	LVD	(Fast-80)
U320	320mb/s	16-bit	LVD	(Fast-160)