Z-100 LifeLine
Since 1989

April 2022

#WEB

This article was first published in issue #39, October 1995
~~~~~~

SCSI

What is SCSI?

Note: The following is from an explanation of **SCSI** from the "Winn L. Rosch Hardware Bible, Third Edition"

Popularly pronounced *scuzzy*, SCSI is a system-level interface that provides what is essentially a complete expansion bus into which to plug peripherals. SCSI is not simply a connection that links a device or two to your PC, but rather functions like a sub-bus. SCSI devices can exchange data among themselves without the intervention of the host computer's microprocessor. They can act across the SCSI bus even while other transfers are shifting across the host computer's normal expansion bus.

The original SCSI standard evolved from another interface called SASI, the Shugart Associates Standard Interface, which was developed in 1981 by hard-disk pioneer Shugart Associates with NCR Corporation as an 8-bit parallel connection between host computers and disk drives. Later that year, the X3T9 committee of the American National Standards Institute used the SASI specification as the foundation for its work on a parallel interface standard. That standard, now known as SCSI, was formally approved in 1986.

As with any expansion bus, any of a variety of device types can be connected to the computer's SCSI bus, all communicating through a single-port connection. Up to seven SCSI devices can be daisy-chained to one SCSI port, yet still function independently. SCSI provides a parallel connection between its devices via the SCSI adapter. In most SCSI systems, only a single cable is needed for a SCSI linkup.

Under the original SCSI specification, SCSI operated at a speed of 5 MHz. Its 8-bit parallel interface (with one additional bit for parity) allowed for a peak data transfer rate of 5M per second.

What is SCSI?

by Steven Vagts
Editor, "Z-100 LifeLine"

SCSI-2

In 1991, a revision of SCSI was introduced to help fix some of the problems in mating SCSI devices, as well as to increase the speed of SCSI transfers. Referred to as SCSI-2, the new standard integrated a complete software-control system called the *Common Command Set (CCS)* with several optional hardware enhancements:

- Wide SCSI: The broadening of the 8-bit SCSI data bus to use 16 or 32 data lines. These increased the effective peak transfer rate of the interface to 10M or 20M per second.

- Fast SCSI: With an 8-bit bus width, fast SCSI pushed transfer rates up to 10M per second; wide and fast SCSI could peak at 20M to 40M per second.

SCSI-3

Almost immediately after the SCSI-2 standard was approved, the industry began work on its successor, SCSI-3, which further refined the standard.

In a dramatic backward shift, SCSI-3 again separated the software from the hardware, making the CCS independent of the underlying hardware. In addition, SCSI-3 provided mechanisms for using the CCS across several hardware-connection schemes:

- **Parallel SCSI:** Essentially what we know as SCSI-2 today, it is enhanced into *16-bit SCSI* which increases the number of devices that can be connected to a single SCSI bus to 16.

- **Serial SCSI:** Based on P1394 serial port standards

- **Fiber Optical** Connection and several others.

SCSI-3 also officially standardized the P-connector used in most wide SCSI-2 implementations.
~~~~~~

The speed of SCSI-3 depends on its hardware implementation. The cabling methods and speed of SCSI-2 are still allowed, but new transmission systems allow transfer rates in excess of 100M per second.

Operation and Arbitration

All devices connected to a single SCSI bus function independently, under the control of the host system's SCSI adapter. Rather than just using signals on dedicated conductors on the bus, SCSI presupposes a high degree of intelligence in the devices it connects and provides its own command set, or language, for controlling the devices.

SCSI also provides an arbitration scheme, which enables the devices connected to the bus to determine which can send data across the bus at a given time. Instead of being controlled by the host computer (with its associated delays), the arbitration of the SCSI bus is distributed among all the devices on the bus.

Arbitration is handled by hardware. All the SCSI devices are assigned a unique identifying number, usually by setting jumpers or DIP switches on the drive in a manner similar to Drive Select jumpers.

When a device, called the *Initiator*, wants to access the SCSI bus, it waits until the bus is free, then identifies itself by sending a signal down one of the SCSI data lines. At the same time, it transmits a signal down another SCSI data line corresponding to the other SCSI device, called the *target*, that it wants to interact with. The eight data lines in the SCSI connection allow the unique identification of seven SCSI devices and one host.

SCSI devices can initiate arbitration on their own or can transfer information between one another without host intervention. A SCSI hard disk, for example, may back itself up to a SCSI tape drive without requiring the attention of its host computer. Better than background operation, this form of backup represents true parallel processing in the computer system.

SCSI also provides for reselecting, where a device that temporarily does not need bus access can release the bus, carry out another operation, and then resume control. For example, a disk drive can be commanded to format and can carry out that operation without tying up the bus. The net result is, again, true parallel processing.

Because SCSI is a high-level interface, it also isolates the computer from the inner workings of the peripherals connected to it. The SCSI standard allows hard disks to monitor their own bad tracks independently from the computer host. The hard disk drives can be designed to automatically detect sectors that are going bad and to reassign the data they contain elsewhere, all without the host computer or the user ever being aware of any problems.

Hardware

The basic SCSI hardware interface is a parallel 8-bit bus with a ninth parity bit for error detection. As a bus, all devices are simultaneously connected and receive all transmissions (commands and data). Commands are routed to individual SCSI devices by identifying them by their SCSI address. SCSI uses a 3-bit addressing scheme, allowing 8 unambiguous addresses, which usually are given in standard Arabic numerals as SCSI ID numbers 0 thru 7. One of these, 7, is normally reserved for the SCSI host adapter.

The addresses, 0 thru 6, can be assigned to each device connected anywhere in the SCSI chain. Each address is assigned a priority to the device - with 7 (the host adapter) having the top priority and 0 having the lowest.

Most external SCSI devices are assigned their ID number by a pushbutton or rotary switch on the rear panel of the equipment. Internal SCSI devices, such as hard disks, typically have several jumpers or switches on each device that sets its own unique SCSI ID number.

In addition to physically setting the address, the software must be properly configured to recognize a device's address. In some cases, however, programmers may reserve a specific address for a particular SCSI device. For example, most SCSI host adapters that emulate the Western Digital WD1002 controller require that any SCSI drive meant to boot your computer use the ID number 0 (zero).

The original SCSI specifications allowed for two types of SCSI buses:

- ***Single-ended SCSI:*** Uses an unbalanced or single-ended electrical signal -- a single wire for each signal, with all signals in the bus using a single common ground return.

- ***Differential SCSI:*** Uses balanced or differential signals, where each signal on the SCSI bus has its own return line that is isolated from the reference ground. Differential SCSI signals use twisted-pair wiring.

Most SCSI implementations have been single-ended because they require half the pins, cheaper wire, and simpler electronics than do differential SCSI implementations.

However, single-ended SCSI is more prone to picking up noise and interference than differential SCSI. As a result, single-ended SCSI systems are limited to less than 6 meter (just under 20 feet) cable lengths. Differential SCSI allows for bus lengths up to 25 meters (about 82 feet).

At least one-third meter (about 12 inches) of cable must be installed between SCSI devices and external SCSI cables should be shielded.

SCSI devices can use asynchronous or synchronous transfer protocols when communicating. Asynchronous SCSI transmissions are slower because they require a handshake signal for every byte transferred. You can mix both asynchronous and synchronous devices in a single SCSI system.

SCSI Cabling

Because SCSI is a bus, its devices are connected together by daisy-chaining. A straight cable, without twists or crossovers, is run from the host adapter to each SCSI device.

Internal SCSI devices like hard drives use a simple flat ribbon cable with multiple connectors attached to it. All connectors have identical signals, so you can use any convenient connector for any SCSI device. The devices and host adapter use the SCSI ID numbers to sort out which commands and data go where.

External SCSI cabling is somewhat different. Most external SCSI devices have two identical SCSI connectors to facilitate daisy-chaining. The first cable connects the host adapter to the first device in the external SCSI chain. For the next device, another cable connects from the first device to the second device. For each additional device, another cable is added from the last device to each new device.

The standard SCSI connector has 50 pins arranged in two rows of 25 and looks like an enlarged Centronics printer connector. This connector is standardized by the SCSI specifications and is termed the *A Connector* (See Table 1). A few host adapters and some external SCSI devices use 25-pin, D-shell connectors (like the serial or parallel ports on the back of the computer) which were popularized by Apple Computer for its Macintosh equipment.

Table 1. SCSI A-Cable

Pin	Function	Pin	Function
1	Ground	26	Data bit 0
2	Ground	27	Data bit 1
3	Ground	28	Data bit 2
4	Ground	29	Data bit 3
5	Ground	30	Data bit 4
6	Ground	31	Data bit 5
7	Ground	32	Data bit 6
8	Ground	33	Data bit 7
9	Ground	34	Parity bit
10	Ground	35	Ground
11	5V/3.3V Ground	36	5V/3.3V (Motor)
12	12V/5V Ground	37	12V/5V
13	TermPwr	38	TermPwr
14	12V/5V	39	12V/5V Ground
15	5V/3.3V (Logic)	40	5V/3.3V (Return)
16	-ADDR #1/Ground	41	-ATN
17	Ground	42	SYNC
18	Ground	43	-BSY
19	Ground	44	-ACK
20	Ground	45	-RST
21	-Addr #2/Ground	46	-MSG
22	Ground	47	-SEL
23	-Addr #3/Ground	48	-C/D
24	Ground	49	-REQ
25	VU/Ground	50	-I/O

The 25-pin connectors can handle only single-ended signals because they don't have enough connections for differential systems. An adapter cable is required to match these devices.

Table 2 shows the signal assignment on these connectors. It's best to put any 25-pin SCSI device at the end of the SCSI daisy-chain.

Table 2. 25-Pin D-Shell SCSI Cable

Pin	Function	Corresponding 50-Pin Assignment
1	-REQ	49
2	-MSG	46
3	-I/O	50
4	-RST	45
5	-ACK	44
6	-BSY	43
7	Ground	"16,18,19"
8	Data bit 0	26
9	Ground	"20,21,22"
10	Data bit 3	29
11	Data bit 5	31
12	Data bit 6	32
13	Data bit 7	33
14	Ground	"1,2,3"
15	-C/D	48
16	Ground	"4,5,6"
17	-ATN	41
18	Ground	"7,8,9"
19	-SEL	47
20	Parity bit	34
21	Data bit 1	27
22	Data bit 2	28
23	Data bit 4	30
24	Ground	"23,24,25"
25	Termination power	38

Wide SCSI requires more connections than are possible with the A cable alone. Although the SCSI-2 specifications indicate the use of a second, *B cable* to provide a path for these additional signals, a similar, *P cable* may be used instead.

Both the B and P cables use high-density, 68-pin, SCSI-2 connectors consisting of two rows of 34 male contacts on 0.050-inch x 0.100-inch centers. Only the pin assignment of the connector differs.

Under the SCSI-3 proposal, bus widths up to 16 bits use the P cable (called the primary cable); wider buses require a secondary cable with the same connector but different signals and pinouts (see the remaining Tables).

After connecting all the SCSI cables and terminating the daisy-chain, the retaining clips or wires on each connector should be snapped in place to be sure that each connector is held securely in place.

This mechanical locking is particularly important with SCSI connections because any interruption will disable all devices further down the daisy-chain.

Moreover, because the chain will no longer be terminated properly, even the devices earlier in the chain may not work reliably.

Table 3. SCSI P-Cable; Single-Ended Primary Bus

Pin	Function	Pin	Function
1	Ground	35	Data bit 12
2	Ground	36	Data bit 13
3	Ground	37	Data bit 14
4	Ground	38	Data bit 15
5	Ground	39	Parity bit 1
6	Ground	40	Data bit 0
7	Ground	41	Data bit 1
8	Ground	42	Data bit 2
9	Ground	43	Data bit 3
10	Ground	44	Data bit 4
11	Ground	45	Data bit 5
12	Ground	46	Data bit 6
13	Ground	47	Data bit 7
14	Ground	48	Parity bit 0
15	Ground	49	Ground
16	Ground	50	Ground
17	Termination Power	51	Termination Power
18	Termination Power	52	Termination Power
19	Reserved	53	Reserved
20	Ground	54	Ground
21	Ground	55	-ATN
22	Ground	56	Ground
23	Ground	57	-BSY
24	Ground	58	-ACK
25	Ground	59	-RST
26	Ground	60	-MSG
27	Ground	61	-SEL
28	Ground	62	-C/D
29	Ground	63	-REQ
30	Ground	64	-I/O
31	Ground	65	Data bit 8
32	Ground	66	Data bit 9
33	Ground	67	Data bit 10
34	Ground	68	Data bit 11

Table 4. SCSI P-Cable; Single-Ended Secondary Bus

Pin	Function Function		Pin
1	Ground	35	Data bit 28
2	Ground	36	Data bit 29
3	Ground	37	Data bit 30
4	Ground	38	Data bit 31
5	Ground	39	Parity bit 3
6	Ground	40	Data bit 16
7	Ground	41	Data bit 17
8	Ground	42	Data bit 18
9	Ground	43	Data bit 19
10	Ground	44	Data bit 200
11	Ground	45	Data bit 21
12	Ground	46	Data bit 22
13	Ground	47	Data bit 23
14	Ground	48	Parity bit 2
15	Ground	49	Ground
16	Ground	50	Ground
17	Termination Power	51	Termination Power
18	Termination Power	52	Termination Power
19	Reserved	53	Reserved
20	Ground	54	Ground
21	Ground	55	Terminated
22	Ground	56	Ground
23	Ground	57	Terminated
24	Ground	58	-ACKQ
25	Ground	59	Terminated
26	Ground	60	Terminated
27	Ground	61	Terminated
28	Ground	62	Terminated
29	Ground	63	-REQQ
30	Ground	64	Terminated
31	Ground	65	Data bit 24
32	Ground	66	Data bit 25
33	Ground	67	Data bit 26
34	Ground	68	Data bit 27

SCSI TERMINATIONS

Finally, one last device must be placed at the end of the daisy-chain. This terminator prevents spurious signals from bouncing back and forth across the SCSI cable chain. The SCSI-2 standard allows for two methods of terminating SCSI buses:

Table 5. SCSI P-Cable; Differential Primary Bus

Pin	Function	Pin	Function
1	Data bit 12 +	35	Data bit 12 -
2	Data bit 13 +	36	Data bit 13 -
3	Data bit 14 +	37	Data bit 14 -
4	Data bit 15 +	38	Data bit 15 -
5	Parity bit 1 +	39	Parity bit 1 -
6	Ground	40	Ground
7	Data bit 0 +	41	Data bit 0 -
8	Data bit 1 +	42	Data bit 1 -
9	Data bit 2 +	43	Data bit 2 -
10	Data bit 3 +	44	Data bit 3 -
11	Data bit 4 +	45	Data bit 4 -
12	Data bit 5 +	46	Data bit 5 -
13	Data bit 6 +	47	Data bit 6 -
14	Data bit 7 +	48	Data bit 7 -
15	Parity bit 0 +	49	Parity bit 0 -
16	Differential sensing	50	Ground
17	Termination Power	51	Termination Power
18	Termination Power	52	Termination Power
19	Reserved	53	Reserved
20	+ATN	54	-ATN
21	Ground	55	Ground
22	+BSY	56	-BSY
23	+ACK	57	-ACK
24	+RST	58	-RST
25	+MSG	59	-MSG
26	+SEL	60	-SEL
27	+C/D	61	-C/D
28	+REQ	62	-REQ
29	+I/O	63	-I/O
30	Ground	64	Ground
31	Data bit 8 +	65	Data bit 8 -
32	Data bit 9 +	66	Data bit 9 -
33	Data bit 10 +	67	Data bit 10 -
34	Data bit 11 +	68	Data bit 11 -

Table 6. SCSI P-Cable; Differential Secondary Bus

Pin	Function	Pin	Function
1	Data bit 28 +	35	Data bit 28 -
2	Data bit 29 +	36	Data bit 29 -
3	Data bit 30 +	37	Data bit 30 -
4	Data bit 31 +	38	Data bit 31 -
5	Parity bit 3 +	39	Parity bit 3 -
6	Ground	40	Ground
7	Data bit 16 +	41	Data bit 16 -
8	Data bit 17 +	42	Data bit 17 -
9	Data bit 18 +	43	Data bit 18 -
10	Data bit 19 +	44	Data bit 19 -
11	Data bit 20 +	45	Data bit 20 -
12	Data bit 21 +	46	Data bit 21 -
13	Data bit 22 +	47	Data bit 22 -
14	Data bit 23 +	48	Data bit 23 -
15	Parity bit 2 +	49	Parity bit 2 -
16	Differential sensing	50	Ground
17	Termination Power	51	Termination Power
18	Termination Power	52	Termination Power
19	Reserved	53	Reserved
20	Terminated	54	Terminated
21	Ground	55	Ground
22	Terminated	56	Terminated
23	+ACKQ	57	-ACKQ
24	Terminated	58	Terminated
25	Terminated	59	Terminated
26	Terminated	60	Terminated
27	Terminated	61	Terminated
28	+REQQ	62	-REQQ
29	Terminated	63	Terminated
30	Ground	64	Ground
31	Data bit 24 +	65	Data bit 24 -
32	Data bit 25 +	66	Data bit 25 -
33	Data bit 26 +	67	Data bit 26 -
34	Data bit 27 +	68	Data bit 27 -

- **Alternative 1:** The original SCSI method of passive terminations using only resistors. Electrically, the terminator is the equivalent of a voltage source of three volts in series with a 132-ohm resistor. This value is achieved by connecting a single-ended signal through a 220-ohm resistor to the TERMPWR line and through a 330-ohm resistor to ground.

All signals on the SCSI bus (except those labeled Ground, TERMPWR, or Reserved by the standard) require this kind of termination at each end of the bus.

Alternative 1 terminations work well when four or fewer devices are connected to the SCSI bus.

- **Alternative 2:** Uses active terminations where the terminator uses a voltage regulator to source a 2.85 VDC level in series with a 110-ohm resistor.

This active termination reduces the susceptibility of the bus to noise, particularly when cables are long or when many devices are connected to the bus.

Differential signals use a different termination method. All signals are terminated at each end of the cable with a network having two 330-ohm resistors and 150-ohm resistor arranged to provide the equivalent of a 122-ohm impedance. The TERMPWR line connects to the negative signal line through a 330-ohm resistor; the negative signal line is connected to the positive through the 150-ohm resistor; and the positive signal line is connected to the ground through the second 330-ohm resistor.

SCSI initiators supply the termination power to their TERMPWR connections through diodes to prevent termination power from other devices from flowing back into the device. Although target devices do not need to supply terminator power, any SCSI device is permitted to supply terminator power.

A third form of termination called Forced Perfect Termination (FPT) is rarely used. FPT uses diodes to regulate the power of the SCSI bus.

In classic SCSI implementations, the three most physical means of providing a SCSI termination are:

- Internally with resistor packs,
- Externally with dummy termination plugs, and
- Using switches.

Resistor packs are components attached directly to circuit boards. Unlike the other interfaces, SCSI devices typically use three (instead of one) resistor packs for their terminations. Most PC-based SCSI host adapters and hard disks come with termination resistors already installed on them.

You can easily identify terminating resistors as three identical components about 1" long, 1/4" to 3/8" high, and hardly 1/8" thick. Most commonly, these resistor packs are red, brownish yellow, or black and shiny, and they are located adjacent to the SCSI connector on the SCSI device or host adapter. They may be removed simply by pulling them out of their sockets.

External SCSI terminators are plugs that look like short extensions to the SCSI jacks on the back of SCSI devices. One end of the terminator plugs into one of the SCSI device's jacks, and the other end of the dummy plug yields another jack that can be attached to another SCSI cable.

Some external terminators, however, lack the second jack on the back. Generally, the absence of a second connector is no problem because the dummy plug should be attached only to the last device in the SCSI chain.

Switches, the third variety of termination and commonly used on SCSI-2 systems with active terminations, may be found on both external and internal drives. Sometimes a single switch handles the entire termination, but occasionally a SCSI drive will have three banks of DIP switches that all must be flipped to the same position to select whether the termination is active. These switches are sometimes found on the SCSI device or on the case of an external unit.

A few external SCSI devices rely on the terminators on the drive inside their cases for their terminations. For these, you must take apart the device to adjust the terminators.

According to the SCSI specification, the FIRST **and** LAST device in a SCSI chain must be terminated. The first device is almost always the SCSI host adapter in your PC. If you install a single internal hard disk to the host adapter, the hard disk becomes the other end of the chain and requires terminations. Similarly, a single external hard disk also requires termination.

With multiple devices connected to a single host adapter, the termination issue becomes complex. Generally, the host adapter will be one end of the SCSI chain. However, when you have both internal and external devices connected to it, then the terminations should be removed from your host adapter and the device nearest the end of the internal SCSI cable and the external device at the end of the daisy-chain should be terminated. This external device the only device that likely has an empty connector. Remove or switch off the terminators on all other devices.

COMPATIBILITY

SCSI hard disks entirely isolate the host computer from concerns about disk sector and tracks. The SCSI system deals with data at a higher level, as blocks, so any block-oriented device can take advantage of the connection scheme.

This arrangement works well in the Macintosh environment because the Mac operating system has built-in provisions for dealing with SCSI.

PC-DOS and MS-DOS lack such provisions, however, so SCSI host adapters for IBM-standard systems must convert sector and track requests into their SCSI equivalent. As a result, the system gets, at best, an indirect look at the disk drive. At worst, the overhead required for the address conversions can considerably slow the performance of an IBM-based SCSI system.

This symptom was particularly noticeable in the first generation of SCSI devices and host adapters. Drive and host adapter manufacturers have learned to glean more of SCSI's speed, but you still find a wide variance in the throughputs of the SCSI host adapters on the market.

The Apple Macintosh implementation of SCSI has been criticized for being a variance from the otherwise accepted industry standard, but the only place it varies is with the connector choice. While the standard SCSI hook-up uses a single special 50-pin connector, the Macintosh uses a 25-pin miniature D-shell connector much like that used by serial ports and does away with many of the redundant ground connections of the standard. The more compact size of this connector was probably one reason for its choice. It also makes cabling easier and more convenient.

A bigger compatibility issue arises when trying to take advantage of SCSI's capability to link multiple devices to one host adapter. Some devices just will not work with others. The incompatibilities arise out of the flexibility of the SCSI standard.

Although the specification strictly defines all hardware parameters, it is much more loose when it comes to software features. Much of the SCSI command set is optional -devices only have to implement the features that they will use.

Moreover, the SCSI specification provides no standard means of the host computer controlling SCSI devices through the interface. That is left up to the system designer.

As a result, four methods have been used for logically linking SCSI to PCs: ASPI, CAM, Int4Ah, and LADDR.

Int4Ah and LADDR have found limited support. When IBM integrated SCSI support into its PS/2 series of computers, it used a system interrupt, number 04A(Hex), to command the SCSI system. As with other aspects of PS/2s, few other manufacturers have copied this feature.

LADDR, for *Layered Device Driver Architecture*, was Microsoft's first system to use SCSI. Although aimed at making SCSI easier to use with multitasking and built into OS/2 Version 2.1, few makers of SCSI equipment provided drivers to accommodate LADDR.

The *Common Access Method* or CAM Committee developed an implementation of the SCSI standard for the IBM AT. It allowed access to SCSI devices directly through the PC's operating system.

Although the CAM standard was not formally adopted by any standard-setting organization at the time this reference book was written, the specification has been around long enough that many manufacturers use it for their products. Such CAM-compliant SCSI host adapters have onboard BIOSes that link with the computer's operating system.

Programs written to take advantage of CAM make requests to the operating system and have them carried out by the appropriate SCSI device. Unfortunately, DOS is not currently CAM-compliant, but OS/2 versions since 2.0 are CAM-compliant.

The *Advanced SCSI Programming Interface* or ASPI is an alternate SCSI control system originally developed by host adapter-maker Adaptec (the A in ASPI originally stood for Adaptec, but the company yielded to change to broaden the appeal of the standard). It is now widely used in the PC industry and Adaptec calls it a defacto standard.

ASPI uses a layered approach to the software interface using driver software. Programs communicate and send commands to SCSI devices through an individual software driver for each device. An overall ASPI driver links the individual device drivers to the SCSI system hardware.

The BIOS on an ASPI-compliant host adapter merely provides fundamental services that establish the link with the ASPI driver. In general, the ASPI BIOS provides WD1002 emulation. It enables you to connect one or two SCSI hard disks to the host adapter and have them mimic a Western Digital WD1002 ST506-sytle hard-disk controller and its associated disks. Without drivers, the first SCSI disk is able to boot your system as drive C and the second serve as drive D.

That is as far as the BIOS support goes, however. Without the loading software drivers, your ASPI-based system cannot recognize further hard disks or other SCSI devices.

To completely set up an ASPI system, all the required device drivers must be installed in the PC's CONFIG.SYS file. The ASPI driver must be installed with the host adapter and a driver installed for each SCSI device to be connected (except for the first two hard disks).

Because the device-specific software drivers need the ASPI driver to link to the SCSI system, the ASPI driver entry must precede that of the other SCSI device drivers in your PC's CONFIG .SYS file.

One problem you may encounter when getting your ASPI system to work may have its roots in impatience. If you bought your SCSI host adapter along with a hard disk and were anxious to get things running, you simply may have connected everything as if it were an IDE AT-interface or ESDI hard disk.

The hard disk probably would have worked just fine (thanks to the WD1002 emulation of the BIOS), but when you later try to install a CD-ROM player, its driver will not be able to find the ASPI driver you failed to install. You will see an obscure error message about the lack of an ASPI driver that probably will make you scratch your head for hours.

The solution to this problem is to fetch the disk that came with your SCSI host adapter and install the ASPI driver.

Most software drivers search for their target devices when they are booted into your system. Consequently, all your external SCSI devices should be running when you switch on your PC. Turn on your SCSI devices before you switch on your PC or use a power director (outlet box) that ensures that your entire computer system-PC and SCIS peripherals-switch on simultaneously.

POWER CABLES

All drives require powere to run their motors and their control electronics, and most drives regardless of size or interface use the same kind of power connection. The primary exceptions are the 3 1/2-inch hard disks meant for installation in IBM's PS/2 internal drive bays which have their power and signal connectors integrated into a single plug-in unit. With other drives, the power connection is a standard device power plug-a nylon connector that accomodates four separate wires, one of which is redundant. Note that the AT Attachment standard also recognizes a miniaturized power connector like that used by some 3 1/2-inch floppy disk drives. Power connectors and power requirements are discussed in Chapter 9, "The Power Supply."

CACHING

All mass storage devices - be they magnetic hard disks, floppies, or optical - face two primary performance constraints: access speed and transfer rate. Access speed is the inevitable delay between the instant your computer requests a particular byte or block of information from the disk drive and when that information is located on the disk. In specifications, access speed is represented by a number termed average access time, which descries the mean time (in milliseconds) required for the read-write head of a drive to move between disk tracks. Transfer rate describes the speed at which the information stored on the disk can be moved into the working memory of your PC. It is usually measured in megabytes per second.

If you have any questions or comments, please email me at:
z100lifeline@swvagts.com

Cheers,

Steven W. Vagts