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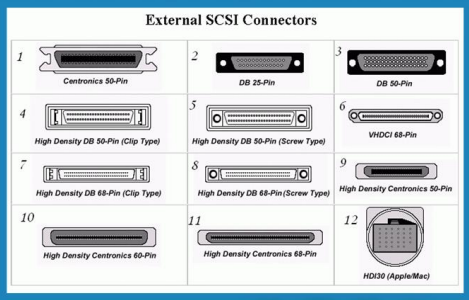

SCSI

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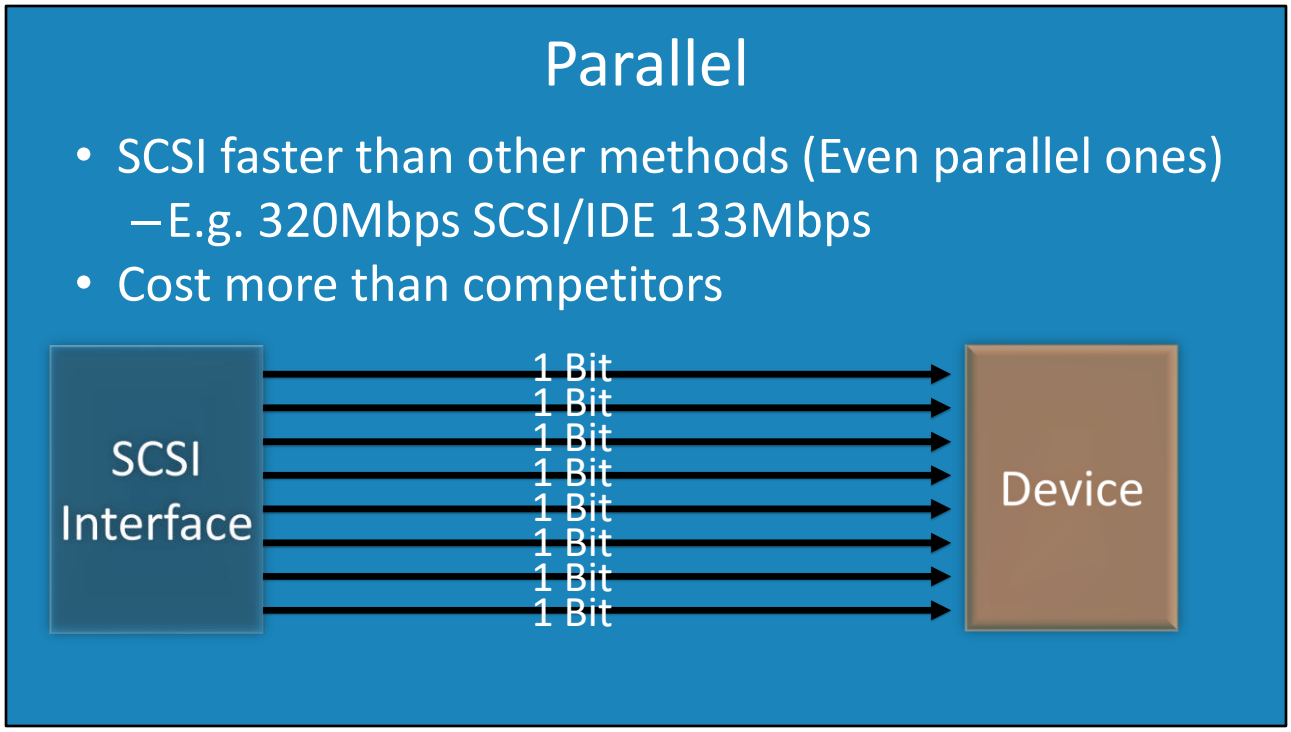
In this video from ITFreeTraining, I will look at the Small Computer System Interface or SCSI. SCSI has been around since the 80's, however it is being replaced by other standards like SAS which I will look at later in the video. Although SCSI is not used in new computers nowadays, it is important to have a basic understanding of it if you are repairing old equipment.

SCSI

- Small Computer System Interface

0:22 SCSI stands for Small Computer System Interface. As the name suggests, it is an interface designed to connect devices to a computer. SCSI has different levels of success in the marketplace and is fundamentally used to connect hard disk drives to computers. However, it could also be used to connect other devices to computers, like optical drives and scanners.

Computers sold on the market today no longer use the SCSI interface. Later in the video, I will look at how SCSI has changed and where you may encounter it today. For the exam, it is good to have an understanding of how SCSI is used today. For the technician, it is good to have a basic understanding, in case you have to fix an old computer that still uses SCSI. To start with, I will have a look at how SCSI works, so you can understand why it was used in the marketplace.



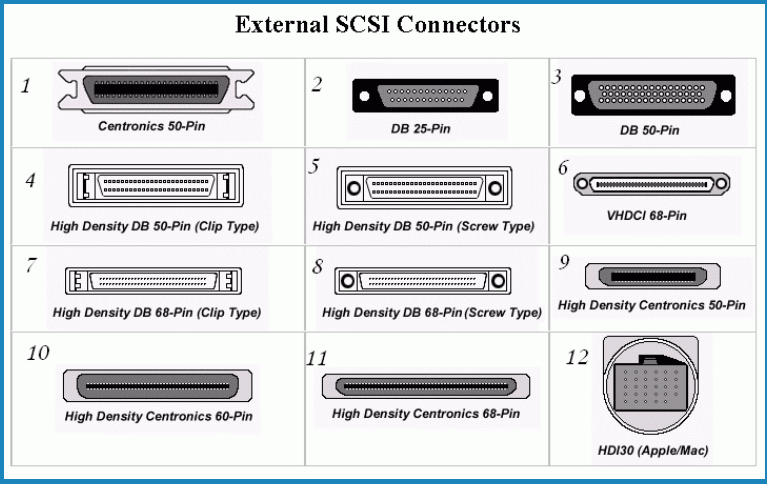
1:10 The SCSI interface uses parallel technology. So essentially this means that multiple bits are transferred at once in sync with each other. You may be thinking that there were a lot of other interfaces that also transferred data in parallel, so what made SCSI different?

SCSI generally transferred data faster than its competitors. Although there are many different versions of SCSI which have different speeds, let's consider an example of what sorts of speeds we are looking at, compared with a competitor.

Back in the 90's, SCSI was transferring data at 320 Mega Bits per second whereas IDE was transferring at 133 Mega Bits per second. There were different versions of each which ran at different speeds, however this will give you an idea what speeds were available at the time. The main take away is that SCSI ran faster than the competing products. This extra speed cost more money to implement, and thus SCSI devices cost more than their competitors.

Due to the higher cost, SCSI devices tended to be used on high-end workstations and servers. Some manufacturers like Apple used them for a while. Essentially, in the old days, if you wanted more performance you would get SCSI; however, you would pay more for it.

SCSI Connectors



2:26 There were many different versions of SCSI over the years. Each version of SCSI offered increased speed, and with the different versions came many different connectors. You can see some of the connectors that SCSI uses. There are too many to go through and there is not much point learning them since SCSI is not used in new computers any more. If you are fixing a computer and see a connector like one of those shown, you are probably working with SCSI.

It is unlikely that you will get tested on the old SCSI technology in the exam, but I will go through some basic things so you will have an idea how to support it if you come across it.

Termination

- Supports 8/16 devices
- Last device needs to be terminated
- Prevent reflections at end of transmission line
- Some devices are self-terminated

SCSI Terminator
Plugged into last device

3:03 SCSI supports multiple devices being chained together. SCSI generally supports eight or sixteen devices on the same daisy chain. The last device on the chain needs to be terminated. A terminator is a plug that connects to the last device like the one shown.

A terminator helps to prevent what is referred to as reflections. Reflections are essentially when the electrical signal hits the end of a transmission line and bounces back. Think of it like a wave in a pool hitting a wall. When the wave hits the wall, it bounces back. In the case of electronics, an electrical reflection is a bounce back of an electrical signal when it hits the end of the cable, which can cause corruption of any signal following it. A terminator helps prevent the bounce back of an electrical signal, which improves the accuracy of the signal. With SCSI, there needs to be a terminator on each end of the cable. The SCSI interface will have a built-in terminator, so all you need to worry about is making sure the other end is terminated.

In some cases, the devices may be self-terminated. This means the device essentially has a built-in terminator and does not need a terminator plugged into it. Don't worry if you do plug a terminator into a self-terminating device, it won't affect it. As long as a terminator is plugged in or the device is self-terminating, the device will operate.

4:26 Since SCSI allows devices to be connected together, you may find that a SCSI device may have two connectors. Devices like an internal hard disk will most likely just have the one connection. External devices like CD-ROMs, external hard disks and scanners may have two. To connect multiple devices, you simply connect one device to the next in a daisy chain. The last device in the chain needs to have a terminator plugged in or be self-terminating.

In order to have multiple devices connected together, each device needs to be given a different SCSI ID. Each SCSI device is assigned a number which allows the computer to determine which device is which.

To change the device ID, the device may have a counter on the back or some jumpers. In this case there is a counter on the back of the SCSI device. This will increase or decrease the SCSI ID. SCSI supports a maximum of 16 IDs. You may sometimes see the terms ‘wide’ and ‘narrow’. Wide SCSI has more pins than a narrow SCSI. Wide supports 16 IDs, but keep in mind that the ID count starts from zero. So the highest ID will be 15.

Narrow SCSI supports eight ID’s. The IDs again start from zero and thus the highest number is seven. The last type is Ultra SCSI which supports four devices starting from device zero.

When connecting SCSI devices, your cable may have different connectors on the end. If one is a wide connector and the other narrow, this will reduce the number of SCSI IDs supported by the cable. Besides the speed of SCSI, there were some other features that made SCSI popular despite its higher price.

SCSI Features

- Better support for +10,000 RPM hard disks
- Support for hot swapping
  - Depends on hardware (Usually found in RAID)
- Better handling overlapping multiple read/write

6:13 Back in the day, SCSI was used more for high-end workstation and servers. There were a lot of reasons for this, besides it just being faster. SCSI, over other technology back then, had better support for hard disks that spun at 10,000 or greater revolutions per minute.

SCSI has support for hot swapping devices. New technology like SATA and USB supports hot swapping, but back then, technology like IDE did not. Having said this, the hot swapping depends on the hardware being used. Usually SCSI hot swapping is found with removable hard disks which have a different connector on them that includes power. In some cases, you can plug in a device and it will work. However, be careful to ensure hot swapping is supported. I worked with someone who plugged an external device into a server and this caused the RAID in the server to fail. Sometimes an external SCSI connector will be connected to internal devices, so don't assume that hot swapping is supported. If you are not sure, check the product documentation and test first.

SCSI has better handling of overlapping multiple reads and writes. This becomes important when multiple devices are connected to the same cable. Technology like IDE would have performance problems when two hard disks were used on the same cable if both were being heavily used at the same time. SCSI handled this situation a lot better. You can start to understand why SCSI was so popular in the high-end workstation and server market, even though it cost more.

So far, I have looked at the basics of the old SCSI technology in case you need to support it. I will now look at modern SCSI and see how it has changed. In the exam you are more likely to

get asked a question about modern SCSI rather than the older SCSI.

Modern Day SCSI

- Now uses serial communication
- SCSI over Fibre Channel Protocol (FCP)
- USB Attached SCSI
- iSCSI (Over network)
- Serial Attached SCSI (SAS)

8:06 Modern SCSI now uses serial communication rather than parallel communication. As parallel communication got faster, problems used to occur like 'clock skew'. Clock skew essentially means the timing of each line would get slightly out of sync. As parallel communication got faster, it became harder and harder to keep multiple signal lines in sync with each other. Since serial communication does not have to keep multiple lines in sync, it does not have clock skew problems and thus can transmit at faster speeds.

Although SCSI has changed forever, the command set that SCSI uses remains the same. Thus, there are many different SCSI implementations that use serial communication. For example, SCSI over Fibre Channel Protocol and USB attached SCSI. Both of these use a physical cable to transmit data.

SCSI also can be transmitted over the network using iSCSI. Essentially the SCSI commands are sent over IP. This is a powerful feature, as it does not require special cables, and all you need is a network and the required software.

Lastly, there is Serial Attached SCSI or SAS. You will most likely come across SAS in modern servers and high-end workstations when SCSI is used. So, I will now have a closer look.

9:28 Serial attached SCSI as the name suggests, uses a point-to-point serial connection to transfer data. The connector used is similar to the SATA connector. The connector will generally contain both the power and the data wires. This helps support hot swapping.

The SAS adapter will support multiple devices and lanes. The number will be determined by the SAS adapter. Generally, it will be one, four or eight devices or lanes. SAS also supports bi-directional signaling. This means that it can be sending or receiving data at the same time. To do this, it will require two lanes. So, the devices you put on the adapter will determine how many and what features you can use. For example, if there are four lanes, you will be able to put two bi-directional SAS drives on the adapter, since each device will require two lanes.

The number of devices is not as high as SCSI; however, the number can be increased by using a SAS expander. A SAS expander essentially allows a single SAS connection to be divided up into multiple connections. It essentially works the same as plugging a network cable into a network switch. Using this method, you can increase the number of devices on a single SAS adapter to over 65,000. I don't think anyone would ever need that many!

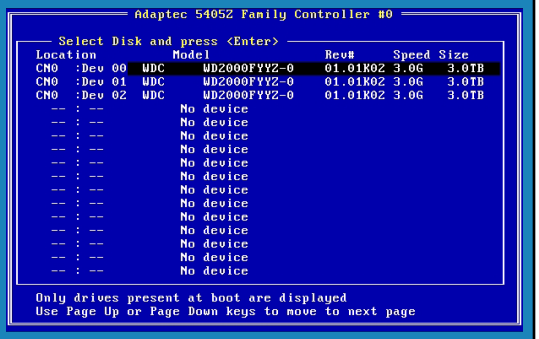
SAS is also compatible with SATA 2 and above. The SAS adapter is designed to support SAS or SATA drives. This is possible as SATA is electronically designed the same as SAS but not the protocol; however, the main difference is that SATA does not support bi-directional signaling. Thus, SATA can only send data in one direction at a time. So, in a way, you can think of SAS as an upgraded version of SATA.

You understand how this works with this SAS to four SATA cable. There are a few different connector types that connect to different SATA adapters; however, on the other end, you are free to use whatever connections are supported. In this case, the four lanes from the SAS adapter are divided up into four SATA connections. Since SATA only requires the one lane, this can be done. In this case, we could have also used a SAS to two SAS connectors to support two SAS hard disks.

There is a lot to SCSI and I could go on for hours about it. For the old SCSI devices, you just need a basic understanding in case you come across it and need to support it. For modern devices, you also just need to have a basic understanding of how SCSI works. I will now summarize the major things to know.

Summary

- Old SCSI devices need to be terminated
  - Either self-terminating or terminating adapter
- Parallel SCSI no longer used. Only Serial SCSI used
- SCSI ID
  - Set on the device
  - Set by plug connected to
- SAS compatible with SATA



12:06 If you come across some old SCSI equipment, remember that the end of the cable needs to be terminated. This can either be done by using an adapter or the device may be self-terminating. The terminator essentially prevents the electrical signal from bouncing back. So, it does not matter if the device is self-terminating and you plug in an additional terminator. As long as there is a terminator on the end of the cable, it will work.

In the old days, SCSI was parallel but now days SCSI is only serial. You may sometimes hear it referred to as parallel and serial SCSI.

Each SCSI device has an ID value. On some devices this will be configured on the device. For example, a jumper or a counter switch on the back of the device. On other devices, this is configured by which plug the device is plugged into. For example, if you have a RAID device with 16 bays, the SCSI ID will be set by which bay the hard disk is plugged into. You can see in this setup screen that three SCSI devices have been found. It is just a matter of selecting which SCSI ID you want. In this case, which device you want to boot from. In some cases, you will need to manually configure a SCSI ID in software. Regardless of how the SCSI ID is configured, make sure you don't configure the same SCSI ID on two different devices connected to the same adapter.

If you come across SAS in your work place, remember that it is compatible with SATA. You want to use SAS devices when they are available, because they support features like bi-directional signaling, but you have the option to use SATA if you need it.

I hope you have enjoyed this video from ITFreeTraining and found it informative. Until the next video from us I would like to thank you for watching.

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