ATA/EIDE DRIVE INTERFACE

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IDE AND ATA

IDE (Integrated Drive Electronics) and ATA (Advanced Technology Attachment) are one and the same thing - a disk drive implementation designed to integrate the controller onto the drive itself. **EIDE** (Enhanced IDE) is merely a marketing program from Western Digital that builds upon a couple of real standards, ATA-2 and ATAPI (Advanced Technology Attacment Packet Interface). **Fast ATA**, launched by Seagte and endorsed by Quantum, is a response to Western Digitals' marketing that bulilds on ATA-2 only.

IDE/ATA Specifications

- Designed specifically for disk drives
- Disk buffer to host transfer rates limited to 4.1 MB/s
- Adapters connected to system expansion bus

EIDE/ATA-2 Specifications

- A compatible extension to ATA (backward compatible)
- Connects directly to system bus
- Adds support for secondary port, thus up to four devices
- Adds PIO modes 3 with transfer rates up to 11.1 MB/s
- Fast ATA-2 adds PIO mode 4 for transfer rates up to 16.6 MB/s
- Adds Multiword DMA mode 1 for transfer rates up to 13.3 MB/s
- Fast ATA-2 adds Multiword DMA Mode 2 for transfer rates up to 16.6 MB/s
- Improves upon the ***Identify Drive*** command for plug and play compatibility
- Supports LBA
- Supports enhanced BIOS (EBIOS)
- Includes provision and supports ATAPI
- Read/Write multiple commands (block mode)

ATA-3 Specifications

- Adds DMA mode 3 for 20 to 32 MB/s transfer rates

IDE (ATA) TECHNOLOGY

Introduction

Modern desktop computers come with ATA-2/EIDE (enhanced IDE) built into the mainboard. This is perfectly adequate for personal workstations. A high performance SCSI controller can be added to a new system for an extra $220. IDE and SCSI disks operate at the same speed, but SCSI has advantages for a multitasking server because it allows many devices to be performing operations at the same time.

The hard disk has one or more metal platters coated top and bottom with a magnetic material similar to the coating on a VCR magnetic tape. In the VCR the tape moves by a fixed recording and sensing device (the head). With a disk, the head is connected to an "arm" which is moved in and out along a radius of the disk circle. To read or write information, the computer or disk controller must figure out where the data is on the disk. The arm is then moved the correct distance, then it waits until the location on the disk where the data is located rotates around to the point where it passes under the head and can be transferred. The surface of the disk is preformatted into units that hold 512 byte of data (the sectors).

In the first generation of PC's, the electronics to move the arm, position, and to control the recording or sensing was placed in a separate controller card. Advances in chip technology allow this function to be done by logic on the disk which can be more easily tuned at the factory to the special features of each type of device. Today there are two technologies, IDE and SCSI.

IDE (Standard on Desktop PCs)
IDE (Integrated Disk Electronics) is the least expensive current disk technology. IDE support is usually built into the mainboard, though it is also possible to get an interface card for the ISA bus for around $30. An IDE disk is connected to the mainboard or interface card through a flat "ribbon" cable. Rather than invent a new interface, the signals in the IDE cable simply duplicate the activity on the ISA bus itself.

After Nov, 1994 vendors started to ship systems with Enhanced IDE (EIDE also called ATA-2). Classic IDE supported two hard disks of 528 megabyte or less. EIDE allows four devices, including a mixture of disks, tapes, and CD-ROM, and the hard disks can be larger.

An IDE interface cable has two plugs and can be attached to two devices. The first device acts as the master, and the second device acts as a slave. This interface is busy if either device is processing a request, so activity on one device blocks access to the other. It will generally be necessary when adding a new disk to a system to set a switch or connector on the disk to indicate if it is to function as master or slave.

When they designed the EIDE standard, they needed compatibility with all the existing IDE devices. So they didn't change the rules on the cable. An EIDE interface chip can support four devices, but it has two interface cables each connecting two devices. The EIDE chip looks and acts like two IDE chips. An old IDE disk can be connected to a new EIDE connector.

However, a new large EIDE disk cannot always be connected to an old PC. The original IBM programming interface limited the disk space to 528 megabytes (not a big problem when hard disks had 10 or 20 megs). Today there are 1 gig disks advertised for little more than $200. However, an old IDE disk interface chip may not support data beyond the first 528 megs. You can buy a new interface card for $25, but even then the BIOS on old systems will not support I/O to partitions that extend beyond 528 megs. You may need to load a new operating system (Windows 95, OS/2, or Windows NT) and the partitions containing the operating system files may have to reside completely within the first 528 megs of the disk.

Pentium systems come with Extended IDE (EIDE). The extensions overcome limits in the original IDE design:

- IDE supports only disks. EIDE supports a mixture of disks, tapes, and CDROM drives.
- IDE supports only two devices. EIDE supports up to four devices on the same controller chip although it uses two cables.
- EIDE allows disks up to 1 gigabyte. Larger disks may also work, but that is up to the vendor. IBM, for example, doesn't officially support EIDE disks larger than one gig.

Since EIDE simulated two separate IDE interface chips, there is an optimization that many customers do not fully appreciate. Newer operating systems (OS/2, Windows NT, and even Windows 95 to some extent) permit more than one I/O request to be running at a time. When a program wants to read something from a disk, the request is given to the disk interface and another program is allowed to run while the first program waits for data. However, the IDE interface allows only one of the two disks connected to the same cable to be active at a time, and any request to use the second disk will be blocked while data is being read from the first disk. An EIDE interface duplicates this IDE restriction, but since the EIDE chip looks like two IDE devices, a request can be made through the second interface while the first interface is busy.

If you run plain old DOS and Windows 3.x, it doesn't matter. Those systems will wait for any operation to complete before running any other program. However, if you are running a new system, and if you purchase a second IDE hard disk, then there is a performance advantage to putting the second drive on the second interface cable (managed by the second simulated IDE "device") rather than connecting it to the same flat disk interface to which the first disk is connected. On separate cables, the two disks can be active at the same time.

However, if you have two hard disks and an EIDE CD-ROM, then it is best to put the two disks on the same cable and isolate the CD-ROM on the second cable. A CD-ROM is much slower than a hard disk, and it will be busy longer. If it is on the same cable with a hard disk, it will block access to that disk when any request is made. Unless it is used very infrequently, the best performance will probably be provided by isolating the slow CD-ROM on its own cable.

Comparing the Fast ATA and Enhanced IDE Disk Drive Interfaces

The introduction of new high-speed microprocessors and local bus architectures for PCs has led to the development of faster disk drives and other peripheral devices. On hard disk drives, high-speed data transfer rates are essential to improved PC performance because a computer is only as fast as its slowest component. Until recently, the term Enhanced Integrated Drive Electronics (IDE) was used to identify drives with faster data transfer rates. However, **Enhanced IDE means** more than that, and the term has often been misused or misunderstood.

Quantum, Seagate, and numerous other manufacturers in the computer industry have joined together to introduce Fast AT Attachment (ATA), which represents only the high-speed data transfer rates for ATA hard drives. The term Fast ATA can be easily identified by computer users when they purchase the fastest peripherals for their notebook and desktop PC systems. Unlike Enhanced IDE, Fast ATA is based on industry standards to help ensure compatibility with older systems and disk drives. Fast ATA data transfer protocols meet the specifications of the Small Form Factor (SFF) Committee's official ATA-2 document.

The most common disk drive interface designed for the PC is the **ATA interface**, originally known as the IDE interface. The interface was designed specifically for disk drives, and when first introduced, **limited disk buffer-to-host data transfer rates to 4.1 megabytes (MB)/second**. Since that time, the ATA industry standards committee has greatly extended the capabilities of the interface to keep pace with other computer industry advancements. The introduction of accelerated data transfer rates was essential to these industry improvements.

In late 1993, a faster ATA interface, made possible by the new local bus architecture, was introduced. In this implementation of the interface, the disk drive is connected directly to the CPU bus, bypassing the expansion bus completely. Therefore, data transfer speeds are limited only by the speed of the local bus and the disk drive itself.

As with the SCSI interface, there are different implementations of the ATA interface: ATA, Fast ATA, and Fast ATA-2. The various SCSI protocols include Fast SCSI-2, Wide SCSI-2, SCSI-3, and others. End users and system designers alike can easily identify with the principal benefit of each ATA and SCSI implementation - faster data transfer rates.

Disk drives that incorporate the **Fast ATA standard** achieve the high-speed data transfers when the ANSI Standard Programmed Input/ **Output (PIO) mode 3 and Multiword Direct Memory Access (DMA) mode 1 protocols** are implemented. System and disk drive manufacturers who implement the PIO mode 3 or Multiword DMA mode 1 can **transfer data up to a maximum of 11.1 MB/second (PIO mode 3) or 13.3 MB/second (DMA mode 1).** System designers choose the protocol they want to support.

Fast ATA-2 refers to both the new PIO mode 4 and Multiword DMA mode 2 protocols (not yet available on systems). System and disk drive manufacturers who implement PIO mode 4 or Multiword DMA mode 2 will be able to **transfer data up to a maximum 16.6 MB/second (both PIO mode 4 and DMA mode 2 have the same maximum data transfer rate).** With Fast ATA-2, system designers will also choose the protocol they want to support.

Fast ATA and Fast ATA-2 are based on industry standards to help ensure compatibility with older systems and disk drives. The data transfer protocols meet the specifications of the SFF Committee's official ATA-2 document (Ref: 9048D), which has been submitted to ANSI for approval.