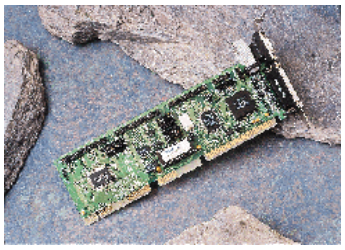
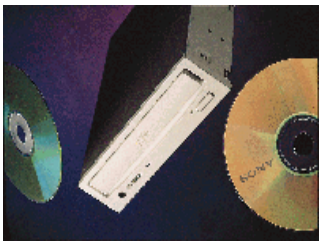
WESTERN DIGITAL

THE WORLD OF ENHANCED IDE





Welcome to The World of Enhanced IDE. This presentation by Western Digital consists of three articles that appeared as a supplement to Reseller Management magazine in May 1995. The text and graphics have been reproduced in this format using Adobe Acrobat. To view sections of the articles and data, simply click on any text that is *highlighted* in red.

The Evolution of an Interface

INCREASING SYSTEM PERFORMANCE AND DEMAND FOR GREATER DRIVE CAPACITY SPURS THE EVOLUTION OF THE IDE INTERFACE

The last year has seen developments that have practically redefined desktop computing. The list includes the establishment of 75- and 90-MHz Pentiums as mainstream processors, the increase in capacity of entry-level hard drives to 420 or 540 MB, and the enormous popularity of the CD-ROM. One of the most significant but least understood developments of this period (and one that promises to lead the way to a whole new model of what constitutes a "basic" desktop computer) is the Enhanced IDE (Integrated Drive Electronics) interface. This evolutionary extension of the standard IDE hard-drive interface occupies a central position in the effort to provide personal computers with a mass-storage connection that is flexible, fast, inexpensive, expandable, and easy to use.

"Enhanced IDE extends the life and performance of the AT-IDE interface while keeping the traditional advantages of cost, compatibility and ease-of-use," said John Burger, vice president of marketing for Western Digital's Personal Storage Group. "IDE has proven to carry a lower cost of connection, a greater degree of compatibility, and is easier to use and install in comparison to other mass storage interfaces."

The original IDE specification, also known by its ANSI Committee designation, ATA or AT Attachment, was proposed by Western Digital in 1984 and came to market in 1986 on Compaq computers. Now IDE hard drives dominate the desktop PC world. According to Dataquest figures, 74% of all 3.5" and 76% of 2.5" drives shipped in 1994 were for the IDE interface, with SCSI accounting for the remainder. Other estimates show 90% of windows and OS/2 systems running on IDE drives.

IDE succeeded because it offered a cost-effective and easy-to-manage solution to the problem of integrating hard drives on the PC platform. Combining the hard disk and its controller electronics into a single unit simplified the process of installing drives and avoided many of the configuration, compatibility, and upgrade problems possible with separate drive- and-controller subsystems. IDE also retained full backward compatibility with the ST506 subsystems that it replaced.

"Enhanced IDE extends the life and performance of the AT-IDE interface while keeping the traditional advantages of cost, compatibility and ease-of-use..."

The original IDE specification called for:

- drives of up to 528 MB
- a transfer rate of 3 MB/sec over the ISA bus
- a single I/O channel supporting two hard drives in a master-slave arrangement
- a cable limit of 18" (IDE drives are meant to be internal).

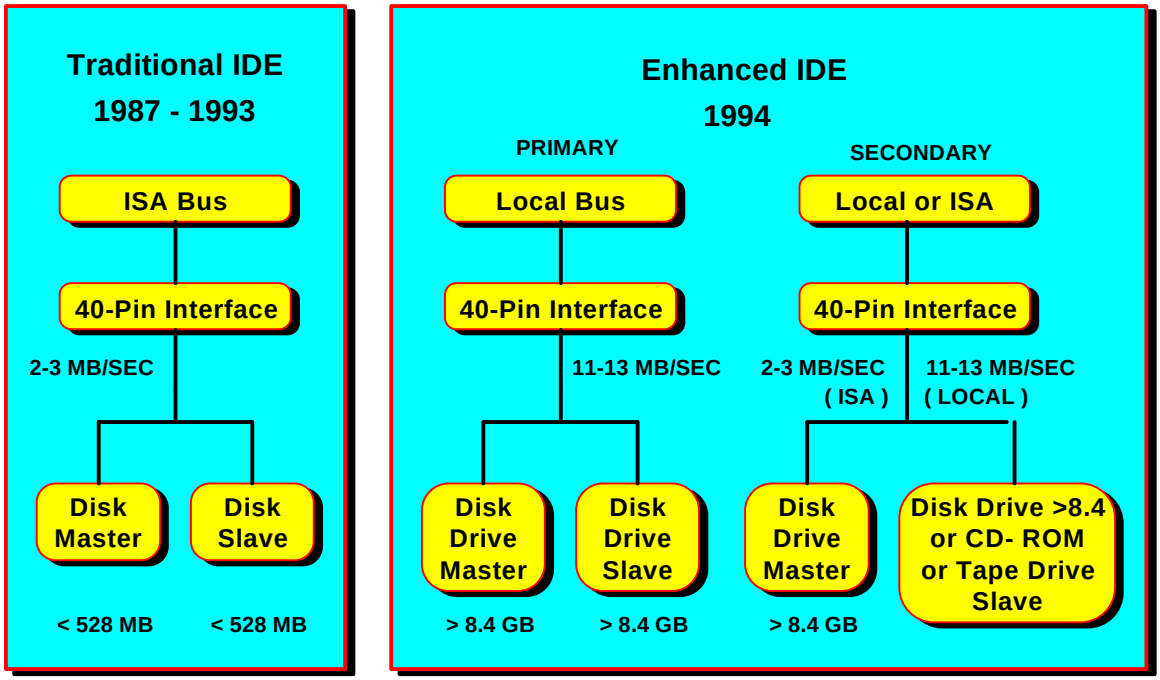
This formula was sufficient for the computers of the mid-1980s, but the evolution of the desktop PC into a high-powered workstation running a graphical user interface and multimedia applications makes new demands on the storage system. IDE still remains the best choice for a low-cost disk interface, but new technologies on either side of that interface are pushing at its limits. The three most significant factors in this push have been:

- the demand for more storage and the corresponding availability of affordable drives larger than 528 MB (see sidebar, "Insatiable appetite for storage" on pg. S3)
- fast local-bus host systems and high-performance hard drives with higher data-transfer capabilities
- the explosion of CD-ROMs and, to a lesser extent, tape drives installed on PCs, and the benefits of having a single interface for these devices.

To address these issues, Western Digital has worked with industry partners to build on the original strengths of IDE in four areas:

1) To increase the maximum drive size
2) To increase data transfer rates
3) To add a second two-device channel
4) To allow the connection of other devices, such as CD-ROM and tape drives.

Putting It All Together With Enhanced IDE



Bigger & Faster

The 528 MB limit on IDE drives has its roots in the different formats used by the BIOS's INT 13 and the IDE drive controller to determine the physical location of data on a disk. CHS (cylinder-head-sector) addressing locates data in terms of drive geometry: "Go find what's on cylinder X, head Y, sector Z." With CHS addressing, when you've reached the highest number for any one of the three locators-when the drive has more cylinders, heads, or sectors than the format can handle-you've run out of describable space, no matter how much physical space is available.

136.9 GB and the BIOS limit is 8.4 GB, but a mismatch between the details of the two formats resulted in an artificial limit of 528 MB. As a result, installing a drive larger than 528 MB has meant either "throwing away" any capacity over the limit or else using driver software to address the full disk capacity.

The Enhanced IDE solution is a set of extensions to the host BIOS that lets it translate between the methods used by INT 13 and IDE drives. The drives themselves can work with either the CHS format or a newer system, Logical Block Addressing (LBA), which has the added advantage of being independent of drive geometry. In

either case, a "translating BIOS" works transparently, so that the operating system need not be changed for large drives to be used.

On the performance side, the 2-3 MB/sec transfer rates (see sidebar, "Disk Drive Performance Factors" on pg. S4) of the original IDE specification were keyed to the speed of the ISA bus, but as drives and host CPUs got faster, that maximum became a throughput bottleneck. One way of squeezing more performance out of the original specification would be to use a faster local bus connection, but even across a VL or PCI bus, the maximum transfer rate would still be only 5.5 MB/sec, because of the drive controller's own data transfer timings.

To address this, the Small Form Factor Committee's ATA-2 specification adds new high-speed data transfer modes that match the capabilities of the local bus: PIO (Programmed Input/ Output) Mode 3 at 11.1 MB/sec and Multiword DMA (Direct Memory Access) Mode 1 at 13.3 MB/sec.

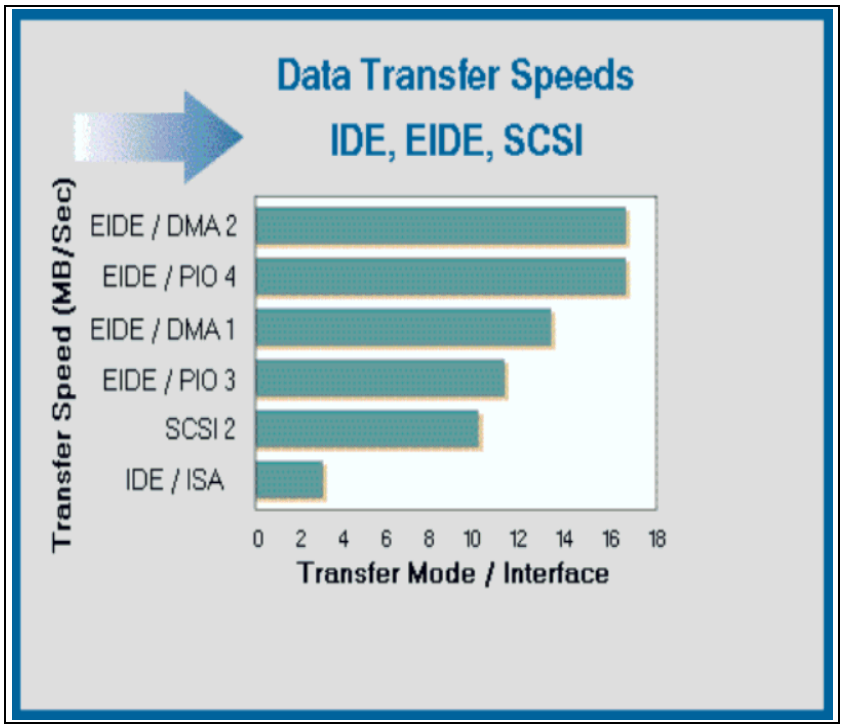
In order for a system to take advantage of high-speed transfers, not only must the drive support the particular high-speed transfer modes, but the host-side electronics must be able to accept data at the higher speeds, and there must be software (in the BIOS or a driver) that recognizes the hardware's capabilities and switches on the appropriate mode.

Two more, even faster transfer modes have also been defined. PIO Mode 4 and DMA Mode 2 will up the transfer rate to 16.6 MB/sec, and the drives and host-side chipsets that use them will be available in the very near future. In addition, there are already plans to add SCSI-like features such as command queuing and to establish a bus master specification for IDE and the PCI bus, so Enhanced IDE will be able to keep up with multitasking, multithreaded operating systems such as OS/2, Windows NT, and Windows 95-which means that the interface will keep up with the even higher performance demands of the next generation of desktop computers.

INSATIABLE APPETITE FOR STORAGE

The demands of both applications and operating system are driving the storage market. Windows programs need plenty of elbow room, while the data for media-everything from CD-quality sound clips to document images to full-motion video-gobble disk space at an alarming rate. Future operating systems will require even more space just to boot up, and there is no reason to believe that the applications will get slimmer.

The result is an apparently endless demand for bigger and faster disks, and thanks to advances in technology, those big drives get more affordable every quarter. As the storage capacity for each platter in a drive increases-and it has been doubling every 16-18 months-not only does the size of the average drive increase, but the entry-level threshold gets higher. How many system builders ship a 170 MB drive any more? Mid-level "multimedia" models now routinely come with 540-730 MB drives, with "business" systems bumped to 850 MB or more. Meanwhile, retail prices in the upgrade market are well under $.50/MB, and 1-1.2 GB drives are already on the shelves of superstores.



ROM and tape drives that allows them, like IDE hard drives, to be attached directly to a host by an IDE cable. (See sidebar "A New Standard for CD-ROM and Tape: ATAPI," at right.) The second channel, whether its connector is on the motherboard or a plug-in card, can be designed to communicate with a local or ISA bus and thus can support either the old or new data transfer modes.

More channels, more devices

Hard drive size and speed are only half the story, because hard drives are not the only high-capacity devices being used in desktop computing. The CD-ROM has become a near-universal peripheral on new systems and is a popular add-on by itself and in the multimedia kit aftermarket. But the competing interfaces, proprietary and SCSI, used by manufacturers have made both vendor integration and end-user installation a confusion of hardware connections, interrupts, DMA channels, and driver software.

Enhanced IDE offers a way around this multiplication of interfaces by defining a second two-device channel for the host and a new standard, ATAPI (AT Attachment Packet Interface), for CD-

Since the majority of desktop users need a CD-ROM or tape connection, a common implementation of the second IDE channel is as a "slow" channel connected to the ISA bus, while the primary "fast" channel serves the hard drive(s) via the local bus. Or systems can be designed with fully configurable dual channels, permitting the use of four high-speed devices.

Enhanced IDE CD-ROMs have rapidly replaced proprietary-interface products in the new-systems market, as both peripheral manufacturers and system builders seize on the advantages of a single, low-cost connection. The home-oriented multimedia kit market is not far behind in its acceptance of Enhanced IDE, with IDE CD-ROM connections appearing on sound boards

DISK DRIVE PERFORMANCE FACTORS

While the performance of a hard disk system can sometimes be summed up by a single number such as the throughput or data transfer speed, the final number depends on the interaction of three components of the host-disk system:

- The disk transfer rate-the speed at which data can be read from or written to the drive's media-is governed mainly by drive mechanics. Rotational speed and latency and seek time are the major factors here.
- The controller transfer rate-the speed at which the drive's controller electronics can move data across the interface-is governed by the design of the integrated drive controller.
- The host transfer rate-the speed at which the computer can transfer data across the interface-is a matter of both CPU and bus speeds as well as the hardware that provides the bridge between the host bus and disk interface.

Both host computers and hard drives have gotten dramatically faster since IDE was introduced-so much faster that the IDE interface itself, designed for the ISA bus, became the slowest component in the data transfer chain. The introduction of the local bus offered a high-speed, 32-bit-wide data path for a disk system, but taking advantage of it required adding to the IDE specification new transfer modes. The results are PIO Modes 3 and 4 and DMA Modes 1 and 2, which can boost the overall data transfer rate to between 11.1 and 16.6 MB/sec.

In order to take advantage of these, not only must the controller and host computer be able to implement a given mode, but the drive's own disk transfer rate has to be a match for the controller and host. If the drive's disk transfer rate is 8 MB/sec, for example, there is no gain in invoking PIO Mode 4.

.The tape drive is the other mainstream peripheral that benefits from ATAPI. Most desktop systems that have tape backup depend on a floppy-interface minicartridge drive. While these products are inexpensive, they are also slow, and a full backup of several hundred megabytes of data can take hours and require multiple tapes. Enhanced IDE tape drives offer immediate speed improvements, and the tape formats used (QIC-Wide, DAT) have much higher capacities, making for a better match between hard drives and backup systems.

"Enhanced IDE's support of non-disk peripheral support opens the mainstream PC market to cost-effective, easy-to-use multimedia systems," said Western Digital's John Burger. "We are pleased at the incredible industry support that has developed behind our ATAPI standard. We initiated this activity at the request of several of our key OEM customers, who asked us to apply our long-standing IDE expertise and assist them in the development of a single, compatible IDE CD-ROM interface to further enable Plug-and-Play multimedia systems. It is exciting to see the industry sharing the same vision. Together we've delivered a cost-effective solution, as well as assisted in the continued growth of the standard with areas such as tape."

A NEW STANDARD FOR CD-ROM AND TAPE: ATAPI

The AT Attachment Packet Interface (ATAPI) specification does for CD-ROM and tape drives what ATA-2 does for hard drives: it defines device-side characteristics for an IDE-connected peripheral. The benefits of having a single interface for the most common non-disk storage device in the desktop world, the CD-ROM, are obvious. For the manufacturer, there is no need to add a separate controller card for the CD-ROM. For the aftermarket reseller, there are no worries about compatibility and installation. For the end-user, no more fussing with interrupts, cards, and proprietary driver software.

ATAPI adapts the established SCSI command set to the IDE interface; this has allowed the quick development of the interface for IDE CD-ROM and tape drives. It also allowed Enhanced IDE CD-ROMs to remain compatible with the Microsoft CD-ROM Extensions (MSCDEX) that have become the standard drivers for CD-ROMs.

An adaptation of ATAPI for tape drives has been published by the QIC (Quarter-Inch Cartridge) standards committee. IDE tape drives promise faster backups of increasingly bulky hard disks than are possible with floppy-interface units, and without resorting to proprietary dedicated controllers or moving up to the SCSI-based DAT format.

As more ATAPI-compliant peripherals become available, the standard desktop machine can be configured with not only one or two high-capacity disk drives, but CD-ROM and tape backup, all running from a single, affordable interface. At the moment, CD-ROM and tape cannot share the same channel, but with the addition of ATAPI bus-management software by the middle of this year, they will

WESTERN DIGITAL

Interface TradeOffs: Enhanced IDE, SCSI, & Fast - ATA

Choosing the right interface for your needs

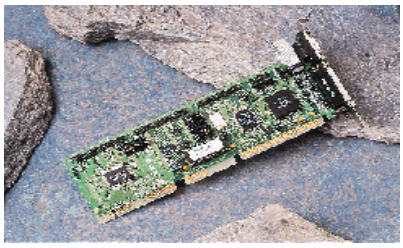
In some application areas-multimedia, document image processing, CAD-there is no such thing as too much storage or too much speed. For these areas, one way of getting bigger, faster hard drives and more devices has been to "go SCSI." Despite lower prices and improvements in ease-of-use for SCSI interface products, though, this remains a relatively pricey solution, and one that still requires dealing with the kind of technical details that most end-users could do without.

Now, Enhanced IDE provides an alternative to SCSI for the overwhelming majority of desktop users. Enhanced IDE combines the low cost and ease-of-use of IDE with the SCSI-like features and functions most needed in desktop computing. High-capacity Enhanced IDE drives are less expensive than their SCSI counterparts, and the second IDE channel allows the connection of up to four internal devices, eliminating the need for a second controller card (and its accompanying drivers and settings for interrupts and ports) for CD-ROM and tape.

Despite Enhanced IDE's SCSI-like features, the two interfaces are not really direct competitors. IDE has been designed and optimized for desktop computing, emphasizing low cost and ease of implementation. Enhanced IDE's four internal devices are a close fit for what desktop users need, while SCSI's mix of up to seven internal or external devices, its host-independence, and its general-purpose design suit it to the world of large file servers and high-performance workstations.

Small file servers should not, however, rule out Enhanced IDE. With drive sizes of up to 8.4 GB possible currently and 1.6 GB and larger drives priced at less than fifty cents a megabyte, Enhanced IDE systems offer impressive bang for the buck. Add support for the data security of NetWare's mirroring and the possibility of connecting CD-ROM and tape backup to the same interface, and it's clear that Enhanced IDE can handle single-office or departmental networks.

Enhanced IDE combines the low cost and ease-of-use of IDE with the SCSI-like features and functions most needed in desktop computing.



By any other name

The ATA-2 specification published by the Small Form Factor Committee represents one part of the overall solution offered by Enhanced IDE. The ATA-2 standard addresses data-transfer speed and device size by defining additional transfer modes and addressing schemes, but it deals only with the hard drive and does not by itself offer a second channel or the ability to connect CD-ROM and tape.

Drive makers Seagate and Quantum use the terms "Fast ATA" and "Fast ATA-2" to describe drives that meet the SFF ATA-2 specification. The Fast ATA campaign focuses on drive-side specifications and features, particularly high-speed data transfer modes, while the Enhanced IDE effort aims at expanding the scope as well as the performance of the IDE connection.

There are, however, no real compatibility or technology conflicts between Fast ATA and Enhanced IDE. A Fast ATA drive installed in an Enhanced IDE environment will provide all the benefits offered by that system's IDE interface because it implements the same ATA-2 specification. While there may be engineering and performance differences between drives marked "Fast ATA" and "Enhanced IDE," those differences have nothing to do with their relationship to the standard- when it comes to hard drives, Fast ATA is essentially a subset of Enhanced IDE.

WESTERN DIGITAL

Systems, Peripherals & Upgrades

A glance through the specs for nearly any major computer maker demonstrates that Enhanced IDE is already following the local bus into the mainstream of desktop computing. At the center of this are system builders, listening to customer needs and finding the cost-effective (and profitable) solutions that will satisfy them. With Enhanced IDE, they have found a way to integrate the big, fast hard drives and CD-ROMs that their customers want without driving up the manufacturing and support costs.

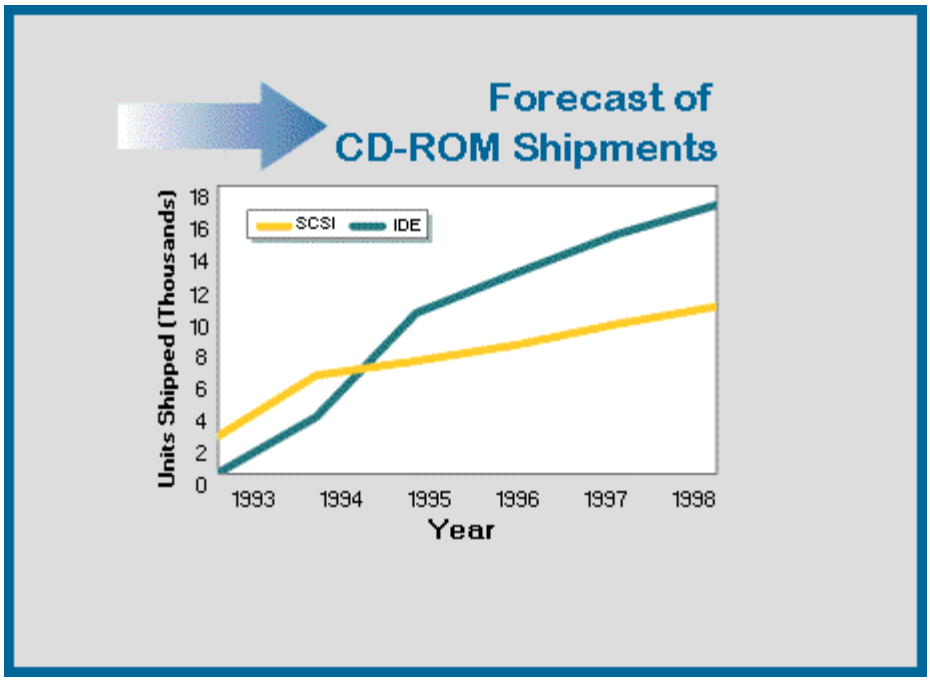
Major system vendors settled on Enhanced IDE as the best interface for single-user DOS/Windows systems, with the transition to SCSI coming at either the file server level or when the operating system requires a multitasking peripheral interface. Over the last year, the middle range and up of desktop systems have moved to Enhanced IDE, first for the hard drives and then for the CD-ROM which has become almost as standard as a floppy drive or mouse.

The appeal to the end-user is obvious. As Greg Weir, peripherals marketing manager of Dell points out, "En-hanced IDE is essentially free to the customer when it's integrated on the board. You've got local bus, you've got great performance. What else could you ask for? Mode 3 PIO today with 11 MB/sec, that's great stuff-it's SCSI-like performance. And there's compatibility because the peripherals are industry-standard."

On new systems, an Enhanced IDE BIOS is now the rule. American Mega-trends (AMI) has been shipping an En-hanced IDE BIOS for more than a year, and Mark Huffman of AMIBIOS marketing reports that "The overall worldwide demand is almost 100% in concert that they want Enhanced IDE on every board shipped. That is a necessary component of the BIOS." Enhanced IDE is also standard on Phoenix Technologies' BIOS products. John Archer of Phoenix says that "There probably are no Phoenix BIOS customers who are not shipping Enhanced IDE," citing as its main appeals driverless support for large disk drives and the second channel as a low-cost, non-proprietary connection for CD-ROM.

CD-ROM

One of the most dramatic signs of the impact of Enhanced IDE is in the creation of ATAPI, an industry



standard Enhanced IDE interface for CD-ROMs. Manufacturers have shifted from a mix of SCSI and SCSI-related proprietary interfaces to just two: ATAPI and SCSI. Dataquest projections show Enhanced IDE CD-ROM shipments nearly tripling from 1994 to 1995-and surpassing SCSI as well. Mitsumi, for example, has been shipping Enhanced IDE CD-ROMs exclusively for the last year. Most of their production goes to system vendors for inclusion in multimedia machines, with a smaller portion for the aftermarket.

Sony is another major vendor committed to Enhanced IDE, which has become "the volume interface, the interface of choice," according to senior marketing manager for CD-ROM products Patty Kim. "We decided we would pursue Enhanced IDE because it gets us out of the proprietary environment and into an open architecture," she continues. "If you look at the history of the computer industry, there are very few peripherals that have proprietary interfaces at this point in time." While there will be no more proprietary CD-ROMs from Sony, SCSI will continue to serve as a development platform for new and high-performance products, but, according to Kim, "once that performance is nailed down in a SCSI interface, what usually happens is that an IDE replacement or an IDE interface product that delivers the same type of performance, usually at a cheaper price point, will be available....It is sort of a trickle-down."

One indication of the future direction for the ATAPI specification is the joint development by Phoenix Technologies and IBM of an extension for a bootable CD-ROM. According to Phoenix's John Archer, the CD-ROM Boot Specification is not part of ATAPI but

"leverages the ATAPI capability... without ATAPI, this option would not be possible in the IDE world....It's one of the big benefits of having ATAPI capability in an IDE CD-ROM,...the option, if you're a manufacturer, of including a bootable CD, and the BIOS can recognize it and boot from it." Possible applications include CD-ROMs with multiple operating systems, self-configuring abilities, whole software suites, or copy-protected data or programs.

Tape

Tape backup market for desktop systems has focused on very low-cost, and correspondingly low-capacity and -performance products. The floppy-controller connection that made the dominant QIC-80 drive inexpensive also serves as a speed bottleneck, and the time and the number of tapes needed to back up a large drive are hardly incentives for good data protection practices. The combination of the second IDE channel and the ATAPI specification for tape drives points the way to products that will make desktop backup, if not a pleasant, at least a less burdensome chore.

The first Enhanced IDE tape drive to ship is Conner's TapeStor 4000-IDE, aimed straight at that part of the market constricted by floppy-interface backup. Using QIC-Wide minicartridges, the 4000-A has a native capacity of 2 GB (up to 4 GB compressed), enough backup storage even for a multimedia power-user's desktop system. Through its FastSense feature, the drive adjusts its transfer rate to match the speed of its host, downshifting from 27 to 18 to 12 MB/minute as needed. Conner's Michael Helsel says that it has the same performance as their SCSI drive. "The advantage of IDE," he says, "is that it offers a lower-cost connection than SCSI and higher performance than floppy."

The only problem at the moment is that tape and CD-ROM drives cannot yet share the same channel on a controller without some software help. Either device can occupy the bus by itself, but when the both are attached, they need an ATASPI (AT Advanced SCSI Programming Interface) bus manager to route commands to the right device. A universal ATASPI bus manager is being developed by a consortium of drive, controller, and software vendors; it will be available by mid-year, at which point CD-ROM and tape will be able to peacefully coexist on the same channel.

The upgrade market

While Enhanced IDE is the wave of the future, there are plenty of systems from the past (which may mean only last year) that will be around for some time yet. This means that the Enhanced IDE upgrade market will be a busy place, as offices full of machines with otherwise modern capabilities get retrofitted to take advantage of the big hard disks and Enhanced IDE CD-ROMs and tape drives that extend their useful lives.

John Archer of Phoenix says that "probably the most sought-after

upgrade today [is] the ability to support large disk drives without drivers." Upgrading a whole BIOS is not the first thing most users think of, but it can be done, and if the target machine uses FLASH ROM, it's a fairly straightforward matter.

For a machine without a translating BIOS, Microhouse's EZ Drive software provides the necessary extensions, as well as offering automated setup of new drives, support for a secondary channel (when the hardware is present), and a 32-bit Windows driver for bigger-than-528 MB drives. EZ Drive's BIOS extension works differently from the usual device driver in that it does not load from the CONFIG.SYS file. Instead, its code is copied onto the master boot record of the drive itself, where it executes at bootup. A 4K resident portion makes sure that the host BIOS's INT 13 calls get translated into the right format for the drive.

Controller-card vendors are aiming at both the OEM and upgrade/retail markets. Acculogic, CMD Technology, DTC Data Technology, and Promise Technology all include in their lines the sort of multi-I/O local bus cards (with high-speed serial and parallel ports and floppy controller) that turn a minimalist motherboard into a functioning computer. For VARs and dealers who build their own systems, these products offer access to all the benefits of Enhanced IDE.

The upgrade market is much less straightforward, thanks to the variety of systems that are candidates for some sort of retrofit. Near-miss computers-nearly-new machines with an open local bus slot and an original-spec IDE connector, but lacking a translating BIOS and a second connector-can have it all by plugging in a controller with high-speed mode support, dual channels, and an on-board BIOS. Original-version IDE systems with an IDE motherboard connector but without local bus slots can gain three of the four key benefits of Enhanced IDE, but they will not have access to high-speed data transfers, due to the ISA bus speed limit. For these systems there are ISA-based cards from Acculogic and Promise that offer both large-drive support and a second two-device channel-or, if it's just a second channel for CD-ROM or tape that's needed, Accu-logic and Promise have a board just for that.

Finally, there's another kind of upgrade altogether, the kind that brings to the desktop functionality and features not yet common there. For example, CMD Technology has developed software that brings disk mirroring (RAID Level 1) to DOS and Windows. WinRAID works with controllers (whether plug-in or embedded on the motherboard) based on CMD's Enhanced IDE chipsets and is available as an add-on for their own hardware and as a reseller/VAR/integrator product. "A few years ago, we wouldn't need this," says CMD's Robert Leondis, "but now with the capacity levels you're putting on a desktop, you actually do need some kind of real-time backup."

On the hardware side, vendors are also anticipating features that have yet to show up on the newest system boards. CMD's PCI-06046, DTC's 2132D, and Promise's DC5030 PCI bus-mastering cards are not yet main-stream products,

but their appearance this early points to how quickly the combination of Enhanced IDE and local bus architecture is preparing for the multitasking, multithreaded operating systems that will bring the next redefinition of desktop computing.

For a partial list of EIDE manufacturers, please *Click Here*

Enhanced IDE is already following the local bus into the mainstream of desktop computing. System bulders are listening to customer needs and finding solutions that will satisfy them.

TECHNICAL SOURCE DOCUMENTS

1) AMIBIOS 101094 Enhanced IDE Support, American Megatrends, Inc., Revision 2.0, October 1994.
2) ATA Packet Interface for CD-ROMs, Small Form Factor Committee, SFF-8020, June 1994.
3) ATA Packet Interface (ATAPI) for Streaming Tape, Quarter-Inch Cartridge Drive Standards, Inc., QIC-157, June 1994.
4) AT Timing Extensions for Local Bus Attachment, Rev.1.0, Small Form Factor Committee, SFF-8011, August 1993.
5) "El Torito" Bootable CD-ROM Format Specification, Version 1.0, Phoenix Technologies and IBM, November 1994.
6) Enhanced Disk Drive Specification, Version 1.0, Phoenix Technologies, January 1994.
7) Western Digital Enhanced IDE Implementation Guide, Revision 5.0, November 1993.

GLOSSARY

ATA: The AT Attachment specification defines the original IDE interface for the ISA bus. It is fully backward-compatible with the ST-506 standard that it superseded.

ATA-2: The second-generation AT Attachment specification for IDE devices that defines faster data transfer speeds and LBA sector-locating method.

ATAPI: AT Attachment Packet Interface is the IDE standard for CD-ROM and tape drives. Like the ATA and ATA-2 specifications, this defines the command and connection characteristics of the peripheral device.

CHS: Cylinder-head-sector; the method for identifying a given location on a hard drive used by original PC-AT BIOS (INT 13) and original IDE specification. Differences between details of the two methods resulted in the 528 MB limit on IDE drives. Enhanced IDE-compliant BIOSes can translate between the two methods, allowing drive sizes up to 8.4 MB.

Data transfer rates: Can be broken down into the disk or media rate (the speed at which data can be read from or written to the disk's platters); the controller rate (the speed at which the drive can transfer data across the IDE interface); and the host rate (the speed at which the host computer can transfer data across the IDE interface). Enhanced IDE adds high-speed transfer modes for the controller (see DMA, PIO-3 and PIO-4).

DMA: Direct Memory Access; a DMA Multi-word mode of data transfer is defined in ATA-2 to take advantage of the higher data transfer speeds possible with local bus connections.

Fast ATA, Fast ATA-2: Marketing terms used by Seagate Technologies and Quantum Corp. to indicate compatibility with the SFF ATA-2 high-speed transfer modes. Fast ATA drives support PIO Mode 3 or DMA Mode 1; Fast ATA-2 supports PIO Mode 4 or DMA Mode 2. Fast ATA is essentially a subset of Enhanced IDE.

INT 13: The BIOS interrupt for general disk services. The mismatch between the methods used by INT 13 and the original ATA implementation to calculate disk size resulted in the 528 MB limit on IDE hard drives. Enhanced IDE specifies a way for a BIOS to translate between the methods used by INT 13 and the hard drive's embedded controller.

LBA: Logical block address numbering; an Enhanced IDE-supported method of identifying a given location on a hard drive that permits disk sizes greater than 528 MB.
PIO Mode 3, PIO Mode 4: Processor Input/Output modes defined in ATA-2 to take advantage of the higher data transfer speeds possible with local bus connections. PIO-3 speed range from 11-13 MB/sec and PIO-4 from 13-16 MB/sec.

SFF: Small Form Factor Committee, the body that devised the ATA and ATA-2 specifications.

Translating BIOS: An Enhanced IDE-compliant BIOS designed to permit the use of drives larger than 528 MB by translating between INT 13's native CHS data and LBA or the IDE CHS
format.

Reference Materials

Western Digital has developed an Enhanced IDE logo program supported by those manufacturers meeting the appropriate Enhanced IDE specifications. These products, warranted by their respective companies, carry the blue EIDE logo. A partial list of manufacturers appears below.

ENHANCED IDE PARTNERS & RESOURCES

NAME	COUNTRY	PHONE
Enhanced IDE CD-ROM		
Sony Electronics	USA	(408) 955-4344
Wearnes Technology	USA	(408) 432-1888
Hitachi	USA	(800) HITACHI
Enhanced IDE Controller Cards		
Acculogic Inc	USA	(714) 454-2441
CMD	USA	(714) 454-0800
DTC	Germany	0211-597980
DTC	USA	(408) 942-4000
Longshine	USA	(310) 903-0899
Promise Technology	USA	(408) 452-0948
Tekram	USA	(512) 418-1221
Tyan Computer Corp.	USA	(408) 956-8000
GSI	USA	(800) 486-7800
Enhanced IDE Disk Drives		
Western Digital	USA	(800) 832-4778
Enhanced IDE Software Drivers		
Microhouse International	USA	(800) 926-8299
Ontrack	USA	(612) 937-1107
Enhanced IDE Chip Set		
Symphony	USA	(408) 986-1701
Enhanced IDE BIOS		
American Megatrends Inc.	USA	(800) 828-9264
Phoenix Technology	USA	(714) 440-8000
Enhanced IDE Tape Drives		
Conner Peripherals	USA	(800) 6-CONNER

FREQUENTLY-ASKED QUESTIONS

Q: What do I need to get all the benefits of anEnhanced IDE hard drive on my system?

A: There are two sets of issues here: 1) recognizing drives larger than 528 MB, and 2) taking advantage of high-speed data transfer modes. Size recognition is taken care of by the host computer's BIOS or, for older machines, driver software or the BIOS extensions on an add-on controller card. High-speed data transfer requires a local-bus connection and support in the IDE interface chipset. In addition, the BIOS or driver needs to recognize the appropriate transfer mode and tell the hardware on the drive and host interface to switch on.

Q: Do all Enhanced IDE systems and controllers have dual channels? Can they all run at high speed?

A: The second channel can be implemented in a number of ways.
Many motherboards and local bus plug-in adapters offer two channels that can support high-speed devices on both. Adapters aimed at the upgrade market, though, vary according to the host's bus and features offered. Some offer only a fast local bus primary channel and a slow ISA bus secondary channel, while ISA adapters might offer primary or secondary only. It should be possible, how-ever, to add a primary and a secondary channel to almost any reasonably modern computer.

Q: Do I need operating system support for Enhanced IDE?

A: The operating system is not directly involved in the parts of Enhanced IDE that deal with large hard drives and high-speed data transfer-these are handled by a combination of hardware and the BIOS or driver software. Operating systems can, however, recognize IDE non-disk devices. OS/2 Warp and Windows NT can autodetect Enhanced IDE CD-ROMs, as will Microsoft Windows 95. In the future, multitasking and multithreading operating systems will require a closer connection between the OS and the drive interface, and that an area where Enhanced IDE will continue to develop.

Q: Is Enhanced IDE a standard?

A: Enhanced IDE is an open architecture that includes standards developed by the Small Form Factor Committee-ATA-2 and ATAPI CD-ROM-as well as the ATAPI specification for streaming tape from the QIC (the Quarter-Inch Cartridge) standards organization. In addition, the elements of an Enhanced IDE-compliant BIOS are described in Phoenix Technologies' Enhanced Disk Drive Specification and American Megatrends' AMIBIOS Technical Manual. Other components of Enhanced IDE - the second channel and the requirements of BIOS and support software - are described in Western Digital's Enhanced IDE Implementation Guide.

In this situation, no single organization or vendor can "own" Enhanced IDE, but Western Digital has played a leading role in promoting it and, through product testing and dissemination of technical information, is working to ensure that Enhanced IDE products will work together as the interface continues to evolve.

Q: How is Enhanced IDE different from Fast ATA?

A: Fast ATA and Fast ATA-2 are terms used by a number of vendors to identify and promote high-speed hard drives that comply with the ATA-2 specification. Since Fast ATA concerns only the hard drive itself, it is essentially a subset of Enhanced IDE, and Fast ATA drives can be used interchangeably in Enhanced IDE systems.

Q: Is Enhanced IDE a replacement for SCSI?

A: While it does offer SCSI-like features such as dual channels and support for multiple devices, Enhanced IDE is not intended to supplant SCSI in large file servers and high-performance workstations that need to connect to a wide variety of peripherals. It does, however, give desktop PCs a cost-effective way of adding large hard drives, CD-ROMs, and tape drives without the expense and complexity of adding a SCSI controller.

Q: Will there be other IDE or ATAPI peripherals, the way there is a variety of SCSI devices?

A: The ATAPI extensions can be adapted to various kinds of peripherals, so there is nothing in principle preventing other Enhanced IDE devices. But as with CD-ROM and tape, the incentive has to be there in the form of a large potential market to make the effort worthwhile. Removable-media devices, particularly CDR (CD-Recordable), might be an area to watch in this regard.

How to contact Western Digital

For the most up-to-date information on Enhanced IDE, you can contact Western Digital four ways:

Call (800) 832-4778.
Log onto the Western Digital BBS at (714) 753-1234.
Send e-mail via the Internet: HTPP://WWW.WDC.COM.
Call the automated fax service, Autodoc Fax: (714) 932-4300.

How to contact the Editor

This PDF document was prepared for Western Digital by Rick Harris, Sysop of the Benchmarks and Standards Forum on Compuserve. If you found this presentation to be useful, contact Rick for details on how this and other information distribution techniques may be applied to meet your needs.

CSIS E-mail, 74431,2534
CSIS Benchmark & Stds, *SYSOP
Inet, 74431.2534@compuserve.com