



# Tough customers

## contents

### EIDE hard drives

- 194** IBM DeskStar 34GXP  
Maxtor Diamond Max Plus 40  
Quantum Fireball CX
- 197** Quantum Fireball Plus KX  
Seagate Barracuda ATA  
Seagate U8
- 198** Western Digital Caviar 307AA

### SCSI hard drives

- 198** IBM UltraStar 18LZX  
IBM UltraStar 36ZX
- 201** Quantum Atlas IV  
Quantum Atlas 10K  
Seagate Barracuda 50
- 202** Seagate Cheetah 18LP  
Seagate Cheetah 36  
Western Digital Enterprise

**204** Disk drive interfaces

**207** Test results

**211** Table of features

**212** Editor's Choice

• Hard drives tested by David Ludlow and reviewed by Riyad Emeran.

**You can never have too much hard-disk space, and a good hard drive can mean the difference between waiting for data or getting on with your life. To help you make that all-important decision, we've put 15 EIDE and SCSI drives through their paces.**

**A**s components go, processors seem to get the most exposure. People usually decide what PC they are going to buy on the speed and type of the CPU. However, the hard disk is a very important part of a PC and deserves a great deal of consideration before purchase as well.

A hard disk is also one of the only components that you can upgrade your PC with, without having to discard the old one. Your system will run quite happily with more than one hard drive inside it. That said, you're still best buying the best hard drive to suite your needs in the first place.

A hard disk can affect the performance of a system and the amount of hard-disk space can directly affect what type of work can be done on a machine.

There are generally two types of hard-disk interface, EIDE and SCSI. EIDE tends to be the standard for everyday use, while SCSI tends to fall more in the realm of the professional, a fact that is born out by the price premium paid for SCSI drives.

To cover the market fully we tested both EIDE and SCSI devices. So, if you want to find out who offers the best storage solution, read on.

## IBM DeskStar 34GXP

EIDE



**IBM HAS MADE A** big splash in the hard-disk market recently, producing large, high-performance EIDE devices that have tempted many workstation users away from SCSI.

This 34GB disk makes good use of IBM's GMR (giant magneto resistive) head technology, squeezing an impressive amount of data across only five platters and maintaining the standard 1in-high form factor.

This drive should handle almost anything you throw at it, including video or sound editing. The spin rate of 7,200rpm produces an average latency of 4.17ms. While the drive interface conforms to the latest UltraDMA66 standard. The 2MB data buffer is up there with the SCSI drives and should ensure a smooth transfer of data.

However, the most impressive aspect of this drive is the price. At £205 ex VAT, the DeskStar 34GXP provides a price per GB of £6. Compare this to a SCSI drive

and you'll see why the EIDE option is becoming more attractive. The drive's performance is almost as impressive as the price, with the 34GXP performing the sequential write test faster than both the 7,200rpm SCSI units. However, the score of 0.85Mbytes/sec in the random read and write test was some way behind the SCSI devices.

### DETAILS

★★★★

**PRICE** £240.88 (£205 ex VAT)

**CONTACT** IBM 01475 898 125

[www.ibm.com/harddrive](http://www.ibm.com/harddrive)

**PROS** High capacity, reasonable value

**CONS** There are faster and cheaper devices available

**OVERALL** A good high-capacity EIDE drive

## Maxtor Diamond Max Plus 40

EIDE



**THE MAXTOR IS THE LARGEST** EIDE hard disk on test, sporting a whopping 40GB. The data density of the drive is amazing, with 40GB spread over only four platters and serviced by eight GMR

heads. Data density can directly affect the performance of a hard disk. The closer the data is packed together, the less distance the heads have to move to read that data – ultimately speeding up the overall performance.

Consequently, the Maxtor was able to perform the sequential write test faster than any other drive, including the SCSI units. It did only manage 0.8Mbytes/sec during the random read and write test, though.

Performance is also aided by the 7,200rpm spindle speed, currently the fastest spin rate supported by EIDE drives. The data buffer matches the SCSI drives at 2MB.

However, the Maxtor isn't just very fast, it also offers great value for money.

With a price of £230 ex VAT, the Maxtor turns in a cost per GB of only £5.75.

Maxtor has produced an incredible EIDE solution for the very space-hungry user. If you need masses of space and fast EIDE performance, the Diamond Max Plus 40 is definitely worth a look. For the video editor on a budget, it's a dream come true.

### DETAILS

★★★★★

**PRICE** £270.25 (£230 ex VAT)

**CONTACT** RK Distribution 01844 261 226

[www.maxtor.com](http://www.maxtor.com)

**PROS** Very high capacity, fast

**CONS** Higher cost per GB than the Seagate

**OVERALL** If the Seagate is too small, this is a great alternative

## Quantum Fireball CX

EIDE



**THE QUANTUM FIREBALL** hard disk was a formidable unit a few years ago. Quantum moved up to a spindle speed of 5,400rpm, while much of the competition were stuck on 4,500rpm.

The result was that the Fireball became the most sought after EIDE hard disk.

Unfortunately, Quantum didn't keep up the momentum and many other drive manufacturers stole its thunder.

Now Quantum has split its drives into two distinct categories, the 5,400rpm value drives and the 7,200rpm performance drives. This unit falls into the former category.

The areal density is fairly low, with the 20GB spread across six physical platters. This is disappointing, since the 28GB Seagate Barracuda spans only four platters. The fact that Quantum has used standard magneto resistive heads instead of GMR ones is probably the reason for this.

Another strange decision was

deciding to equip the drive with only a 512KB data buffer. Since the majority of the drives on test have a 2MB buffer, the Fireballs are a little lacking.

Unfortunately, the Fireball CX can't even be saved by its price. At £135 ex VAT it's only £8 cheaper than the Seagate Barracuda, that is both faster and more capacious.

### DETAILS

★★

**PRICE** £158.62 (£135 ex VAT)

**CONTACT** Quantum 01344 353 500

[www.quantum.com](http://www.quantum.com)

**PROS** None

**CONS** Slow, small data buffer, expensive

**OVERALL** The Fireball CX is completely eclipsed by the competition



## Quantum Fireball Plus KX

EIDE



**ALTHOUGH QUANTUM DESIGNS** its own drives, they are actually manufactured by Matsushita, more commonly known as Panasonic in the west. It's been a fairly successful partnership so far, with

Quantum generating good design ideas and Panasonic providing the production capacity. Unfortunately Quantum's design prowess seems to have deserted it, at least with its EIDE range of disks.

The Fireball Plus KX falls into the high-end range of Quantum's EIDE hard disks, and spins at a rate of 7,200rpm. Unfortunately, the Fireball KX shares the small 512KB data buffer of its slower sibling. That said, performance wasn't all bad. The sequential write was far from impressive, but it managed a very healthy 0.9Mbytes/sec transfer rate in the random read and write test.

However, even with the impressive random-access transfer, this particular Fireball KX is difficult to recommend. With a capacity of only 10GB, the KX

still costs just over £100 ex VAT, turning in a cost per GB of around £10. That's almost twice the cost of the Seagate Barracuda. The KX is also a little behind in the technology stakes, using MR heads instead of the latest GMR heads for greater areal density. Ultimately, spending a little bit more money will get you a lot more disk.

### DETAILS

★★

**PRICE** £123.37 (£105 ex VAT)

**CONTACT** Quantum 01344 353 500

[www.quantum.com](http://www.quantum.com)

**PROS** Fast random transfer rate

**CONS** Low capacity, small data buffer

**OVERALL** The Fireball KX exhibits poor value and dated technology

## Seagate Barracuda ATA

EIDE



**SEAGATE HAS A STRONG** reputation for producing quality SCSI hard disks with well-known brand names. So far, however, no such brand awareness has been evident in its EIDE devices, until

now. The Barracuda is one of Seagate's most successful brands – it took a relative strangle-hold on the SCSI market a few years back. Now Seagate has decided to brand its high-end EIDE drives with the Barracuda name as well – definitely a smart move.

Being aimed at the high-end EIDE market, the Barracuda's spin speed is 7,200rpm, and this makes it a quick performer. In fact, it was the second-fastest drive in the sequential write test and managed 0.89Mbytes/sec in the random read and write test.

There is also one feature that sets this drive apart from the competition. On the underside of the drive casing you'll find detailed installation instructions. It even has illustrations,

showing how the EIDE cable should be inserted. Although this information will be redundant for many installers, for the novice user it's a great bonus.

Add the fact that there's 28GB of storage space for the reasonable price of £143 ex VAT (a cost per GB of only £5.10) and the Barracuda ATA looks even more attractive.

### DETAILS

★★★★★

**PRICE** £168.03 (£143 ex VAT)

**CONTACT** SMC Direct 01753 550 333

[www.seagate.com](http://www.seagate.com)

**PROS** Fast, capacious, great value, good installation instructions

**CONS** None

**OVERALL** The best EIDE hard disk available



## Seagate U8

EIDE



**SEAGATE'S SECOND ENTRANT** into the EIDE section is a more budget-oriented model than the award-winning Barracuda. In fact, it's the cheapest disk on test, with the very affordable price

tag of only £85 ex VAT. That said, considering its capacity is only 13GB, you're only getting a cost per GB of £6.53. Not the best value for money, but if you can't stretch your budget too far, it's not bad.

Unlike the Barracuda, this drive spins at only 5,400rpm bringing in an average latency of 5.56ms. Areal density is higher than the 10GB Quantum Fireball KX, with the 13GB of storage spread across only two platters. But don't expect lightning performance from this unit. It turned in the lowest transfer rate in the random read and write test at 0.66Mbytes/sec and the sequential write time was only a couple of seconds in front of the Quantum Fireball CX.

However, there are a couple of things that set this Seagate drive apart from the pack. For a start, the drive casing is surrounded by a black rubber sheath. We assume that this is to reduce the noise made by the drive. It also has installation instructions printed on it, but not to the same level of detail as its Barracuda brother.

### DETAILS

★★★

**PRICE** £99.87 (£85 ex VAT)

**CONTACT** SMC 01753 550 333

[www.seagate.com](http://www.seagate.com)

**PROS** Low price, instructions on casing

**CONS** Slow, fairly low capacity

**OVERALL** Worth a look if you're on a very tight budget



## Western Digital Caviar 307AA

EIDE



**THE WESTERN DIGITAL CAVIAR** range of hard disks has been on the market for a very long time. This latest addition is aimed at the value – rather than the performance – user and WD seems to

have hit the target pretty much on the bull's-eye.

Unlike the majority of the drives on test, the Caviar spins at only 5,400rpm instead of 7,200rpm, producing an average latency of 5.5ms. However, other than the reduced spin rate, the Caviar is a top-notch drive.

Thanks to the GMR heads the data density is extremely high, spreading over 30GB of data across only three physical platters. The data density, coupled with the 2MB data buffer ensures that the Caviar still puts in a respectable performance – considerably faster than the Quantum Fireball CX, that also spins at 5,400rpm.

However, the best aspect of the Western Digital is the price. At only

£169 ex VAT you're getting a cost per GB of £5.52, which represents good value for money.

Although the computer industry is driven by numbers, you don't necessarily need to have the fastest hard disk money can buy. For everyday use, the Caviar is more than adequate and you're getting a lot of storage space for your money.

### DETAILS

★★★★

**PRICE** £198.57 (£169 ex VAT)

**CONTACT** Western Digital 01372 360 055

[www.wdc.com](http://www.wdc.com)

**PROS** High capacity, low cost

**CONS** Relatively slow

**OVERALL** If speed isn't an issue, this drive is worth a look

## IBM UltraStar 18LZX

SCSI



**IBM HAS BUILT A REPUTATION** for producing good hard disks, and the 18LZX is no exception. It shares the same areal density as its larger 36GB brother, spreading its storage over five

platters rather than 10. The L in its name stands for Low Profile, since the five physical disks are squeezed into a 1in-high case. This makes it applicable to lower-end servers, which may not be able to accommodate larger drives, while its price may also attract users who can't afford a 36GB device.

Unsurprisingly, the average latency is brought down to a very respectable 2.99ms, thanks to the 10,000rpm spindle speed. Only Hitachi has a disk that spins faster than this, but its 12,000rpm Pegasus II drive uses 2.5in platters instead of the standard 3in models, to keep the heat under control.

Like its big brother, the UltraStar 18LZX sports a 2MB data buffer and GMR heads. Performance was

respectable, beating the 18GB Cheetah in the sustained write test, but not quite matching the speed of the Western Digital Enterprise drive. Random reads and writes produced a 1.41Mbytes/sec transfer rate – the second fastest on test.

The 18LZX is a good drive if you need the speed, but if not, the Quantum Atlas IV is almost £100 cheaper.

### DETAILS

★★★★

**PRICE** £421.82 (£359 ex VAT)

**CONTACT** SMC Direct 01753 550 333

[www.ibm.com/harddrive](http://www.ibm.com/harddrive)

**PROS** Fast, low profile casing

**CONS** Pricey compared to the Atlas IV

**OVERALL** A great disk for a fast workstation or small server

## IBM UltraStar 36ZX

SCSI



**OVER THE PAST COUPLE** of years IBM has made some significant advances in hard-disk technology, the most important being the implementation of GMR heads. These heads are more

sensitive than standard MR heads, which means they can read data that is very tightly packed together. This allows IBM to increase the areal density on its physical platters and thus increase the overall speed of the drive by reducing the amount of head movement.

As a result this drive spreads its 36GB across 10 platters, as opposed to the 12 platters employed by the Cheetah. Unfortunately, even with the high data density, IBM has still had to opt for a 1.5in-high drive case.

As well as the high areal density, this drive provides a spindle speed of 10,000rpm, producing an average latency of 2.99ms.

The 36ZX managed the fastest sequential write speed, making it an

ideal device for the likes of video editors. There's also a healthy 2MB buffer cache, to ensure a steady flow of information.

The only downside is the power consumption. This baby will draw a whopping 17.4W of power while it's idle, so make sure you have a decent-sized power supply. Apart from that, this is a first-rate, high-capacity drive.

### DETAILS

★★★★

**PRICE** £786.07 (£669 ex VAT)

**CONTACT** SMC Direct 01753 550 333

[www.ibm.com/harddrive](http://www.ibm.com/harddrive)

**PROS** Fast and capacious

**CONS** Draws a lot of power

**OVERALL** A great high-speed, high-capacity drive at a good price



## Quantum Atlas IV

SCSI



**QUANTUM IS ABOUT TO RELEASE** the Atlas V drive – which is unfortunate, as it would have been good to see the latest drive that Quantum had to offer, rather than one reaching the end of its lifecycle.

The Atlas IV is not aimed at the very high-performance user, although its 7,200rpm spindle speed still makes it more than adequate for workgroup and file servers. It's hard to judge the Atlas IV in this company, since the only other 7,200rpm drive is the 50GB Seagate Barracuda, which is a different product altogether.

Unsurprisingly, the Atlas IV scored similarly to the Barracuda in the performance tests, but it was no match for the 10,000rpm drives.

Like the Western Digital Enterprise, the Atlas IV spreads its 18GB across only four platters, giving it a fairly high areal density and allowing everything to be squeezed into a 1in-high case. Unlike the Western Digital, however, the Atlas IV

sports an average latency of 4.17ms because of its slower spin rate. The data buffer is an ample 2MB, twice the size of the 18GB Seagate Cheetah.

Power consumption is a low 7.9W, making it ideal if you don't have a heavy-duty power supply. The Atlas IV isn't the fastest SCSI solution, but it offers better value than the 10,000rpm units.

### DETAILS

★★★★

**PRICE** £316.07 (£269 ex VAT)

**CONTACT** SMC Direct 01753 550 333

[www.quantum.com](http://www.quantum.com)

**PROS** Good value for money

**CONS** Not as fast as the 10,000rpm drives

**OVERALL** Like the Barracuda, the Atlas IV is a great drive if speed isn't paramount

## Quantum Atlas 10K

SCSI



**THE ATLAS 10K LOOKS** considerably different to all the other Quantum drives on test. The main change is the array of heat fins surrounding the casing where the disk platters reside. This is a wise

and common design with 10,000rpm drives, since the excessive spin speed causes an alarming amount of heat.

Like the Atlas IV, this Atlas 10K is Ultra160 compatible, although you won't see much benefit unless it's part of a hefty RAID array. The data is spread across 12 platters, serviced by 24 heads. This makes the areal density lower than the GMR-equipped IBM UltraStar 36ZX, so unsurprisingly it's slower than the IBM drive. However, it has the same number of platters as the 36GB Seagate Cheetah but that drive also beats the Atlas 10K.

Power consumption is just below the Cheetah at 15.5W and almost 2W lower than the IBM drive. The data buffer is 2MB, which seems pretty standard in

this test. Only the Fibre Channel variety of the drive comes with an increased buffer of 4MB.

As with all the drives in this SCSI category, the Atlas 10K will be up to almost any task you throw at it.

However, it's slightly more expensive than the faster IBM drive, making it seem like a less attractive prospect.

### DETAILS

★★★★

**PRICE** £797.82 (£679 ex VAT)

**CONTACT** SMC Direct 01752 550 333

[www.quantum.com](http://www.quantum.com)

**PROS** Reasonable price

**CONS** Not the fastest on test

**OVERALL** A decent alternative if you can't get the IBM UltraStar

## Seagate Barracuda 50

SCSI



**ALTHOUGH MOST USERS** generally want the fastest hard drives they can get, it's sometimes not necessary to have a 10,000rpm unit. For many uses, a disk spinning at 7,200rpm is more than

adequate and the cost savings can be significant. Also, since a 7,200rpm unit runs considerably cooler than a 10,000rpm model, you'll need less cooling in your machine.

The Barracuda is a bit of a classic in the world of high-performance SCSI drives, and at one time was the drive of choice for most uses. It may no longer be the formidable piece of hardware it was, but it's still a great piece of kit.

This particular drive breaks with the SCSI tradition of doubling capacities with each generation. Instead of jumping from 36GB to 72GB, Seagate has opted for a middle capacity of 50GB. The areal density is quite impressive, with the 50GB of space spread across only 11 platters – that's

fewer physical surfaces than its cousin the Cheetah uses to store only 36GB.

That said, the most important aspect of this drive is price. Considering that it is cheaper than all the 36GB 10,000rpm drives, its value for money is outstanding. If you want very high capacity and can live without cutting-edge performance, it is worth a look.

### DETAILS

★★★★★

**PRICE** £645.07 (£549 ex VAT)

**CONTACT** SMC 01753 550 333

[www.seagate.com](http://www.seagate.com)

**PROS** Huge capacity, great value for money

**CONS** 1.5in case height

**OVERALL** A stunning top value drive, ideal for a file server





## Seagate Cheetah 18LP

SCSI



**SEAGATE WAS THE FIRST** hard-drive manufacturer to push the spindle speed to 10,000rpm. Prior to this, the fastest SCSI hard disks ran at a spindle speed of 7,200rpm. Of course, it didn't take the

competition too long to catch up with Seagate and produce 10,000rpm drives of their own. That said, Seagate made quite a splash with the Cheetah, building on the previous success of the Barracuda range, and they are still the drive of choice in many server and workstation set-ups.

This breed of Cheetah has an 18GB capacity in a 1in-high case, hence the 18LP name, where LP stands for Low Profile. The smaller dimensions make this drive attractive to the workgroup-server market, although probably in an SCA version. Inside the casing are six platters, serviced by 12 MR heads. The 10,000rpm spindle speed produces an average latency of 2.99ms.

Performance was a little behind its

36GB big brother, but this is to be expected – since the larger drive has a 4MB data buffer, compared to the 1MB buffer on this unit.

On the whole, this is a decent high-end drive, but it's more expensive than the IBM UltraStar 18LZX, which has a 2MB buffer, GMR heads and faster sequential write speeds.

### DETAILS

★★★★

**PRICE** £457.07 (£389 ex VAT)

**CONTACT** SMC Direct 01753 550 333

[www.seagate.com](http://www.seagate.com)

**PROS** Better value than its 36GB cousin

**CONS** Only 1MB data buffer

**OVERALL** Not a bad drive, but outclassed by the IBM UltraStar

## Seagate Cheetah 36

SCSI



**CHEETAH'S LARGER-CAPACITY** drive is also physically larger at 1.5in-high. This could make it incompatible with smaller workgroup servers, but you're unlikely to want multiple 36GB disks in a small

workgroup server. The Cheetah sports heat fins around the outside edge of the case where the platters reside. This design will help dissipate the excessive heat generated by the 10,000rpm spindle speed, which was a problem with early Cheetah drives.

Differentiating itself from its smaller brother, the 36GB Cheetah sports a 4MB data buffer that should provide smoother and faster sustained transfer rates. The average latency is identical to all 10,000rpm drives at 2.99ms. The Cheetah managed to perform the sustained write test faster than the 36GB Quantum Atlas 10K, but came in a little slower than the IBM UltraStar. For random reads and writes, it managed a transfer rate of

1.38Mbytes/sec, which is a little behind a couple of the 18GB drives.

This drive is double the capacity of the other Cheetah on test in every way, it has double the amount of physical disks and heads at 12 and 24 respectively. The areal density is therefore the same as the smaller drive, which is why the performance is similar between the two.

### DETAILS

★★★★

**PRICE** £938.82 (£799 ex VAT)

**CONTACT** SMC Direct 01753 550 333

[www.seagate.com](http://www.seagate.com)

**PROS** Relatively fast

**CONS** Relatively expensive

**OVERALL** IBM's UltraStar 36ZX is a more cost-effective 10,000rpm drive

## Western Digital Enterprise

SCSI



**WESTERN DIGITAL USED TO BE** a force to be reckoned with in the hard-disk market. Around the time of the 486 you couldn't buy a better or faster hard disk than a WD. Unfortunately the company

lost its crown to the likes of Seagate and IBM. That said, it's had a bit of a renaissance of late and has started to produce some first-rate products.

Western Digital licenses IBM's GMR head technology, allowing it to push the areal density on its drives quite high. Consequently, the WD has managed to spread the 18GB of data across only four physical platters, which is one less than the IBM UltraStar and two fewer than the Seagate Cheetah. Only the 7,200rpm Quantum Atlas IV has managed to match the density of the Enterprise.

The high data density, coupled with a 2MB data buffer, helped the WD produce some impressive results in our tests. It was the second-fastest drive in

the sequential write test and produced a random read and write transfer of 1.37Mbytes/sec. Power consumption is average for a drive of this size, at 11W.

Ultimately, Western Digital has produced a very impressive 10,000rpm SCSI hard disk. It's a little bit more expensive than the competition, but not prohibitively so.

### DETAILS

★★★★

**PRICE** £539.32 (£459 ex VAT)

**CONTACT** SMC Direct 01753 550 333

[www.wdc.com](http://www.wdc.com)

**PROS** Solid specification, fairly fast

**CONS** More expensive than some

**OVERALL** A good drive but a little pricey compared to others on test

## Getting to grips with disk-drive interfaces

Perhaps the most confusing thing about buying a new hard drive is trying to make sense of the different interfaces. The base level is a choice between IDE and SCSI, but inside each of these interfaces is a subset of standards, all of which can be confusing.

The best place to start is with IDE, the most readily-available interface for the PC, appearing as standard on the majority of motherboards. The name IDE, which stands for Integrated Drive Electronics, is a little confusing in itself. It basically means that the controller for the hard drive is on-board the drive itself. This provides less interference and therefore higher reliability. However, it's not just IDE that puts the drive controller on-board, so more correctly IDE should be referred to as ATA (AT Attached).

Starting at the beginning, ATA specified a standard for connecting hard drives of up to 504MB to a PC. The specification detailed the master/slave relationship that restricts ATA to two devices per channel.

The ATA specification defined three different transfer modes for hard drives to operate in. First on the menu was Programmed Input/Output (PIO). PIO mode is very processor-intensive, as it requires the CPU to deal with the job of writing data from the drive to main memory. However, the ATA specification also provided details for a more sensible method of transferring data, Direct Memory Access (DMA). DMA, as the name suggests, allows a device – in this case a hard drive – to write data directly to memory. This frees up the processor for more important tasks.

### Transfer modes

Just to make things more confusing there are two DMA transfer methods: Single Word, and Multiword. Single Word DMA is now an obsolete standard and has mainly been replaced by the more advanced Multiword DMA, which allows for faster transfer rates. For a full look at all the transfer modes available for different ATA standards, take a look at the ATA Standards table.

### SCSI

An interface that is technically better, although more expensive, is the Small Computer System Interface (SCSI) standard. Thanks to the clever initial specification, little has changed over time except higher speeds. SCSI is a parallel interface that is designed to allow all manner of devices to be attached, both internally and externally. Traditionally it was a more complex standard, with each new standard having different cabling, and confusing rules saying which devices you could and couldn't mix. In recent years things have changed, and SCSI is not nearly as complex as it used to be. Newer SCSI host adaptors will include a 50-pin connector for legacy devices, and a 68-pin connector for newer, faster devices, so it's just a matter of plugging your kit into the correct connectors.

SCSI started off with SCSI-1 which defined a 5Mbytes/sec 8bit bus. However, as SCSI-1 only supported a single device, you're more likely to know

standards can now support up to 15 devices per channel.

At this point it's important to understand Narrow and Wide SCSI. Narrow SCSI has an 8bit bus, and Wide has a 16bit bus. Wide SCSI is therefore twice as fast as narrow. Typically inside a SCSI standard you'll find both narrow and wide. This explains why you get Ultra SCSI, and Ultra Wide SCSI. For a full view of SCSI standards and speeds, see the table below.

### LVD

Originally SCSI ran over Single Ended (SE) cabling. This transmitted bits down a single cable, and was fine for speeds up to 40Mbytes/sec. Once SCSI speeds reached 80Mbytes/sec (Ultra2 Wide), a new technology called Low Voltage Differential (LVD) was introduced. LVD allows reliable transmission at this speed by transmitting data over two wires, one a mirror image of the other. Without LVD, cable lengths would be dramatically reduced, and reliability wouldn't be very good due to interference. However, as LVD and SE devices can both be run over 68-pin cabling, it's worth pointing out that you shouldn't run them both over the same SCSI channel, as this will slow down the LVD devices.

One final point about SCSI is the introduction of the SCA (Single Connector Attachment) interface. SCA appears on hard drives and allows the drive to get power, a SCSI ID, and connection to the SCSI bus through a single 80-pin connector. Typically this is used on servers for hot-swap drives, but you can get converters so that they'll run in a standard PC.

DAVID LUDLOW

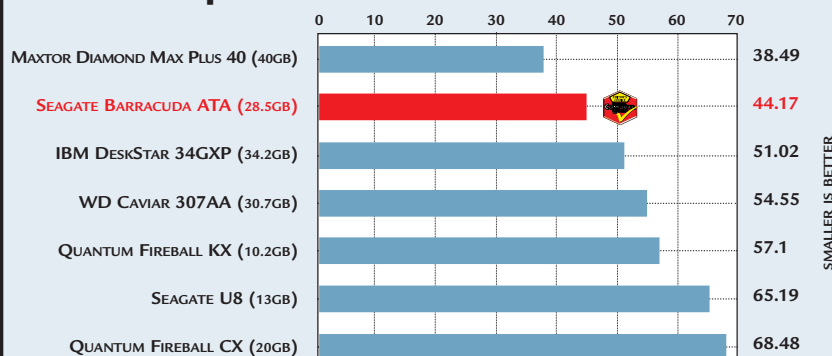
#### SCSI speeds

Narrow (8bit)			Wide (16bit)	
Standard	Protocol	Transfer rate (Mbytes/sec)	Protocol	Transfer rate (Mbytes/sec)
SCSI-1	SCSI-2	5	Wide SCSI	10
Fast	Fast SCSI	10	Fast-Wide SCSI	20
Ultra	Ultra SCSI	20	Ultra-Wide SCSI	40
Ultra2			Ultra2-Wide SCSI (LVD)	80
Ultra160			Ultra160 (LVD)	160

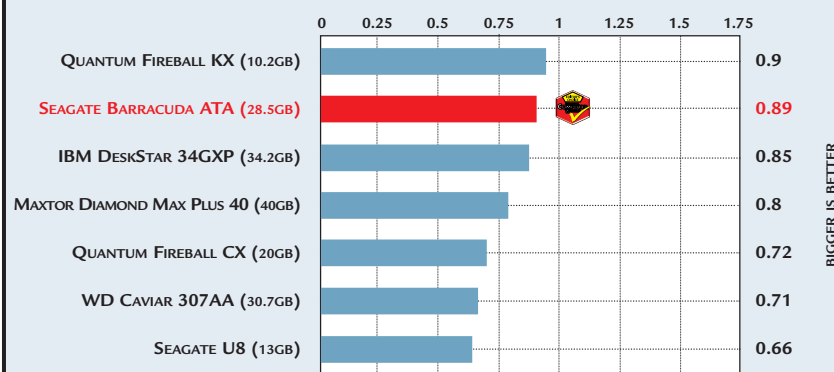
#### IDE speeds

Standard	DMA modes	PIO modes	Max transfer (Mbytes/sec)
ATA	Single Word 0,1,2. Multiword 0	0, 1, 2	8.3
ATA-2	Single Word 0,1,2. Multiword 0, 1, 2	0, 1, 2, 3, 4	16.6
Ultra ATA/33	Single Word 0, 1, 2. Multiword 0, 1, 2, 3	0, 1, 2, 3, 4	33.3
Ultra ATA/66	Single Word 0, 1, 2. Multiword 0, 1, 2, 3, 4	0, 1, 2, 3, 4	66.6
ATAPI	Single Word 0, 1, 2. Multiword 0, 1, 2	0, 1, 2, 3, 4	16.6

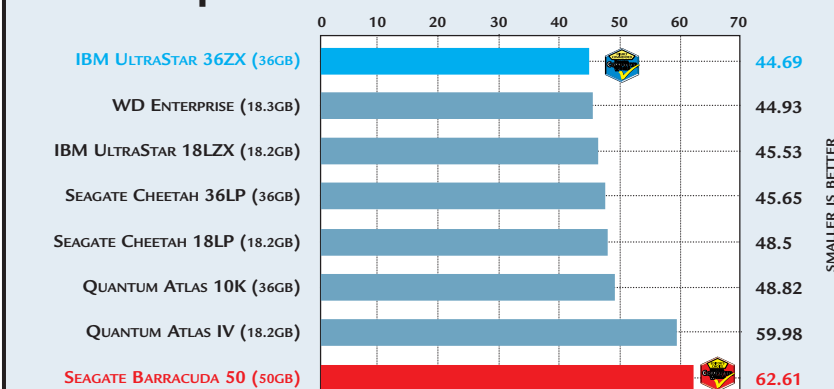
## EIDE Sequential 1GB write



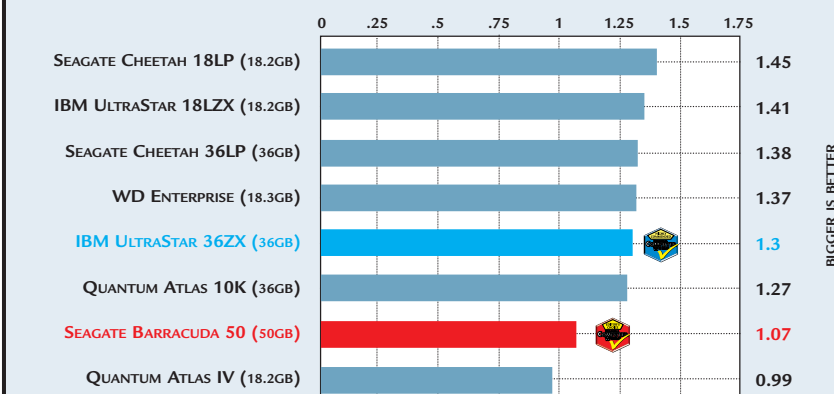
## EIDE Random reads and writes



## SCSI Sequential 1GB write



## SCSI Random reads and writes



## How we did the tests

Testing hard drives is not easy. Two kinds of access modes need to be looked at: random and sequential. Random access is used when the drive needs to get at information stored on different parts of the disk, and as such requires that multiple seeks – the drive moving its heads – are performed over the surface of the disk drive.

Sequential access is when the drive reads contiguous data. This typically returns faster results as the drive only needs to move its heads to find the start of the data, and only to change tracks after that. Manufacturers usually quote sequential access when mentioning maximum transfer rates. However, this is a little unrealistic, as a drive rarely reads large sequential files for any length of time. So, to get a better idea of performance both sequential and random access need to be looked at.

In order to test the drives fairly we used the following setup: a Dell PowerEdge 6300 Quad Xeon server, with a 64bit PCI Adaptec 29160 host adaptor for the SCSI drives, and a Promise UltraDMA/66 card for the IDE drives. The high-spec machine made sure any performance results were down to pure drive speed due to there being no I/O performance bottlenecks in the server.

Performance testing was done with two tests. First, sequential write speeds were tested by timing a copy operation of a 1GB zip file from the server's RAID partition to the test drive. The reason for the RAID partition was to make sure the source we were streaming data from was quicker than the destination, otherwise we'd just be testing the server's read speed. Timing was done by recording the system clock time before the copy operation began, and again once the copy operation had finished. This was automatically logged to a text file via a batch file we wrote to perform the test. The quicker the time in which the drive wrote the file, the faster the drive.

To test Random operations we used Intel's Iometer version 1998.10.08. This allows user-defined access parameters to be applied to a given drive. We used an access specification called 'File Server'. This was set to perform random reads and writes to a drive, for different sized files. To be more precise, one-third of the operations were writes, and two-thirds were reads. This kind of specification gives a more accurate representation of how the drive will perform running software such as Windows. The end result gives an idea of how fast a drive is under normal stress conditions. The results are presented as Mbytes/sec, and the higher the figure the faster the drive.



EIDE HARD DRIVES							
MANUFACTURER	IBM	MAXTOR	QUANTUM	QUANTUM	SEAGATE	SEAGATE	WESTERN DIGITAL
MODEL	DESKSTAR 34GXP	DIAMOND MAX PLUS 40	FIREBALL CX	FIREBALL PLUS KX	BARRACUDA ATA	U8	CAVIAR 307AA
Model number	DPTA-373420	54098U8	CX20A011	KX10A00A	ST328040A	ST313021A	WD307AA-00ANA0
Price (ex VAT)	£205	£230	£135	£105	£143	£85	£169
Supplier	IBM	RK Distribution	Quantum	Quantum	SMC Direct	SMC Direct	Western Digital
Phone Number	01475 898 125	01844 261 226	01344 353 500	01344 353 500	01753 550 333	01753 550 333	01372 360 055
DRIVE SPECS							
EIDE type	UltraDMA/66	UltraDMA/66	UltraDMA/66	UltraDMA/66	UltraDMA/66	UltraDMA/66	UltraDMA/66
Nominal capacity (GB)	34.2	40.98	20.4	10.27	28	13	30.7
Price per GB (ex VAT)	£5.99	£5.61	£6.62	£10.22	£5.11	£6.54	£5.50
Height (inches)	1	1	1	1	1	1	1
Spindle speed (rpm)	7,200	7,200	5,400	7,200	7,200	5,400	5,400
Buffer (KB)	2,048	2,048	512	512	512	512	2,048
Read head technology	GMR	GMR	MR	MR	GMR	GMR	GMR
Read channel technology	PRML	PRML	PRML	PRML	EPRML	EPRML	PRML
Idle power consumption (W)	6.9	6.6	6.2	7.5	7.5	3.5	6.18
Heads	10	8	6	3	8	3	6
Platters	5	4	3	2	4	2	3
Cylinders	17,494	79,406	15,957	16,878	16,383	16,383	16,383
Track density (tracks per inch)	18,300	19,700	16,700	16,700	16,420	18,700	Not supplied
SMART capable	✓	✓	✓	✓	✓	✓	✓
PERFORMANCE							
Average read seek (ms)	9	9	9.5	8.5	8	8.9	9.5
Average latency (ms)	4.17	4.17	5.56	4.17	4.17	5.56	5.5
Track to track (ms)	2.2	1	2	0.8	0.9	1.5	2
Full stroke (ms)	15.5	20	18	15	14.5	23	19
OTHER INFORMATION							
Standard warranty (years)	3	3	3	3	3	3	3

SCSI HARD DRIVES								
MANUFACTURER	IBM	IBM	QUANTUM	QUANTUM	SEAGATE	SEAGATE	SEAGATE	WESTERN DIGITAL
MODEL	ULTRASTAR 18LZX	ULTRASTAR 36ZX	ATLAS 10K	ATLAS IV	BARRACUDA 50	CHEETAH 18LP	CHEETAH 36	ENTERPRISE
Model number	PN09L3905	PN09L3903	TN36L011	KN18L011	ST150176LW	ST318203LW	ST3136403LWV	WDE18310-005042
Price (ex VAT)	£359	£669	£679	£269	£549	£389	£799	£459
Supplier	SMC Direct	SMC Direct	SMC Direct	SMC Direct	SMC Direct	SMC Direct	SMC Direct	SMC Direct
Phone	01753 550 333	01753 550 333	01753 550 333	01753 550 333	01753 550 333	01753 550 333	01753 550 333	01753 550 333
DRIVE SPECS								
SCSI type	Ultra2	Ultra2	Ultra160	Ultra160	Ultra2	Ultra2	Ultra2	Ultra160
Nominal capacity (GB)	18.3	36.7	36.4	18.2	50.1	18.2	36.4	18.3
Price per GB (ex VAT)	£19.62	£18.23	£18.65	£14.78	£10.96	£21.37	£21.95	£25.08
Height (inches)	1	1.5	1.6	1	1.5	1	1.5	1
Spindle speed (rpm)	10,000	10,000	10,000	7,200	7,200	10,000	10,000	10,000
Buffer (KB)	2,048	2,048	2,048	2,048	1,024	1,024	4,096	2,048
Read head technology	GMR	GMR	MR	MR	MR	DSMR	DSMR	GMR
Read channel technology	PRML	PRML	24/25 RLL PRML	24/25 RLL PRML	PRML	PRML	PRML	EPRML
Idle power consumption (W)	11.5	17.4	15.5	7.9	11.8	10.4	15.7	11
Heads	10	20	24	8	22	12	24	8
Platters	5	10	12	4	11	6	12	4
Cylinders	11,748	11,748	10,042	13,816	12,024	9,801	9,801	13,614
Track density (tracks per inch)	13,595	13,595	13,060	13,700	12,905	12,580	12,580	13,500
SMART capable	✓	✓	✓	✓	✓	✓	✓	✓
PERFORMANCE								
Average read seek (ms)	4.9	5.4	5.5	6.9	7.4	5.4	6.5	6.6
Average latency (ms)	2.99	2.99	2.99	4.17	4.17	2.99	2.99	2.99
Track to track (ms)	0.3	0.3	0.8	0.8	0.9	0.7	0.8	0.6
Full stroke (ms)	10.6	11.4	13	15	16	12.2	14.2	14.5
OTHER INFORMATION								
Standard warranty (years)	5	5	3	3	5	5	5	3

# Editor's Choice

Choosing the right hard disk is a tricky decision. There's a certain degree of economies of scale involved, where the larger the drive you buy, the lower the cost per GB will be. That said, most people are on a set budget, so working things out in a cost per GB manner isn't possible. To cater for this we looked at a number of different capacity drives in both EIDE and SCSI flavours.

This test has shown that there is still a huge gap between the cost of EIDE and SCSI drives, while the difference in performance between the two interface types is growing smaller all the time. Considering that there are fewer and fewer tasks that require a SCSI I/O system, EIDE has become far stronger. And with the introduction of EIDE RAID controllers, you don't even have to go down the SCSI route for video-editing workstations or small department servers.

That said, SCSI will always be the interface of choice for high-end applications. With the bandwidth now up to 160Mbytes/sec, even the largest server isn't likely to hit any I/O bottlenecks. Also, SCSI has the advantage of being able to attach up to 15 devices, whereas most EIDE systems can only manage four.

Another interface for hard disks is Fibre Channel. This is a very high-end I/O interface and boasts bandwidths even faster than that of SCSI. Fibre Channel managed a

bandwidth of 100Mbytes/sec, while SCSI was still stuck at 40Mbytes/sec. Now Adaptec is predicting that Fibre Channel will be up to 1Gbyte/sec bandwidth by Q2 this year. Also, Fibre Channel drives don't need to be connected to a computer and can be attached to a Fibre Channel switch directly connected to a network. Finally, the length of cable between drives and controllers far exceeds that of SCSI and can even span between buildings. Although most high-end drive manufacturers produce Fibre Channel variants of their drives, SCSI is still the most common variety found.

We couldn't really talk about hard disks without mentioning IBM's landmark product: the Microdrive. This feat of technical engineering squeezes a 340MB hard disk into a CompactFlash card. Not only does the Microdrive have unlimited implementations, it also shows that the hard disk still has a bit of life left in it as a PC device. No doubt IBM will eventually filter down some of the technology used in the Microdrive into its regular hard disks, especially the shock resistance. And don't be surprised if we start to see CompactFlash hard disks from some of the other manufacturers in this test in the not too distant future.

Surprisingly, the same manufacturer managed to grab the Editor's Choice award in both categories, producing two superb hard disks.

In the SCSI section, Seagate stole the show with its massive 50GB Barracuda and won the **Editor's Choice** in the process. This unit managed to squeeze in 14GB more storage space than any other SCSI device, even though it used one less platter than the 36GB Cheetah also produced by Seagate. It may only spin at 7,200rpm, but this is fast enough for most uses, and it costs less than all the 36GB 10,000rpm units. For a small business or a department looking for a storage solution for a server, this drive is a godsend. So if you're looking for a massive SCSI hard disk at a great price, this is it.

Also in the SCSI section, the IBM UltraStar 36ZX wins a **Highly Commended** award. Spinning at 10,000rpm, this is a truly fast hard disk, with an impressive capacity to boot. IBM has implemented its Giant Magneto Resistive heads into this drive, to increase the areal density and ultimately improve performance. It may not offer the same value for money as the Seagate, but if it's speed you want it's worth a look.

Seagate takes the **Editor's Choice** in the EIDE section, with another Barracuda drive. Again this is a great disk, spreading 28GB of storage across four platters. Like its SCSI cousin, the Barracuda ATA offers excellent value for money, with a cost per GB of only £5.10. It also has installation instructions printed on the casing, making it the most user-friendly device on test.



*The Seagate Barracuda 50 offers a massive 50GB of storage spread across 11 platters*



*IBM won the Highly Commended award for its UltraStar 36ZX SCSI drive*



*Seagate's Barracuda ATA scooped the EIDE prize for its all-round excellence*