Backup tape drives

Dave Mitchell reels in a winner from 12 of the best spoolers around

The majority of companies realise the importance of backup, but there are still many that are prepared to take appalling risks by having no coherent strategy to secure their data. Data is just as much an asset to a business as staff, property or hard cash, so it seems insane not to have a policy for keeping it protected. Without the ability to restore lost or corrupted data, network administrators are putting their business and possibly their own jobs on the line. While it's true that the chances of a major disaster occurring are slim, this is no excuse for leaving data unprotected.

Our foray into the world of data recovery started in enterprise, issue 86, with reviews of the top network backup software products along with a look at other aspects of recovery, including backup strategies. This month's enterprise group test completes the circle by looking at the other key component of data recovery – backup tape drives. Here we've selected 12 of the top small to mid-range devices on the market and put them through their paces to help you choose the best one for your backup strategy. No two companies will have the same backup requirements, so the drives we've selected for review represent various combinations of speed, capacity and price to help you pick the right one for your circumstances.

> "...significant changes in tape drive technology...will have a major impact on the decisions companies make about their long-term strategy"

Since our last tape drive group test (*see enterprise, issue 64*), there have been significant changes in tape drive technology and some will have a major impact on the decisions companies make about their long-term strategy. To maximise investment in a backup system, you need to choose a technology that will not only satisfy your requirements now but can expand as your storage and performance demands grow. There's no point in buying into a tape drive technology that will be a dead end in a couple of years, as moving to a new format will be costly due to all media and hardware becoming redundant. Furthermore, even when a new format has been introduced, existing hardware will need to be retained for a long period of time to ensure that data possibly from previous year-end backups can still be restored if needed.

The imminent demise of DAT (digital audio tape) as a backup medium is a classic example, as all major vendors have announced that a successor to DDS-4 will not be forthcoming. Those that have relied on this popular format for years will eventually have to look around for a replacement – a fact that hasn't escaped the notice of other tape drive vendors as they rush to take a slice of this potentially enormous market. Tandberg Data is putting forward its low-cost SLR7 (*see enterprise, issue 88, p229*) as a suitable DAT replacement, while Exabyte recently acquired Ecrix and its VXA technology and is also promoting the VXA-1 (*see p185*) as a successor to DAT.

Despite Seagate pulling out of the AIT (advanced intelligent tape) market a couple of years ago, Sony has continued to promote this technology vigorously. Even though it only announced the AIT-3 format shortly before we started testing, it did manage to supply us with a review sample, which proceeded to deliver some impressive performance results. Companies looking for a new technology to migrate to should consider AIT, as it looks to have a long future. Sony expects to continue development up to AIT-6, which will offer a native storage capacity of 800Gb and transfer rates of 96Mbytes/sec. The AIT-1 and AIT-2 formats are also being touted as a replacement for DDS-4, and it's worth noting that AIT is one of few formats where all drives are fully backward read and write compatible with the earlier formats.

The new LTO (linear tape open) Ultrium format has caused a stir, as it delivers the best performance we've yet seen from a mid-range tape drive, with review units from IBM and Hewlett-Packard getting close to 1Gb per minute. This is unlikely to be beaten for some time, since the majority of competing formats have already released their next phase in development at the same time as Ultrium. However, speed isn't everything – the Ultrium's weakness is a complete lack of backward compatibility with any other format. The guaranteed data interchange between different vendors' tape drives and media also looks appealing, although our own tests indicated it may not be 100 per cent perfect.

Some stagnation looks to be settling into the entry-level server and high-end workstation end of the backup market. Few formats have seen any significant advances recently, making it even tougher to decide which format to follow. Although Seagate and Imation have announced full support, Travan is in dire need of improvement. When the Travan TR-5 format was introduced in 1998, its native 10Gb capacity looked capable of dealing with most demands, but since then hard disk storage has increased almost exponentially, with even the most lowly server coming equipped with at least 20Gb of storage. Its pedestrian transfer rates are unlikely to impress either. Unfortunately, moving up to the higher capacity and faster formats means a substantial hike in price, with many small businesses looking to buy a tape drive that costs more than the server it's protecting. Nevertheless, tape is still the top choice for backup because it offers the best combination of capacity and performance, and its low storage costs can't be beaten by any other media. ➤

Specifications & features

	Benchmark ValuSmart Tape 80	Exabyte Mammoth-2	Exabyte VXA-1	HP DAT40e	HP Ultrium 230e	IBM 3580 Ultrium	Seagate TapeStor Travan 20	Seagate Viper 200	Sony StorStation AIT260i	Tandberg Data DLT8000	Tandberg Data SDLT220	Tandberg Data SLR100
Supplier	Micro Warehouse 0870 555 0000	CMS Peripherals 020 8960 6000	CMS Peripherals 020 8960 6000	Hewlett-Packard 08705 474747	Hewlett-Packard 08705 474747	IBM 08700 102515	Seagate 0800 783 5177	Seagate 0800 783 5177	Sony 08705 111999	Tandberg Data 01223 598002	Tandberg Data 01223 598002	Tandberg Data 01223 598002
Manufacturer's Web site	www.4benchmark.com	www.exabyte.com	www.exabyte.com	www.hp.com	www.hp.com	www.ibm.com	www.seagate.com	www.seagate.com	www.sony-cp.com	www.tandberg.com	www.tandberg.com	www.tandberg.com
Price (exc VAT)	£1,099	£3,773	£803	£930	£3,790	£3,468	£300	£3,200	£2,790	£2,188	£3,899	£1,722
Warranty	3yrs	3yrs	3yrs	3yrs	3yrs	1yr	2yrs	2yrs	3yrs	3yrs	3yrs	3yrs
Specifications												
SCSI interface type	Wide Ultra2/LVD	Wide Ultra2/LVD	Narrow SCSI-2	Wide Ultra2/LVD	Wide Ultra2/LVD	Wide Ultra2/LVD	Narrow SCSI-2	Wide Ultra2/LVD	Ultra160 LVD	Wide Ultra2/LVD	Wide Ultra2/LVD	Wide Ultra2/LVD
Buffer	Not supplied	32Mb	4Mb	8Mb	16Mb	Not supplied	2Mb	64Mb	18Mb	8Mb	Not supplied	8Mb
Tape format	DLTtape IV	8mm AME	VXAtape	DAT DDS-4	LTO Ultrium 1	LTO Ultrium 1	Travan TR-5	LTO Ultrium 1	8mm AIT-3	DLTtape IV	Super DLTtape I	SLRtape100
Native capacity (Gb)	40	60	33	20	100	100	10	100	100	40	110	50
Maximum compressed capacity (Gb)	80	150	66	40	200	200	20	200	260	80	220	100
Tape length (m)	557	225	170	150	580	580	226	580	230	557	557	Not supplied
Media price	£70	£58	£55	£29	£170	£165	£26	£150	£85	£66	£124	£61
Native storage cost (£/Gb)	1.75	0.97	1.67	1.45	1.70	1.65	2.60	1.50	0.85	1.65	1.13	1.22
Quoted performance												
Native (Mbytes/sec)	3	12	3	3	15	15	1	16	12	6	11	5
Maximum compressed (Mbytes/sec)	6	30	6	6	30	30	2	32	31	12	22	10
Maximum compression ratio	2:01	2.5:1	2:01	2:01	2:01	2:01	2:01	2:01	2.6:1	2:01	2:01	2:01
Burst transfer rate (Mbytes/sec)	16	80	Not supplied	40	80	80	Not supplied	80	160	20	80	40
Average file access (secs)	68	60	Not supplied	50	Not supplied	Not supplied	Not supplied	76	35	60	70	89
Backward compatibility												
Read	DLT4000	Mammoth-1	✗	DDS-2, DDS-3	✗	✗	TR-4	✗	AIT-1, AIT-2	DLTtape III	DLTtape IV	SLR60, 50,
		Mammoth-LT								DLTtape IIIXT		40, 32, 24, 7
Write	✗	✗	✗	DDS-2, DDS-3	✗	✗	✗	✗	AIT-1, AIT-2	DLTtape III	✗	SLR60, 50, 40
TapeAlert support	✗	✓	✓	✓	✓	✓	✗	✓	✗	✓	✓	✓
OBDC support	✗	✗	✗	✓	✓	✗	✗	✗	✗	✗	✗	✗
Package contents												
Software included	✗	✗	Optional (Retrospect)	TapeWare XE	TapeWare XE	✗	Backup Exec Desktop	✗	NovaStor	Optional	Optional	Optional
SCSI cable supplied	✓	✓	✗	✓	✓	✓	✗	✗	✗	✓	✓	✓
Host adaptor supplied	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗
SCSI terminator supplied	✓	✓	✓	✓	✓	✓	✗	✗	✗	✓	✓	✓
Tape supplied	✓	✓	✓	✓	✓	✓	✓	✗	✓	✓	✓	✓
Cleaning tape supplied	✗	✗	✓	✓	✓	✓	✗	✗	✓	✓	✓	✓

How we tested

With many of the latest tape drives in this group test having extremely high transfer rates, we chose a benchmark system with a specification that could handle their requirements. Our thanks go to SPD (www.spd.ltd.uk) for providing us with the 1U version of the Asus AP2400R (*see enterprise, issue 87, p261*).

The AP1400R came equipped with dual 1GHz Pentium III processors backed up by 1Gb of PC133 SDRAM memory. The storage subsystem was handled by the on-board LSI Ultra160 SCSI chipset, but we had to run a number of tests before we were happy with our choice of hard disk. We used HP's PAT (performance analysis tool) and Intel's Iometer (www.intel.com/design/servers/devtools/iometer/index.htm) to test the I/O rate of the system. An 18.2Gb IBM Ultrastar drive was tested first and returned I/O rates of around 23Mbytes/sec. We wanted more than this, so we replaced the drive with a Seagate Cheetah X15 and saw I/O rates increase to a more acceptable high of 32Mbytes/sec. The only difference between these two drives was that the IBM was a 10,000rpm model, whereas the Cheetah's spindle speed was 15,000rpm.

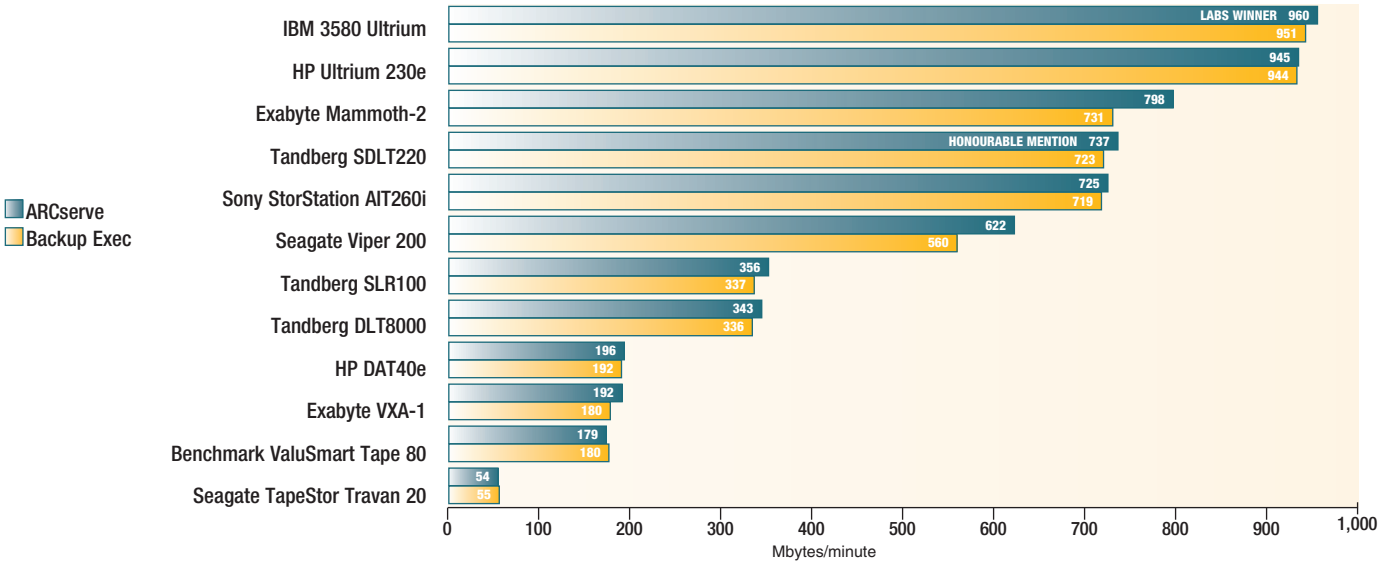
In theory, the maximum throughput of 160Mbytes/sec of the LSI chipset should allow the tape drives to be connected to the same SCSI channel as the hard disk, but to avoid any contention we used a separate, dedicated Adaptec 39160 PCI card. The test server had Windows 2000 Server with SP 2 installed, and backup software came courtesy of Computer Associates ARCserve 2000 with SP 3 along with the latest Backup Exec 8.6 from Veritas. Where possible, all tape devices were installed with the latest drivers downloaded from each manufacturer's Web site, and any firmware upgrades were applied as well.

To represent the average departmental server, we used a typical 6.5Gb mixture of data consisting of 8,000 files in 550 directories. This was made up of a variety of Word documents, Excel spreadsheets, Access databases and PowerPoint presentations along with HTML files, video clips, bitmaps, sound files and Acrobat PDF files. Each drive was asked to back up the entire 6.5Gb and then run the ARCserve tape-to-disk verification and Backup Exec tape read test. The third task was a full restore of all the test data back to its original location. All runs were timed, allowing an average DTR (data transfer rate) to be calculated for each operation.

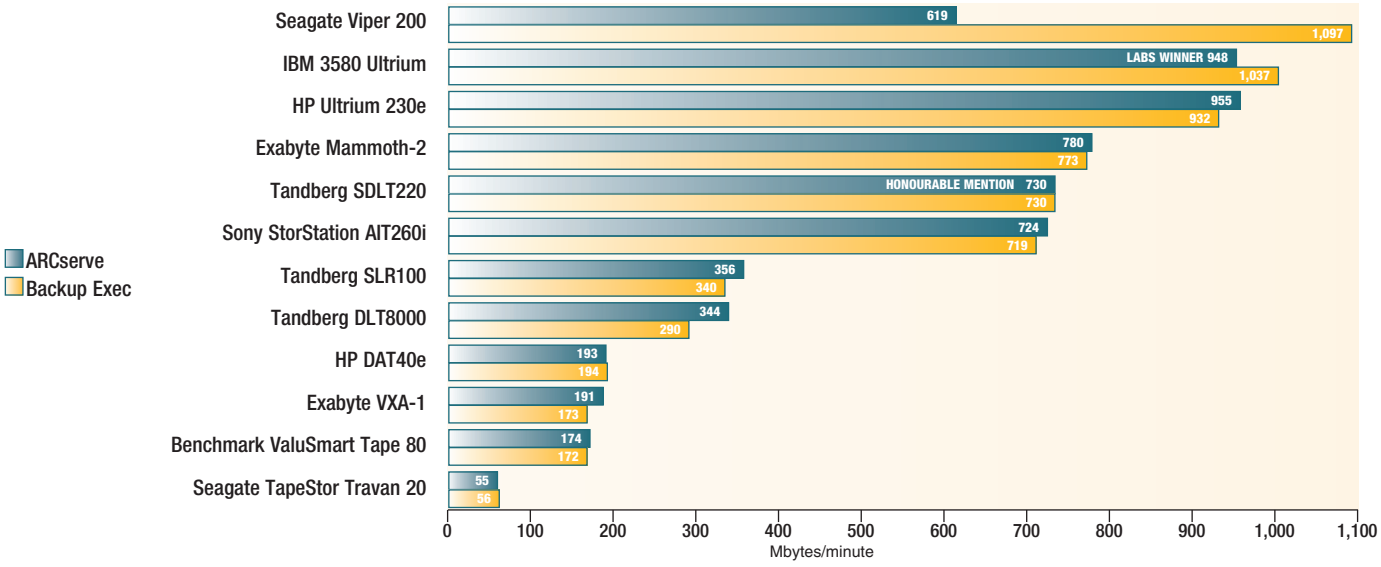
Contact: SPD 01420 563588

Performance graphs

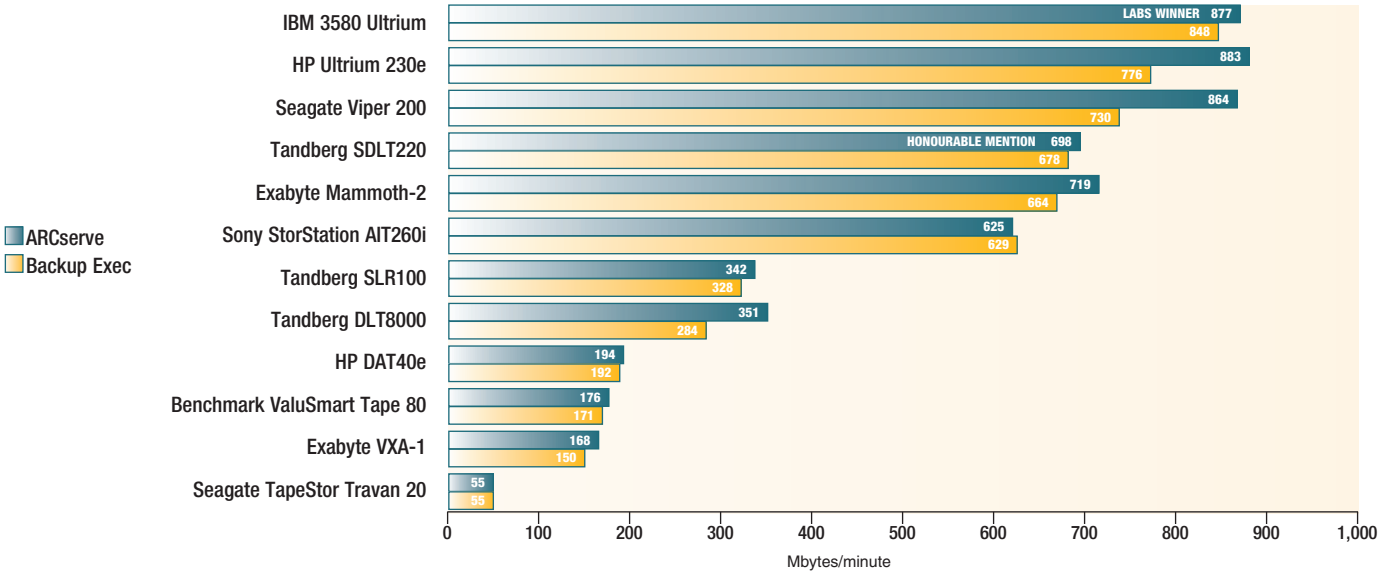
BACKUP



VERIFY



RESTORE



Benchmark ValuSmart Tape 80

- **Price: £1,099 (exc VAT)**
- **Supplier: Micro Warehouse 0870 555 0000**
- **Internet: www.4benchmark.com**

When the DLT1 from Colorado-based Benchmark Storage Innovations was released at the end of 1999, it put an interesting new angle on the current DLT (digital linear tape) technology. It combined the capacity of DLT8000 with the performance of DLT7000 and yet cost the same as DAT DDS-4.

Benchmark achieved this remarkable feat by licensing Quantum's original DLT technology and modifying it to create a new tape drive. A two-channel MR (magneto-resistive) head replaced the DLT4000 ferrite head, while four tape rollers were used instead of six, and a soft-load mechanism was introduced to replace the manual locking lever on standard DLT drives. Manufacturing costs were reduced further by using a thin steel mounting plate for the drive mechanics, rather than the solid aluminium block found in standard DLT drives. Note also that, although the drive uses industry-standard DLTtape IV media, it's only backward read compatible with DLT4000 tapes.

The ValuSmart Tape 80 takes this development a stage further, as it uses the same DLT1 technology, but crams it into a 5.25in half-height form factor, allowing it to fit into a single standard expansion bay. This has also allowed it to develop the ValuSmart Tape 640 Blade – a low-profile rack-optimised DLT autoloader.

The external version of the Tape 80 on review is enclosed in a compact, sturdy chassis complete with a small cooling fan at the rear. Installation on our test server was simple using the latest drivers downloaded from Benchmark's Web site, and the drive proceeded to demonstrate marginally slower speeds when compared to HP's DAT40e drive.

The ValuSmart Tape 80 is a tempting proposition for small to medium-sized businesses, as it offers a healthy backup capacity at a reasonable price. While overall performance is on a par with HP's DAT40e, the Tape 80 offers double the native storage capacity, making it a more cost-effective alternative. Development of this technology has been comparatively slow – we'd expected to see the DLT2 format at the beginning of 2001, which Benchmark claimed would double both capacity and performance but still cost the same price as DLT1. However, the company expects to have this next stage in its product roadmap available during early 2002.

Benchmark ValuSmart Tape 80

verdict: Similar performance to DAT DDS-4, but twice the capacity. Development has been slow, but this is an innovative DLT-based tape drive offering enterprise-level backup storage at a price the medium-sized business can afford.

OVERALL	★★★★★
performance	★★★★★
features	★★★★★
value for money	★★★★★

Exabyte Mammoth-2

- **Price: £3,773 (exc VAT)**
- **Supplier: CMS Peripherals 020 8960 6000**
- **Internet: www.exabyte.com**

When the Mammoth-2 first appeared a couple of years ago, it took the backup market by storm, as it was clearly the fastest tape drive around, and by a significant margin. It also offered a storage capacity that no other format could match. At the time, it only had to compete with the likes of the DLT8000 and AIT-2 formats, but this has all changed now since the recent introduction of a number of new formats. LTO Ultrium, Super DLT and AIT-3 all deliver similar or faster performance and greater storage capacities.

The Mammoth-2 offers a native 60Gb storage capacity on 8mm AME cartridges and a data transfer rate of 12Mbytes/sec – marginally faster than the latest SDLT-based drives. Furthermore, the combination of the latest ECC3 error correction algorithms and ALDC (Adaptive Lossless Data Compression) technology improves the hardware compression ratio to 2.5:1, allowing maximum capacity and DTR to be increased to 150Gb and 30Mbytes/sec respectively.

The drive is well built and is one of few now to come with an LCD status panel. It uses a multichannel helical scanning head, sports a large 32Mb internal buffer and has an Ultra2/LVD SCSI interface. The media also uses a system called SmartClean, meaning that each cartridge has a 2m length of cleaning material built in at the start of the tape.

The Mammoth-2 posted some highly respectable speeds in the performance tests, with ARCserve reporting nearly 800Mbytes/min for backup and verification operations. Earlier versions of the drive did exhibit erratic results, with write speeds dropping significantly. Not so with this model, as both ARCserve and Backup Exec only saw data restoration speeds drop by less than 10 per cent.

Despite being a speedy performer, it's clear the Mammoth-2 is now up against some tough competition. Whereas prices for many backup products have been gradually decreasing, this hasn't been the case with this drive, so it's now on a par with the new Ultrium and AIT-3 drives.

Companies looking for a new backup format would do well to consider the Mammoth-2 as it does have a lot to offer, but in the end the price, performance and storage capacity of the latest Ultrium drives are going to look a lot more tempting.

Exabyte Mammoth-2

verdict: A couple of years old now, but still puts up a good fight against the latest formats. Very good performance and storage capacity, but the Ultrium format offers much more for a similar price.

OVERALL	★★★★★
performance	★★★★★
features	★★★★★
value for money	★★★★★

Exabyte VXA-1

- **Price: £803 (exc VAT)**
- **Supplier: CMS Peripherals 020 8960 6000**
- **Internet: www.exabyte.com**

Originally founded in 1996, Ecrix Corporation waited until 1999 to attack the UK market with its single-tape drive product – the VXA-1. It merged with Exabyte in November 2001, and now the VXA-1 represents the new company's low-cost backup product aimed primarily at existing DAT (digital audio tape) users looking for a suitable migration path.

One of the main aims of the VXA-1 is to provide reliable data restoration, and it uses three unique technologies to achieve this – DPF (discrete packet format), VSO (variable speed operation) and OSO (overscan operation). DPF is used to break data down into packets before writing them to the tape. Each packet consists of 64 bytes of user data, synchronisation markers and address information plus error correction codes. During a read operation, the packets can be read back in any sequence, as they're reassembled in the drive's buffer before being sent to the host. Packets that are correctly retrieved on the first pass of the head are stored in the buffer. Subsequent passes are then carried out until all the packets are read in, and then the data string is assembled before forwarding to the host.

VSO allows the drive to adjust tape speed to match the data flow. This avoids a problem common to tape streamers called 'shoe-shining', which occurs when the data flow is interrupted and the drive has to continually stop and reposition the tape. Maintaining a constant speed can reduce tape and drive component wear significantly. During write operations, OSO is used to scan the data and rewrite it if an error is detected. On read operations, all four heads on the rotating drum are used to make multiple scans, so correct track geometry and pitch are unimportant. The key benefit here is that Ecrix guarantees that a tape created on one VXA-1 drive can be read on another.

Backup performance was on a par with HP's DAT40e, although we saw a noticeable drop in speed during the verification and restore tests. For a backup device offering a native 33Gb of storage, the VXA-1 is competitively priced and looks a good alternative to DDS-4. We have some concerns about the lack of development of this format, but have been informed that a VXA-2 format will be released during 2002.

Exabyte VXA-1

verdict: A high storage capacity for the price teamed up with some innovative technology. Performance is on a par with DDS-4 drives, making the VXA-1 a good choice as a DAT replacement.

OVERALL	●●●●●●
performance	●●●●●●
features	●●●●●●
value for money	●●●●●●

HP DAT40e

- **Price: £930 (exc VAT)**
- **Supplier: Hewlett-Packard 08705 474747**
- **Internet: www.hp.com**

DAT (digital audio tape) has been a favourite backup choice for small to medium-sized businesses for many years, but sadly it's reached the end of the road, as all major vendors have announced that there will be no further development of this format.

So why are we reviewing it? First, it's not a format that's going to be abandoned overnight, since there's a large and well-established user base in existence. Many single users and small companies use DDS-3 drives, and for them DDS-4 is still a viable upgrade option as their backup demands grow.

Originally announced in 1999, HP's DAT40e offers a healthy native storage capacity of 20Gb on compact 4mm cartridges. Performance is impressive, as its 3Mbytes/sec native transfer rate stands up well against many newer formats such as the VXA-1 and ValuSmart Tape 80. The drive still uses helical scanning technology to write data in diagonal stripes across the tape and is fully backward compatible with all DDS formats.

The DAT40e introduced many innovative features including HP's TapeAlert. Installed in the drive's firmware, it runs diagnostics on the hardware and media and sends alerts to the backup software. Both ARCserve and Backup Exec support TapeAlert, so messages can be sent to administrators by a variety of methods including email and network broadcasts. Another useful feature is OBDR (one button disaster recovery), which ties in with the bundled TapeWare XE backup software. Holding down the eject button while powering it on causes the DAT40e to emulate a bootable CD-ROM drive. Start the server and it will boot from the latest disk image, allowing the hard disk to be easily restored.

The DAT40e delivered good performance, with little difference between ARCserve and Backup Exec. The top backup speed of 196Mbytes/min confirmed that the drive is capable of delivering its native transfer rates. Verification rates were even better, with only a small drop in speed during the file restoration tests.

For most users with modest storage needs that they don't see expanding significantly, DAT40e is still worth considering. However, if you're looking for a backup technology with a future to invest in, DAT isn't a sensible long-term choice.

HP DAT40e

verdict: The DAT DDS-4 format still delivers a fine combination of high storage capacity and performance, but it's the end of the road for this format, so it's not a good choice for larger companies.

OVERALL	●●●●●●
performance	●●●●●●
features	●●●●●●
value for money	●●●●●●

HP Ultrium 230e

- **Price: £3,790 (exc VAT)**
- **Supplier: Hewlett-Packard 08705 474747**
- **Internet: www.hp.com**

Co-developed by Hewlett-Packard, IBM and Seagate, the LTO (linear tape open) specification aims to do away with one of the biggest problems facing network administrators when deciding on the right tape format for their backup strategy. By defining a tape technology that's available to all manufacturers, it allows a tape created on one vendor's LTO-compliant drive to be used on any other. Furthermore, it provides a wide variety of product and media sources, and uses an independent compliance verification program that ensures vendors meet the LTO specifications.

Built on LTO technology, the Ultrium tape format is designed to deliver high capacity, high performance and reliability to the mid-range backup market. Based on 0.5in linear recording technology, the Ultrium 230e uses a TF/MR (thin film/magneto-resistive) head with eight read-write elements. The media is held in a single-reel cartridge that takes many features from DLT (digital linear tape), as it provides a stable tape path at high speeds. Using a single reel also allows more tape to be stored, with the Ultrium 1 cartridge holding 580m. It also uses an on-board memory chip to store information about the tape contents, usage and identity to increase performance – a feature introduced in Sony's AIT (advanced intelligent tape) format. However, HP has introduced a non-contact design that uses inductive coils to read the data stored on the chip and aims to improve reliability.

The Ultrium 230e uses 'smart' data compression to detect incompressible data and automatically switch to a passthrough mode that avoids data already compressed from being unnecessarily expanded as it passes through the drive's compression engine. HP also incorporates ATS (adaptive tape speed) technology, allowing the drive to maintain an optimum speed for the host system. The drive has a 16Mb buffer and it attempts to store incoming data up to an 8Mb watermark. If it goes above this, the drive will increase speed, and when stored data drops below the mark it will slow down.

In the performance stakes, there's nothing to touch Ultrium, as it's easily the fastest format currently available. HP's drive proved to be slightly slower than IBM's 3580 Ultrium and is marginally more expensive, but it still looks a good choice for enterprise-level backup.

HP Ultrium 230e

verdict: The lack of backward compatibility with any other format is certainly a drawback, but the Ultrium 230e delivers a fine performance and offers a huge storage potential.

OVERALL	★★★★★
performance	★★★★★
features	★★★★★
value for money	★★★★★

IBM 3580 Ultrium

- **Price: £3,468 (exc VAT)**
- **Supplier: IBM 0870 010 2515**
- **Internet: www.ibm.com**

The LTO (linear tape open) Ultrium specification may have been agreed between the three participating vendors, but this hasn't stopped them adding their own touches. In the case of IBM, it has enhanced the data compression algorithms and claims that it offers the most efficient use of storage media.

Ultrium is an amalgamation of many of the best features found in other tape formats and includes some of IBM's own developments. A closed loop servo control is used to precisely track tape movement, and is a technology employed in Tandberg Data's SLR (scalable linear recording) and IBM's MagStar tape drives. A dual servo system is used to control the vertical location of the read-write head to ensure it stays on track in the event of tape wander. IBM's MagStar technology stays in the spotlight, as the Ultrium cartridges incorporate its cartridge reel gear and reel lock mechanisms. DAT (digital audio tape) technology gets a look-in too, as it provides the basis for the Ultrium's ECC (error detection and correction code). This is so robust that the vendors claim data is retrievable even if a 32mm length of tape is destroyed or one tape channel is disabled.

IBM's external Ultrium drive is well built and, unlike the drives from Seagate and HP, it has opted to add a useful LCD panel showing operations status, error conditions and cleaning notification. Performance-wise, there's nothing to really separate IBM and HP, with both drives delivering excellent results. IBM was marginally faster in the backup tasks, delivering a scorching 960Mbytes/min under ARCserve 2000, but overall there was little to tell them apart.

The Ultrium format delivers an impressive performance and storage capacity, but it has one disadvantage. During the design phase, no requirements were made for Ultrium to be backward compatible with any other format. So, if you opt for Ultrium, all your current investment in backup hardware and media is wiped out. Even so, the future is bright, as this is the first of four planned generations. The development phase covers a large time scale, with Ultrium 2 being released in 2003 and Ultrium 4 in 2007, which is expected to deliver 800Gb of storage and transfer rates of 160Mbytes/sec.

IBM 3580 Ultrium

verdict: The 3580 Ultrium offers an excellent combination of price, performance and capacity. IBM's drive is well built and offers the best overall value of the three Ultrium drives on review.

OVERALL	★★★★★
performance	★★★★★
features	★★★★★
value for money	★★★★★

Seagate TapeStor Travan 20

- **Price: £300 (exc VAT)**
- **Supplier: Seagate 0800 783 5177**
- **Internet: www.seagate.com**

Aimed at workstation and entry-level server backup, the TapeStor Travan 20 offers a low-cost solution packed into a small form factor. However, of all the tape formats available, Travan always seems to be lagging behind, as the current TR-5 format as used by the TapeStor was originally released in 1998 and hasn't seen any advances since. We'd expected to see the new TR-6 format during 2000, but this never materialised, causing many to wonder whether Travan would be going down the same route as DAT (digital audio tape).

However, there's life in the old dog yet, as Seagate and Imation recently announced a firm commitment to this format and plan to introduce the next-generation Travan 40 during 2002. It's likely this will utilise Overland Data's VR^2 technology (variable rate randomizer) – a variant of PRML (partial response maximum likelihood), which allows capacity and performance to be increased without changing the media or drive design.

The TR-5 format is now starting to look rather dated. The mini-cartridges offer a comparatively low native capacity of 10Gb, while the drive delivers pedestrian transfer rates of 60Mbytes/min. Storage capacity over the TR-4 format has been improved by increasing the number of tracks from 72 to 108. Cartridges are loaded and unloaded manually, and protrude slightly from the front to allow them to be pulled from the drive.

Performance in our real-world tests was particularly poor. The TapeStor was the slowest drive on review by a significant margin, delivering average speeds of around 55Mbytes/min for both ARCserve 2000 and Backup Exec across the backup, verification and restore tasks. If you're looking to secure and verify a similar amount of data to that used for testing, you can expect the process to take over four hours. Another drawback is the cost of the cartridges. They're well built, with a solid aluminium backplate, but, at £26 each, you're looking at around 2.6p per gigabyte – one of the highest storage costs in the industry.

With the SCSI drive costing a mere £300, the TapeStor initially looks a good candidate for budget-priced backup. However, performance isn't a strong point and storage costs are now looking unacceptably high.

Seagate TapeStor Travan 20

verdict: The TapeStor Travan 20 may be a budget-priced tape drive, but performance is comparatively low and the Travan TR-5 technology is now looking dated as it hasn't seen any advances since 1998.

OVERALL	●●●●●●
performance	●●●●●●
features	●●●●●●
value for money	●●●●●●

Seagate Viper 200

- **Price: £3,200 (exc VAT)**
- **Supplier: Seagate 0800 783 5177**
- **Internet: www.seagate.com**

As the third member of the LTO (linear tape open) initiative, Seagate originally announced its implementation of this format as far back as February 2000. It actually took over a year for the provocatively named Viper 200 to appear, allowing Hewlett-Packard to be first to market by a matter of weeks. As expected, the Viper employs much of the same technology as the HP and IBM Ultrium drives, but adds a unique feature called dynamic power down. The Viper maintains a small amount of stored power that's used to gently slow the supply and take-up reels to a full stop in the event of a power failure. The drive also uses the same adaptive tape speed technology as the competition, but refers to it as FastSense.

Whereas IBM and HP quote native performance of their Ultrium drives as 15Mbytes/sec, Seagate has gone one step further and upped the Viper's throughput to 16Mbytes/sec. However, in our real-world tests, this proved to be largely academic, as results for the Viper 200 were surprisingly erratic and the drive was noticeably slower than its Ultrium stablemates. Under ARCserve 2000 and Backup Exec, it secured the test data at a rate of only 622Mbytes/min and 560Mbytes/min respectively. Restoration speeds were also similarly slow, while the verification tasks returned 619Mbytes/min under ARCserve and inexplicably shot up to an amazing average of 1,097Mbytes/min during Backup Exec's tape read test.

As data interchange is a key feature of Ultrium, we opted to test this claim across all three tape drives by swapping each vendor's tape from one drive to another and running the backup test. On completion, the tapes were then moved around different drives and a full restoration was attempted to see if each could read a tape created on another drive. Unfortunately, we didn't see a perfect score for co-operation, as a double act comprising a backup tape created on the IBM drive using IBM's own media failed on the Viper 200.

Overall, the Ultrium format looks to be delivering most of its promises, although Seagate does appear to be the exception. There's no denying the Viper 200 is fast, as it outstrips most mid-range backup devices currently on the market, but it's comprehensively beaten by the Ultrium drives from both IBM and HP.

Seagate Viper 200

verdict: The slowest of the three Ultrium drives on review and by a significant margin. The Viper 200 looks better value than IBM's 3580, but this is offset by the drop in performance.

OVERALL	●●●●●●
performance	●●●●●●
features	●●●●●●
value for money	●●●●●●

Sony StorStation AIT260i

- **Price: £2,790 (exc VAT)**
- **Supplier: Sony 08705 111999**
- **Internet: www.sony-cp.com**

Since Seagate withdrew its support for AIT (advanced intelligent tape) in 1999, Sony has had to go it alone but has worked hard to promote this unique format. The release of the new AIT-3-based drive shows clearly that it's committed to its future.

Helical scanning is the preferred recording technology, and the AIT260i uses 8mm AME (advanced metal evaporated) tapes with native capacity doubled over the AIT-2 format to 100Gb. Using ADLC (adaptive lossless data compression), the AIT-3 format supports a top compression ratio of 2.6:1, allowing maximum capacity to be stretched to an impressive 260Gb. Performance also sees a considerable boost, with native transfer rates rising to an equally impressive 12Mbytes/sec.

The AIT cartridge introduced a feature called MIC (memory in cartridge), which consists of a 64Kb Flash memory chip mounted internally and accessed via a five-pin connector. This has been improved to R-MIC (remote MIC) in the AIT-3 cartridges, which allows the memory chip to be read without the tape being loaded and is aimed at autoloader and library applications. The main function of MIC is to reduce the time spent searching for data, as it stores information that's normally found on the first segments of the tape. MIC creates up to 64 partitions on the tape that can be accessed independently using address information stored in the chip, and this allows the drive to estimate how far to fast-forward or rewind the tape. During loading, a small board springs up and makes contact with the five pins on the back of the cartridge, giving the drive access to the internal memory chip. This is an automatic function of the drive and there's no control of this feature extended to the backup software.

During testing, the drive achieved close to its native transfer rate, with ARCserve 2000 reporting an average backup speed of 718Mbytes/min. Although the drive produced good results under Backup Exec, at the time of writing it wasn't officially certified for this software platform, and we encountered minor problems while installing it. Even with this in mind, the AIT260i does look a good alternative to SDLT (Super DLT), as it's just as fast but delivers a similar storage capacity for substantially less money.

Sony StorStation AIT260i

verdict: A fine performance teamed up with a high capacity and low storage costs. Better value than SDLT, but not fully certified with Veritas' backup software at the time of writing.

OVERALL	★★★★★
performance	★★★★★
features	★★★★★
value for money	★★★★★

Tandberg Data DLT8000

- **Price: £2,188 (exc VAT)**
- **Supplier: Tandberg Data 01223 598002**
- **Internet: www.tandberg.com**

During 2000, Tandberg Data was appointed by Quantum as the first independent manufacturer of DLT (digital linear tape) drives. The following year, the Norwegian tape specialist became the sole manufacturer and distributor of DLT and SDLT (Super DLT) products for the European and Japanese markets, leaving Quantum to focus on North and South America.

DLT has always been a top choice for enterprise backup, as it combines high capacity, good performance and reliability. Plus, even though the SDLT format is now available, the DLT8000 format is still a viable choice for backup. Unlike SDLT and Ultrium, the DLT8000 format didn't take the backup world by storm, since it only took native capacity modestly forward, from the 35Gb of the DLT7000 to 40Gb, while transfer rates were stepped up from 5Mbytes/sec to 6Mbytes/sec.

DLT8000 still uses the same recording method where tracks are written along the length of the tape. At the end of the tape, the head steps down and reverses tape direction to create an S-shaped, or serpentine, recording pattern.

This can be a comparatively expensive choice for backup, but when you see the build quality you'll understand why. The drive mechanism sits on a thick aluminium base plate, with the controller board mounted underneath and protected further by a steel sheet. The drive and loading mechanisms sit above, and the internal spool is enclosed in a plastic shell. The solid DLTtape cartridges only have a single spool inside, as the tape is withdrawn during loading and wrapped around the drive spool. A comprehensive LED at the front shows the capacity of the tape currently loaded, compression status plus activity, and warns when a cleaning cartridge is required.

The DLT8000 delivered a reasonable performance in the speed tests, returning average backup and restore speeds of 343Mbytes/min and 351Mbytes/min respectively under ARCserve 2000.

One of the DLT format's strengths is the fact that it has built up a very large following, particularly in the corporate arena, and these companies aren't prepared to write off their investment. Many are still using DLT4000 or DLT7000 drives and will see the DLT8000 as a natural progression. Furthermore, they'll be safe in the knowledge that SDLT is already available when they need to expand further.

Tandberg Data DLT8000

verdict: Average performance, although still a sound choice for enterprise backup as it combines this with a high storage capacity. A natural upgrade for DLT4000 and DLT7000 users, with SDLT available as the next step up.

OVERALL	★★★★★
performance	★★★★★
features	★★★★★
value for money	★★★★★

Tandberg Data SDLT220

- **Price: £3,899 (exc VAT)**
- **Supplier: Tandberg Data 01223 598002**
- **Internet: www.tandberg.com**

It's taken a while for the next generation of DLT (digital linear tape) to materialise, but the SDLT (Super DLT) format makes the wait look worthwhile. Whereas DLT8000 made modest improvements over the previous generation, SDLT takes a great leap forward, with native capacity boosted to a record 110Gb, while transfer rates move up to an equally impressive 11Mbytes/min.

The SDLT220 brings into play a wide range of technological improvements. A key feature of SDLT is Quantum's LGMR (laser-guided magnetic recording) technology. Traditionally, the servo tracks used for media positioning have always been placed on the same side of the tape used to record data. More tracks means higher capacity, so, to free up more surface area, Quantum opted to laser etch the servo tracks on the back of the tape. Tracking is carried out by a POS (pivoting optical servo) system, which incorporates an improved PRML (partial response maximum likelihood) channel and MR (magneto-resistive) cluster heads.

As the new LGMR head is only designed to work with SDLTtape 1 media, an extra read head had to be built in to allow the SDLT220 to be backward compatible with earlier DLT media. Non-backward-compatible models primarily for use in tape libraries are also available, with Overland Data using them in its LibraryExpress NEO range (*see enterprise, issue 83, p220*). Tandberg Data advised us that its SDLT220 range all have dual heads fitted as standard.

The SDLT220 is sheathed in a sturdy chassis complete with integral cooling fan and a bank of status indicators on the front panel. Tape loading is motorised, so you won't see the manual locking lever as found on previous DLT drives.

Performance testing showed that the SDLT220 is quite capable of delivering the quoted native transfer rates. The best backup speeds were achieved under ARCserve 2000, where the drive returned an average of 737Mbytes/min.

Clearly, SDLT offers big improvements in speed and capacity, although it's nowhere near as fast as the Ultrium format. Even so, it's the smart choice for companies that need to protect their investment in existing DLT media, as the new drive will be able to read it, whereas Ultrium isn't backward compatible with any other format.

Tandberg Data SDLT220

verdict: The new SDLT format offers big speed and capacity improvements over the DLT8000 format. Not as fast as Ultrium, but it's backward read compatible with existing DLT media.

OVERALL	★★★★★
performance	★★★★★
features	★★★★★
value for money	★★★★★

Tandberg Data SLR100

- **Price: £1,722 (exc VAT)**
- **Supplier: Tandberg Data 01223 598002**
- **Internet: www.tandberg.com**

Tandberg Data may have the DLT (digital linear tape) and SDLT (Super DLT) market sewn up in Europe, but it has other strings to its bow too, as its own SLR (scalable linear recording) drives have consistently offered a solid alternative to other formats for a number of years.

The budget-priced SLR7 (*see enterprise, issue 88, p229*) is aimed at entry-level server backup and looks a good alternative to DAT DDS-4. The SLR100 delivers an impressive native capacity of 50Gb and data transfer rates of 300Mbytes/min, and is aimed at high-end workstation and mid-range server backup.

A key feature of the SLR100 is Overland Data's VR^2 (variable rate randomizer) technology. Implemented on a chip, it uses PRML (partial response maximum likelihood), which allows the native capacity and performance to be increased without requiring any modifications to the heads, tape path or media. The drive can also monitor the host bus and adjust tape speed to match throughput, avoiding a common problem called 'shoe-shining', which occurs when the data flow is interrupted and the drive has to stop, back up and reposition the tape.

The SLR100 uses a six-channel TF/MR (thin film/magneto-resistive) head that writes four tracks simultaneously, and features include striping ECC (error correction code) blocks over each track to improve error correction, and data restoration.

Capacity has been improved by increasing the track density from 144 to 192 tracks, but the drive still uses the same simple load mechanism as its predecessors, which doesn't remove the tape from the cartridge. Rather than wrap it around multiple rollers, a single capstan inside the cartridge keeps a slight pressure on the tape to move it into contact with the head. This tender treatment of media will undoubtedly result in greater reliability and longevity.

The SLR100 produced consistently stable results in the performance tests across both backup software platforms and was marginally faster than the DLT8000 drive on nearly all counts. In previous tests, we've noticed that the SLR drives regularly deliver more than their quoted native transfer rates. The SLR100 looks a good choice for medium to high-end backup and also challenges the DLT8000 format, as it offers higher storage capacity, very similar performance and costs substantially less.

Tandberg Data SLR100

verdict: Part of a strong product line and a good choice for mid-range backup. Delivers more storage capacity than and similar performance to the DLT8000 format, but is more cost-effective.

OVERALL	★★★★★
performance	★★★★★
features	★★★★★
value for money	★★★★★