

Troubleshooting DAT Drives

DAT drive failures can manifest themselves in many different ways. Fortunately for the support engineer, all these problems can be resolved by knowing just a handful of remedies.

By Andrew Ward

As a backup device, a DAT drive often receives less attention than it should. A DAT drive plays a critical role in ensuring data reliability and should therefore be considered just as much a fundamental and vital component of a system as the hard drive itself.

Unfortunately, DAT drives go wrong far more frequently than hard drives, and DAT drive problems manifest themselves in a lot of different and obscure ways. But usually, these problems can be resolved fairly easily, and most are due to the same cause – media problems.

Media problems are often caused by bad or incompatible media. The usual first line of defence for many support engineers, to change the drive itself, won't help much in these circumstances. Therefore, it's important to pay attention to the media first and the drive second.

In theory, DAT drive media is relatively little used, and most cartridges should thus never wear out – you would need to use the same tape every day for a year for its life to be exceeded. In a real-life backup régime, a minimum of three, or more usually five,

tapes will be used in rotation, so that no one tape ever receives a great deal of wear.

Tape cartridge life is determined by factors such as the design of the tape path and head, the number of passes a drive requires for one complete backup, humidity and temperature. It's also dependent upon whether the header at the beginning of the tape is read and updated frequently, which causes additional passes.

Tape manufacturers quote various different figures for tape life, but these can be between 2,000 and 20,000 end-to-end passes in ideal environmental conditions, which is between 300 and 3,000 backups. Unfortunately, the reality is that production techniques and the effects of a real-life office environment mean that media can't be guaranteed to be perfect, and media problems are not uncommon.

Media Type

One of the most common problems with DAT drives is using the wrong type of tape. DAT cartridges look alike, and it is very easy to mistake one type for another. The quickest way to distin-

guish tape cartridges is by the length – 60 metre and 90 metre tapes are always DDS1 media, and 120 metre tapes are always DDS2 media. The new 125 metre tapes are only for DDS3.

And an obvious way to distinguish tape cartridges is by the label. DDS1 media is generally labelled DDS (not DDS1). DDS2 and DDS3 tapes are labelled DDS2 and DDS3 respectively. Cartridges are also colour-coded by some manufacturers: red (60 m), yellow (90 m) and green (120 m).

Note that you cannot use 120 m tapes in a DDS1 drive. Some DDS1 drives will automatically eject 120 m tapes.

Also, do not attempt to label the tapes themselves with anything other than the labels provided, carefully placed in the recessed areas, otherwise you may well encounter physical tape insertion problems.

Drive Firmware

It is unlikely that DAT drive firmware should cause you many problems. There may be some special circumstances, such as using a particular drive with a certain operating system and backup software, but these should be known to the drive manufacturer.

It is not generally a good idea to update DAT drive firmware as a matter of course – if anything should go wrong with the procedure, you could be left with a completely dead drive. For that reason, DAT drive manufacturers will not normally make their firmware upgrades available to you, unless they know you have a problem that new firmware is guaranteed to solve.

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Firmware upgrades can be carried out in two ways. Some are issued on a tape: to upgrade the firmware, merely install the tape into the drive. Everything thereafter is automatic. Alternatively, firmware may be obtained from a manufacturer's ftp site on the Internet, and then programmed into the drive using the appropriate software.

Cleaning

Many DAT drive problems result from dirty heads, which in turn result from using defective or sub-standard media. Although the theoretical cleaning interval is 25 hours of use, following the recommendations listed here should result in far fewer DAT drive problems.

- Clean tape drives after every eight hours of use, not after 25 hours. Cleaning DAT drives is easy: just insert the tape into the powered-on drive and wait for it to be automatically ejected when the cleaning cycle is complete.
- If you use new media, your drive will require cleaning more frequently than if you use media that has already been used several times.
- Clean a drive at least four times after any type of failure has occurred – a single clean may not remove a head clog.
- Replace cleaning tapes with a new one when a manual eject is required to remove a cleaning cartridge from a drive, or when a Replace Cleaning Tape or equivalent message is reported by an autoloader.

- If you have been carefully following a frequent cleaning programme, and then a head clog error is reported, record that error on the label of the cartridge in use at the time. Replace any cartridges that fail more than two times out of three.
- Use the same tapes in the same drive each time. This makes problem diagnosis a great deal easier, and prevents a faulty tape from contaminating other drives.

Failure to observe routine maintenance and cleaning of tape drives can produce a variety of errors, some of which may result in you being unable to recover data from a backup tape. Other problems can be physical media damage, and dropouts that result in reduced tape capacity and performance.

Viewing Sense Codes

For some backup applications, sense codes are captured by default, and it is straightforward to view them. These instructions provide help for some special circumstances.

Windows NT Event Log

SCSI sense codes can be retrieved from the Windows NT System Event Log. When the **4mmdat.sys** device driver encounters a tape hardware error, it displays the message "STOP: The tape device reported an error on a request to read data from tape. Error reported: Bad data." This lets you know that the tape drive has returned error code information. Other error messages you might see may not indicate actual hardware errors.

To recover the sense codes from the log, use the Windows NT Event Viewer. Select System from the Log menu. Find and highlight the entry that has "4mmdat" as the source, and double-click it to view the details. If you select the Words radio button, the data will be easier to read. Regardless of how many lines of data there are, the last three bytes of information will be the SCSI sense code data.

If the sense codes are blank, then the DAT drive was not the source of the error.

ArcServe for Windows NT

To turn on sense code logging in ArcServe for Windows NT, first launch the ArcServe Server Admin utility. From the menu bar choose Admin, then Configuration. In the Configuration screen, choose the Tape Engine tab, and change the Message Level from None to Brief. (Don't set it to Detail, or the log file will grow at a very rapid rate. Brief will provide you with all the information you need.)

Change the Message Output to either File Only, or Both Screen and File, as you prefer. Ensure that either All Devices, or the correct tape device, is selected in the Device To Monitor section.

Information in the Activity Log and Tape Engine Log can be viewed from the menu by selecting Manager Quick Status.

Sense Codes

The SCSI specification allows for any SCSI device that encounters an error to return quite detailed information about the error, in the form of SCSI sense codes (see box – SCSI Sense Codes). These sense codes can therefore be of considerable help when diagnosing DAT drive problems and even media problems. However, you'll need to configure your backup software to ensure that it logs these sense codes (see box – Viewing Sense Codes).

Sense codes are a useful way of diagnosing problems for several reasons. They provide a good level of detail, and because they originate from the device itself, they should enable you to pinpoint quickly the real cause of a problem. And they are independent of the operating system or backup application.

Here are some of the common DAT drive problems you may encounter, and their corresponding sense codes.

Head Clogs

Head clogs are the most common cause of media problems. They are caused by loose particles from the tape being deposited on the read/write heads, which then prevent the drive from reading from or writing to the tape. Usually, any sense code beginning with 03 (Media Error) and with a

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third byte of BE or BF indicates a head clog.

Be sure to clean the drive at least four times after a head clog to guarantee that the heads are clean. (Do not normally clean the drive more than once, or the action of the cleaning tape will wear the heads out prematurely.)

High-Torque Cartridges

Some cartridges are incorrectly wound during manufacturing, so that the tape rubs against the top and/or bottom of the tape cartridge shell (a problem you may well have noticed with audio cassettes). This rubbing action causes sufficient resistance to prevent the DAT drive from moving the tape at a consistent rate. This may be reported as sense code 04/44/AF. The tape must be replaced.

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BOT/EOT Prism Problems

Prism problems are a rare occurrence caused by bad cartridges. When they do happen, however, they will intermittently stop the drive from sensing the beginning or end of the tape. This will result in the tape motion motors stopping suddenly, reporting an error. These may be reported by sense

codes 04/44/AF (the same as high-torque tapes) or 04/44/B9; in any case, the tape must be replaced.

Physical Tape Damage

Tape damage can be caused during manufacturing, or by the DAT drive itself. Because the tape is damaged, the problem will always occur at the same physical spot on the tape. If you see sense codes 03/31/00 or 03/3B/00 reported consistently at the same place in a tape, it's probably due to physical tape damage. This can only really be verified by a special tool that is able to eject without rewinding in order to visually inspect the tape, but it's not worth doing; just replace any tape that returns these codes.

Tape Hub Alignment

Tape hub problems manifest themselves by noises during high-speed tape motion such as rewinding. If you hear anything like this, just replace the tape.

Duty Cycle

The suggested eight-hour cleaning interval introduces an interesting problem. If you're backing up large amounts of data, then depending on the data transfer rate to the drive and the compression ratio, you could actually exceed that eight-hour period with a single tape.

In general, tape drives can back up at 1 GB per hour. If you're achieving a 1.5:1 compression ratio and using an 8 GB tape, that's a total backup capacity of 12 GB, which will take around 12 hours. Obviously, in these circumstances, the drive heads will not be able to be cleaned every eight hours as recommended.

An obvious way around this prob-

SCSI Sense Codes

Sense codes are of considerable help in pinpointing SCSI device problems since these codes are generated by the device itself. However, a sense code does not always mean that the drive is the cause of the problem, just that the drive was the origin of the sense code. Usually, a sense code indicates a firmware, hardware, or media issue.

If there is no sense code returned, the problem can usually be diagnosed as a software or driver issue, a failure for the drive to respond at all, or time-out values that are set too low.

Sense codes are returned by SCSI devices when both recoverable and non-recoverable errors occur. Returned sense codes are three bytes long. The first byte tells you the type of error, as shown below. The second and third bytes give more detailed information, but these are manufacturer-specific.

Code 01 (Recoverable Error) indicates a recoverable error. Code 05 (Illegal Command) usually indicates a software application or driver problem. Codes 03 (Media Errors) and 04 (Hardware Errors) are the ones most of interest – these indicate unrecoverable problems.

Codes 02 (Not Ready) and 07 (Write Protect) are self-explanatory; code 06 (Unit Attention) is harmless, and follows a SCSI bus reset, a power-up sequence, or a tape change.

Length	Type	Capacity	Compressed capacity
60 m	DDS1	1.3 GB	up to 2 GB
90 m	DDS1	2 GB	up to 4 GB
120 m	DDS2	4 GB	up to 8 GB
125 m	DDS3	12 GB	up to 24 GB

You may see higher compressed capacities claimed – some companies base their claims on a theoretical maximum compression ratio of 4:1. A DDS2 drive, for example, may be advertised as a 4/16 GB drive or even a 16 GB drive.

While 60 m and 90 m tapes can be used in a DDS2 drive, 120 m tapes cannot be used in a DDS1 drive.

Figure 1 – Tape sizes and capacities.

lem is to break the backup job into smaller, eight-hour chunks, and clean between every tape. But if your backup requirements are much larger than 12 GB or so, you may want to consider using an alternative tape technology better suited to high capacities.

Physical Problems

You might not normally think that there was any scope for attempting to repair a DAT drive yourself. Certainly, as far as electronic faults go, a drive is best returned to the manufacturer. But DAT drives have a lot of moving parts, and many problems can have a simple explanation – perhaps a lever has become bent, disengaged or misaligned. These problems can sometimes be triggered by user abuse, such as forcing a tape into the drive.

For example, certain drives are notorious for failing in such a way that they can no longer eject the tape. Although the tape is pushed out by the drive, the flap covering the aperture isn't first lifted clear, so the tape simply gets jammed against the flap. This particular problem is due to a lever that has become disengaged from its driving mechanism.

This, and other similar problems, can readily be solved using a simple technique, provided you have a working drive of the same type. All you have to do is to observe exactly what happens in the working drive, and this should provide you with enough information to be able effect the repair. Of course, if a part is actually broken,

you're out of luck.

Configuration

DAT drives usually have a set of DIP switches that control the drive's behaviour (this is apart from the usual switches to set the SCSI ID). Whilst on the subject of the SCSI bus, it makes good sense not to put the DAT drive at the very end of the chain. DAT drives go wrong more often than hard drives, and you don't really want to have to go to the trouble of re-jigging SCSI bus termination just in order to remove the drive for servicing.

Sometimes, switches must be set depending on the operating system and backup software in use. So, if you change the operating system on a server, or move a DAT drive, you may well need to change the switches. Also, this is one of the occasions where a firmware upgrade may be necessary – if you are using an operating system that was unsupported at the time of the drive's manufacture.

Some drives have switches that control the availability of compression. Usually, there is one switch to turn compression on and off, and another to permit the host to have software control over the compression setting. Consequently, it is possible to set the switches in such a way that compression is never enabled – and drives are sometimes shipped in this state by default. So, if you don't appear to be getting as much on a tape as you would expect, or your software isn't even offering you the choice of using the hard-

ware compression on the drive, then do check these switches.

Unfortunately, DAT drives can be particularly sensitive to power supply voltage. Whatever DAT problems you are experiencing, it makes sense to check and double-check that the supply voltage is well within specifications.

Summary

Contact the drive's manufacturer to determine whether a firmware upgrade is required. Check that the drive is correctly configured, that it is clean, and that you are using the correct media type. Changing the tape itself will resolve many problems immediately; if in doubt, use the SCSI sense codes to understand better what the problem really is.

Always follow an appropriate cleaning régime to maintain drives in good working condition, and make sure that your backup programme does not cause the recommended cleaning interval to be exceeded.

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