Build Your Own Vanilla SCSI Tape Backup System

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Make Mine Vanilla   (Introduction)

     Last autumn, I assembled my own "vanilla" SCSI hard drive subsystem
using the Seagate ST277N drive, the Tulin AppleHive case, and CMS SCSI
Interface Card and saved about $250 by "building my own". Since my first
online article on the assembly appeared last year, thousands of others
have followed suit and assembled their own SCSI hard drive, and the
popularity of these homebrew hard drives is illustrated by the wealth of
online and magazine articles which have followed.

     During the following months of helping others assemble their own
hard drive, giving tutorial presentations before Apple user groups where
members would assemble their own hard drive during the presentation, and
writing follow-up articles for online services, my own BBS, magazines and
newsletters, it became quite apparent to me that what we all needed next
was an inexpensive SCSI tape backup system. Acquiring and assembling the
hardware was the easiest part - find the software needed to format, backup
and restore was the difficult part since Apple, nor anyone else, has
released either drivers for a SCSI tape system or tape backup software.
Fortunately more me - and you - a friend of mine was willing and able to
write the necessary software - HDTAPE - which is now available at a
shareware price.

     Tim Grams, author of HDFORMAT (the very popular SCSI hard drive
formatting software), is the author of HDTAPE. (If you are already familar
with HDFORMAT or any of Tim's other software products, you already
appreciate the quality of his work!) HDTAPE is NOT a tape driver; rather,
it is a ProDOS-8 application which allows you to format, backup to and
restore from tape. As a ProDOS-8 application, the version of HDTAPE
described here is specific for the Apple //gs. A GS/OS version as well as
a version for the Apple //e are planned, and current owners of HDTAPE will
be notified of the availability of significant upgrades. HDTAPE is
available by direct order from Tim, and ordering information follows this
article.

     If you're a SCSI hard drive owner who has quickly tired of backing up
your drive to floppy disk, read on: I will lead you through the purchase of
the hardware, its assembly and use. And before you say "I can't build
anything" let me say that if you can use a screwdriver, you CAN build your
own SCSI tape backup system - its THAT easy!

Why A Duck?   (Why a SCSI Tape Backup System?)

     Do you find yourself asking, "Why should I invest in a tape backup
system when 3.5" disks will do?" There are three reasons which come to
mind instantly: (1) Using 3.5" disks, you must remain glued to the chair
in front of your system, swapping disks - lots of disks - and for a 32 meg
volume this can take well over one hour. Using a tape system, you start
it up, wander off and do other things while the system is backing itself
up, and return when its done. (2) The tape system I'll describe here
uses DC2000 tapes, each of which holds 40 megs, equivalent to 50 3.5"
disks. Since the DC2000 tapes (which are also used in many of the MS-DOS
systems and are therefore readily available) can be purchased for as low

as $15 each, tape backup is more economical than disk backup. (3) And
finally, since the DC2000 tape is roughly the size of an audio cassette,
it requires a lot less storage space than do 50 3.5" disks.

Lincoln Logs   (The Hardware)

     The hardware needed for this project is listed below. I provide
information on vendors and approximate prices (based on what I paid in
March 1989) at the end of this article.

     1 - 3M brand MCD-40 DM/SCSI tape unit
     1 - Tulin AppleHive case with 30 watt power supply &
           fan; includes all internal cabling; the optional
           open face plate is highly recommended
     1 - Apple SCSI Interface Card (ROM version C)
     1 - SCSI Interface Cable terminating in a DB-25 pin
           connector on one end and Centronics-like 50-
           pin connector on the other end
     1 - Standard Power Cord (as used on the Apple // line)
     1 - DC2000 40 meg (250') SCSI tape cartridge
     1 - HDTAPE (Formatting, Backup & Restore Software)

Ummm...A Frozen TV Dinner!   (The Assembly)

     For the initial assembly and connection, I'm going to provide
directions assuming that your SCSI tape backup system will be operating
on a seperate Apple SCSI Interface card from your hard drive. Operation
on the same SCSI chain (i.e., Interface Card) as your hard drive requires
a few extra steps, which will also be explained.

     1.   If your tape unit arrived with the attachment brackets already
          installed, skip down to Step 3.

     2.   Attach the brackets to either side of the tape unit using the 4
          screws supplied. When facing the tape unit's front panel, the
          tape ejection button should be below the tape insertion opening.

     3.   If you purchased the optional open face plate from Tulin, skip
          to Step 4; if not, you will need to cut a hole in the face plate:
          Using a sabre saw with sheet metal blade, cut a rectangular hole
          in the AppleHive face plate measuring 4.25" wide and 1.5" high.
          The lower left corner of this hole should be 1" from the left
          edge and 0.25" up from the bottom of the face plate (on the
          bottom half of the face plate when facing the AppleHive). When
          cutting this hole, be sure to make the cut far away from the
          tape unit itself - preferrably in another room - to keep metal
          shavings from coming in contact with the drive and case. Use a
          metal file to round the cut edges smooth.

     4.   With one hand, hold the tape unit so that its underside is facing
          UP. (The tape's eject button is on the bottom front of the unit.)
          With your other hand, grab the distal end of the flat, 50-wire
          ribbon cable coming from the connectors on the back plate of the
          case and extend the cable so that it is NOT twisted. Insert the
          connector at the end of this cable into the 50-pin connector at
          the back of the tape unit. Be careful to insert this connector
          properly so that no pins are bent, broken or sticking out. When
          you press the connector into the back of the tape unit, the
          latches on either side of the tape unit's connector should lock
          the cable in place. Once this connection has been secured,
          rotate the tape unit so that it is right side UP, resulting in

the 50-pin cable having a 180 degree twist in it.

5.   Connect the 4-prong power line connector from the power supply
     unit in the case to the tape unit. Note that this power
     connector is D-shaped, and can only be inserted into the tape
     unit's power plug receptor one way (the correct way!).

6.   Gently set the tape unit onto the base plate of the case. Hold
     securely to the case base plate and turn the entire assembly
     upside down while continuing to hold the tape unit firmly against
     the base plate. Using the 4 flathead screws provided with the
     case, secure the tape unit to the bottom plate by inserting the
     screws through the holes in the bottom plate and into the bottom
     of the brackets on either side of the tape unit. Tighten securely.
     Turn the assembly right side UP.

7.   Check that the settings of the DIP switch bank (on left side of
     drive when facing drive from the front) are properly set (Dips
     1-6 should be towards the bottom of the drive, 7-8 towards the
     top of the drive). The SCSI ID of the tape unit should be LOWER
     than that of your SCSI hard drive; setting the tape unit ID to 0
     is a safe bet since most commercial hard drives are shipped with
     SCSI ID = 6.

8.   Install the case cover and face plate, and fasten securely using
     the screws supplied. Attach the power cord and SCSI interface
     cable to the connectors on the back of the case, but do not yet
     plug the power cable into a wall outlet.

9.   Install the Apple SCSI Interface Card into your Apple as per the
     manufacturer's directions.

10. Attach the SCSI Interface Cable from the tape unit to the Apple
     SCSI connector on the back of your computer.

11. Plug the tape power cord into a wall socket and turn the tape
     unit ON.

12. Turn your computer and hard drive ON, and boot the HDTAPE disk.
     Follow the instructions below for using HDTAPE.

Solo Flight   (Using The Tape System On A Single SCSI Chain)

     If you will be chaining your tape backup system off your existing
SCSI hard drive, you will need to (1) make sure that the SCSI tape backup
system is the last device in the chain and (2) remove the terminator
packs from the hard drive.

     To remove the terminators from your hard drive, open your hard drive
case and remove the hard drive unit itself. Locate the terminator packs
(usually 2-3 small, thin yellow units which vaguely resemble catapillars
on the underside (circuit board) of the hard drive) by gently pulling them
off. Be careful not to bend or break any of their pins. Also note how
they are attached to the drive (which side is "up") so that you can
properly reinsert them at a later date if necessary.

     If you remove all terminators for all drives, including the tape
drive, you can chain or remove drives at will, providing you attach an
Apple SCSI Terminator to the daisy chain port of the last drive on the
chain. This will require that you purchase an Apple SCSI Terminator at
additional cost.

After reassembling your hard drive, connect the SCSI Interface Cable
from your tape backup system to one of the connectors on the back of your
SCSI hard drive. You are now ready to boot HDTAPE and begin your backup.

Its Soft Where?   (Using HDTAPE)

     With your computer, hard drive and tape backup systems ON, boot the
HDTAPE disk. After the program boots and the credits screen is displayed
(indicating the version of HDTAPE you're using), HDTAPE checks for the
presence of an Apple SCSI Interface Card and tape drive, and then
instructs you to insert a tape. When you receive this instruction,
insert a brand new, unformatted tape.

     Your tape drive will perform about 30 seconds worth of tape access.
During this time, it is checking the tape. It will determine that the
tape needs to be formatted and will issue a message indicating this.
When you see the menu line

     0=Backup 1=Restore 2=Format 3=Diagnostics Q=Quit

select 2 to format the new tape. Formatting takes approximately 38-40
minutes, so go grab an iced tea and watch a rerun of Taxi.

     When Taxi is over, so is your formatting of the tape. The menu line
is again displayed and you're all set to begin backing up your hard drive.
Fortunately you will only format each tape you use once and never again,
so you may want to take the time to format all your tapes now and get
that out of the way for good.

     HDTAPE is a ProDOS-8 application using the old Slot and Drive
designations for the volume to backup. To backup a volume, select 0 from
the menu line. HDTAPE responds with questions on which Slot and then
which Drive you wish to backup. If you have a 60 meg hard drive attached
to slot 6 and wish to backup the first volume, select Slot 6 Drive 1; to
backup the second volume in that hard drive, select Slot 6 Drive 2.

     Three hexidecimal numbers are displayed during the backup process:
the total number of ProDOS blocks that will be backed up, the number of
blocks read from the volume, and the number of blocks written to the tape.
The number of blocks written to the tape will eventually go higher than
the number of blocks read from the volume being backed up due to
buffering and differences in the block sizes of the two devices (hard
drive and tape drive); this is of no importance to the backup process
itself, so don't be alarmed! In general, each megabyte being backed up
takes about 2-2.5 minutes, so estimate how long the entire backup process
will take based upon the size of the volume being backed up, and go have
some fun while the backup occurs.

     Note that if you wish to cancel a backup or restoration, you can
press ESCAPE to return to HDTAPE's main menu - but beware that the tape
(if backing up) or hard drive (if restoring) will contain incomplete data.

     When the backup is done, select Q from the menu line and HDTAPE will
rewind the tape for quick mounting the next time that tape is used. After
rewinding, HDTAPE will ask you if you wish to either quit the program or
process another tape.

     Restoring a backup from tape is just as easy as backing up to tape.
Select 1 from the menu line to restore, and tell HDTAPE which Slot and
Drive you wish to restore to - the rest is automatic. And yes, it is
THAT easy!

There are a variety of cases that can be used instead of the Tulin AppleHive. If you purchase a case with an "open" front plate, you will not need to cut a rectangular hole in the front as we did with the Tulin AppleHive case; the "open" front plate cases already have that opening. The one problem that can crop up with any case/power supply/fan combination you choose is magnetism.

Unlike hard drives, tape drive units are open and not as well protected as hard drives are from magnetic fields, dust and other data goblins. Many of the power supplies and fans in popular hard drive cases emit enough magnetism to interfer with the operation of the tape unit. If you find that your tape unit does not operate properly, try removing the case covering and carefully try using the system opened. If the tape unit works under these conditions, chances are that enough magnetism is being created when you close up the case to interfer with the tape unit's performance. If this is true, try this home remedy: cut a piece of cardboard box to make a "lid with sides" which can stand over the tape drive and along either side of the tape drive for its length. (I used part of the tape drive shipping box, which was the perfect size.) This "lid with sides" should fit so that there is sufficient space between it and all components of the tape drive itself. Completely encase this cover with aluminum kitchen foil, taping all edges so that the foil edges can not unravel and touch any of the tape drive components. Set this aluminum-covered cardboard lid over the tape drive so that is surrounds the tape drive and provides a physical barrier between the tape drive and the power supply and fan. You may also want to place a sheet of plastic film between the bottom of the tape unit and the case (I used a plastic page protector trimmed to the size of the tape unit's footprint). Also check that all cable connections are secure.

Another problem which ocassionally occurs is a bad tape. Just like disks, you can ocassionally receive a bad tape. If your tape unit seems to function properly but you receive an error during the format process, try another new tape or two - you may simply have a bad tape (or two if its your unlucky day).

Finally, note that tapes can wear out after prolonged use. To help extend the life of your tapes, always store them in a clean, out-of-the-way place away from magnetic fields.

"I Love You" & Other Lies   (Warranties & Promises)

One of the major concerns for all do-it-yourself projects is the warranty. One of the first questions posed to me when I built my vanilla SCSI hard drive is, "What about a warranty?" If you purchase a new drive, you should receive the manufacturer's warranty - which usually runs about one year. This is the same as is usually given on commercially-assembled tape backup systems. Check with the vendor of the case/power supply on their warranty; Tulin offers a 6-month warranty on the AppleHive case. Apple offers their standard, chintzy 90-day warranty on the SCSI Interface Card. In general, with the possible exception of a shorter warranty on the case & power supply, the warranty on the tape unit itself and the Apple SCSI Interface Card are the same as if you purchased a commercial tape backup system. The big difference in assembling your own system, of course, is price.

The Bottom Line   (Price)

I purchase my brand new 3M tape unit for $299. The Tulin AppleHive
case with 30 watt power supply is $119. The Apple SCSI Interface Card can
be purchased mail order for about $100, the SCSI Interface Cable and power
cord together will cost you another $30 or so, and HDTAPE $50. The bottom
line comes to around $600, excluding tapes. (If you already have a SCSI
hard drive with Apple SCSI Interface Card, your tape backup system can run
less than $500 complete.) Scouring the local computer faires and Computer
Shopper, you might be able to save $50 on a case with power supply, and if
you make your own SCSI Interface Cable, you can save another $20 or so.
Considering that Apple sells their similar SCSI Tape Backup System for
the Mac, sans Apple SCSI Interface Card, for $1499 list, $600 doesn't
seem that expensive to begin with!

    If you are considering assembling your own hard drive AND tape unit
simultaneously, you can save a few dollars by using the Tulin AppleHive
case since this case will hold both one half-height hard drive and the 3M
tape unit. But since the AppleHive comes in two flavours - with a 30
watts power supply or with a 60 watts power supply - which do you select?
The Seagate ST277N 60 meg SCSI hard drive draws a maximum of approximately
12.5 watts (when accessing the drive) and the 3M tape unit draws a maximum
of 20 watts when moving the tape (but only 9 watts when in stand-by mode).
Since the two devices are accessed alternately, it appears that the 30
watts power supply is sufficient to power both devices. Tim is using
the 30 watts version to power both his Seagate ST277N 60 meg drive and 3M
tape unit and reports no problems thus far (I have my vanilla tape system
in a seperate case since I move it between two Apple //gs units), but we
both suggest that the 60 watts AppleHive be considered just to be safe.

The Cast Of Players   (The Vendors)

    HardTimes (1070 Commercial St. San Jose CA 95112; 408-
        452-5700) sells the 3M tape units for $299, while
        their supply lasts.

    Tulin Corp. (2393 Qume Dr., San Jose CA 95131; 408-432-
        9025) sells the 30 watts AppleHive for $119 and a
        60 watts AppleHive for $169, power cords for $4
        $20 for the SCSI Interface Cable.

    Mytech Electronics (300 Breesport, San Antonio TX 78216
        800-527-7435) is a good source for cables & other
        electronic components (including all you will need
        to make your own SCSI Interface Cable).

    Diskette Connection (272 Quigley Blvd., New Castle DE
        19720; 800-451-1849; & other locations around the
        US) is an excellent source of 3M DC2000 tapes for
        $15 each. Quick reliable service & best prices!

    Tim Grams (P.O. Box 462283, Garland TX 75046) provides
        HDTAPE for $50. When ordering, specify HDTAPE,
        computer type being used, and 3.5 or 5.25 disk.
        Checks or money orders (made payable to Tim) are
        accepted.

The Free Clinic   (Sources of Information & Help)

    The Washington Towne Crier BBS (1-201-689-3649; 8-N-1; 300/1200/2400
bauds) is a free, public-access BBS specializing in the Apple // family of
computers. WTC has extensive libraries of public domain and shareware SCSI
utility software and information files. The author can also be reached at
WTC via private EasyMail (user #1) or the public forums.

     The author may be contacted electronically via the following services:

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