DataGeneral

Supplement

Supplement to Managing AOS/VS and AOS/VS II

093–000855–00

This supplement, applicable to AOS/VS II systems only, contains replacement pages for Chapter 6, pp. 14-5 through 14-12, and Docset-3/Docset-4 of your manual 093–000541–03. Please see "Updating Your Manual."

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Notice

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In the margins of replacement pages, a vertical bar indicates substantive technical change from 093–000541–03.

The supplement number appears on all pages in this supplement.

Updating Your Manual

This supplement (093–000855–00) to *Managing AOS/VS and AOS/VS II* provides new information on the FSCOPY utility and C2-level system security effective with AOS/VS II Release 3.01. It also includes minor corrections.

To update your copy of 093–000541–03, please remove manual pages and insert supplement pages as follows:

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Managing AOS/VS and AOS/VS II

093–000541

For the latest enhancements, cautions, documentation changes, and other information on this product, please see the Release Notice (085–series) and/or Update Notice (078–series) supplied with the software.

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Chapter 6
Using FSCOPY to Back Up AOS/VS II LDUs and to Restore LDUs or Files

Read this chapter

- When you want to back up AOS/VS II LDUs; or,
- When you want to restore LDUs or individual files from an FSCOPY backup.

FSCOPY Features

FSCOPY is an AOS/VS II backup and recovery utility that is part of AOS/VS II Revision 3.01. FSCOPY is optimized to work with large disks, including disk-array storage systems, and with tape-array storage systems. You can use it, however, with any disk or tape. FSCOPY provides the following benefits:

- provides on-line consistent backup of up to 20 Gbytes of data in an operator shift
- lets users continue to work while the backup is in progress
- restores LDUs or individual files
- streams tape-array storage systems without monopolizing system resources
- writes ANSI tape labels
- provides backup/restoration status and statistics

FSCOPY backs up initialized AOS/VS II LDUs to tape, which means that users can continue to work while the backup occurs. FSCOPY provides a consistent backup because it backs up files just as they were when the backup began.

You can use FSCOPY as your backup/restore utility of choice. You may want to use FSCOPY for full backups and DUMP_II/LOAD_II or DUMP_3/LOAD_3 for incremental backups.

FSCOPY will back up an LDU on any disk to any tape. If you are using it with a tape-array storage system, each volume can be up to seven cartridge tapes. See the manual *Installing, Operating and Maintaining the CLARiiON™ Tape-Array Storage System – DG/UX or AOS/VS II.*

This chapter explains how to use FSCOPY. For more information about backup in general and the uses of other backup utilities, see Chapter 4.

Where to Run FSCOPY

You can issue an FSCOPY command line from the system console or from a user terminal. If tapes are premounted, you can run FSCOPY in batch.

FSCOPY requires that the process that runs it have Superuser and Superprocess privileges; FSCOPY will turn the Superuser and Superprocess modes on for you.

If you want FSCOPY to continuously display statistics, then you must run FSCOPY from a console that is DASHER™ D200-compatible. If you want to interact with FSCOPY (for example, so that FSCOPY can ask you to mount a new tape, and you can tell FSCOPY when it is mounted), then you must run FSCOPY from a console, but it can be hardcopy or any other console type.

For command line formats and examples of how to use FSCOPY, see the sections that follow: "Backing Up an LDU," "Restoring an LDU," and "Restoring Files."

Deciding Whether to Use FSCOPY

When deciding whether to use FSCOPY, consider how using FSCOPY affects the backup and recovery procedures for your system. You may want to use FSCOPY only for certain LDUs. Or you may want to use FSCOPY only for full backups. Consider the following information when making this decision.

- Backups are done much more frequently than restores. If you want to back up or restore an entire LDU, FSCOPY is much faster than DUMP_II/LOAD_II or DUMP_3/LOAD_3. Review the "FSCOPY Performance" section to help assess how FSCOPY will perform in your system environment.
- FSCOPY lets you back up only one LDU to one or more tape volumes. DUMP_II and DUMP_3 let you back up multiple LDUs to one or more tape volumes.
- For increased performance, FSCOPY, like LDCOPY, does an LDU-level backup, although LDCOPY can back up only uninitialized LDUs. DUMP_II or DUMP_3 do file-level backups. FSCOPY does allow file-level restoration directly from the backup tape. However, FSCOPY, with its LDU-level orientation, may be slower and more cumbersome than DUMP_II/LOAD_II or DUMP_3/LOAD_3 when restoring individual files. See the section called "Restoring Files" on page 6-15 for more information.
- If you can create a spare LDU with space matching the original LDU, you can restore individual files without having to use the FSCOPY index file and list of pathnames. See "Restoration Tips" for details.

FSCOPY Performance

Compared to LDCOPY and DUMP_II, FSCOPY completes an LDU backup in less time and uses less CPU time. The following table compares the elapsed time and CPU usage for FSCOPY, LDCOPY, and DUMP_II. For the comparison, we constructed an LDU on a RAID-0 CLARiiON disk array connected to an MV/35000. A CLARiiON tape array with five 4-mm DAT tapes received the backup. Each backup utility backed up the same 1-gigabyte LDU to the same tape drives.

Back-up Tool	Time (Hrs:Min:Secs)	CPU Usage
DUMP_II	01:01:25	54%
LDCOPY	00:27:33	43%
FSCOPY	00:22:26	27%

These statistics illustrate the relative differences in performance between DUMP_II, LDCOPY, and FSCOPY. The statistics will vary, depending on specific LDU and system configuration.

To restore an LDU with FSCOPY requires approximately the same time as the FSCOPY backup. To restore files with FSCOPY, you must first create an index, which takes the same time as the FSCOPY backup. The overall time required to restore files with FSCOPY (creating index, creating a list of pathnames, actually restoring the pathnames) generally takes one to two times as long as the FSCOPY backup. How long it takes to create the list of pathnames and actually restore the files depends on the number of files on the LDU and where they are located.

Memory Required for Backup

Total memory required for FSCOPY backup is approximately

```
FSBUFFERS*TAPEREQ + TAPEBUFFERS*TAPEREQ +
                    (LDUSIZE/(DISKREQ*4) bytes) + FSCOPYMEM
```

where `FSBUFFERS`, `TAPEBUFFERS`, `TAPEREQ`, and `DISKREQ` are the values specified by the /FSBUFFERS, /TAPEBUFFERS, /TAPEREQ, and /DISKREQ switches, respectively. `FSCOPYMEM` is the memory required by the FSCOPY program itself.

If default values are used and we assume a 2-Gbyte LDU, total required FSCOPY memory for backup is approximately

```
5*224K + 10*224K + (2G/(64K*4) bytes) + 1.5M = ~5 Mbytes.
```

(where G=1024^3, M=1024^2, K=1024)

Memory Required for Restore

Total memory required for FSCOPY restore is approximately

```
TAPEBUFFERS*TAPEREQ + (LDUSIZE/(DISKREQ*4) bytes) + FSCOPYMEM
```

where `TAPEBUFFERS`, `TAPEREQ`, and `/DISKREQ` are the values specified by the /TAPEBUFFERS, /TAPEREQ, and /DISKREQ switches, respectively. `FSCOPYMEM` is the memory required by the FSCOPY program itself.

If default values are used and we assume a 2-Gbyte LDU, total required FSCOPY memory for restore is approximatley

```
10*224K + (2G/(64K*4) bytes) + 1.5M = ~4 Mbytes.
```

(where G=1024^3, M=1024^2, K=1024)

How FSCOPY Works

FSCOPY provides three major functions: backing up LDUs, restoring LDUs, and restoring files. This section gives a simplified overview of how FSCOPY works.

FSCOPY makes a "snapshot" of the disk when the backup started: file edits made and files created after the backup begins are not part of the backup. When you execute it with the /BACKUP switch, FSCOPY reads the bitmap of the LDU you are backing up and then backs up all allocated disk blocks as they were at this date and time (these are called **backed up blocks**). FSCOPY also copies blocks users are about to modify before they are actually modified by the filing system (these are called **copied blocks**). (If you use the /TIMESTAMP switch, FSCOPY creates a file, FSCOPY_TLB by default, whose date and time of creation show when the backup started. You can use this file when doing incremental backups. See "Using FSCOPY_TLB When Doing Incremental Backups," later in this chapter.)

To restore an LDU, FSCOPY must have exclusive access to the disk. FSCOPY simply writes data from tape to disk, reconstructing the LDU as it existed at the time the backup started. When FSCOPY finishes, you must reinitialize the LDU. Because an LDU cannot be accessed while it is being restored, special consideration must be given when using FSCOPY to back up and restore the root. See "Restoring an LDU," later in this chapter, for more information.

To restore individual files to an LDU, you must follow a three-step process:

- First, you run FSCOPY to create an index of what is on the backup tape.
- Next, you create a list of pathnames that you want to restore.
- Finally, you run FSCOPY to restore the files in the list(s) of pathnames.

Backing Up an LDU

An FSCOPY backup tape set includes backed up blocks, copied blocks, and formatting and header information, and typically is up to one and one half times larger than the LDU. (If the system is actively writing to the LDU during the backup, there will be more copied blocks.) Set aside enough tapes for the backup.

Preparing for Backup

To prepare for a good backup, bring the system to a stable state. Broadcast a message to users that they should exit applications and stop editing files. FSCOPY does not automatically close files or flush buffers in user programs. If such actions are required to assure that the backup contains usable files, the system manager or users must take appropriate action. For server-based applications, stop the servers. If databases are involved, create checkpoint files to preserve the status of each of the databases.

If you start FSCOPY without first stabilizing the system, FSCOPY will create a backup that includes files in an unstable state. If you subsequently restore these files from the FSCOPY backup, the application or server may find them inconsistent and unusable, as if the system terminated abnormally and ESD did not run.

Starting the Backup

Mount or insert the tape in its unit. (You can premount tapes if you have multiple units and expect to use multiple tapes.) Your working directory does not matter.

Then, start the backup, using the following format:

FSCOPY/BACKUP*[/optional_switches]* ldu_pathname @tapeunit *[@tapeunit]* ...

FSCOPY requires that you have the Superuser and Superprocess privileges, and turns them on for you. FSCOPY restricts you to one LDU per tape set. When you specify one tape unit, FSCOPY prompts you to mount the next volume if required. If you specify more than one tape unit, FSCOPY continues the backup automatically.

For example, to do a backup of the LDU named UDD1 and initialized in the root (:) directory, type

```
) FSCOPY/BACKUP/DISPLAY/STATISTICS/TIMESTAMP :UDD1 @MTJ0↵
```

In this example, we are backing up the LDU UDD1 (a disk-array storage system) to a tape-array storage system. We use the /DISPLAY switch because we want to monitor runtime status, the /STATISTICS switch to get total statistics when FSCOPY finishes, and the /TIMESTAMP switch to create the file FSCOPY_TLB.

If we had been using individual 4-mm or 8-mm tape drives and needed to premount tapes on units MTJ0 and MTJ1, the command line would have been:

```
) FSCOPY/BACKUP/DISPLAY/STATISTICS/TIMESTAMP :UDD1 @MTJ0 @MTJ1↵
```

There are a number of other backup switches that we could specify, but we accept FSCOPY defaults and do not show these switches in our examples. See Table 6–1 at the end of this section for a list of all backup switches. You can abbreviate switch names as long as they are unique. For example, you can use /DISP for the /DISPLAY switch.

FSCOPY writes an ANSI tape label with a (default) 90-day retention period.

If a tape has an ANSI label (written by another backup utility), FSCOPY will examine it. If there is no expiration date or if the retention period has expired, FSCOPY will overwrite the contents of the tape.

To reuse a tape when its retention period has not expired, you must overwrite the label. For example, you can type the following CLI command:

```
) WRITE/L=@MTJ0  SCRATCH
```

CAUTION: *During a backup, FSCOPY cannot recover from hard disk errors or hard tape errors. If you get either of these errors, you need to restart the FSCOPY backup.*

Handling Premounted Tapes

Each time FSCOPY comes to the end of a volume, it looks for another scratch tape to use. Beginning with the next tape drive specified on the command line, FSCOPY checks each subsequent tape drive to find one that is online and also has a valid scratch tape mounted on it. For each tape drive encountered that is offline or does not have a scratch tape mounted on it, FSCOPY displays an error message to the screen and tries the next drive. If FSCOPY comes to the end of the tape drives specified on the command line, it goes back to the first. If FSCOPY tries all the drives and cannot find a scratch tape, it will prompt you to mount a tape on a specific drive.

Restarting Servers

When FSCOPY begins executing, it displays the message

```
FSCOPY backup is now initializing.
```

After FSCOPY does enough preprocessing to guarantee a good snapshot, it displays the message

```
Initialization completed. Performing backup.
```

Then you can restart servers and broadcast a message to users that they can resume their work.

Tuning FSCOPY Backup

A number of FSCOPY backup switches let you modify how FSCOPY performs. The switches are /DISKREQ, /FSBUFFERS, /RECORDSIZE, /TAPEBUFFERS, /TAPEREQ, and /TASKS. Normally, you will never need to specify these switches, since we have provided reasonable default values.

If these switches result in the error "Insufficient memory available," you may be able to run FSCOPY by decreasing the switch values. (See memory usage formulas in the section "FSCOPY Performance.")

Using FSCOPY_TLB When Doing Incremental Backups

You can use the date and time of creation of FSCOPY_TLB when deciding a time *after* which to perform incremental backups using DUMP_II or DUMP_3. To record this information, specify the /TIMESTAMP switch when you perform an FSCOPY backup.

For example, assume that FSCOPY creates file FSCOPY_TLB with a timestamp of 10–DEC–93 at 18:00:00. (Type F/AS FSCOPY_TLB to view the date and time of creation of this file.) The next day, you do an incremental backup with DUMP_II, using the command line

```
Su) DUMP_II/AFTER/TLM=10–DEC–93:18:00:00 @MTJ0 UDD:#
```

DUMP_II dumps all files in :UDD and below which were modified after 6:00 p.m. on December 10, 1993.

FSCOPY Backup to Multiple Tapes

If the FSCOPY backup requires more than one tape, then FSCOPY will need to wait while the next tape is mounted, unless the tape is already premounted. While FSCOPY is waiting, write activity to the LDU could require saving some "copied blocks" in the FS buffers. The number of copied blocks is determined by the amount of write activity to the portion of the LDU that has not been backed up at the time of the user write request.

Once these FS buffers are full, the system must pend any further attempts to modify the LDU. In fact, such a condition may cause other system activity to pend. Nonetheless, FSCOPY is still "running" and waiting for the next tape to be mounted. Once the tape is mounted, and FSCOPY can clear out its FS buffers, system activity will resume.

If FSCOPY is waiting for you to mount the next tape, it will wait indefinitely unless a time-out value is specified with the /TIMEOUT switch. If the specified time-out value expires, FSCOPY will terminate the backup and report the error message "Operator timeout period has elapsed. Program Terminated."

If at all possible, you should premount the tapes required for FSCOPY backup. This will avoid having FSCOPY terminate due to a time out. And this will allow FSCOPY to keep writing to the tape.

If you cannot premount sufficient tapes and you want to minimize the possibility of FSCOPY running out of buffers, you can do the following:

1. Allocate as many FS buffers as possible.
2. Minimize LDU use during the FSCOPY backup.

Running Concurrent FSCOPY Backups to Multiple Tape Drives

If you have multiple tape units available, running multiple copies of FSCOPY concurrently may be advantageous.

- You can save time by simultaneously backing up multiple LDUs. Before attempting this, you must first determine that adequate memory and CPU resources exist (see the section "FSCOPY Performance").
- You can simultaneously back up logically related databases that are on multiple LDUs. This method maintains consistency between databases. If recovery is necessary, the related databases will be synchronized when you load the LDUs from backup.

Monitoring Status

Use the /DISPLAY switch to monitor runtime status. FSCOPY computes the percentage of the backup completed and estimates the amount of time remaining until the backup is done. FSCOPY also displays the tape transfer rate, in bytes/second (byte/s), Kbytes/second (Kbyte/s), or Mbytes/s (Mbyte/s). The transfer rate varies, depending on the number of soft errors, the characteristics of the tape drive, and how far along in the backup you are. The accuracy improves as the backup continues. Figure 6–1 gives an example of this screen. FSCOPY displays a similar screen for other activities such as restoring an LDU, creating an index, or creating a list of pathnames.

```
FSCOPY Revision nn.nn                          10-Dec-93 11:38

                          Backup of UDD1

+================----------------------------------------------+
|################                                             |
+================----------------------------------------------+

Backup 25% complete.  Estimated time remainirg: 120 minutes.
                                  Disk        Tape
Transfer Rate:                  200.5KB/s    210.8KB/s
```

Figure 6–1 FSCOPY Backup Status Screen

Getting Backup Statistics

Use the /STATISTICS switch to get statistics after FSCOPY runs. Figure 6–2 gives an example of the screen you can use to examine backup status.

```
Statistics for full volume backup of UDD1
The backup took 1347 seconds to complete.
It required 1 backup tape(s).
                         DISK                    TAPE
Transfer Rate:         747.1KB/s               871.9KB/s
Requests:               5242                    5243

Copied blocks:          0
Backed up blocks:       2012651
```

Figure 6–2 FSCOPY Backup Statistics Screen

FSCOPY reports the time it took to complete the backup, the number of tapes in the backup set, and the transfer rate for disk and tape in bytes/second (byte/s), Kbytes/second (Kbyte/s), or Mbytes/s (Mbyte/s), as well as the number of requests for disk and tape and the number of copied blocks and backed up blocks. Here, there was no user activity, so there were no copied blocks.

Table 6–1 FSCOPY Backup Switches

Switch	What It Does
/BACKUP	Backs up an LDU.
/DISKREQ=n[1]	Specifies the number of bytes FSCOPY will request at one time from disk during backup. You can specify a number from 8192 through 1048576 bytes (1 Mbyte). The value you specify must be smaller than the value for /TAPEREQ. The default, if you omit this switch, is 64 Kbytes.
/DISPLAY	Displays runtime status.
/FSBUFFERS=n	Specifies the number of buffers used for copied blocks when backing up an LDU. You can specify a number from 1 through 1024. The default, if you omit this switch, is 5.
/NOBITMAP	Does not scan the bitmap for the LDU and therefore copies **all** blocks on the LDU, including unallocated blocks.
/NPROMPT	Terminates the backup if FSCOPY encounters errors that normally produce an interactive prompt. If you omit this switch, system activity may pend waiting for the operator to mount a tape. Use this switch when you cannot ensure that someone will be attending the backup.
/RECORDSIZE=n[1]	Specifies the size of the tape record FSCOPY uses during a backup. You can specify a number from 8192 through 32768 bytes. If your system or tape drive has a maximum buffer size of 16384, you must specify 16K. The default, if you omit this switch, is 32768 bytes.
/RETAIN=n	Specifies the number of days that a labeled tape is retained. The default is 90 days.
/SPLIT=n	Divides an FSCOPY backup into multiple n-Megabyte physical files on the backup tape. Having a smaller split size may speed up file restoration or reduce data loss if a part of a backup tape becomes unreadable. You can specify a number from 1 through 2097152 Mbytes. The default, if you omit this switch, is 1024 Mbytes (1 Gbyte).
/STATISTICS	Displays statistics when FSCOPY completes.
/TAPEBUFFERS=n	Specifies the number of buffers used for backed up blocks that are written to tape when backing up an LDU. You can specify a number from 1 through 1024. The default, if you omit this switch, is 10.

[1] For these switches, you can specify K for Kbytes or M for Mbytes.

(continued)

Table 6–1 FSCOPY Backup Switches

Switch	What It Does
/TAPEREQ=n[1]	Specifies the number of bytes FSCOPY will write to tape at one time. You can specify a number from 8192 through 1048576 bytes (1 Mbyte). The value you specify must be larger than the value for /DISKREQ and must be a multiple of the value for /RECORDSIZE. The default, if you omit this switch, is 224 Kbytes.
/TASKS=n	Specifies the number of system tasks FSCOPY uses to access an LDU during a backup. You can specify a number from 1 through 60. The default, if you omit this switch, is 10.
/TIMEOUT=n	Specifies the number of minutes FSCOPY waits for an operator response before timing out and aborting the FSCOPY process. You can specify a number from 1 through 15000. The default, if you omit this switch, is no time out; FSCOPY will wait indefinitely.
/TIMESTAMP*[=name]*	Specifies the name of the file FSCOPY creates whose date and time of creation indicate when the backup occurred. You can specify a regular AOS/VS filename, which FSCOPY creates in the top-level directory of the LDU you are backing up. The default, if you omit *name*, is FSCOPY_TLB.

[1] For these switches, you can specify K for Kbytes or M for Mbytes.

(concluded)

Restoring an LDU

Preparing for Restoration

Typically, you will need to restore an LDU when a disk has a hard failure (crashes) and you need to replace it. The LDU to be restored by FSCOPY must be exactly the same size as the LDU it is replacing. If you don't know the size of the LDU, you can determine the size with the following procedure.

1. First, create a small temporary LDU.
2. Then, attempt to restore to this temporary LDU. FSCOPY will report the error message "Restore LDU size (X) does not match the LDU size on tape (Y)."
3. Take the LDU size on tape (Y), and add to it the number of remap blocks you plan to specify for the new LDU. When you create the new LDU, create an LDU of this combined size. See "Resolving Disk Errors" in Chapter 6, and "Creating a System Area[SACREATE]" in Chapter 7 in the manual *Installing, Starting, and Stopping AOS/VS II* for more information about remap blocks.
4. If you choose to "Change default LDU parameters" while creating this new LDU, you will be prompted for the "Number of remap blocks," which has a default value of 256.

Restoring the root (:) LDU

If you need to restore the root LDU of a system from an FSCOPY backup, you must first bring up this system with another root LDU. Then you can INITIALIZE the original LDU and restore it from the FSCOPY backup. It is easier and preferable to work from a tailored system tape to restore the root LDU using LOAD_II or DJ. For this reason we recommend using SYSTAPE.CLI and DUMP_II for backing up the root LDU. See the manual *Installing, Starting, and Stopping AOS/VS II* for more information about making a tailored system tape set.

Starting the Restoration

To restore an LDU, FSCOPY must have exclusive ownership of the LDU. If other users are using the LDU, FSCOPY will warn you that it cannot run. In this case, you can release and reinitialize the LDU, and then run FSCOPY again so that it can gain exclusive ownership. To release an LDU, use the CLI command RELEASE. You may also need to use the /FORCE switch to do this.

Mount or insert the tape in its unit (you can premount tapes if you have multiple units and will be restoring from multiple tapes).

Then start the restoration, using the following format:

FSCOPY/RESTORE*[/optional_switches]* ldu_name_on_tape ldu_pathname_on_disk @tapeunit *[@tapeunit]* ...

For example, to restore the LDU named UDD1, type

) SUPERUSER ON↵

Su) DIR :↵

Su) RELEASE/FORCERELEASE UDD1↵

Su) INITIALIZE/DIR=: @DPJ1↵

UDD1

Su) FSCOPY/RESTORE/DISPLAY/STATISTICS UDD1 :UDD1 @MTJ0↵

We are restoring the LDU named UDD1 from a high-capacity cartridge tape. We specify UDD1, the *name* of the LDU on the backup tape, and :UDD1, the *pathname* of the directory on disk. We use the /DISPLAY switch because we want to monitor runtime status, and the /STATISTICS switch to see total statistics. There are a number of other switches that you can specify, but we accept FSCOPY defaults and do not show these switches in our examples. See Table 6–2 at the end of this section ("Restoring an LDU") for a list of all LDU restoration switches.

CAUTION: *During a restoration of an entire LDU, FSCOPY cannot recover from hard disk or hard tape errors. If such errors occur, you should fix the hard disk or tape problem, reinitialize the LDU, and then restart the FSCOPY restore. If you are unable to reinitialize the LDU, then you must delete it and recreate it. See "Preparing for Restoration."*

Monitoring LDU Restoration Status

During a file restoration, the /DISPLAY switch monitors the status of the restoration. Figure 6–3 gives an example of this screen. FSCOPY first shows the pathname of each file it is resolving and informs you as it restores blocks to a particular pathname.

```
FSCOPY Revision nn.nn                                  8 Dec 93  11:38

                 Full Volume Restore of UDD1

+==========================----------------------------------+
|##########################                                  |
+==========================----------------------------------+

Full Volume Restore 44% complete.  Estimated time remaining: 0:02:00

Transfer rate:   100KB/s

Restoring blocks to pathname:  =KEVIN:WORK:FILEA
```

Figure 6–3 FSCOPY LDU Restoration Status Screen

Getting Restoration Statistics

The /STATISTICS switch displays statistics after FSCOPY runs. Figure 6–4 gives an example of the screen you can use to examine the status of the restoration.

```
Statistics for full volume restore of UDD1 onto :UDD1
The restore took 0:00:34 to complete.
                        Disk           Tape
Transfer rate:         17.4KB/s       32.9KB/s
Requests:              12             5
Copied blocks:         0
Restored blocks:       1053
0 seconds idle time (operator delay)
```

Figure 6–4 FSCOPY LDU Restoration Statistics Screen

Reinitializing the LDU After FSCOPY Finishes

When FSCOPY finishes restoring the LDU (the CLI prompt returns), it releases the disk. You must reinitialize the LDU into the system.

Polishing a Restored LDU

If you run POLISHER on an LDU restored by FSCOPY, reported errors do not necessarily indicate a problem with FSCOPY. The problem may have existed on the original LDU. When FSCOPY restores an LDU, the LDU will contain any damage that may have existed on the original LDU.

Table 6–2 FSCOPY LDU Restoration Switches

Switch	What It Does
/DISPLAY	Displays runtime status.
/NPROMPT	Terminates the restoration if FSCOPY encounters errors that normally produce an interactive prompt. Use this switch when you cannot ensure that someone will be attending the restoration.
/RESTORE	Restores an LDU.
/STATISTICS	Displays statistics when FSCOPY completes.
/TAPEBUFFERS=n	Specifies the number of buffers used for copying data from tape to disk. You can specify a number from 1 through 1024. The default, if you omit this switch, is 10.
/TASKS=n	Specifies the number of tasks FSCOPY uses to access an LDU when restoring an entire LDU. You can specify a number from 1 through 60. The default, if you omit this switch, is 10.
/TIMEOUT=n	Specifies the number of minutes FSCOPY waits for an operator response before timing out and aborting the FSCOPY process. You can specify a number from 1 through 15000. The default, if you omit this switch, is no time out; FSCOPY will wait indefinitely.

Restoring Files

Restoring files is a three-step process:

1. Create an Index

   You run FSCOPY to create an index of what is on the backup tape. FSCOPY creates three index files based on a name you specify, adding filename extensions .BLKS, .FS_DRV, and .TAPE_DRV.

   For example,

   LDU1_13DEC93.BLKS

   LDU1_13DEC93.FS_DRV

   LDU1_13DEC93.TAPE_DRV

2. Create a List of Pathnames

   If you know the pathnames, you can use a text editor such as SED to create a list of the pathnames you want FSCOPY to restore.

   Otherwise, you run FSCOPY to read the index and to create a list of the pathnames of the files that are on the backup tape. Using a text editor such as SED, you edit the list of pathnames, selecting the pathnames you want to restore.

   FSCOPY can restore from 1 to 240 pathnames each time it runs, so you may create one or more lists of pathnames, each of which has a maximum of 240 pathnames.

3. Restore Pathnames

   You run FSCOPY to restore the pathnames in the list(s) of pathnames you edited in step 2.

The following sections go into more detail. See Table 6–3 at the end of this section for a list of all file restoration switches.

Creating an Index

To create an index of what is on the backup tape, perform the following steps.

1. Mount or insert the tape in its unit (you can premount tapes if you have multiple units and will be restoring from multiple tapes).
2. Choose a working directory to simplify issuing subsequent command lines. Here, we make :BACKUP our working directory.

) DIR :BACKUP↵

3. Run FSCOPY to create an index, using the following format:

   FSCOPY/RESTORE/INDEX=name ldu_name*[/optional_switches]* @tapeunit *[@tapeunit]* ...

   For example,

) FSCOPY/RESTORE/DISPLAY/INDEX=UDD1_INDEX UDD1 @MTJ0↵

   FSCOPY reads the tape set inserted in @MTJ0 and creates the index files UDD1_INDEX.BLKS, UDD1_INDEX.FS_DRV, and UDD1_INDEX.TAPE_DRV in your working directory (here :BACKUP). (The index files use about 4–5% of the size of the LDU.) If these files already exist, FSCOPY warns you that you must delete them. If this happens, delete the files and repeat step 3.

Creating a List of Pathnames

To create a list of the pathnames of the files on the backup tape, perform the following steps.

1. If you know the pathnames you want to restore, you can use a text editor to create a file list of pathnames (from the root of the LDU) of the files. Make sure that each pathname begins with an = sign. You can avoid generating the list of pathnames if you do this. For example, if :UDD is an LDU and TOM and KEVIN are directories, then the following would be a valid list of pathnames for this LDU:

   ```
   =TOM:FILE1
   =KEVIN:FILE1
   =KEVIN:FILE2
   =KEVIN:DIR1:FILE1
   ```

   Note that FSCOPY automatically creates directory DIR1.

2. Run FSCOPY to read the index files, using the following format:

   FSCOPY/RESTORE/INDEX=name/LIST=pathname*[/optional_switches]*

   For example,

) FSCOPY/RESTORE/DISPLAY/INDEX=UDD1_INDEX/LIST=UDD1_FILES↵

   FSCOPY reads the three index files specified by UDD1_INDEX and creates the file list UDD1_FILES.This list includes the pathnames of *all* of the files on the backup tape.

3. To restore individual files from this list, use a text editor such as SED to edit the list of pathnames. Create one or more files containing the pathnames of files to restore. One way to do this is by copying pathnames to one or more files using the SED command DUPLICATE. For example, to restore Kevin's files, you could create UDD1_KEVIN.

   Each file you create can contain a maximum of 240 pathnames, with one relative pathname per line. The pathnames are relative to the top-level directory of the LDU. A relative pathname for FILEA in the directory :UDD1:KEVIN:WORK will appear as =UDD1:KEVIN:WORK:FILEA. FSCOPY will create intermediate directories if they do not exist.

Restoring Pathnames

Finally, to restore files, follow these steps:

1. Change your working directory to the top-level directory of the LDU where you want to restore files.
2. Use the /DIRECTORY= switch, or set your searchlist, to include the directory that contains the index files.
3. Run FSCOPY to restore pathnames listed in the file(s) you created, using the following format:

   FSCOPY/RESTORE/INDEX=name/FILES=pathname*[/optional_switches]* ldu_name @tapeunit*[@tapeunit]* ...

   For example,

) DIR :BACKUP↵

) FSCOPY/RESTORE/DISPLAY/DIRECTORY= *:BACKUP&*↵
   &)/INDEX=UDD1_INDEX/FILES=:BACKUP:UDD1_KEVIN UDD1 @MTJ0↵

   FSCOPY restores to the LDU UDD1 the pathnames listed in the disk file UDD1_KEVIN, using the information in the index files specified by UDD1_INDEX.

For best results, restore files when users are not active. If this is not possible, advise users that certain directories are "off limits." One way to ensure this is to make the ACL of each parent directory a null. For example, if you want to reload files into :UDD1:KEVIN, type

Su) ACL/K :UDD1:KEVIN ↵

After FSCOPY completes, make sure that you change the ACLs back to what they were. For example,

Su) ACL :UDD1:KEVIN KEVIN,OWARE +,RE↵

Restoration Tips

You may save some time by following these suggestions:

- Create the index files and the list of pathnames right after the backup, *before* you actually have to restore files. Then when you are in the midst of an emergency situation, much of the work has already been completed.

- If you can create a spare LDU with space matching the original LDU, you can restore individual files without having to use the FSCOPY index file and list of pathnames. Proceed as follows:

  1. Create a spare LDU with space matching that of the original LDU.
  2. Restore the entire LDU onto the spare LDU.
  3. Initialize the spare LDU onto the system.
  4. Move individual files from the spare LDU to the original LDU.

Monitoring File Restoration Status

During a file restoration, the /DISPLAY switch monitors the status of the restoration. Figure 6–5 gives an example of this screen. FSCOPY first shows the pathname of each file it is resolving and informs you as it restores blocks to a particular pathname.

```
FSCOPY Revision nn.nn                          10-Dec-93  11:38

                    File Restore of UDD1

+=========================================================+
|##########################                               |
+=========================-------------------------------+

File Restore 44% complete.  Estimated time remaining: 0:02:00

Transfer rate:   100KB/s

Restoring blocks to pathname:  =KEVIN:WORK:FILEA
```

Figure 6–5 FSCOPY File Restoration Status Screen

Getting File Restoration Statistics

The /STATISTICS switch displays statistics after FSCOPY runs. Figure 6–6 gives an example of the screen produced with the /STATISTICS switch.

```
Statistics for file restoration of UDD1
The restoration took 0:02:22 to complete.
Transfer rate:          17.4KB/s
Tape requests:          44
Files restored:         31
Blocks restored:        1053
```

Figure 6–6 FSCOPY File Restoration Statistics Screen

Table 6–3 FSCOPY File Restoration Switches

Switch	What It Does
/DIRECTORY=pathname	Specifies the directory where the index files are located (when used with /INDEX).
/DISPLAY	Displays runtime status.
/FILES=pathname	Restores files listed in pathname (when used with /INDEX and /RESTORE).
/INDEX=name	Specifies the name FSCOPY will use when it creates the index files. FSCOPY adds the extensions .BLKS, .FS_DRV, and .TAPE_DRV to name. FSCOPY creates these files in the working directory, or in the directory specified by /DIRECTORY.
/LIST*[=pathname]*	Specifies the pathname of a disk file FSCOPY creates (when used with /INDEX). This file will contain the list of pathnames on the backup tape. The default, if you omit pathname, is @LIST.
/NPROMPT	Terminates the restoration if FSCOPY encounters errors that normally produce an interactive prompt. Use this switch when you cannot ensure that someone will be monitoring the restoration.
/RESTORE	Builds an index of backed up files (when used with /INDEX); lists backed up files (when used with /INDEX and /LIST); and restores files (when used with /INDEX and /FILES).
/STATISTICS	Displays statistics when FSCOPY completes.
/TIMEOUT=n	Specifies the number of seconds FSCOPY waits for an operator response before timing out and aborting the FSCOPY process. You can specify a number from 1 through 15000. The default, if you omit this switch, is no time out; FSCOPY will wait indefinitely.

End of Chapter

The Closed Shop

In a closed shop, few people have physical access to the computer, disk units, or system console. Users (including application programmers) work on terminals in a separate area. The CPU, disk and tape units, and even line printers are out of bounds to all but a few carefully screened and trained people. In closed shops, system operators are on duty most of the time. They mount and dismount tapes for users, handle printers, start application programs, do backups, bring the system up and down, and so on.

A closed shop should have someone check periodically, perhaps daily, for security violations and potential (and actual) break-ins. The site can run system logging with detail set to full, generate logging reports, and have the assigned person examine the reports for signs of unauthorized access.

Very few users in closed shops have Superuser or other special privileges. Any privilege that allows a user to bypass access controls means that he or she must be trusted; system security depends as much on privileged users as on operating system enforcement of access controls.

ACLs in closed shops are quite restrictive. When multiple users need access to a file, a closed shop may use explicit ACLs that spell out usernames, instead of using templates.

Software that's added to the core system, such as networking software, should be used very carefully in closed shops because it can compromise all security. For example, someone may check the files accessed by application programs for signs of Trojan horse incursions. When new versions of application programs are built, the new program file(s) or source file(s) may be compared to the old versions (using the FILCOM or SCOM program), and the differences examined. Media containing updates and revisions of Data General software should be checked, before being installed on the system, to make sure they are genuine Data General products with Data General labels, part numbers, etc.

Software acquired from an online bulletin board, via modem or otherwise, should not be added to the system unless the original source is known and reliable.

The *people* in a closed shop are essential to its security. Users can't touch disk and tape units, so at least one system operator stays on duty while the system runs. Administrators (system managers and operators) make decisions that can affect all access controls. They must plan and implement a secure system (using secure profiles, secure hardware, and ACLs) start logging, generate and check reports, plan user education, enforce password changes, and so on.

In some closed shops, system operators themselves have limited powers. A locked CLI runs on the system console, and very few people know the password. The operator must use EXEC and other CONTROL commands to run the system.

C2-Level Systems

One kind of closed shop is a *C2-level system*. The U.S. National Computer Security Center (NCSC) has defined several classes of computer systems from the standpoint of security; one of these is class C2. A system that meets C2-level security standards (if approved as such by the U.S. government) may be used, according to the rules for this class of systems, to handle sensitive and classified information. AOS/VS II Revision 3.00 is being evaluated for a C2 level of trust.

What Is a C2-Level System?

A C2-level system must meet minimum security requirements in the following general categories:

- *controlled access* to information
- *accountability* — identification of each user and tracking of his or her security-related actions on the system
- *assurance* of continued correct and secure system operation

The core of a C2-level shop is the software and hardware that people rely on to operate securely. This system core is called the *Trusted Computing Base (TCB)*.

For details of C2 and other U.S. government security standards, see the Department of Defense directive, *Security Requirements for Automatic Data Processing (ADP) Systems*, number 5200.28.

Components of the Trusted Computing Base (TCB)

For AOS/VS II Revision 3.01, software in the TCB includes the

- AOS/VS II kernel and tailored system (which enforce access controls)
- Peripheral manager (PMGR and its companion IACRS or CPIRS program). These programs manage character devices such as user terminals.
- PREDITOR profile editor, which creates and edits user profiles, and can provide password encryption
- EXEC and its companion programs XBAT, XLPT, XMNT, which oversee user logon and tape mount requests, and manage batch and printer processes. EXEC has Superuser privilege and can bypass access controls.
- Agent, which provides the user interface
- Other utility programs and files supplied with AOS/VS II, such as REPORT, FSCOPY, and DUMP_II/LOAD_II
- ADEX diagnostic system, to verify your hardware using the same microcode as AOS/VS II

Note that operating system access controls work *only* if, when the system was generated, the VSGEN parameter *Access* remained Y. The Access parameter is set to Y by default. If the Access parameter is changed to N, the resulting operating system will ignore access controls — it will be wide open. You can check all VSGEN settings, including the Access parameter, by typing TYPE SYSGEN:sys.CSF and pressing NEW LINE, where sys is the name of the AOS/VS system. Generally, unless your username is OP, you must turn Superuser on to read this file.

Before loading new AOS/VS or AOS/VS II software make sure the tape or diskette containing it was provided by Data General. It should be clearly labeled as a Data General product, with a Data General part number and copyright symbol.

Hardware in the TCB includes

- the system console (because anyone with access to it can penetrate all safeguards)
- ECLIPSE MV/Family CPU and microcode
- disk and tape controllers
- host–bus adapters
- disk and tape units and I/O storage systems
- all removable media (like backup tapes) that contain security-related information
- printers, if they print sensitive material and are accessible to users

Communicating with the Trusted Computing Base (TCB)

Assembly language and high-level language programs use system calls to transfer execution from a user program running in rings 4 through 7 to the Trusted Computing Base (TCB) running in rings 0 through 3. Using the normal system call interface involves using code which is located in URT16.LB or URT32.LB runtime libraries. When you must communicate directly with the TCB, without using the runtime libraries, you need to use LJMP to get into the lower rings directly from your program. Chapter 1 of the system call dictionaries, 093–000542–02 and 093–000543–02, includes a section about "Implementation of System Calls" which describes how the runtime libraries use LJMP to get into the lower rings. Using this as a model, you can write similar code which issues the LJMP without use of the runtime libraries.

C2 Configuration Hardware

Along with AOS/VS II Revision 3.01, the following Data General hardware is being evaluated by the NCSC for a C2 level of trust:

Processors

MV/1000 DC and MV/1000 RM
MV/1400 DC and MV/1400 RM
MV/2000 DC and MV/2000 RM
MV/2500 DC and MV/2500 RM
MV/3200 DC and MV/3200 RM
MV/3500 DC and MV/3500 RM
MV/3600 DC and MV/3600 RM
MV/4000
MV/4000 SC
MV/4000 DC
MV/5500 DC and MV/5500 RM
MV/5600 DC and MV/5600 RM
MV/7800
MV/7800 DC
MV/7800 DCX
MV/7800 XP
MV/8000 II
MV/8000 C
MV/9300
MV/9500
MV/9600
MV/10000
MV/10000 SX
MV/15000 Models 8, 10, and 20
MV/18000 Models 1 and 2 and MV/18000 SX
MV/20000 Models 1 and 2
MV/30000 Models 1, 2, 3, and 4
MV/35000 Models 1, 2, 3, 4, 5, and 6
MV/40000
MV/40000 HA Models 1, 2, 3, and 4
MV/60000 HA Models 1, 2, 3, 4, 5, and 6

Processor hardware includes processor boards, memory boards and system console.

BMC/DCH Controllers

Model Numbers	Description
4593	Dataproducts Parallel Printer
6795	Centronics Parallel Printer
6433	SCSI I Disk/Tape (Single–ended)
6434	SCSI I Disk Only (Differential)
6435	SCSI I Tape Only (Single–ended)
6786	SCSI II Disk/Tape (Differential)
6787	SCSI II Disk/Tape (Single ended)

MRC Controllers

Model Numbers	Description
80021/80022	BMC E–MRC Channel Processor
80020	MV/40000 Channel Processor
80018/80019	MRC System Interface
80013	MRC Bus Controller
80030	MRC RAMS Disk Controller
80023	MRC ARGUS Disk Controller
80033	MRC Tape Controller
6823	MRC SCSI II Disk/Tape (Differential)

Terminal Controllers

Model Numbers	Description
5916G	FCM/16
4543	MCP1
4359/4367/4369	IAC/8 (uECLIPSE)
4624/4625	IAC/8 (68K)
4360/4368/4370	IAC/16
4622/4623	IAC/24
5093LMC/4806	LMC/8
4814	LMC/8 II
4560	LAC/12
4712/4713	LAC/16 II
4750/4803	LAC/16
4626/4627/4626C/4627C	LAC/32
4626S/4627S	LAC/32 II

Disk Drives

Model Numbers	Description
6067	50–Mbyte Removable
6060	96–Mbyte Removable
6061	192–Mbyte Removable
6122	277–Mbyte Removable
5061RSD	73–Mbyte Removable Winchester
5061RDD	146–Mbyte Removable Winchester
6627	590–Mbyte Removable Magneto–Optical
6670	332–Mbyte Removable SCSI
6671	662–Mbyte Removable SCSI
6030	370 Kbyte 8" Floppy
6096/6097	1.2–Mbyte 8" Floppy
4514	48 TPI 5 1/4" Diskette
6309	96 TPI 5 1/4" Diskette
6098/6099	12.5–Mbyte
6100/6103	25–Mbyte
6225	5–Mbyte
6227	15–Mbyte
6234	50–Mbyte

Disk Drives (continued)

Model Numbers	Description
6160	73–Mbyte
6161	147–Mbyte
6214	602–Mbyte
6236/6237	354–Mbyte Argus
6239/6240/6290	592–Mbyte Argus
6357/6398/6399	862–Mbyte Argus
6581/6582/6584	500–Mbyte RAMS
6631/6632/6634	662–Mbyte RAMS
6621/6622/6624	1.2–Gbyte RAMS
6310	38–Mbyte ST506
6328	70–Mbyte ST506
6329	120–Mbyte ST506
6363	160–Mbyte ST506
6446	234–Mbyte SCSI
6491	322–Mbyte SCSI
6554	662–Mbyte SCSI
6492/6578/6579	727–Mbyte SCSI
6716/6718	1.4–Gbyte SCSI
6539	179–Mbyte SCSI
6662	332–Mbyte SCSI
6796/6799/61000	520–Mbyte SCSI
6685/6740/6802/6805/6861	1.0–Gbyte SCSI
6841	2.0–Gbyte SCSI
7905	30–Disk SCSI Array
7907	20–Disk SCSI Array

Tape Drives

Model Numbers	Description
6026	800/1600 BPI 9–Track
6299/6300	1600/6250 BPI 9–Track
4307–TL	800/1600/6250 BPI 9–Track
5123SC/6341–A/6125	1600 BPI 9–Track
6586/6587/6855/6856	1600 BPI 9–Track SCSI
6588/6589	800/1600/6250 BPI 9–Track SCSI
6231/6311	15–Mbyte Cartridge
6351/6444	21–Mbyte Cartridge
6426	130–Mbyte Cartridge
5080	750–Mbyte Cartridge
6590	2–Gbyte 8mm Cartridge SCSI
6760	5–Gbyte 8mm Cartridge SCSI
6577	150–Mbyte QIC SCSI
6677	320–Mbyte QIC SCSI
6762	4–Gbyte 4mm DAT SCSI
7921	4–mm DAT Array

Terminals

Model Numbers	Description
6084/6085/6093	Hardcopy
6040/6041/6042	TP1 Hardcopy
6075/6193/6194	TP2 Hardcopy
6424/6428/6440	D577 System Console
6455	D578E System Console
6052/6053/6054/6055	D1/D2/D3 Mono Alphanumeric
6182/6242	D210 Mono Alphanumeric
6169/6243	D211 Mono Alphanumeric
6344/6391	D214 Mono Alphanumeric
6345/6388/6392/6395	D215 Mono Alphanumeric
6500/6505/6520/6565/6566/6521/6578	D216/D216+/D216E/D216E+ Mono Alphanumeric
6682	D217 Mono Alphanumeric
6284	D220 Mono Alphanumeric
6692	D230C Color Alphanumeric
5654	D430C Color Alphanumeric
6166/6255	D410 Mono Alphanumeric/Graphics
6346/6389/6393/6396	D411 Mono Alphanumeric/Graphics
6501/6522/6567	D412/D412+ Mono Alphanumeric/Graphics
6683	D413 Mono Alphanumeric/Graphics
6167/6256	D460 Mono Alphanumeric/Graphics
6347/6390/6394/6397	D461 Mono Alphanumeric/Graphics
6502/6504/6523/6524/6568	D462/D462E/D462+ Mono Alphanumeric/Graphics
6684	D463 Mono Alphanumeric/Graphics
6291	D470C Color Alphanumeric/Graphics
6150	G300 Graphic
6241	G500 Graphic

Parallel Printers

Model Numbers	Description
4327/4328	230/300 line–per–minute band printer
4363/4364	436/600 line–per–minute band printer
4373/4374	872/1200 line–per–minute band printer
4595	300 line–per–minute band printer
4596	600 line–per–minute band printer
4597	1200 line–per–minute band printer
4598/4603	1500 line–per–minute band printer
4599/4604	2000 line–per–minute band printer
6216	180 character–per–second dot matrix printer
4355	200 character–per–second dot matrix printer
6617	400 line–per–minute line dot matrix printer
6883	1200 line–per–minute line dot matrix printer
6618	800 line–per–minute line dot matrix printer
6640T	9 page–per–minute laser printer
6646T/6779T	9 page–per–minute PostScript® laser printer
6892	10 page–per–minute PostScript laser printer

Parallel Printers (continued)

Model Numbers	Description
4425	12 page–per–minute laser printer
6771	16 page–per–minute laser printer
6772/6773/6893	16 page–per–minute PostScript laser printer
6479	26 page–per–minute laser printer

Serial Printers

Model Numbers	Description
4433	150 character–per–second dot matrix printer
4434/4451	160 character–per–second dot matrix printer
6215	180 character–per–second dot matrix printer
4535	200 character–per–second dot matrix printer
4589/4590	240 character–per–second dot matrix printer
6594	400 character–per–second dot matrix printer
6425	300 character–per–second dot matrix printer
6647/6648	300 character–per–second dot matrix printer
6788	300 character–per–second dot matrix printer
6514/6515	300 character–per–second dot matrix printer
4354	340 character–per–second dot matrix printer
6789	622 character–per–second dot matrix printer
6617/6618	800 line–per–minute line dot matrix printer
6883	1200 line–per–minute line dot matrix printer
4518	35 character–per–second letter–quality printer
4320/4322	55 character–per–second letter–quality printer
6321	40 character–per–second letter–quality printer
5431	50 character–per–second letter–quality printer
6640	6 page–per–minute laser printer
6646	6 page–per–minute PostScript laser printer
4557/8	8 page–per–minute laser printer
6454	8 page–per–minute laser printer
6640T	9 page–per–minute laser printer
6646T/6779T	9 page–per–minute PostScript laser printer
6892	10 page–per–minute PostScript laser printer
4424/4426	12 page–per–minute laser printer
6474/6475/6476/6477	12 page–per–minute laser printer
6480	12 page–per–minute PostScript laser printer
6771	16 page–per–minute laser printer
6772/6773/6893	16 page–per–minute PostScript laser printer
6479	26 page–per–minute laser printer

You will invalidate the C2 rating if you use any hardware not named above or any of the items described in the next section.

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For Programmers

AOS/VS, AOS/VS II, and AOS/RT32 System Call Dictionary, ?A through ?Q (093–000542)
AOS/VS, AOS/VS II, and AOS/RT32 System Call Dictionary, ?R through ?Z (093–000543)

For system programmers and application programmers who use system calls, this two–volume manual provides detailed information about system calls, including their use, syntax, accumulator input and output values, parameter packets, and error codes. *AOS/VS System Concepts* is a companion manual.

AOS/VS Debugger and File Editor User's Manual (093–000246)

For assembly language programmers, this manual describes using the AOS/VS and AOS/VS II debugger for examining program files, and the file editor FED for examining and modifying locations in any kind of disk file, including program and text files. The *AOS/VS Debug/FED* template (093–000396) accompanies this manual.

AOS/VS Link and Library File Editor (LFE) User's Manual (093–000245)

For AOS/VS and AOS/VS II programmers, this manual describes the Link utility, which builds executable program files from object modules and library files, and which can also be used to create programs to run under the AOS, MP/AOS, RDOS, RTOS, or DG/UX™ operating systems. This manual also describes the Library File Editor utility, LFE, for creating, editing, and analyzing library files; and the utilities CONVERT and MKABS, for manipulating RDOS and RTOS files.

AOS/VS Macroassembler (MASM) Reference Manual (093–000242)

For assembly language programmers, this reference manual describes the use and operation of the MASM utility, which works under AOS/VS and AOS/VS II.

AOS/VS System Concepts (093–000335)

For system programmers and application programmers who write assembly–language subroutines, this manual explains basic AOS/VS system concepts, most of which apply to AOS/VS II as well. This manual complements both volumes of the *AOS/VS, AOS/VS II, and AOS/RT32 System Call Dictionary.*

SPEED Text Editor (AOS and AOS/VS) User's Manual (093–000197)

For programmers, this manual explains how to use SPEED, a powerful (but unforgiving) character–oriented text editor.

Other Related Documents

AOS/VS and AOS/VS II Performance Package User's Manual (093–000364)

For system managers, this manual explains how to use the AOS/VS and AOS/VS II Performance Package (Model 30718), a separate product that is useful for analyzing and perhaps improving the performance of AOS/VS and AOS/VS II systems.

Backing Up and Restoring Files With DUMP_3/LOAD_3 (093–000561)

For system managers, operators, and experienced users, this manual explains the DUMP_3/LOAD_3 product, separately available, which provides backup and enhanced restoration functions, including precise indexing of files on a backup tape set.

The CLARiiON™ Series 2000 Disk–Array Storage System with AOS/VS (093–002227)
The CLARiiON™ Series 2000 Disk–Array Storage System with AOS/VS II (093–002190)

For system managers, these manuals explain how to understand and/or configure and use a CLARiiON disk–array storage system with AOS/VS or AOS/VS II.

Installing, Operating and Maintaining the CLARiiON™ Tape–Array Storage System – DG/UX or AOS/VS II (014–002181)

For system managers and operators, this manual explains how to install, operate, and maintain the CLARiiON deskside tape-array storage system. This manual also explains how to make the physical tapes accessible to the operating system.

Configuring and Managing DG/FTAM (093–000817)

For system managers, this manual explains how to configure, start, and manage DG/FTAM, the Data General implementation of ISO 8571—the File Transfer, Access and Management (FTAM) standard of the International Organization of Standardization.

Configuring and Managing the High-Availability Disk-Array/MV (H.A.D.A./MV) Subsystem (014–002160)

For system managers, this manual explains how to understand and/or configure and use a H.A.D.A./MV disk–array storage system with AOS/VS II.

Configuring Your Network with XTS (093–000689)

For network administrators, managers, or operators responsible for designing, configuring, or maintaining a network management system, this manual describes how to manage and operate Data General's XODIAC™ Transport Service (XTS and XTS II) under AOS/VS and AOS/VS II.

Installing and Administering DG TCP/IP (093–701027)

For network managers and operators, this manual explains how to install and manage a TCP/IP network under AOS/VS.