NOVA DISC OPERATING SYSTEM

Data General's Disc Operating System is a versatile, sophisticated operating system of a design comparable to systems used with the largest current computer configurations. It can be used with any Nova-line computer of 12K or larger memory in a system having any combination of fixed, or moving head discs, removable disc cartridges, or magnetic tape units.

DOS provides comprehensive file system capabilities, allowing the user to edit, compile, assemble, execute, debug, save, and delete files. Complete file protection is provided using a number of system defined attributes. For fixed head discs, disc packs, or disc cartridge systems, files are maintained on a directory basis. For magnetic tape systems, files are maintained on a file number basis.

Disc packs, disc cartridges, and magnetic tape reels can be initialized or released from the system. The command INIT followed by the device code will initialize a device. Disc pack or cartridge units are initialized in sequence. For example, in a system of three disc packs, DP0, DP1, and DP2; DP0 must be initialized first. Initializing a tape drive causes a tape reel on that drive to be rewound. Tape drives do not need to be initialized in sequence. MT2 can be initialized before MT1, for example. To remove disc packs, cartridges or tape reels from a system, the command RELEASE followed by the device code is given. No further access to files on those devices is allowed.

Peripheral devices are named and treated as files, providing complete device independence by symbolic name.

All I/O including file I/O is buffered. An interrupt will key the transfer of data in memory buffers to an I/O device. The transfer of data will continue until the memory buffers are emptied, without delaying the assembling of the program.

Two modes of program communication are provided. The first is interactive teletypewriter communication made possible by an executable system program, the Command Line Interpreter (CLI). The second mode enables the user to communicate directly with the system using a series of command words recognized by the assembler and forming an integral part of his executable program. These command words are interpreted by DOS at run time.

DOS can support as many as eight fixed head discs, up to four disc pack units, and up to eight magnetic tape drives. A special system configuration program determines amount of storage, I/O devices, the master storage device, and how many discs, disc packs, or magnetic tape drives are in the system.

A complete line of system software is available for use under DOS. This includes a relocatable assembler, relocatable loader, text editor, octal editor, Extended ALGOL, Extended FORTRAN, a library file editor, and a symbolic debugger.

In addition, the use of interpretive system calls enables the user to write his own special-purpose software while utilizing all the file capabilities and peripheral device support of DOS.

FILES AND DIRECTORIES

The term *file* applies to any collection of information. Typical examples are source program files, relocatable binary files, listing files, and absolute binary files.

The source program is input to the assembler, which produces as output a relocatable binary file. The relocatable binary file is input to the relocatable loader, which loads and relocates the program as absolute locations, producing an absolute core image file, also called a save file.

All files and devices are accessible by *filename*. The basic file name is a string of alphanumeric characters and the character $. File names can be extended by adding another string of alphanumerics with a period between the basic file name and the extension. The user can also assign special file names to conditional access devices such as teletypewriter readers and printers, paper tape readers and punches, card readers, line printers, and incremental plotters. The user can assign special names to files other than devices to facilitate input/output operations. For example, the contents of a paper tape mounted in a reader may be transferred to another file simply by equating, by name, a file and a device.

A file may store over 4 billion bytes of information, including file name, the precise byte length of the file, and the file attributes. All file names on a given storage device are contained in a single directory, and are unique. File attributes are characteristics of files that can be set and changed by the user.

DOS provides permanent system files and attribute protection system files. The user can restrict the reading, writing, or changing of files according to his own requirements. These files are coded as follows:

P - Permanent file — file cannot be deleted or renamed
W- Write protected — file cannot be written
R - Read protected — file cannot be read
A- Attribute protected — the attributes of the file cannot be changed

PROGRAM COMMUNICATION

DOS provides two modes of program communication through which the user can edit, assemble, debug, change, and delete files. The first, the Command Line Interpreter (CLI) is an executable system program which makes possible interactive teletypewriter communication.

The Command Line Interpreter accepts commands from a teletypewriter and translates them as commands to the operating system. CLI types a ready message (R) on the teletypewriter. This lets the user know the system is idle and CLI is ready to accept a command line. The user then types a command line, presses RETURN and CLI executes the command. The basic command line is simply a list of one or more file names with command instructions. Except for a number of simple commands that CLI executes directly, the first file name in the command line is the name of the program to be loaded into core for execution. Any file names following the program name are treated as arguments. For example, if the user types the command ASM $ PTR↙, CLI builds a file containing the edited command line and loads the file with the name ASM for execution. The additional command $ PTR is the file name of the paper tape reader from which a file is to be assembled. CLI also provides execution of a number of commands stacked on any given command line. The commands will be executed in order until the entire line is completed, then CLI will type R to indicate it is ready for further commands. There is no limit, other than memory capacity, to the number of commands in any command line.

The library of CLI commands provides a complete file maintenance system and an interface to system software. Some important CLI commands are listed below:

ALGOL	-	compile an ALGOL source file
ASM	-	assemble a program
BPUNCH	-	punch files in binary on a high speed punch
CGATR	-	change attributes of a file
CREATE	-	create a file; CLI can handle this directly
DELETE	-	delete a file or series of files
DISK	-	obtain a list of the number of blocks used and the number of blocks still available on disc
DUMP	-	dump includes directory information for each file, which enables later reloading
EDIT	-	bring in the TEXT EDITOR to build or edit source file
FORT	-	compile a FORTRAN source file
INSTALL	-	specify system saved file for use in bootstrapping DOS system
LFE	-	update DOS library files
LIST	-	list names of files in the file directory with their byte length and attributes
LOAD	-	reload dumped files
MKABS	-	make an absolute binary file from an absolute core image file; (the reverse of this command is possible with the instruction MKSAVE
OEDIT	-	bring in the octal editor to examine and modify locations in octal
PRINT	-	print files on a line printer
RENAME	-	change the name of a file; CLI can handle this directly
RLDR	-	load a core image from a series of relocatable files
TYPE	-	copy file or files to the teletypewriter
XFER	-	transfer contents of one file to another

SYSTEM COMMAND WORDS

The second mode of program communication allows the user to communicate with DOS by using system command words assembled into his program. System command words are recognized by the DOS assembler as legal mnemonics.

By building the mnemonic .SYSTM, into his program, the user may provide system communication through the main entry address stored in page zero. DOS then provides direct and simultaneous management of multiple directory devices. Complete file maintenance, file attribute, I/O control, memory values, program overlay, and device control are provided.

There are seven categories of system command words. Each category contains commands designed to perform specific related functions.

DIRECTORY DEVICE MONITOR COMMANDS: DOS has the ability to manage multiple directory devices simultaneously. As many as four similar moving head disc units and up to eight fixed head disc units may be operated by a simple three character code. The first two characters define the device type, and the third character defines the unit number. For example, DK0 indicates fixed head disc, unit 0. DP3 indicates disc pack, unit 3.

FILE MAINTENANCE COMMANDS: File maintenance commands are used to enter file names into the file directory and to perform file maintenance. The file name is stored as a character string. These commands allow the user to create, delete, and rename files.

FILE ATTRIBUTE COMMANDS: File attribute commands allow the user to determine the correct attributes of a file and the device from which it is being processed and to change the file attributes.

I/O COMMANDS: All I/O is handled by system I/O commands in three basic modes: live mode, which allows reading or writing of character strings; sequential mode, in which data is transmitted exactly as read from the file or device; and random access mode, for reading or writing disc files.

TELETYPEWRITER COMMANDS: Teletypewriter commands provide buffered transfer of single characters between ACO and the teletypewriter. .PCHAR transmits a character in ACO to the teletypewriter. .GCHAR returns a character typed from the teletypewriter into ACO.

MEMORY COMMANDS: These commands allow the user to determine the highest available memory address and the first location available above the loaded program. A change command allows the user to increase or decrease the amount of memory required for any program.

PROGRAM OVERLAY COMMANDS: DOS allows any program to suspend its own execution and to begin a new program. The suspend program is temporarily stored on disc until the termination of the overlay. Then, if no other overlays are called, it is resumed. DOS provides for up to four program overlays.

SYSTEM SOFTWARE
DOS PROGRAMS

DOS supports a complete line of systems software, including a text editor, which provides for reading and writing of files for editing; an octal editor, a relocatable assembler to assemble source files, a relocatable loader, and a symbolic debugger, DEBUG III. Also supplied are two high level languages for use in minicomputer systems: Extended ALGOL and Extended FORTRAN.

The Extended ALGOL compiler is supplied as two tapes and the ALGOL library as four tapes, including software and hardware multiply/divide. Either DEBUG III or a special Extended ALGOL program, TRACE, can be used to debug ALGOL.

The FORTRAN compiler is supplied as one tape, and the FORTRAN library as four tapes, again with software and hardware multiply/divide. Each FORTRAN main program, external subroutine, or external function is separately compiled. DEBUG III can be loaded with the program and used for run-time debugging of FORTRAN programs.

DOS supplies a special editor, the Library File Editor (LFE) which provides a means of interpreting and updating relocatable binary library files. Library tapes are supplied with DOS and with ALGOL and FORTRAN. LFE allows the user to analyze and update the contents of a given library file and to create his own library files, either selected from the contents of system files or specifically written by the user. Other functions of LFE provide for insertion, deletion and replacement of programs.

SYSTEM GENERATION

SYSGEN, the DOS system generation program, produces a Disc Operating System precisely tailored to the user's hardware configuration, and makes it possible to bootstrap the system directly from disc or magnetic tape devices.

To implement SYSGEN, the user inputs the amount of core storage available; whether there are fixed head discs, disc pack units, or magnetic tapes; the storage capacities of each; the designation of the master device and the bootstrap device; the kinds of paper tape or card devices; and whether there are incremental plotters and teletypewriter peripherals available.

The user then issues the command to load his system using the relocatable loader. After the loader prints the storage map, the system file is punched on paper tape or transferred to magnetic tape. Upon command, CLI will load the system tape, protect the system from accidental deletion, and install the system. The system can now be bootstrapped directly from disc or disc pack.

For the user with magnetic tape, the Tape Bootstrap Program is supplied for building a DOS system on magnetic tape.

DOS CONFIGURATION

The 12K bootstrap DOS tape assumes the following minimum hardware configuration.
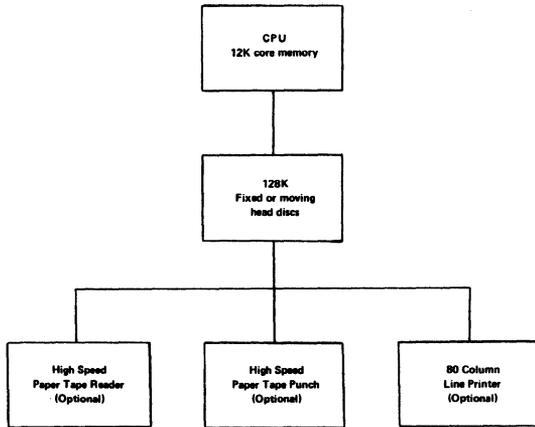
DOS SYSTEM TAPES

Data General supplies 12K bootstrap tapes for fixed and moving head discs and six dump tapes for saving and loading files, and for CLI and system libraries.

All DOS systems include the following dump tapes:
- System Generation
- Relocatable Loader
- Relocatable Assembler; Editor; Cross Reference
- Octal Editor
- Command Line Interpreter Library
- System File 0
- System File 1A (No magnetic tape hardware)
- System File 1B (Magnetic tape hardware)

Two 12K bootstrap systems are provided in absolute binary format:
- Fixed Head Disc Bootstrap
- Moving Head Disc Bootstrap