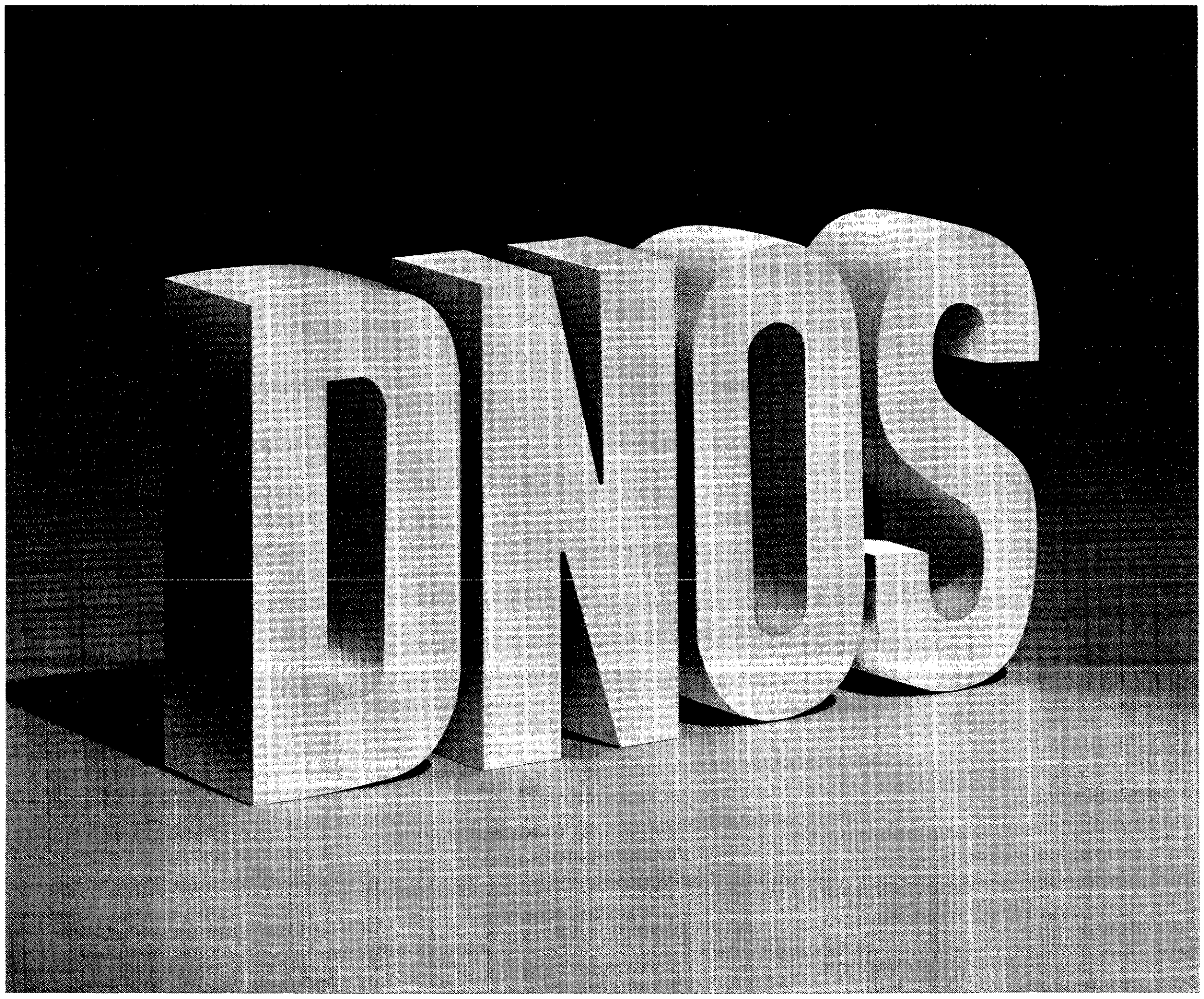
DNOS
Concepts and Facilities



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DNOS Software Manuals

This diagram shows the manuals supporting DNOS, arranged according to user type. Refer to the block identified by your user group and all blocks above that set to determine which manuals are most beneficial to your needs.

All DNOS Users:

DNOS Concepts and Facilities
2270501-9701

DNOS Operations Guide
2270502-9701

DNOS System Command Interpreter (SCI) Reference Manual
2270503-9701

DNOS Text Editor Reference Manual
2270504-9701

DNOS Messages and Codes Reference Manual
2270506-9701

DNOS Reference Handbook
2270505-9701

DNOS Master Index to Operating System Manuals
2270500-9701

High-Level Language Users:

COBOL Reference Manual
2270518-9701

DNOS COBOL Programmer's Guide
2270516-9701

DNOS Performance Package Documentation
2272109-9701

TI Pascal Reference Manual
2270519-9701

DNOS TI Pascal Programmer's Guide
2270517-9701

FORTRAN-78 Reference Manual
2268681-9701

DNOS FORTRAN-78 Programmer's Guide
2268680-9701

MATHSTAT-78 Programmer's Reference Manual
2268687-9701

FORTRAN-78 ISA Extensions Manual
2268696-9701

TI BASIC Reference Manual
2308769-9701

RPG II Programmer's Guide
939524-9701

Assembly Language Users:

990/99000 Assembly Language Reference Manual
2270509-9701

DNOS Assembly Language Programmer's Guide
2270508-9701

DNOS Link Editor Reference Manual
2270522-9701

DNOS Supervisor Call (SVC) Reference Manual
2270507-9701

Productivity Tools Users:

DNOS Sort/Merge User's Guide
2272060-9701

DNOS TIFORM Reference Manual
2276573-9701

DNOS Query-990 User's Guide
2276554-9701

DNOS Data Base Management System Programmer's Guide
2272058-9701

DNOS Data Base Administrator User's Guide
2272059-9701

Data Dictionary User's Guide
2276582-9701

DNOS TIPE 990 Reference Manual
2308786-9701

DNOS TIPE 990 Exercise Guide
2308787-9701

Communications Software Users:

DNOS DNCS/SNA User's Guide
2302663-9701

DNOS DNCS Operations Guide
2302662-9701

DNOS DNCS 914A User's Guide
2302664-9701

DNOS 3270 Interactive Communications Software (ICS) User's Guide
2302670-9701

DNOS 3780/2780 Emulator User's Guide
2270520-9701

Systems Programmers:

DNOS System Generation Reference Manual
2270511-9701

DNOS Systems Programmer's Guide
2270510-9701

DNOS Online Diagnostics and System Log Analysis Tasks User's Guide
2270532-9701

Universal ROM Loader User's Guide
2270534-9701

Source Code Users:

DNOS System Design Document
2270512-9701

DNOS SCI and Utilities Design Document
2270513-9701

DNOS Software Manuals Summary

Concepts and Facilities

Presents an overview of DNOS with topics grouped by operating system functions. All new users (or evaluators) of DNOS should read this manual.

DNOS Operations Guide

Explains how to perform daily tasks at a DNOS installation; includes step-by-step procedures for performing such tasks as operating peripherals, initializing and backing up the system, and manipulating disk files.

System Command Interpreter (SCI) Reference Manual

Describes how to use SCI in both interactive and batch jobs. Describes command procedures and primitives and gives a detailed presentation of all SCI commands in alphabetical order for easy reference.

Text Editor Reference Manual

Explains how to use the Text Editor on DNOS and describes each of the editing commands and function keys.

Messages and Codes Reference Manual

Lists the error messages, informative messages, and error codes reported by DNOS.

DNOS Reference Handbook

Provides a summary of commonly used information for quick reference.

Master Index to Operating System Manuals

Contains a composite index to topics in the DNOS operating system manuals.

Programmer's Guides and Reference Manuals for Languages

Contain information about the languages supported by DNOS. Each programmer's guide covers operating system information relevant to the use of that language on DNOS. Each reference manual covers details of the language itself, including language syntax and programming considerations.

Performance Package Documentation

Describes the enhanced capabilities that the DNOS Performance Package provides on the Model 990/12 Computer.

Link Editor Reference Manual

Describes how to use the Link Editor on DNOS to combine separately generated object modules to form a single linked output.

Supervisor Call (SVC) Reference Manual

Presents detailed information about each DNOS supervisor call and general information about DNOS services.

DNOS System Generation Reference Manual

Explains how to generate a DNOS system for your particular configuration and environment.

User's Guides for Productivity Tools

Describe the features, functions, and use of each productivity tool supported by DNOS.

User's Guides for Communications Software

Describe the features, functions, and use of the communications software available for execution under DNOS.

Systems Programmer's Guide

Discusses the DNOS subsystems at a conceptual level and describes how to modify the system for specific application environments.

Online Diagnostics and System Log Analysis Tasks User's Guide

Explains how to execute the online diagnostic tasks and the system log analysis task and how to interpret the results.

Universal ROM Loader User's Guide

Explains how to load the operating system using the ROM loader and describes the error conditions.

DNOS Design Documents

Contain design information about the DNOS system, SCI, and the utilities. This information is useful when using a source kit.

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Introduction

1.1 DNOS FEATURES

DNOS is a general-purpose, multitasking operating system designed to operate with the Texas Instruments 990/10, 990/10A, or 990/12 minicomputers that use the memory mapping feature. DNOS includes a sophisticated file management package which provides support for key indexed files, sequential files, and relative record files. DNOS is a multiterminal system that is capable of making each of several users appear to have exclusive control of the system. DNOS supports output spooling and program accessible accounting data. Job-level and task-level operations enable comprehensive and efficient use of system resources.

In addition to multiterminal applications, DNOS provides support for advanced program development. Users communicate with DNOS by entering commands at a terminal or by providing a file of commands. The System Command Interpreter (SCI) processes those commands and directs the operating system to initiate the action specified by a command. A Text Editor allows the user to enter source programs or data into the system. A macro assembler is provided for assembly language programs. Several higher-level languages, including FORTRAN, COBOL, and Pascal, are supported. A Link Editor and extended debugging facilities are also provided. A variety of utility programs and productivity tools support access and management of information contained in a data base, design of specific forms on the screen of a video display terminal, and word processing.

The system supports a wide range of user environments. DNOS can support as few as one or two terminals, thus allowing the small user to perform tasks efficiently and yet inexpensively. Larger configurations with a wide variety of peripherals are also supported. The maximum configuration size varies with the user's environment. The hardware (equipment) and software (programs) that can be configured guarantee that most computer system requirements and applications can be met with DNOS.

DNOS provides a foundation for future distributed data processing products. System capabilities support access to functional subsystems, devices and files, utilities, and terminal users. That access is transparent to computer boundaries. System features that provide a foundation for distributed data processing include interprocess communication (program to program communication) and an interface to network communication subsystems.

DNOS is an international operating system designed to meet the commercial requirements of the United States, most European countries, and Japan. DNOS supports a complete range of international data terminals that permit users to enter, view and process data in their own languages. Specialized data terminals are currently available for the languages used in these countries: Austria, Belgium, Denmark, Finland, France, Germany, Japan, Norway, Sweden, the United Kingdom, and the United States. The system includes error text files that can be edited so error messages can be easily translated into languages other than English.

DNOS supports features that incorporate the increased computing power of the 990/12 computer, but it is also upwardly compatible with other Texas Instruments operating systems. Some of these features are:

Multiple Terminals
: The number of online terminals is limited only by the available computing power and memory for systems structures.

Output Spooling
: Output spooling is the process of queuing files for printing. Files are scheduled for printing based on job priority and availability of a printing device(s). You can specify special printing forms and formats.

Accounting Function
: The system can optionally include an accounting function that allows you to maintain accounting information on use of system resources.

Logical Names
: Logical names can be used to define I/O resource access and can include parameters associated with that resource (spooler devices, files).

Job Structure
: The system incorporates a job structure that aids in program management and promotes efficient use of resources. A job is a sequence of cooperating tasks.

Input/Output Resource Management
: Resource-specific and resource-independent input/output (I/O) operations provide you with flexibility in the selection of devices and file types.

Program Segmentation
: Program segmentation is the process of separating a program into segments. A program can consist of up to three segments at any one time. Additional segments can be accessed as necessary during program execution. Segments can be shared by programs.

Interprocess Communication
: The system provides the capability, through interprocess communication (IPC), for two programs (tasks) to exchange information.

Power Failure Recovery
: In the event of a power failure, and assuming the optional backup power supply is included, DNOS maintains the state of the system at the time of the failure. When power is reapplied, the operation continues at the point where the power failure occurred.

Synchronization Methods
: Event and semaphore synchronization methods are included to promote interaction between programs within a job or across job boundaries. Event synchronization allows the program to wait for one or more events to complete before processing is continued. Semaphores are variables used to exchange signal information between programs within a job or across job boundaries.

Concatenated Files

The system supports file concatenation, in which two or more physical files are considered as a logically contiguous set of data. These files can exist on one or more volumes.

Temporary Files

A temporary file is one that exists only during the life of the creating job or for a program in that job. A job temporary file can be accessed by using a logical name and is deleted when the job terminates. Other temporary files are created for use by a single program and are deleted when the program terminates.

Diagnostic Support

The system supports both online diagnostics that operate concurrently with program execution and system log analysis tasks.

Batch Jobs

A batch job is a job that executes in the background, independent of a terminal. A user at a terminal can be executing multiple batch jobs, and at the same time, be performing foreground and/or background operations in an interactive job.

Dynamic Configuration Changes

Table size, system parameters, and device configuration changes can be enabled and take effect immediately or after the next Initial Program Load (IPL) sequence, rather than requiring system generation.

Compatibility

DNOS design promotes compatibility with the DX10 operating system. Many of the familiar operating concepts of the DX10 operating system are inherent in the design of DNOS. DNOS includes an SVC interface, SCI user commands, and disk and other media formats that are upwardly compatible with the same items for DX10.

System Generation

The system generation utility allows a user to interactively specify all necessary features, available devices, and optional functions when creating an operating system. This data is used to construct a file that defines the configuration of the operating system.

Message Facilities

The system provides a comprehensive set of codes and messages describing errors and special conditions that occur when using the operating system. The system handles messages in a uniform manner to ensure that they are easy to use. Two system directories maintain message files that contain text describing errors, information, and completion messages generated by the system. The directories are expandable to include message files written by users.

System Log

Information about errors and messages generated by hardware, input/output operations, tasks, and user programs is reported to a system log that is stored on two files and an optional specified device.

Systems Problem Analysis

If problems occur during system operation, they can be diagnosed by using a system utility that can analyze the system whether it is operating or has experienced a failure. In the event of a system failure, an image of memory can be copied to a file that the utility analyzes by commands entered by a user.

System Configuration History

Information about all supplied software products installed on a system is maintained on a system disk file. Users can also send entries to the file for application products they develop.

DNOS International Features

International use of DNOS is facilitated by error message files that can be text edited to translate those files into a language other than English. Another concern in the international use of DNOS is the necessity to change the collating sequence of key indexed files (KIF) according to country. DNOS provides methods to change the required collating sequence.

DNOS Performance Package

An optional add-on package is available for DNOS 990/12 users. This package enhances DNOS performance by using several system routines implemented in microcode in the writable control storage.

1.2 DNOS SYSTEM CONFIGURATIONS

System configuration refers to the arrangement or presence of various devices and functional features to meet the requirements for a particular user or application. The hardware configuration allows a wide range of peripheral devices to be used (refer to Table 1-1). The software configuration is defined during the system generation process to meet specific requirements of the installation. Most of these items can also be dynamically configured during system operation.

1.2.1 Hardware Configuration

The following hardware configuration is the minimum required for DNOS:

- The 990/10, 990/10A, or 990/12 computer with the memory mapping option and a minimum random-access memory of 256K bytes
- A 911 Video Display Terminal (VDT), or a 940 Electronic Video Terminal (EVT), or a teleprinter device (TPD)
- A system disk
- A means of disk backup

Disk backup can be magnetic tape, a second disk drive, or cartridge disk. DNOS supports the hardware devices listed in Table 1-1.

Table 1-1. DNOS Hardware Devices

Device Type	Model Number	Description
Disk Drives	DS10	Dual-platter, single-access moving-arm drive with 10 megabytes (MB) storage; 4.8 MB nonremovable platter and 4.8 MB 5440-type disk cartridge.
	DS31/32	Moving-head disk units with two 2315-type disk cartridges; 2.8 MB storage per cartridge.
	DS25/50	Moving-head disk units with five-platter disk packs. DS25 provides 22.33 MB storage; DS50 provides 44.6 MB storage.
	DS80	Moving-head disk units with five-platter disk packs; provides 80 MB storage.
	DS200	Moving-head disk unit with 10-platter disk pack; provides 169.4 MB storage.
	DS300	Moving-head disk unit with 10-platter disk pack; provides 300 MB storage.
	CD1400/32	Moving-head disk unit with two platters, one fixed and one removable. Each platter provides 16 MB storage.
	CD1400/96	Moving-head disk unit with fixed and removable units. Fixed unit contains three platters that provide 80 MB storage. Removable unit is one platter with 16 MB storage.
	WD800/18 WD800/43	Eight-inch Winchester disk system with cartridge tape backup; WD800/18 has 18.5 MB formatted storage, WD800/43 has 43.2 MB, and the tape backup has 14.5 MB.
	FD1000	Flexible diskette, random-access drive; provides 1.1 MB storage on a double-sided, double-density diskette.
Data Terminals	911 VDT	Video display terminal (VDT), displays 80 characters per line, 24 lines at a time (1920 characters). The 911 VDT supports uppercase and lowercase characters and displays them in high or low intensity; control characters are also supported. The 911 VDT is available in international versions, supporting the local character set in both uppercase and lowercase.
	733 ASR/KSR	Hard-copy data terminals using a thermal type dot matrix printhead to print up to 30 characters per second (cps). The 733 ASR/KSR terminals are automatic send/receive and keyboard send/receive hard-copy data terminals.

Table 1-1. DNOS Hardware Devices (Continued)

Device Type	Model Number	Description
	743/745 KSR	Portable keyboard send/receive hard-copy data terminals using a thermal type dot matrix printhead to print 50 cps (743) or 30 cps (745). Terminals support ASCII standard (64 printable characters) or optional (95 characters) keyboards. Standard keyboard includes numeric keypad; Model 745 includes acoustic coupler for remote capabilities.
	820 KSR	Keyboard send/receive hard-copy data terminal using a 9 x 7 dot matrix printhead printing up to 150 cps. Characters received via an EIA line interface are held in a 640 character buffer and are printed either unidirectionally or bidirectionally for greatest efficiency.
	940 EVT	Electronic Video Terminal (EVT) displays 80 characters per line, 24 lines at a time (1,920 characters). A 25th line provides selectable information display. The 940 EVT supports a 128 displayable ASCII character set including true character descenders for lowercase. International versions are available.
Printers	810	The Model 810 printer with a 9 x 7 dot matrix printhead prints 132 columns bidirectionally at 150 cps. Vertical forms control is supported. Optionally, the printer provides a full ASCII character set (both uppercase and lowercase characters) and vertical forms control.
	840 RO	The 840 RO printer with a 9 x 7 (or optional 9 x 9) dot matrix printhead prints bidirectionally at 75 characters per second and has a 256-character receive buffer. Device forms control and enhanced print options are supported. Control is accomplished by a stored-program microprocessor.
	2230/2260	Models 2230 and 2260 are medium to high speed, high quality impact printers that print at 300 and 600 lines per minute, respectively. Both printers support a 64-character ASCII character set in a 132-column format.
	306	The Model 306 printer with a dot matrix printhead can print lines of up to 80 characters each at 120 cps. The printer uses a standard 64-character ASCII character set (uppercase characters only).
	588	The Model 588 printer with a dot matrix printhead prints lines of 132 characters at 88 cps. The printer uses a standard 64-character ASCII character set (uppercase only).
	LP300	The LP300 printer is a medium-speed line printer that prints 132-character lines at a rate of 300 lines per minute.

Table 1-1. DNOS Hardware Devices (Continued)

Device Type	Model Number	Description
	LP600	The LP600 line printer is a high-speed line printer that prints 132-character lines at up to 600 lines per minute.
	LQ45	The LQ45 printer is a letter quality printer using a daisywheel printing element to print at speeds up to 45 characters per second. The printer supports a full 96-character printwheel.
Other I/O Devices	804 Card Reader	The Model 804 card reader is a column-oriented serial card reader that reads 80-column cards at a rate of 400 cards per minute (CPM). The 804 uses a photoelectric sensor and can read both punched and mark-sense cards.
	979A Magnetic Tape	Serial-access 9-track magnetic tape transport. Standard recording density of 800 bits per inch (bpi) (NRZI); optionally supports 1600 bpi (phase encoded).

1.2.2 Software Configuration

The software configuration, other than the inclusion of certain optional software packages, is specified during the system generation process. System generation is the process of designing the functional capabilities of the operating system by answering a series of questions. DNOS system generation offers a high degree of variability in designing system software configurations. System generation includes linking system object modules and user-supplied modules that were created specifically for an application.

1.2.3 Dynamic System Configurability

In addition to the flexibility of system configuration during system generation, DNOS also allows modification of most features of the system while the system is running. A system configuration utility allows you to:

- Add or delete devices
- Modify table area size
- Modify scheduler and swapping parameters

For some features, the changes take place immediately. For others, the new set of system characteristics is in effect after an initial program load (IPL) sequence is performed. Another system generation is unnecessary.

2

System Command Interpreter

2.1 GENERAL INFORMATION

You communicate interactively with the operating system by entering commands via the keyboard of a video display terminal (VDT) or a hard-copy data terminal (a terminal that prints the commands instead of displaying the commands). The commands are interpreted by the System Command Interpreter (SCI), and are called SCI commands. When an SCI command is entered, the system can request additional information about the intended operation. The additional information, called parameters, is interpreted by SCI, which then initiates the requested operation.

SCI is supported on DNOS interactive devices including VDTs and hard-copy data terminals. SCI operations on a VDT allow all parameter values to be displayed at once. When using hard-copy data terminals, you are prompted for parameter entry one line at a time.

2.2 FLEXIBLE COMMAND PROCEDURES

All SCI commands are processed by a set of command specifications. The command specifications are coded in a special-purpose language consisting of primitive and other commands. As you enter commands, SCI interprets the specification language and performs the prompting, data entry, and verification functions that are appropriate to the command. Statements within the language structure tell the system what data to collect and to which processing program to pass the data. The SCI language allows you to modify the set of available procedures.

2.3 SYNONYMS

SCI language variables called synonyms can be used as abbreviations for long text strings frequently entered by a user. Synonyms allow the substitution of a long text string with as little as a one-character abbreviation. DNOS maintains the list of synonyms that is associated with each user. When entered by the user, the synonym takes the place of the actual text string. Each user can assign several synonyms, then use those synonyms as a response to SCI prompts (e.g., a synonym can be used as a prefix for the entry of a file name).

2.4 INTERACTIVE AND BATCH MODE SCI

At each terminal, a user can have one foreground task and one background task active at the same time in the interactive job. A foreground task is a task that requires the use of the display screen (of the VDT) or the printing capability (hard-copy data terminal) of the terminal. Background tasks, although they are associated with the terminal, do not tie up the interactive capability. Batch jobs can be started independently of the interactive job at the terminal, and they make use of a file of commands for SCI. DNOS provides the capability of executing foreground and background activity as well as concurrent execution of batch job activity.

When operating in the interactive or batch job environment, logical name and synonym definitions are supported. A logical name can define parameters for an operation, including which resources are required. Logical names and their use within DNOS are described in Section 6 on I/O resource management. A background task can use a logical name definition supplied by the job, or the logical name can be redefined without affecting the foreground definition. As in the case of synonyms, after a background task is initiated, changes in foreground definitions do not affect background definitions.

2.5 TAILORING SCI TO AN APPLICATION ENVIRONMENT

DNOS provides extensive support for application development. One of the primary tools is the capability to modify existing SCI commands or add new SCI commands in order to tailor a particular user's SCI to a specific environment.

In those instances where a detailed menu approach is desired, application programs can be developed that incorporate both existing SCI commands and new SCI commands. (Refer to the *DNOS Systems Programmer's Guide* and the *System Command Interpreter (SCI) Reference Manual* for detailed information on SCI capabilities.)

2.6 COMMANDS AVAILABLE

DNOS offers a comprehensive set of SCI commands that perform various utility operations. Many other commands are supplied for programmers to use as they develop applications under DNOS. (Refer to the *DNOS System Command Interpreter (SCI) Reference Manual* for complete details on specific SCI commands.) The following is a list of the functional areas served by one or more SCI commands.

- Log on and off
- Set and display the time and date
- Initialize, install, and unload disk volumes
- Restore, backup, and copy disk directories
- Create and delete directories, files, and IPC channels
- Support synonyms
- Allow file alias name(s)
- Change file names and protection
- View and list directories and files
- Copy files
- Assign, position, and release logical units

- Display I/O status
- Display job and task status
- Activate and control programs and jobs
- Activate and monitor batch status
- Maintain terminal status
- Install and delete programs
- Activate the system log
- Debug programs and include items such as:
  - Breakpoints
  - Memory/disk dump or display
  - Decimal/hexadecimal arithmetic
  - Interactively controlled program trace
- Control text editing
- Activate Assembler, COBOL, FORTRAN, and Pascal applications
- Activate Link Editor
- Activate Sort/Merge
- Activate DBMS-990
- Activate Query-990
- Activate DD-990
- Activate TIPE
- Start communications systems
- Use TIFORM
- Assign logical names and parameters
- Support spooling system
- Support operator interface
- Support teleprinter devices

3
Application Development

3.1 APPLICATION DEVELOPMENT TOOLS

Texas Instruments provides a comprehensive set of application development tools that operate in conjunction with DNOS. Some of these tools are standard system utilities; others are optional software packages or communications emulators. The utilities and packages that are available include the following:

- Interactive Text Editor
- Macro Assembler
- Link Editor
- Interactive Debugger
- High-Level Languages (COBOL, FORTRAN, and Pascal)
- Data Base Management System (DBMS-990)
- Data Dictionary (DD-990)
- Interactive DBMS Retrieval (Query-990)
- Interactive Screen Format Design (TIFORM)
- Sort/Merge
- TIPE-990
- Communications Support

3.1.1 Interactive Text Editor

The Text Editor operates under the DNOS System Command Interpreter (SCI). An SCI command activates the Text Editor. When the Text Editor is active, you use the edit control keys to enter, modify, delete, and display data. You can also use Text Editor commands, which affect the entire file, to efficiently display, move, and modify data. Commands generally require response to field prompts for information necessary for command execution. You can easily change data at any position in the file, as the system allows positioning to a given character string or line number within the file. You can copy data into your edit file from other files. All new data and any changes made become part of the output file created at the end of the edit session. You can edit files up to 240 columns wide. Edit control functions are similar for both video and hard-copy terminals.

3.1.2 Macro Assembler

The DNOS macro assembler accepts the standard 990 assembly language instructions, and includes a macro facility and conditional processing. The macro facility provides character string manipulation, access to binary values in the symbol table, and support of macro definition libraries. The relocatable object code produced by the assembler can be partitioned in segments. Common blocks, program segments, and data segments are contained in separate location counters. The Link Editor collects segments of the same type into contiguous memory areas. Conditional processing of a sequence of assembly language statements is dependent on the value of an arithmetic or logical expression. Directives are provided to specify the amount of information in the assembly listing.

3.1.3 Link Editor

The DNOS Link Editor is used to accept relocatable object code produced by the assembler or a compiler, and combines the individual modules into a linked module. References between modules are resolved to the correct values. Common blocks, program segments, and data segments are collected and each segment type is assigned to a contiguous area of memory.

The Link Editor accepts control statements that can specify the use of shared resources and the use of overlay structures. Available options include generating a load map, searching a set of object libraries to automatically resolve unresolved values, and establishing a partial link that leaves external references for later resolution. Where functions require overlays, an automatic overlay load option is available. Link Editor output can be an object file or can be written directly as memory image into a program file or DNOS image file.

3.1.4 Interactive Debugger

The Interactive Debugger is a program that is used for symbolic debugging of assembly language tasks. The Debugger can operate interactively from a video display terminal or a hard-copy device. It allows display and modification of the contents of CPU registers, workspace registers, and memory. The Interactive Debugger also controls execution of a task.

In the run mode, a task can be halted or started, and new breakpoints can be set to halt the task when a breakpoint is encountered.

In the simulation mode, task execution is analyzed between each instruction. You can specify conditions to interrogate the program counter or memory content.

3.2 LANGUAGE SUPPORT

DNOS provides developmental and operational support for programs written in COBOL, FORTRAN, and Pascal. These high-level languages are available from Texas Instruments as options with DNOS. Basic features of these languages are described in the following paragraphs.

3.2.1 COBOL

COBOL is a high-level computer language especially designed for business data processing. COBOL consists of a set of English words and symbols that the programmer can use to define the problem and create a program to solve that problem. The COBOL language is self-documenting because the commands are English-like statements that use familiar business terms.

The COBOL compiler conforms to the American National Standards Institute (ANSI) COBOL subset as defined in ANSI document X3.23-1974 and incorporates extensions to this subset to provide added capabilities. The compiler package employs the following ANSI 74 standard COBOL modules at the level indicated in Table 3-1.

Table 3-1. TI COBOL Features

COBOL Module	Level
Interprogram communications	1
Library	1
Segmentation	1
Nucleus	1 + *
Relative I/O	1 + *
Indexed I/O	1 + *
Sequential I/O	1 + *
Table Handling	1 + *
Debug	Nonstandard

Note:

* Selected features from level 2.

In addition, the accept/display statements provide standard COBOL functions and nonstandard extensions that are designed for ease of use on video display terminals.

COBOL object code modules can be executed directly with SCI Execute COBOL commands, or they can be link-edited and installed on DNOS program files for execution as tasks.

3.2.2 FORTRAN-78

FORTRAN is a high-level, general purpose programming language whose form contains mathematical statements and English words. The FORTRAN language allows programmers to write programs to solve problems involving mathematical and logical computations.

The version of FORTRAN implemented for the Model 990 Computer conforms with the subset specifications set forth in American National Standards Institute (ANSI) publication USAS X3.9-1978 and is referred to as FORTRAN-78. FORTRAN-78 includes extensions to the ANSI standard subset that provide increased flexibility. Some of the more significant extensions are as follows:

- Dynamic subprogram recursion
- Optional array bounds checking
- Variable names of any length
- DO loop control variables of any numeric type

- ACCEPT/DISPLAY video terminal handling statements
- Multirecord internal units with error exit
- Mixed-mode expressions
- Hexadecimal constants and assignments
- Extended integer data type
- Sixteen-bit, fixed-point arithmetic
- Optional direct floating-point arithmetic execution on 990/12 CPUs
- Character string manipulation run-time routines
- Key indexed file handling run-time routines
- Full ANSI standard version of the OPEN and CLOSE statements that provide the following additional capabilities:
  - Specification of file access privileges
  - Creation of temporary scratch files
  - Control of blank interpretation during formatted numeric input

In addition, FORTRAN-78 incorporates the extensions to the FORTRAN language recommended by the Instrument Society of America (ISA extensions S61.1-1975).

The FORTRAN-78 package also includes a set of mathematical and statistical subprograms referred to as MATHSTAT-78. The MATHSTAT-78 subprograms perform functions such as matrix operations, polynomial operations, integration, linear programming, Fourier Series analysis, statistical analysis and presentation, regression, and analysis of variance.

3.2.3 Pascal

Texas Instruments Pascal is a general-purpose language well suited for a variety of applications. Pascal is straightforward to learn and use. Its readability makes it especially useful when programs are maintained by users other than the original author.

One application of Pascal is the development of systems-level software. Pascal is also ideal for scientific or engineering applications that are traditionally written in FORTRAN or ALGOL. The general-purpose structure is also useful for many business problems.

Some of the more significant features of Pascal are:

- A block structured format that directly supports structured programming concepts
- Stack allocation of variables for each routine
- Recursive routines
- User-defined data structures that are adaptable to specific applications
- User-defined data types
- Bit manipulation capabilities

Pascal consists of five major components:

- Nester utility
- Configuration processor
- Pascal compiler
- Pascal run-time library
- Reverse assembler

The nester utility generates source code indented in a standard format to improve readability. The configuration processor supports the separate compilation of nested program modules. The Pascal compiler with optimizing features produces linkable object modules. The Pascal run-time library provides an interface with the operating system. The reverse assembler can produce assembly language source files or listings from object modules created by the compiler.

3.3 PRODUCTIVITY TOOLS

A set of productivity tools is provided with special purpose application options that are available to accomplish specific tasks. The tools available with DNOS include the following:

- DBMS-990
- DD-990
- Query-990
- TIFORM
- Sort/Merge
- TIPE-990

3.3.1 DBMS-990

The Data Base Management System (DBMS-990) is designed for minicomputer data base applications. DBMS-990 handles data access in a logical format similar to the use of physical documents or records in daily business transactions. DBMS-990 allows you to define and access a centralized, integrated data base without the physical data access requirements imposed by conventional file management software. Considerations such as access method, record size, blocking, and relative field positions are resolved when the data base is initially defined. Thus, you can concentrate fully on the logical data structure needed for interface operations.

Since the data definitions are independent from the application software, the data base can be changed without affecting existing programs. DBMS-990 also provides a single, centralized copy of the data to be used for all application subsystems. (Conventional file management results in fragmented and/or multiple copies of data, one for each application.) A centralized copy results in more efficient data storage on disk, uniform processing of data requests, and simpler data base maintenance.

Security is an optional feature of DBMS-990. Its purpose is to eliminate unauthorized use of the data base. Password security is provided to control file access. Access authorization is provided to define the type of access allowed to the data elements of a file for a particular password and/or user. Each file that requires a password also requires access authorization.

The primary user interface to DBMS-990 consists of the data definition language (DDL) and the data manipulation language (DML).

DDL is used to completely describe the DBMS-990 data base and the associated data elements. The DDL logical data base definition source is compiled by the DDL compiler; the output is stored on disk with the associated data.

DML provides a means to manipulate data base information by supporting the reading and/or writing of the information. DBMS-990 data can be accessed by embedding the appropriate DML syntax in a COBOL or Pascal application program. The application program is used to construct a call to DBMS-990 that specifies the function to be performed on the data. The DBMS-990 request is processed and the results are returned to the program.

3.3.2 DD-990

The DD-990 data dictionary allows you to define all the data used in an organization and store these definitions in a central location. This centralization aids in the enforcement of data standards, clarifies the impact of changes to the data, and limits data redundancy.

The DD-990 system consists of a dictionary file, a data librarian, utilities, and a data manager. The dictionary file contains the definitions of data in other files. (Note that the dictionary file does not contain the actual data from these other files.) The dictionary file controls and maintains key indexed, relative record, sequential, and data base files. You use the data librarian to enter information into the dictionary. The data librarian is responsible for the accuracy of all definitions in the dictionary file. The utilities generate detail, summary, and cross-reference reports. This is an effective means of managing file definitions in the dictionary file and understanding the relationships of the definitions to each other. The data manager provides the DD-990 interface to Query-990. This allows total control and access to conventional (non-DBMS) files for inquiry processing.

DD-990 can be used in a stand-alone manner or in combination with Query-990 and DBMS-990 for full data file control. Query-990 does not require the data manager to access data base files.

3.3.3 Query-990

Query-990 is an English-like nonprocedural language with statements composed of several clauses. The clauses allow you to specify the content and format of each line as well as the complex conditions that a data base record or line must meet to be qualified for output. Calculations can be performed on fields and the results can be output, tested, sorted, or used in further calculations. Output sorting, default column headings, and automatic paging are supported. String operations for test conditions (such as "contains") are also available.

The Query-990 language makes it possible to specify a complex report in a few clauses. An application program to obtain the same report might require several hundred lines. The Query-990 software package for DNOS provides you with a convenient and efficient means of retrieving data from a DBMS-990 data base. You can gather and review data without writing a program.

The Query-990 processor produces a report or data file by accepting and executing a Query-990 language statement. You can build and execute a Query-990 statement by either of the following two methods:

- Invoke the Query-990 processor directly and gain access to a Query-990 statement file (interactively or in batch mode) that was built through either the Query-990 editor or the system text editor.

- Build a Query-990 language statement by executing the Guided Query-990 utility, which constructs the statement by prompting you with questions to determine the content and format of the report.

3.3.4 TIFORM

TIFORM is a software utility package for controlling the interactive interface to an application. TIFORM provides convenient control of complex screen formats for COBOL, FORTRAN, and Pascal applications. TIFORM includes an interactive screen drawing capability and a screen description language compiler. Through the use of these tools, TIFORM isolates the description of the screen format from the procedural code of the application. This allows applications to become independent of the terminal. TIFORM also includes:

- All available video display terminal features (blink, dim, high/low intensity, no display)

- Character and field level editing

- Significant improvement in the time required to develop interactive applications

3.3.5 Sort/Merge

DNOS supports a comprehensive Sort/Merge package. SCI commands provide access to Sort/Merge in batch or interactive mode. Sort/Merge supports the following features:

- Record selection
- Reformatting on input
- Summarizing on output

Ascending key order, descending key order, or an alternate collating sequence can be specified. Any number of keys can be specified as long as the total is less than 256 characters. The merge process supports up to five input files. The sort process allows the following:

- Key sort (tag-along)
- Summary sort (summary tag-along)
- Address only sort

Figure 3-1 shows an example of the Sort/Merge process with printouts of the results at each step.

3.3.6 TIPE-990

The TIPE-990 package provides word processing features for the creating, filing, printing, and editing of memos, reports, and letters, including form letters. TIPE operations can be performed at any desired video terminal. TIPE includes the primary features required to efficiently produce letters and documents while maintaining ease of operation and minimal training requirements.

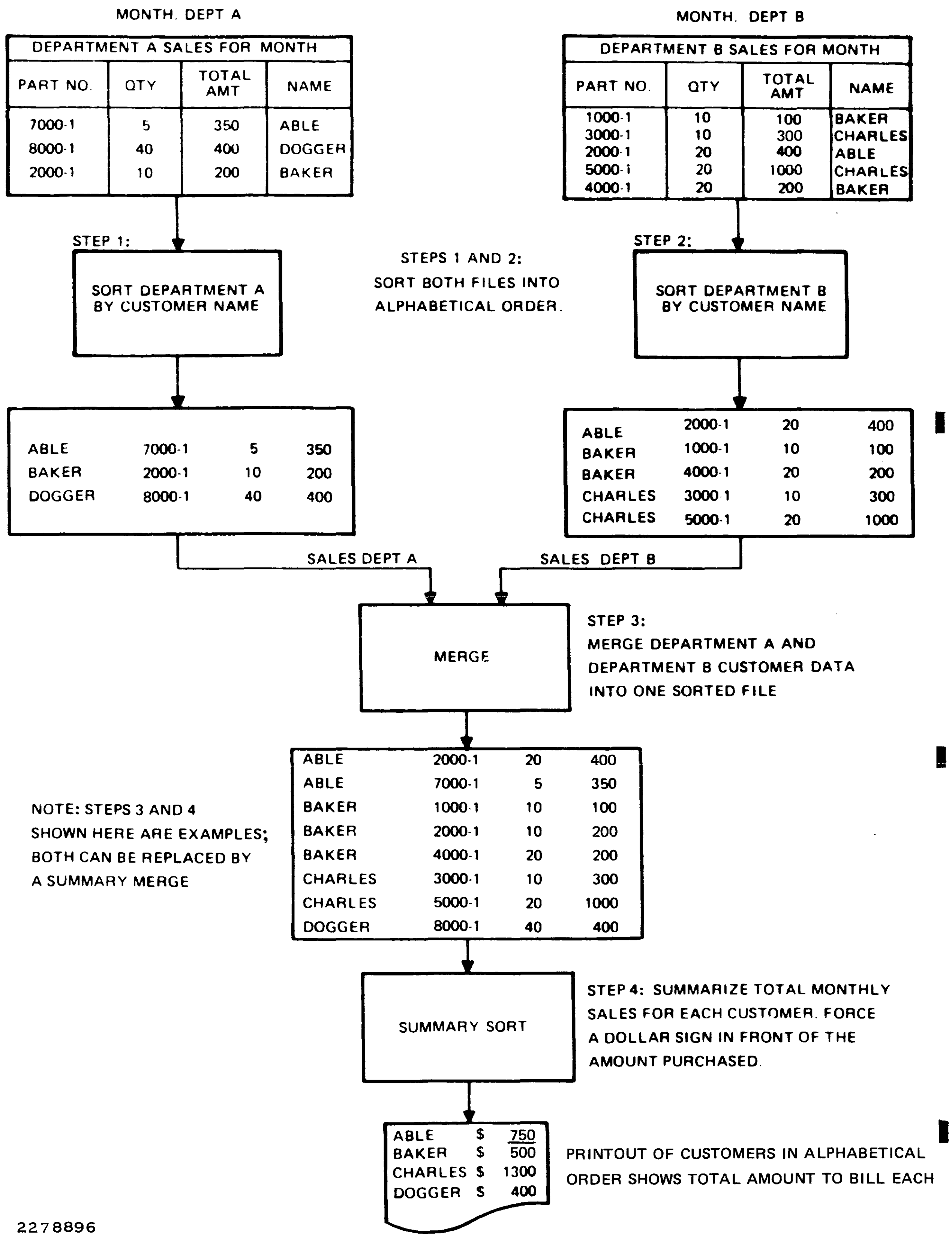
TIPE features provide you with the capability of performing a wide variety of page editing operations. The following descriptions introduce some of the features of the system.

Wordwrap/automatic return
: When the right margin is reached, the cursor and any unfinished word automatically move to the next line.

Foreground or background printing
: Specify foreground printing so that you can halt the print operation before completion to insert more paper, change a printwheel, and so on. Specify background printing to allow other activity (such as creating or editing files) to be performed at the terminal while the documents are being printed at the same time.

Shared/multiple printers
: Several operators can share the same printer; only one print operation takes place at a time. Additional printers can be connected to TIPE and the operator can specify which printer to use for a given print operation.

Form letter printing
: Allows you to merge variable data with the body of the letter to produce form letters automatically. Each letter has the appearance of an original, since it is tailored for each recipient.



MONTH. DEPT A
MONTH. DEPT B
STEP 1:
SORT DEPARTMENT A BY CUSTOMER NAME
STEP 2:
SORT DEPARTMENT B BY CUSTOMER NAME
STEPS 1 AND 2:
SORT BOTH FILES INTO ALPHABETICAL ORDER.
SALES DEPT A
SALES DEPT B
MERGE
STEP 3:
MERGE DEPARTMENT A AND DEPARTMENT B CUSTOMER DATA INTO ONE SORTED FILE
NOTE: STEPS 3 AND 4 SHOWN HERE ARE EXAMPLES; BOTH CAN BE REPLACED BY A SUMMARY MERGE
SUMMARY SORT
STEP 4: SUMMARIZE TOTAL MONTHLY SALES FOR EACH CUSTOMER. FORCE A DOLLAR SIGN IN FRONT OF THE AMOUNT PURCHASED.
PRINTOUT OF CUSTOMERS IN ALPHABETICAL ORDER SHOWS TOTAL AMOUNT TO BILL EACH
2278896

DEPARTMENT A SALES FOR MONTH			
PART NO.	QTY	TOTAL AMT	NAME
7000-1	5	350	ABLE
8000-1	40	400	DOGGER
2000-1	10	200	BAKER

DEPARTMENT B SALES FOR MONTH			
PART NO.	QTY	TOTAL AMT	NAME
1000-1	10	100	BAKER
3000-1	10	300	CHARLES
2000-1	20	400	ABLE
5000-1	20	1000	CHARLES
4000-1	20	200	BAKER

ABLE	7000-1	5	350
BAKER	2000-1	10	200
DOGGER	8000-1	40	400

ABLE	2000-1	20	400
BAKER	1000-1	10	100
BAKER	4000-1	20	200
CHARLES	3000-1	10	300
CHARLES	5000-1	20	1000

ABLE	2000-1	20	400
ABLE	7000-1	5	350
BAKER	1000-1	10	100
BAKER	2000-1	10	200
BAKER	4000-1	20	200
CHARLES	3000-1	10	300
CHARLES	5000-1	20	1000
DOGGER	8000-1	40	400

ABLE	$	750
BAKER	$	500
CHARLES	$	1300
DOGGER	$	400

Figure 3-1. Sort/Merge Process

Automatic pagination/repagination

During document creation, TIPE paginates the text into the desired number of lines per page. Repagination, the restructuring of the document into pages of a specified length, occurs automatically during printing.

Insert/delete functions

Allows you complete control over inserts or deletions as small as one character or as large as the entire document.

Move operations

You have control over the relocation of any specified block of text from one location to another. You can also store and recall text blocks. This allows the process of document assembly that speeds up the creation of letters, reports, memos, and so on.

These features (and others) give you powerful capabilites. TIPE eases the task of creating, editing, and printing your documents, reports, and form letters.

3.4 COMMUNICATIONS SUPPORT

Several communications methods are available using DNOS and other 990 software packages and communications modules. Depending on the application, you can generate a custom DNOS system to meet your needs. The communications equipment that is available for DNOS, the 3780/2780 Communications Emulator, and the 3270 Interactive Communications Software (ICS) are described in the following paragraphs.

The 990 communications equipment for DNOS includes the 990 communications interface module (CIM), the Bit-Oriented/Character-Oriented/Asynchronus Interface Module (BCAIM), the Four Channel Communications Controller (FCCC), a choice of an asynchronous or synchronous modem, and an accessory auto-call unit. These can be used with various data sets, modems, and data-access arrangements.

3.4.1 CIM

The CIM provides an RS-232C interface with full modem control signals for asynchronous and synchronous modems with baud rates to meet almost any communications requirement. Character size is selectable from 5 to 9 bits with programmable parity (odd, even, or none). Other features include line break detection/generation, a 250-millisecond timer, programmable SYN, DLE stripping, false-start-bit detection, stop-bit selection, and programmable self-test.

3.4.2 BCAIM

The BCAIM provides an interface between RS-232C or RS-423 compatible devices and a 990 minicomputer. Full modem control and status capability for interfacing to leased-line or dial-up modems is supported.

The BCAIM can be programmed to support synchronous, asynchronous, or isochronous operation. When programmed for synchronous operation, the BCAIM supports bit-oriented protocols such as Synchronous Data Link Control (SDLC), High-Level Data Link Control (HDLC), and Advanced Data Communications Control Procedures (ADCCP). Synchronous operation also supports character-oriented protocols such as Binary Synchronous Communications (BSC or Bisync) and Digital Data Communications Message Protocol (DDCMP).

The BCAIM contains routines that provide complete support including message blocking, error detection, and cyclic redundancy checks (CRCs) for BSC, SDLC, HDLC, and ADCCP protocols. The BSC protocol (Extended Binary-Coded Decimal Interchange Code, EBCDIC) supports IBM 3780/2780 emulation.

Synchronous protocols can be externally or internally clocked (NRZI encoded) data with bit rates of up to 9600 bps.

3.4.3 FCCC

The purpose of the FCCC is to interface up to four RS-232C or RS-423 compatible communications devices to a 990 minicomputer with a TILINE interface. The FCCC may also be used to provide an interface between 990 minicomputers.

The FCCC provides control, error detection, data formatting, and temporary data storage for each of four independent communications channels. Each channel of the FCCC can be programmed separately to support synchronous, asynchronous, or isochronous operation of the devices that they interface. During four channel operation, the FCCC supports bit rates up to 9600 bps on three channels and 4800 bps on the remaining channel. The FCCC also provides full modem control for interfacing to leased-line or dial-up modems.

When programmed for synchronous operation, the FCCC supports bit-oriented protocols such as SDLC, HDLC, and ADCCP. Synchronous operation also supports character-oriented protocols such as BSC and DDCMP, and nonsynchronous or bit-stream protocols.

The FCCC includes routines that provide complete support of message blocking, error detection, and cyclic redundancy checks (CRCs) for BSC, SDLC, HDLC, and ADCCP protocols. BSC (EBCDIC only) supports IBM 3780/2780 emulation.

3.4.4 3780/2780 Emulator Communications Software

The 3780/2780 Emulator communications software package provides a means of remote job entry (RJE) communications with an IBM 360/370 host computer or any other computer equipped with a 3780/2780 Emulator. Communications consist of exchanging data files between master and slave stations over leased point-to-point or switched telephone lines.

Using the 3780/2780 Emulator, DNOS systems can serve as satellite and/or central stations in distributed processing networks, or can be used to handle remote job or batch data entry for processing by a host. Remote stations can be dialed manually or automatically with an optional auto-call unit and a modem. Remote stations can also be operated in an unattended mode as a called station in a distributed network.

Texas Instruments 3780/2780 Emulator communications software emulates the operation of the IBM 3780 Data Communications Terminal, or the IBM 2780 Data Transmission Terminal. However, unlike the IBM 3780 and the IBM 2780, the source and destination of the transferred files are not restricted to the card reader and line printer. Any file, input device, or output device available to a user's system can be used for input or output.

3.4.5 3270 ICS

The 3270 ICS provides a means of connecting IBM mainframe computers to 990 computer systems. ICS allows interactive access to applications on the IBM computers that support the 3270 Information Display System. The software provides interactive access through the 911 or 940 video terminals. ICS also supports batch access through user-written COBOL, FORTRAN, Pascal, or 990 assembly language programs that control the Programmed Station Control (PSC) Emulator.

ICS operates over either leased or private communications lines. Communications require one of the controllers discussed previously (CIM, BCAIM, or FCCC), along with the appropriate modem. When operating with ICS, a 990 computer can share a multipoint line with other IBM 3270 compatible terminals using binary synchronous communications (BSC) protocol.

ICS maintains comprehensive statistics about data-link and application performance to aid network troubleshooting.

4

Program Management

4.1 JOBS AND TASKS

DNOS uses jobs and tasks to perform the functions of a multitasking operating system. A job is a collection of cooperating tasks (programs) initiated either by a user or automatically by a program to perform one or more functions.

An example of a job is the output spooling job. Successful performance of the spooling job requires the cooperation of multiple programs. The device scheduler task dispatches print requests to other tasks that cause files to be printed. The spooler job is the "owner" of the line printer receiving the spooled data. Other jobs, requiring the same or other system resources, can be executing concurrently with the spooler job. Program management is the controlling factor in this multitasking environment, and program management uses scheduling and priority factors to effectively control system operation.

Both interactive and batch jobs run in DNOS systems. An interactive job "owns" at least one interactive terminal (e.g., the 911 VDT). It is through the terminal(s) that tasks within a job communicate with the user. Alternatively, batch jobs do not communicate with a terminal. Both types of jobs carry the attributes of the initiating user. For example, every job is associated with the user ID of the user for whom the job is executing. Execution parameters, associated with past operations for that user, are available for the job. In this manner, an interactive or batch job can be regarded as a representative of the user within DNOS.

A job can be looked at as an environment for cooperating programs that share resources (e.g., files, devices, etc.), semaphores, and variables such as synonyms and logical names. Because programs are not necessarily associated with a physical terminal, this program isolation and job concept provides easy migration of programs between DNOS terminals and systems.

4.2 MULTIUSER SUPPORT CAPABILITY

DNOS allows the simultaneous execution of independent jobs from several terminals. Each user is given the impression that all system resources, including the central processing unit (CPU), memory, disk, and other peripherals are dedicated to that user. In addition to job and task management, other DNOS capabilities help to reinforce this impression. For example, spooling allows a user program to write a file to the printer when the printer is busy. The file is stored on disk until a printer is available.

4.3 ACCOUNTING CAPABILITIES

The DNOS accounting subsystem provides a method of accumulating information related to the use of resources by various jobs in the system. This provides a method of acquiring information for those sites that require a utilization report. The accounting function is an option, selectable during system generation. DNOS keeps track of the amount of system resources used by jobs and tasks. For example, DNOS measures CPU time, memory allocation, and the number of pages printed. At certain times during the existence of the job, the accounting data is stored on disk. When a task terminates, the amount of CPU time and memory used for the task is written to the disk.

DNOS provides two accounting files for the storage of accounting information. Any subsequent processing of the accounting file(s) is accomplished by a user-written application program.

4.4 TASK SCHEDULING AND EXECUTION

DNOS allocates main memory and CPU execution time based on the installed priority and the characteristics of an executing program. The priority of an executing task (effectively the run-time priority) indicates the relative importance of that task to other active tasks in the system. DNOS ensures that the highest priority task that is ready is in execution at any particular time. Tasks that share equal priority, and that are ready to run, share the CPU by time slicing. Time slicing is described in a subsequent paragraph.

4.4.1 Task Priorities

Scheduling tasks for execution in the DNOS system is accomplished by using priorities that are determined when a task is installed. Those priorities are:

- Real-time priority
- Time-sharing dynamic priority
- Time-sharing static priority

A real-time priority is used to assign a constant priority level to a task. Either a dynamic or a static priority can be assigned to a time-sharing task. The initial run-time priority of a time-sharing task is based on the installed priority of the task and the priority of the job in which the task is executing.

A task installed with a dynamic priority has a run-time priority level that can vary several levels during task execution. The degree of priority level change is based on whether the task is I/O-bound or CPU-bound. During task execution, an internal indicator monitors the number of suspensions that occur during a fixed time period. This count determines whether the task is I/O or CPU-bound. I/O-bound tasks are granted a higher priority than CPU-bound tasks.

During execution, a task installed with a static priority has a run-time priority level that can vary by fewer levels than a task installed with a dynamic priority. However, the priority level change is based on the same factors as those for a dynamic priority task (I/O-bound or CPU-bound).

4.4.2 System Clock and Time Slicing

The internal system clock of the computer uses the alternating current (ac) power supply to maintain the system time and date. The system clock interrupts DNOS 120 times per second (100 times per second, international). The interrupts are counted to maintain the time and date and to serve as the time monitor driving the DNOS task scheduler (to maintain the time slicing process).

Time slicing is the process of allowing a task to execute for a given time period then releasing the CPU, allowing another task to execute. The time limit can be specified or can be disabled during the system generation process. Time slicing is accomplished via an interface with the clock interrupt processor. The clock interrupt routine maintains a count of the time that a task has been executing. When the clock reaches a predefined limit, the routine forces a return to the task scheduler rather than to the executing task. At this point the priority queue is used to determine the next task for execution.

4.5 SUPERVISOR CALLS

Programs request services from DNOS by issuing supervisor calls (SVCs). Each supervisor call includes a block of information containing the detailed parameters associated with the services requested. Table 4-1 lists general-purpose application SVCs that are supported by DNOS. All SVCs available to user programs are described in detail in the *DNOS Supervisor Call (SVC) Reference Manual.*

4.6 SYNCHRONIZATION

Synchronization is the process of controlling the execution of one program in relation to the execution of other programs and of ensuring that the execution proceeds in a structured and yet dynamic fashion. DNOS provides synchronization on several functional levels.

The synchronization tools include:

- Interprocess communication (IPC) — Read and write message operations for any two tasks in the system.

- Semaphores — The capability for two tasks, in one or more jobs, to exchange timing signals. A semaphore is implemented as an integer variable. The integer variable indicates the number of remaining timing signals; however, if no signals are present, the integer represents the number of tasks waiting for a timing signal. Semaphores are provided on job local variables via SVCs that detail the completion code, operation code, semaphore number, and the initial or returned value.

- Events — The ability to initiate one or more SVC events, then wait for one (or more) of those to complete before continuing.

Table 4-1. DNOS General-Purpose Supervisor Calls

File and I/O Calls

Perform I/O operations
Wait for I/O
Wait for multiple initiate I/O
Abort I/O
I/O utility requests

Job Management Calls

Create a job
Temporarily halt a job
Resume a job
Modify job priority
Map a job name
Kill a job

Program File Management Calls

Install/delete a task
Install/delete a procedure or segment
Install/delete an overlay
Assign space on a program file

Program Control Calls

Schedule a task
Execute a task
Delay task execution
Resume execution of a delayed task
Change a task priority level
Unconditionally suspend a task
Activate a suspended task
Inhibit task suspension
Force abnormal task termination (kill task)
Terminate a task

Other Calls

Convert ASCII/binary services
Perform job accounting services
Expand/contract segments via memory control
Service task synchronization
Provide status/system information
Manage segments
Encrypt/decrypt data

4.7 PROGRAM SWAPPING

If, during an attempt to load a task, there is insufficient memory available, the task loader enables a swapping routine. The swapping routine attempts to free up memory by temporarily writing program segments to the swap file.

There are three categories of task status that make a task eligible for swapping. These categories, listed from most eligible to least eligible, are as follows.

- Tasks suspended for more than a minimum amount of time. The longer the suspension, the more eligible the task is for swapping.

- Tasks of lower priority than the task to be loaded. The lower the priority, the more eligible the task is for swapping.

- Tasks having the same priority as the task to be loaded and having executed for a minimum amount of time since the last loading. The longer the execution time, the more eligible the task is for swapping.

5

DNOS Memory Organization

5.1 GENERAL INFORMATION

DNOS takes advantage of the 990 memory mapping option to dynamically allocate memory to disk-resident task (program) segments, as well as file blocking buffers. These allocated segments can be released from memory and swapped to disk as necessary. (Program swapping is described in Section 4 of this manual.)

DNOS memory organization serves to support both memory and instruction protection. Memory mapping can protect one program from being accessed by other programs. Privileged instructions, such as instructions that manipulate the memory mapper, can be executed only by privileged tasks.

5.2 MEMORY ALLOCATION

The memory-resident portion of DNOS occupies lower main memory. The remaining memory space is available for user programs, initial memory-resident programs, and dynamically loaded disk-resident programs.

DNOS places tasks into memory wherever space is available. The memory mapping feature permits dynamic memory allocation; that is, a program can be dynamically segmented into separate areas of physical memory. Although an application program can be a task consisting of three segments, physically separated in memory, the mapping feature causes the program to see an environment where:

- All three segments appear to be contiguous in memory with no gaps in addressability
- The first segment appears to begin at memory address 0 (zero)
- The maximum addressable memory space for any one program is 64K bytes
- Each program segment begins on a 32-byte boundary

For example, a program can use one segment containing the data for the program and another segment for the procedure (the executable code). Each of these segments is mapped into the program's address space. Other programs can share the same procedure segment. The segment occupies one physical area of memory, but is mapped into the address space of each program that uses the segment.

5.3 TASK ADDRESS SPACE MANAGEMENT

DNOS provides overlay and segment mechanisms that allow a user to manage the logical address space of user programs. The user has the ability to change the group of current segments, thereby changing the address space. Another technique to control the memory content of user programs is to load the content of segments from a backup storage device via the overlay mechanism.

5.3.1 Overlays

Overlays consist of phases of memory utilization that share common memory addresses with the restriction that only one overlay can occupy memory at one time. When using overlays, a disk or other mass storage medium must be available to store the overlay information. The Link Editor (described in Section 3 of this manual) or user-entered commands can enable the storage of overlays on program files.

5.3.2 Segmentation

DNOS programs can consist of various program sections with each section having certain attributes. The number of segments in a program is somewhat determined by the attributes assigned to the various sections of the program. Generally, if all sections of a program have the same attributes, there is only one segment; however, if the program sections have different attributes, the program requires several segments. If a division of the program can be made into sections with differing attributes, then the use of multiple segments (up to three segments per task can be in use at any one time) can benefit the user.

Segment attributes are specified during task installation. Segment attributes include the following:

- Execute protect — Segment contains no executable code
- Readable — Memory read accesses are allowed
- Write protect — Segment cannot be modified when in memory
- Share protect — Segment cannot be shared (concurrently) by more than one task
- Reusable — Segment can be used consecutively without reloading
- Replicatable — Multiple instances of a segment can exist concurrently
- Copyable — Segment in memory can be copied to effect replication
- Updatable — Segment can be written to its permanent file position after being modified in memory
- System — Segment can be used by a system task only
- Memory resident — Segment permanently resides in memory

Disk based segments are installed as memory images on program files. A maximum of 256 segments per program file is allowed. The system also allows up to 256 task and 256 overlay segments in each program file.

Dividing a program into segments is illustrated by a program that consists of eight logical sections of code. Figure 5-1 shows the segment structure of this program. This program includes a task segment, several segments of equal length (S1, S2, and S3 in Figure 5-1), and several segments of various lengths (S4, S5, S6, and S7). At any point during execution, the program can use three of the following segments:

- The task segment (always present in memory)
- One of the segments S1, S2, or S3
- One of the segments S4, S5, S6, or S7

DNOS also supports memory-based segments created in memory and used during program execution. Users can also map segments that correspond to physical records of a relative record file into their programs.

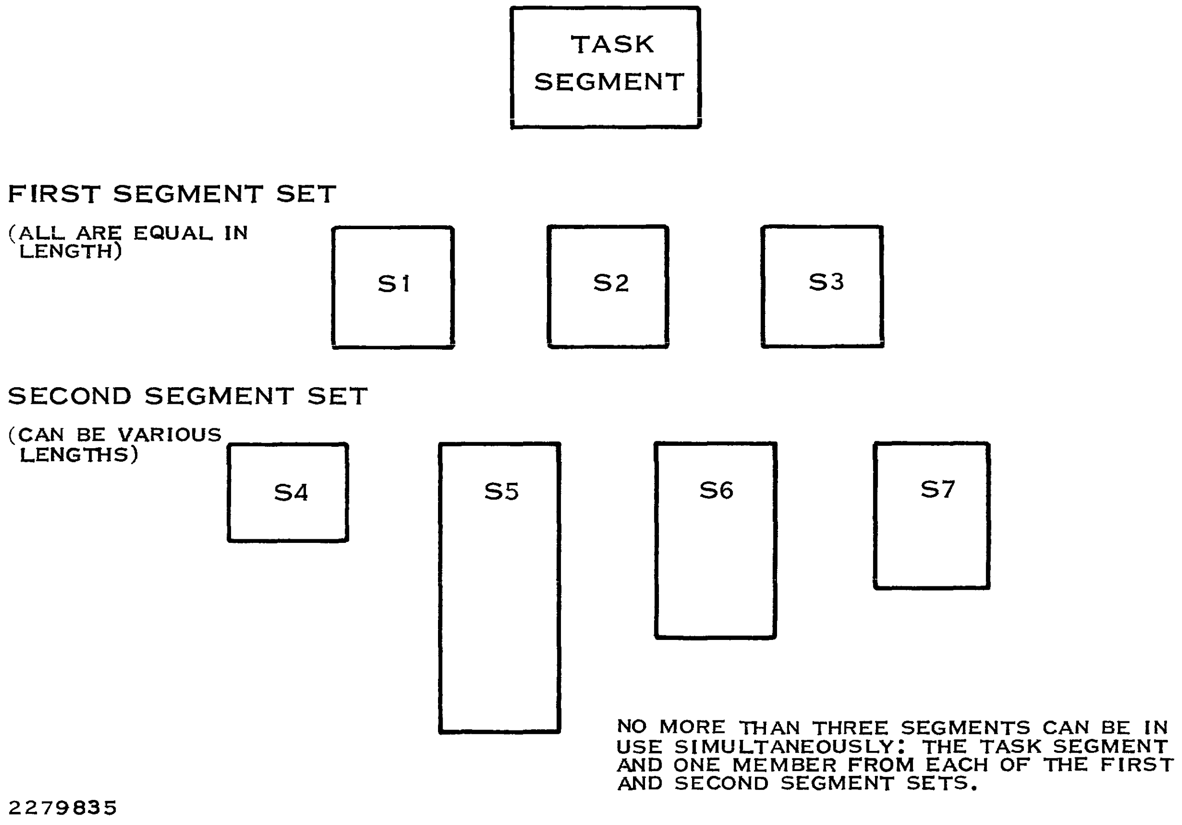

TASK SEGMENT
FIRST SEGMENT SET
(ALL ARE EQUAL IN LENGTH)
S1
S2
S3
SECOND SEGMENT SET
(CAN BE VARIOUS LENGTHS)
S4
S5
S6
S7
NO MORE THAN THREE SEGMENTS CAN BE IN USE SIMULTANEOUSLY: THE TASK SEGMENT AND ONE MEMBER FROM EACH OF THE FIRST AND SECOND SEGMENT SETS.
2279835

Figure 5-1. Program Segmentation

6

I/O Resource Management

6.1 GENERAL INFORMATION

I/O resource management involves the orderly allocation of logical I/O resources to tasks (programs). Logical I/O resources include disk space, devices, files, and interprocess communication (IPC) channels. The DNOS system uses a method called incremental allocation to manage I/O resources. This type of allocation allows a program to dynamically request resources during execution.

Whenever a resource is requested, but is not available, the program or the user is notified immediately. The request for resources is not queued and the program is not suspended; this allows program flexibility to either abort or retry the resource access function.

I/O resources are allocated to programs according to access privileges that the program requests during an open operation. If the requested privilege can coexist with previously granted requests, the open operation completes without error. Thereafter, the program is guaranteed the type of access requested (exclusive, exclusive write, shared, or read only access).

6.2 I/O METHODS

DNOS supports input and output operations to various types of devices and to several types of files, and supports communication between programs. Devices, files, and communication channels are referred to as I/O resources. There are two methods of I/O to resources: resource-specific and resource-independent. Resource-specific I/O is dependent on a particular type of device or file. Resource-independent I/O is more flexible and allows a user to simply specify I/O for any of several types of devices.

Both resource-specific and resource-independent operations allow a program to interact with predefined devices, files, and channels. The interaction occurs through the use of logical unit numbers (LUNOs) that are assigned to the device, file, or channel.

6.2.1 Resource-Specific I/O

Resource-specific I/O allows the programming of specific capabilities of devices, channels, and files. Resource-specific I/O is supported for the following:

- Direct disk I/O
- Extended VDT I/O
- Create/delete files
- File specific I/O utility operations

- Random-access operations to key indexed and relative record files
- Interprocess communication (IPC) operations

6.2.2 Resource-Independent I/O

Resource-independent I/O requires use of a sequentially-oriented device, file, or channel. A program using this kind of I/O call can read and write data records in sequential order, independent of the type of device or file used. Examples of such types of operations include Read, Write, Forward Space, and Write EOF. Extensions to resource-independent I/O allow a program to take advantage of device capabilities. Such programs work only with a specified type of a device or file; that is they are using resource-specific I/O. All devices, files (including key indexed files), and channels support a resource-independent type of access.

6.3 LOGICAL NAMES

A logical name represents the pathname of an I/O resource such as an IPC channel, a file, or a concatenation of files. A user defines a logical name that is 1 to 8 characters in length. A concatenation of files can be accessed only by a logical name; a file can be accessed by a pathname or a logical name. A logical unit number (LUNO) can be assigned to a logical name.

A logical name also provides a mechanism for specifying parameters associated with the resource. For example, a logical name that represents a spooler device has parameters such as form, type, and number of copies. Another use of logical names is the automatic creation of permanent or temporary files, using parameters specified with the logical name.

The System Command Interpreter (SCI) initializes a user's set of logical names from a disk-based file associated with each user ID. Generally, logical names are created at the SCI level, but programs can create them directly.

6.4 SPOOLING

The spooling of data occurs during job execution as output is generated by one or more tasks. Spooling is the process of receiving data destined for a particular device (or class of devices) and writing that data to a temporary file (or files). The spooler subsystem schedules the printing of files among available printing devices.

The user has the option, by using SCI commands, to specify the following:

- Form — The printing form on an output device
- Format — ANSI or standard printing format
- Device Class — A group of related devices
- Number of Copies — Number of copies of a file or files to be printed

For example, using the Device Class, you can specify any line printer, or any printer that prints upper/lowercase without naming a specific printer.

7

Interprocess Communication (IPC)

7.1 GENERAL INFORMATION

Interprocess communication (IPC) allows two or more tasks to exchange information. Tasks exchange messages by reading and writing over IPC channels that are created by the system and exist independently of the tasks using them. A channel is an IPC path between two tasks within the same computer. In all cases, one of the tasks is designated as the owner of the channel. That task controls the channel; the requester task has less flexibility and fewer privileges. Ultimately, IPC channels are intended to cross computer boundaries in a way that is transparent to the communicating tasks.

7.2 USES OF IPC

Interprocess communication is used for four primary reasons:

- Synchronizing jobs and tasks
- Building queue servers
- Intermediate processing of data
- Sending and receiving messages

Task synchronization differs from other uses of IPC in the fact that often only the existence of a message is important, not the content of the message. Tasks may require synchronization in order to share resources or to cause external interactions to occur in a particular order when programs are excecuting in parallel.

IPC provides the mechanism for building system services or user applications to process queues of requests. Associated with each provided service is a channel to receive requests and a task that accepts and handles those requests.

Some queue servers can provide intermediate processing of data between a requesting task and a final destination. These tasks receive requests from queues, interpret or modify the information, and pass the changed data to another task or device.

The other use of IPC is to send and receive messages between tasks.

8

File Organization

8.1 DISK FILE STRUCTURES

DNOS supports three major file types for user data: sequential, relative record, and key indexed. This section details those file types. The multilevel directory structure, disk allocation, and specific file features are also described.

8.1.1 Sequential Files

Sequential files are useful for recording variable length data records in the order in which they are received. Similarly, data must be read back in the same order. Random access to sequential files is not practical because to reach a given random record, all intervening records must be processed. A pointer to the current file position is kept for each active assignment to the file. As each record is read or written, the pointer is advanced.

Sequential files have the property that no valid data can exist beyond the most recently written record. However, records can be written to the file by appending them to the existing data. Thus, a sequential file can contain multiple subfiles in a serial format. Since each subfile is separated by an end-of-file mark, a sequential file can have multiple end-of-file marks within the file.

Several programs can read a sequential file concurrently at different positions in the file. Only one program at a time can write to a sequential file. Current position is retained while the file is logically assigned, even though the file is closed and reopened.

8.1.2 Relative Record Files

Relative record files are optimized for rapid random access. Fixed-length records are accessed by supplying DNOS with the record number. Such files are useful when the nature of the data lends itself to computation of a record number. Sequential access is also permitted. One end-of-file record is maintained wherever last specified by a program.

8.1.3 Key Indexed Files

The most sophisticated file type supported by the system is the key indexed file. In key indexed files, variable length records are accessed by providing the operating system any one of up to 14 keys that identify the data. A key is a string of up to 100 characters. For example, an employee file can be constructed so that the data record for any given employee is accessed by the employee's name, employee number, social security number or any other designated key. Keys can be declared to overlay one another within the record. Although keys can be structured anywhere within the record, they must appear in the same relative position in all records in the file. One of the 14 possible keys must be selected as the primary key. All other keys are known as secondary keys. The primary key must be present in all records, but secondary keys can be optionally present in any given record within the file.

8.1.3.1 Key Values. Key values for both primary and secondary keys are kept in indexes within the file. These indexes are hierarchically structured for rapid random access while still allowing sequential access in the sorted order of any selected key. In a manner similar to that for sequential files, a pointer to the current position within the file is maintained by DNOS for each key. When updating any given record, the user of a key indexed file can add, delete, or change a key value.

8.1.3.2 File Stability. When a write operation is to be performed on records in a key indexed file, DNOS makes a copy of physical records involved in performing the operation. If a failure occurs during the I/O operation, the prelogged records can replace the master copy. Thus, DNOS can guarantee the integrity of the file.

8.1.4 Concatenated Files and Multifile Sets

DNOS file management and I/O utilities support logical files that are created by concatenating several physical files. Concatenated files consist of multiple files that have been logically appended and are known collectively by a single logical name. The physical files can exist on one volume or on several volumes. Only sequential and relative record files can be concatenated. The file concatenation lasts only during the existence of the job, and only the last component is expandable.

A multifile set is a group of key indexed files whose pathnames are the values of a single logical name. Like concatenated files, components of multifile sets can reside on one volume or on several volumes.

You can assign a logical name to two or more key indexed files and use the logical name as if it were the pathname of a key indexed file; in this case, the files are not logically concatenated but are physically associated with one another in a multifile set. The file structure on disk is altered in such a way that you can no longer separately access the individual files by key indexed file operations. You can access individual files by operations that examine a physical record of a file or an absolute disk address.

8.2 MULTILEVEL DIRECTORY STRUCTURE

Under DNOS, each disk volume contains system overhead and space reserved for files. DNOS utilizes one disk volume from which the operating system is loaded. That disk, designated as the system disk, is also used by DNOS to perform internal disk-based functions. Figure 8-1 illustrates the multilevel directory structure of a disk volume.

8.3 DISK ALLOCATION

Track 0 and part of track 1 are always allocated to system overhead. The innermost cylinder is always allocated for use by system diagnostics. The remainder of a disk volume is dynamically allocated to directories and files as they are created, expanded, and deleted. The primary directory is called .VCATALOG; it corresponds to the name of the volume. Within this directory, other directories and files are cataloged, many of which are used for system functions. These system disk files store the DNOS kernel, utilities (in memory image code), swapped program images, and an image of the contents of system memory (in the event of a system crash). The DNOS disk manager task automatically allocates available space to files when they are created and as they expand. When files are deleted, additional disk space is automatically available for other files.

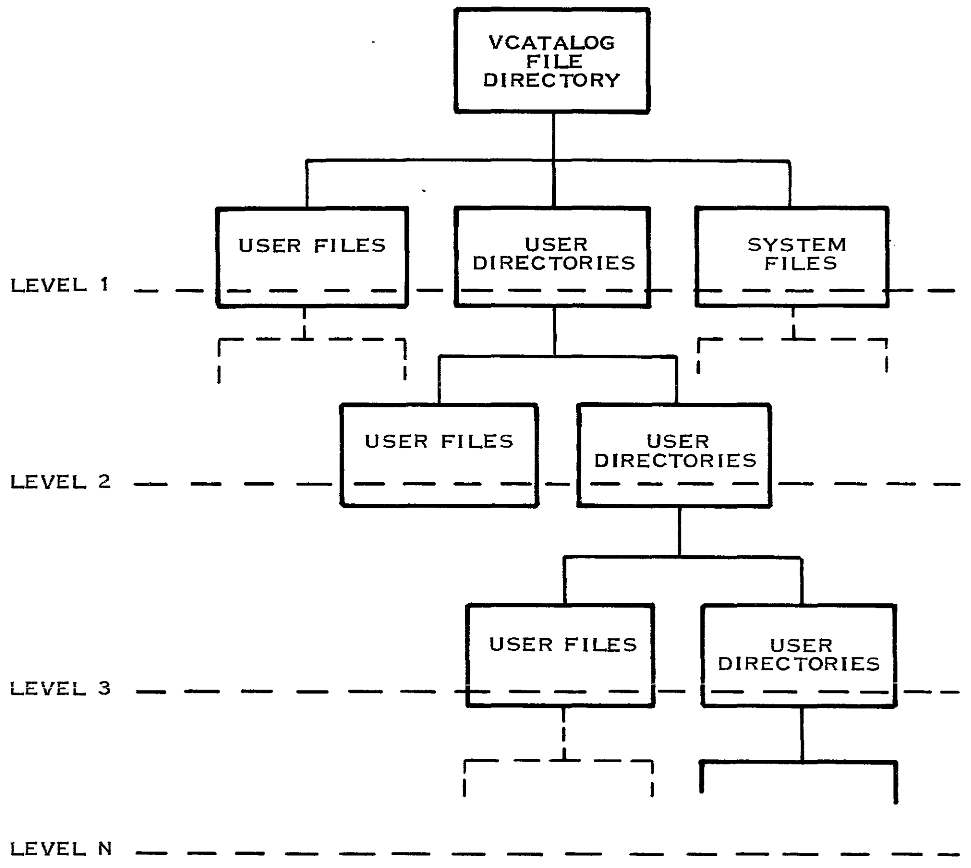


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Figure 8-1. Multilevel Directory Structure

8.4 FILE FEATURES

DNOS supports a variety of file features that add to the flexibility and promote the overall usefulness of the system. The file features include the following:

- File use from high-level languages
- Delete and write protection
- File access privileges
- Record locking
- Temporary files
- Blocked files
- Deferred or immediate write options

- Blank compression and adjustment
- Expandable files

8.4.1 File/Language Relationship

The various file features and file types are all available to the assembly language programmer. High-level languages can access any given feature depending on the syntax of the language. Assembly language programs can be written and called from high-level language programs, thus providing indirect access to features not directly supported by high-level language syntax.

8.4.2 Delete and Write Protection

Although each created file can be protected from accidental deletion (from the disk volume), in some cases it is desirable to further protect the file. DNOS permits write protection for files, meaning that the data in such a file can only be read. Write-protected files are automatically delete protected.

8.4.3 File Access Privileges

Under DNOS, a program can request specific access privileges for any use of a disk file. Use is defined as the entire file transaction from the open through the close. These privileges include exclusive access, exclusive write access, shared access, and read-only access.

8.4.4 Record Locking

Record locking is the process of locking individual records within a file. This feature allows a program exclusive access to a locked record until that record is unlocked. For example, record locking could be used to lock an inventory record while updating the quantity that is in stock. The locking prevents other programs from changing the same quantity before the first update is complete.

8.4.5 Temporary Files

DNOS allows the creation and use of temporary files. These files are subject to automatic deletion by the operating system. This feature allows trial preparation of a file; if the file is satisfactory, it can be renamed and designated as a permanent file. If the file is not satisfactory, and not renamed, it is deleted by DNOS when the LUNO is released or when the task terminates. A job temporary file can be created for use by one or more tasks; it is deleted when the job terminates.

8.4.6 Blocked Files

Multiple logical records can be automatically combined by DNOS into larger physical records. These larger records conserve disk space and reduce the number of physical transfers of data between memory and the disk.

8.4.7 Deferred or Immediate Write

The physical transfer to disk of blocks of logical records is normally deferred by DNOS until the memory space held by the blocking buffer is required for some other purpose. This reduces the number of physical disk accesses. The system automatically updates all records on disk when the file is closed. In some cases it is advantageous to write data immediately upon request (for example, to maintain data integrity in highly sensitive files). The immediate write option supports this capability.

8.4.8 Blank Compression and Adjustment

Blank compression is the process of removing consecutive blank characters from each record in file types that support variable length records. The strings of consecutive blanks in a record are coded in a shortened form. Blank adjustment is the removal of trailing blanks on a write operation and the replacement of the blanks on a subsequent read operation. Blank adjustment is available for devices as well as files.

8.4.9 Expandable Files

DNOS permits the file size to be declared when the file is created. Unless otherwise specified, if the file exceeds the initial allocation, additional space is automatically allocated. This allows files to grow beyond the initial boundary. Secondary allocations to the file become increasingly larger as the file continues to expand.

9

Messages and Exception Handling

9.1 MESSAGE STRUCTURE

All DNOS error messages include the source of the error, the category of the subsystem reporting the error or condition, and a brief description of the problem. The system includes error text files of messages that can be changed or translated into languages other than English by text editing the file. To aid in the error determination, utilities pass information to SCI, that when combined with other information in the error text file, creates a complete message.

Messages are formatted in the following manner:

Source Category-Message ID Message Text ....

The message source (user, system, hardware) is represented by 1, 2, or 3 characters. The subsystem that generated the message is identified by the category of the message. It is an acronym that consists of 1 to 8 characters. The message ID contains 1 to 14 characters identifying the message. It is usually a 4-digit decimal number. The message text is a short description of a special situation or error condition. It can be five lines in length. In addition to the brief description, expanded explanations and recommendations for user action are available. When the brief explanation is displayed, the user can type a question mark to be shown further details.

9.2 ONLINE DIAGNOSTICS

Online diagnostics execute without affecting normal system operations. They execute as application level tasks in a nonprivileged mode, thus assuring that the online diagnostics or tasks do not destroy existing operations or data bases. You can specify the execution of only one diagnostic or the simultaneous execution of two or more diagnostics.

9.3 POWER FAILURE HANDLING

An optional power failure recovery feature is available for DNOS. When this feature is included and selected (a system generation option), and a power failure occurs, the backup power supply (battery) is enabled to refresh and rebuild the VDT screens until power is restored. Any disk I/O that is in progress at the time of the power failure is reissued when power is restored. Input/output operations in progress, to devices other than the disk or the 911 VDT, are aborted with a suitable indication to the requesting task(s). The task can retry the operation when power is restored. The system keeps track of the last instruction that was executed, and execution can be resumed at that point.

DNOS Glossary

The terms defined in this glossary are used to describe the structure and operation of DNOS. All members of the DNOS family of manuals contain some of these terms. The terms are arranged alphabetically except for symbols, which are located at the end.

A

Access Name — A name used to access an I/O resource. An access name can be a device or volume name, a file or channel pathname, or a logical name assigned to a device, volume, file, or channel.

Access Privileges — The level of isolation desired for a given resource. A task is said to have one of the following types of access privileges for a resource:

- Shared access (more than one task can read and write)
- Read-only access (this task will only read)
- Exclusive write access (while others can read, only this task can read and write)
- Exclusive all access (only this task can read or write)

Account ID — A 16-byte character string, defined by a user, that is used by the accounting subsystem to identify the account to be charged for a work session with the computer.

Active State — The state in which a task is ready to execute.

Active Task — See Ready Task.

Address — A group of characters that specify the location of an area of memory. The operating system uses addresses to correctly access data and instructions. For example, an address can be 4 hexadecimal digits that represent a word of memory.

Address Space — The memory that can be accessed by an addressing scheme. The memory that a task can address differs from the memory that the 990 computer can physically address. This difference is resolved by the mapping hardware and the operating system.

ADR — See Alias Descriptor Record.

ADU — See Allocatable Disk Unit.

Alias — An alternate for a pathname component. The alias can be used in place of the pathname component.

Alias Descriptor Record (ADR) — A disk directory record that carries an alias name and a pointer to the structure for which it is an alias.

Allocatable Disk Unit (ADU) — The smallest disk space that can be allocated for file creation or expansion. This space varies from 1 to 12 sectors, depending on the type of disk in use.

Application Program File — A program file on which users install programs that are to be memory resident. It can also include programs that are disk resident, if the user wishes to include them.

ASR — See Automatic Send/Receive.

Automatic Send/Receive (ASR) — A line-oriented terminal device with attached cassette tape drives or paper tape drives.

Autocreate — The process performed by the operating system when a bit is set in the supervisor call block for an Assign LUNO, specifying that the operating system is to create the file to which the LUNO is being assigned if that file does not already exist.

B

Background Mode — A type of system use in which a job executes without interacting with the terminal. The user can do other processing in the foreground mode while a background activity proceeds. The initiated background task receives as its environment a snapshot of the current System Command Interpreter (SCI) environment and proceeds to run simultaneously with SCI.

Base System — The initial system image shipped to the customer. The base system is a minimum system capable of performing system generation and supporting a 911 VDT, a tape drive, a line printer, and multiple disk drives.

Batch Job (Batch Mode) — A job that runs independent of a terminal in which the System Command Interpreter is used to bid a sequence of tasks and pass environments from one task to the next. Note: in a batch job, all parameters must be supplied in "keyword = value" format.

Beet — A 32-byte block of memory starting at a memory address that is exactly divisible by 32.

Bid — To place a task in the active state (ready for execution), requesting that the system bring the task into memory (if necessary) and enter that task on the active list at the appropriate priority.

Blank Adjusted — An attribute of records in a file, denoting the padding of records with trailing blanks on input or the removal of trailing blanks on output. This attribute, when desired, is specified at the time of the I/O operation.

Blank Compressed — A characteristic of a file that indicates each occurrence of a string of consecutive blanks is replaced by a code that represents the number of blanks. Thus, consecutive blanks are not actually stored. This characteristic of a sequential file, when desired, is specified at file creation time. It is used to reduce the disk space required for a file.

Blank Suppressed — See Blank Compressed.

Blocked Disk Transfer — The movement of data through a system-supplied buffer as an intermediary between the disk and the user buffer. This employs packing of one or more logical user records into a single physical record.

Blocked File — A file in which a physical record includes more than one logical record.

Bootstrap — A technique for loading the first few instructions of a system into memory, and then using these instructions to load the rest of the system. For DNOS, this bootstrap sequence begins in a ROM loader after the initial program load sequence is keyed into the front panel of the 990 computer.

Boundary Error — An error in which a task tries to access memory outside its allowed address space. The error causes task termination.

BRB — See Buffered Request Block.

Break Key Sequence — A sequence of key strokes used to abort a task in an interactive job. The system selects the task to be terminated from the tasks of the current job according to the current environment. If only SCI is active, it is killed, the job at the terminal terminates, and the terminal is again available for use. If tasks other than SCI are active, the order in which tasks are killed is: foreground tasks, background tasks, and SCI. Unless the task is being debugged, a task with end action will take end action when killed by the Break Key Sequence. See End Action.

Breakpoint — A place in a routine at which execution halts. A breakpoint is specified to the operating system as XOP 15,15. Except when controlled by the Debugger, breakpoints do not automatically return control to the controlling task.

Buffer — Storage used to compensate for differences in the rate of data flow, time of occurrence of events, packing of data, or transmitting data from one location to another.

Buffered Request Block (BRB) — A data structure used by SVC processors that contains a copy of the user's SVC block and several words of overhead information.

Byte — A group of binary digits operated on as a unit. The 990 computer uses bytes consisting of 8 binary digits.

C

Cache Memory — A portion of memory (2K bytes) that operates much faster than primary memory (64K bytes) and in which the controller stores frequently used data from primary memory.

Call Block — See Supervisor Call Block.

CCB — See Channel Control Block.

CDR — See Channel Descriptor Record.

Central Processing Unit (CPU) — The arithmetic and logic unit of a computer.

Channel, IPC — A logical path used for interprocess communication between two tasks. One of the tasks is designated as the channel owner and can perform special operations, depending on the channel type. See Symmetric Channel and Master/Slave Channel.

Channel Control Block (CCB) — An in-memory data structure that defines a channel; it shows the current state of a channel that is in use.

Channel Descriptor Record (CDR) — A disk-resident data structure that defines the characteristics of a channel and the location of the channel owner task; used to create the channel control block and bid the owner task for the channel.

Channel Name — A pathname for a channel.

Collating Sequence — A method of specifying an order for a collection of character strings. For example, one ordering might be special characters followed by digits followed by alphabetic characters in English alphabetic order. The natural collating sequence for DNOS is determined by the system's country code.

Command — A directive to perform an action. The System Command Interpreter (SCI) is provided to interpret commands and initiate utilities as needed to perform the desired functions.

Command Mode — A processor mode in which the processor interprets input as commands rather than as data. The Text Editor and system generation utility have a command mode.

Command Procedure — A program in the SCI language that implements a command.

Command Processor — A task executed by an SCI procedure to perform a command.

Common Memory — A memory area that is to be shared by more than one routine. Also see System Common.

Communications Register Unit (CRU) — The 990 computer general-purpose, command-driven I/O mechanism. The CRU is used to control I/O to low-speed peripherals such as video display terminals, cassette drives, EIA devices, card readers, line printers, communications devices, ASR and KSR devices.

Compose Mode — A mode of operation in the Text Editor in which data is entered into the file being edited without special commands to cause entry. This is the mode enabled when creating a new file (no name was keyed for the text edit operation).

Concatenated File — A set of two or more physical files (sequential or relative record) considered as a logically contiguous set of data. A concatenated file is accessible by the logical name used when defining the concatenated file.

Concurrent Tasks — Tasks that are simultaneously active, that is, ready to execute.

Configuration File — A file describing a DNOS system created during system generation.

Context Switch — A transfer of control to a program or subroutine, activating a workspace associated with the program or subroutine as control passes to the new program counter contents. The context switch stores the program environment, that is, the workspace address, the address of the next instruction in sequence, and the program status. A Return with Workspace Pointer (RTWP) instruction restores the environment by returning the stored data to the workspace pointer register, the program counter, and the status register. Context switches transfer control to subroutines when an interrupt occurs, when an extended operation instruction is executed, or when a Branch and Load Workspace Pointer (BLWP) instruction is executed.

Controlled Mode — A mode of operation in which one task (the controlled task) yields control to another task (the controlling task), with the provision that the controlled task will eventually regain control. One example of a controlling task is the Debugger initiated by an Execute Debug command.

Copyable — An attribute of a segment specifying that an in-memory copy of the segment can be duplicated to effect replication.

Country Code — An indicator carried within system data structures to indicate the country in which this file or program is used.

CPU — See Central Processing Unit.

CPU-bound — A property that describes a program when it spends more execution time in CPU operations than I/O operations. See I/O-bound.

Crash Code — A numeric code displayed on the programmer panel indicator lights showing that the operating system has detected an uncorrectable system error and has aborted itself (crashed).

CRU — See Communications Register Unit.

Currency — A block of memory that contains information about the current record position while processing a key indexed file.

Cylinder — The bands on the recording surfaces of a multiplatter disk that are accessed when the disk heads are in one position. Each recording band is called a track and is divided into sectors.

D

Deadlock — A system state in which two or more programs are stalled contending for resources in such a way that none can continue unless others release resources they already hold. The operating system will detect the presence of deadlock in some cases, but is unable to prevent or avoid a deadlock. It is therefore the user's responsibility to organize resource requests carefully when contention is possible.

Debug — To remove flaws from a program. Debugging aids include extensive error detection capabilities and the interactive Debugger.

Default Value — A value used by the system if a field prompt for an SCI procedure is null. Also see Initial Value.

Deferred Write — A file creation attribute that causes logical records to be written to disk after they are buffered in memory. File I/O normally uses a deferred write operation to place logical records, being written to disk files, into an area of memory that corresponds to a physical record. Later, they are written to disk when the system requires the memory space occupied by the buffer that contains the physical record. For disk files, deferring disk writes can dramatically increase system throughput. It is the system default. Also see Immediate Write.

Device — Physical equipment, such as a card reader or line printer, to which the system allows input or output.

Device Name — A four-character pathname for a physical peripheral device.

Device Service Routine (DSR) — A routine within the operating system that communicates directly with an I/O device. It services interrupts and performs the desired input and output operations.

Diagnostics — Information, messages, and routines that provide assistance in detecting hardware or software errors and clarifying special conditions. See Online Diagnostics.

Directory — A relative record file that contains the information necessary to locate other files and describe the characteristics of those files. It does not contain user data.

Disk Initialization — See Initialization, Disk.

Disk-Resident Task — A task that resides on disk when it is in a terminated state. Also see Memory-Resident Attribute.

Disk Volume — A disk cartridge that has been named and initialized. A disk volume can be installed in a disk drive and be known to the system by the volume name.

Download — Performing an initial program load (IPL) for a system from a communications link attached to a remote computer rather than from a local storage device. See Initial Program Load.

Drive — A peripheral device that holds and operates a disk volume, a magnetic tape reel, a cassette, or other similar medium.

DSR — See Device Service Routine.

E

Edit Mode — A mode in the Text Editor in which a command function or key is used to enter each new line in a text file. Also see Compose Mode.

End Action — A routine specified by a task, that is to be executed before aborting the task if a fatal error occurs or if the task is killed. This routine is called the end action routine, and the task is said to have taken end action. Unless a Reset End Action instruction is performed, a task can perform end action only once.

End-of-File (EOF) — A mark or other identification that denotes the end of a sequential file of data.

End-of-Information (EOI) — A mark or other identification that denotes the point beyond which there is no information.

End-of-Medium (EOM) — A mark or other identification that denotes the end of available storage space for a file of data. Also referred to as end-of-volume.

End-of-Record (EOR) — A mark or other identification that locates the end of a logical record on a file or device.

Enqueue — To place a request on a list or queue.

Entity — A system component being described in the inquiry mode of the system generation utility. A device is an example of an entity.

EOF — See End-of-File.

EOI — See End-of-Information.

EOM — See End-of-Medium.

EOR — See End-of-Record.

Error Code — A numeric code returned when an error is detected. Depending upon the cause of the error, this code can be returned in a supervisor call block, displayed to a terminal, or displayed on the programmer panel.

Event Character — Characters generated by keys on the keyboard that take precedence over data keys and have special significance to the executing task.

Executable — An attribute of a segment specifying that the segment contains executable code. (This option is not supported on a 990/10 system.)

Executing Task — A task that has control of the CPU.

Expandable File — A file that can be extended beyond its initial size.

F

Fatal Error — An error in a task that causes the task to be terminated. Examples of fatal errors include boundary errors, memory parity errors, use of illegal instructions, and other nonrecoverable situations.

FCB — See File Control Block.

FDB — See File Directory Block.

FDR — See File Descriptor Record.

Field Prompt — A word or phrase shown to the user by an SCI command procedure in order to gather input information for the procedure.

File — A named, organized collection of data records. Disk files can be organized in a sequential, relative record, or key indexed format. Special forms of relative record files include directory files, program files, and image files.

File Attribute — A declared characteristic of a file that limits the types of operations performed on a file. For example, delete protection is an attribute, and files with this attribute cannot be deleted until the attribute is removed.

File Control Block (FCB) — A memory structure that describes the name, location, and characteristics of a disk file. The FCB is built as a result of an Assign LUNO operation to a file.

File Descriptor Record (FDR) — A disk directory record that describes the name, location, and characteristics of a disk file.

File Directory Block (FDB) — A single node of an in-memory directory tree structure used to locate file control blocks for files to which an Assign LUNO operation has been performed.

Foreground Mode — The mode in which an executing task interacts with the terminal. After SCI bids a foreground task, SCI is suspended and releases access to the terminal and the foreground terminal local file. The task that is bid shares the environment in use by SCI. When using SCI from a batch stream, the foreground mode of operation is equivalent to background mode. See Batch Stream, Background Mode.

Front Panel — See Programmer Panel.

G

Global LUNO — A logical unit number that is available to any job or task.

H

Hard Break — See Break Key Sequence.

Hashing — A technique for mathematically processing key words or file names to produce numbers, usually record numbers.

Hexadecimal (Hex) — A numeration system using a radix of 16. Hexadecimal values are indicated by a leading ">" or by the phrase "hexadecimal" or "hex" when showing the value.

I

Image File — A special form of relative record file in which the logical record size equals the physical record size which equals the disk sector size. Image files usually contain a memory image of some code.

Immediate Write — A file creation attribute that forces output to a disk file to occur immediately. Ordinarily, file I/O is buffered in memory and deferred until the memory space is required.

Initial Program Load (IPL) — The operation of pressing buttons on the 990 computer front panel (HALT, RESET, LOAD) that trigger the work of the ROM Loader in performing the bootstrap sequence when the 990 is first powered up. The term is also used to refer to the entire sequence of placing the initial program load (IPL) program in memory and loading the operating system.

Initial Value — A value shown next to a field prompt from an SCI command procedure. The user can choose to use this value as the response to the prompt or can replace it with another response. If the initial value is replaced by a null value, the system will use a default value for the field prompt, if one exists. The initial value is specified by the command procedure to be a constant value or to be the current value of some synonym. Also see Default Value.

Initialization, Disk — The process of writing the required system overhead tracks and formatting a disk prior to using the disk.

Initiate I/O — An I/O call that causes I/O to be started but does not cause the requesting task to be suspended while the I/O is in progress. This mode of I/O is specified by a flag in the SVC block.

Inquiry Mode — A mode in the system generation program in which a new system configuration is described through specific prompts.

Install — When applied to programs, to install means to load a task, procedure, segment, or overlay in a program file. When applied to volumes, install means to direct the system to refer to an initialized volume on a given drive by the supplied name.

Installed ID — A unique identification number from hexadecimal 1 to FF assigned to a task, procedure, segment, or overlay that is installed in a program file. The operating system uses this ID to locate that module in the program file.

Interactive Mode — See Foreground Mode.

Interprocess Communication (IPC) — The capability for two or more tasks to exchange information. Also see Channel.

Interrupt — A coded signal that can transfer CPU control; thus enabling the CPU to service devices, power up/down procedures, and error conditions. The 990/10 and 990/12 computers support interrupts with 16 levels of priority. The interrupt that is currently executing prevents interrupts of a lower level from interrupting the CPU.

Interrupt Service Routine — A system module that directs the system to take action according to the interrupt received. Examples include: power up or down, error instructions, and clock operations.

Intertask Communication Block — An internal data structure used by the Get Data and Put Data SVCs.

I/O-bound — A property that describes a program when it spends more execution time in I/O operations than CPU operations. See CPU-bound.

IPC — See Interprocess Communication.

IPL — See Initial Program Load.

J

JCA — See Job Communications Area.

Job — An entity within the system that exists to perform a user-defined function. In many cases, the user will see a job as an interactive or batch execution of the System Command Interpreter. In general, however, a job has the following characteristics:

- is uniquely identified with a job ID
- accesses certain resources (such as I/O devices)
- possesses authority via an accounting and security system to own and access permanent and job-local files
- consists of one or more cooperating tasks that can execute concurrently or serially

Job Communications Area (JCA) — A section of memory used by the system for information concerning a particular job. Each job has a unique JCA.

Job ID — A 16-bit integer that uniquely identifies a job within a given site.

Job-Local LUNO — A logical unit number that is restricted to use within a particular job, but not to any particular task in that job.

Job Name — An 8-character name associated with a job. A job name is not necessarily unique within the system and is supported only for user convenience.

Job Status Block (JSB) — A memory structure in the system table area that contains information describing the state of a job.

Job-Temporary File — A temporary file which, after creation, exists for the life of the creator's job. A job-temporary file is accessible by a logical name or by the pathname if it is known.

JSB — See Job Status Block.

K

K — An abbreviation for 1024, often used when referring to a number of bytes of memory.

Kernel — The memory-resident portion of DNOS, which includes the device service routines, interrupt processors, extended operation processors, system tables, device buffers, the task scheduler, nucleus support functions, many supervisor call processors, and memory-resident tasks.

Kernel Program File — A program file containing the loadable memory image of the operating system.

Key — A character field within a record in a key indexed file, used to determine the order of the record in relation to other records in the file.

Keyboard Send/Receive (KSR) — A line-oriented terminal device, such as a teletypewriter.

Keyboard Status Block (KSB) — A block of memory used as a workspace by an interrupt service routine for a keyboard device.

Key Indexed File (KIF) — A file in which records can be accessed by the value of a character string called a key. Each record can have up to 14 unique keys, with access through each key independent of the other keys.

Key Value — A particular character string being used in a key field.

KIF — See Key Indexed File.

KSB — See Keyboard Status Block.

KSR — See Keyboard Send/Receive.

L

LDT — See Logical Device Table.

Least Recently Used Strategy — A strategy used by the operating system to choose task segments to be swapped out of memory. The segment that has been inactive the longest is considered the least likely candidate for immediate future use and is thus the first chosen for swapping to disk.

Link Control File — A file created by the user that contains instructions for the Link Editor.

Link Editor — A system utility that takes related object modules and links them together into a single load module.

Linked Object File — A file created by the Link Editor that contains one or more program object modules that have been linked together to produce linked object modules.

Load — To copy a task or segment from an external storage medium into the memory of the computer in preparation for execution.

Logical Address Space — The memory accessible to a task. The maximum extent of any logical address space is 32K words.

Logical Device Table (LDT) — A memory structure in the system that contains the LUNO and pointers to system tables that correspond to the resource to which the LUNO is assigned.

Logical Name — An alphanumeric name of up to eight characters that can be assigned to an I/O resource. The resource can be a file or device that is to be accessed by programs using the logical name, or it can be a set of concatenated files, or it can be a spooler device.

Logical Records — A logical division of data in a file that can be transferred with a single I/O supervisor call.

Logical Record Length — The length (in bytes) of records in a file. This length does not necessarily correspond to any physical division of the medium.

Logical Resource Name — See Logical Name.

Logical Unit Number (LUNO) — A number specified in an I/O operation that represents a file, channel, or device.

Log-off — The action that ends a work session. Using the supplied System Command Interpreter, log-off is accomplished by typing a Q when the command prompt is shown. (Q calls the QUIT procedure.)

Log-on — The action that begins a work session. It identifies a user to the system and allows the user access to it. Using the System Command Interpreter, log-on is accomplished by pressing a keyboard sequence such as Reset (Blank Orange key of a 911 terminal) followed by an exclamation point.

LUNO — See Logical Unit Number.

M

M — An abbreviation for 1,048,576, when referring to bytes of memory.

Machine Operator — See System Operator.

Master/Slave Channel — A type of channel in which the owner of the channel (the master) interprets and/or executes messages and/or commands transmitted by requestors (slaves) of the channel.

Memory-Based Segment — A segment not associated with a file. It is created and assigned attributes at run time.

Memory Mapping — A hardware feature of the 990 computer controlled by the operating system software, which allows the 990 to address 2048K bytes of memory, even though the standard address format of 16 bits could only address at most 64K bytes. Memory mapping is not available on some models of the 990.

Memory-Resident Attribute — The characteristic of a task or segment that indicates it is loaded at the time of the initial program load sequence and remains in memory even when it is in a terminated state. The term can also refer to an attribute of a segment that specifies the segment permanently resides in memory after it has been created.

Modem — (Modulator-Demodulator) A device that interfaces between the digital signals of a computer and the analog signals of data transmission facilities.

Module — A set of computer program instructions treated as a unit by an assembler, compiler, link editor, or other similar processor.

Multifile Set — A set of two or more physical files (key indexed files) considered as a logically contiguous set of data. The set of files composing a multifile set must be accessed only by the logical name assigned to the set.

Multiprogramming — A mode of operation in which more than one computer program can be in memory and queued for execution. This differs from multiprocessing, in which two or more programs can execute simultaneously.

Multitasking — Another term for multiprogramming. Several tasks can be in memory simultaneously, each allotted execution time in turn.

Multivolume File — A logical file that spans volumes. A multivolume file is accessible only by a logical name.

Multivolume Set — A set of tape reels that has specific ordering and is thought of as comprising a single large volume.

N

Name Correspondence Table — A name management structure which contains the synonyms and field prompt values currently defined for a job.

Nonblank Suppressed — The file characteristic that indicates consecutive blanks in a record are stored as consecutive blanks rather than being stored in a compressed format.

Nonexpandable File — A file that cannot be extended beyond its initial size.

O

Object Code — Machine language code together with load control code. This can appear in any of several formats.

Object File — A file that contains one or more program object modules, usually created by an assembler or compiler.

Online Diagnostics — Nonprivileged diagnostic routines that operate concurrently with program execution. See Diagnostics.

Operator — See System Operator.

Overlay — A part of a task that resides on disk until explicitly requested. When requested, the overlay replaces part of the task previously in memory. The use of overlays can reduce the amount of memory required by a task to the amount required for the largest segment needed at one time.

P

Password — A character string supplied by a user for validation of access and security privileges, primarily for log-on.

Pathname — A character string that indicates a path to a resource such as a file, channel, or device. For a file or channel, the pathname components include an optional volume name, 0 to 24 directory names, and a final component identifying the file or channel.

PC — See Program Counter.

PDT — See Physical Device Table.

Peripheral Device — Any equipment in a computer system that is separate from the CPU and can provide information, communication, and capabilities to the system. Examples include: disk units, VDT terminals, printers, and communication equipment.

Permanent Name Definition Table — A disk data structure which contains the synonyms and logical names currently defined for this user ID.

Physical Address Space — The addressable memory of the computer. This term also refers to the range of memory addresses available to the computer although the memory may not actually be implemented in a particular configuration.

Physical Device Table (PDT) — A data structure associated with a device and used by device service routines.

Physical Record Length — The number of bytes of data transferred as a unit to and from a disk or tape. Often, a physical record includes several logical records.

Preanswered Parameter — A parameter for the system generation program that can be explicitly changed by the user, however, no prompt is provided.

Preemptive Scheduling — The task scheduling algorithm that causes the highest priority active (ready) task to be executed even if a currently executing task must be preempted from its time slice.

Priority, Initial — The priority given to a task when it is initially loaded. Initial priorities are in the range of 0 through 255 (with 0 highest and 255 lowest). The initial priority is based on the installed priority of the task and the priority of the job under which it is executing. Priority 0 is for tasks installed at system priority, priorities 1 through 127 are for real-time tasks, and priorities 128 through 255 are for time-sharing tasks.

Priority, installed — The priority given to a task at installation time. For time-sharing tasks it can be one of the 5 priorities (0,1,2,3,4). Priority 0 indicates system priority. Priorities 1, 2, and 3 are for all other fixed priority time-sharing tasks with 1 being highest and 3 lowest. Priority 4 indicates a floating or dynamic time-sharing priority. Real-time tasks can be installed at any one of 127 priorities (1 through 127).

Priority, Run-Time — The priority used to schedule the CPU. Initially, it is the same as the initial priority but can vary (for tasks with dynamic priority) from the initial priority depending on whether the task is I/O-bound or CPU-bound. I/O-bound tasks have run-time priorities higher than their initial priorities and CPU-bound tasks have run-time priorities lower than their initial priorities.

Privileged — Attributes of tasks installed on a program file. "Hardware privilege" allows the task to execute privileged machine instructions. "Software privilege" allows the task to execute SVC operations that are designated as privileged SVCs.

Procedure Segment — A segment of a task that can be shared with any other tasks; usually consists of executable code.

Procedure Library — A directory of files containing SCI command procedure definitions.

Program — The instructions and data to perform a particular function; A program consists of one or more segments that define a logical address space for a set of instructions and data. Also see Task.

Program Counter (PC) — A hardware register that indicates to the computer the next instruction to be executed.

Program File — A special form of relative record file used to contain executable programs and segments in memory image form. A program file contains system generated information that enables more than one program to be stored in the file.

Programmer Panel — A peripheral device mounted on the front of the 990 computer providing an elementary interface to the computer.

Q

Queue — A first-in, first-out waiting list. A queue is a data structure consisting of a list of objects to be processed, where the order of the list is chronological. The first object entered on the list (first-in) is the first object removed for processing (first-out).

R

Random File — A relative record file.

Ready Task — A task that is ready to execute, that is, queued in memory for a given priority level awaiting its turn for execution.

Record Locking — A procedure used to restrict access to a record in a file. A locked record cannot be accessed until it is unlocked. This process is useful when controlling file access by several contending tasks.

Record Lock Table — An internal data structure, associated with a file, that identifies all records of the file that are currently "locked."

Reentrant Program — A program that can be shared among several users in a multitasking environment without conflict of data among the users.

Register — See Workspace Register.

Relative Record File — A directly addressable file in which the records are numbered from the beginning of the file. The length of records in the file is a fixed number specified during file creation. Any record can be easily accessed after calculating the record's displacement from the beginning of the file. The calculation is based only on the record number and the fixed record length attribute of the file.

Relocatable — An attribute of an overlay that allows that overlay to be loaded at an address other than its natural load address. Addresses within the overlay are resolved at load time.

Replicatable Segment — A segment that can have multiple copies in memory simultaneously.

Replicatable Task — An installation attribute for a task, indicating that multiple copies of the task can be simultaneously in memory. This frequently occurs for utility tasks such as the compilers and the System Command Interpreter.

Replication — The action of making available another copy of a task or segment in memory.

Reserved Segment — A segment that will not be discarded by the system even when no task has the segment mapped into its logical address space. Segments can be reserved at the job level, thus ensuring the ability to access the segment when desired. Reserved segments are subject to swapping.

Reserved Segment Table (RST) — A data structure used to contain a list of segments that have been reserved by a job.

Resource — A logical or physical commodity such as a peripheral device, file, or memory, that can be allocated to a program. An I/O resource is any such commodity other than computer memory.

Resource Contention — The situation in which two or more tasks attempt to use the same resource at the same time.

Resource Independent — A type of I/O operation that allows a programmer to specify any of several devices or resources. For those devices, I/O operations occur in essentially the same manner and are specified by assigning a LUNO that represents the resource. Data is accessed sequentially and is supported for such devices as VDT terminals, printers, sequential files, and communication channels. See Resource Specific.

Resource Ownership Block (ROB) — An in-memory data structure that represents a job's ownership of a resource.

Resource Privilege Block (RPB) — An in-memory data structure that is used to control access privilege requests (OPEN SVCs) from tasks within a job and to carry file position information for file access requests from tasks within the job.

Resource Specific — A type of I/O operation that allows the specific capabilities of a device to be programmed. I/O occurs through a LUNO that is assigned to the correct resource. Resource operations are supported for VDT terminals, relative record files, key indexed files, and communication channels. See Resource Independent.

Reusable — An attribute of a segment that specifies the segment can be used consecutively without reloading.

RLT — See Record Lock Table.

ROB — See Resource Ownership Block.

Rolling — See Swapping.

ROM Loader — A program in Read-Only-Memory (ROM) on the system interface board at a dedicated memory address that is triggered by the IPL sequence to initiate loading of the operating system into memory.

RPB — See Resource Privilege Block.

RST — See Reserved Segment Table.

Run-Time ID — An identification number unique within a job, assigned by the operating system to an executing task for the duration of its execution. Also, an identification number assigned by the operating system to a segment for the duration of its existence in memory.

S

SAT — See Secondary Allocation Table.

Scheduler — The part of the operating system that decides which task is to receive execution time.

SCI — See System Command Interpreter.

Scrolling — Moving the contents of the screen of a video display terminal up or down in order to view a file that contains more data than the screen can display. This is accomplished by using the Up Arrow key, Down Arrow key, or some other special key.

Secondary Allocation — A block of disk space automatically allocated by the system to an expandable file that requires more space than its present allocation. The size of the secondary allocation is specified when the file is created, but increases with each subsequent secondary allocation.

Secondary Allocation Table (SAT) — A structure that exists in the file descriptor record of each expandable file. It contains the size (in allocatable disk units) of the secondary allocation and the starting address of the allocation.

Segment — A piece of software occupying a single block of memory, or an in-memory image on disk. Each segment has a set of attributes that describe its characteristics.

Segment Group — A set of related segments, such as those from the same program file or those in a memory-based set of segments.

Segment Group Block (SGB) — An internal data structure that defines the access to a specific set of segments.

Segment Group LUNO — A logical unit number assigned to a file associated with a segment group.

Segment Status Block (SSB) — An internal data structure that describes the attributes, state, and location of a segment.

Segmentation — The process of separating a task into segments. A task can be composed of as many as three segments. During execution only three segments can be addressed at any given time. However, additional segments can be accessed by making supervisor calls to select a new segment to replace one that is currently addressable. If desired, segments can be shared by tasks.

Semaphore — A job-local variable used for exchanging signal information between tasks and for program synchronization. A set of SVCs is provided for handling semaphores.

Sequential File — A file of variable length records accessed in successive order (that is, the order in which the records are written to the file).

SGB — See Segment Group Block.

Shareable — An attribute of a segment that specifies the segment can be shared concurrently by more than one task.

Site — A particular collection of computing resources identified by a name of 1 to 8 characters.

Source File — A file containing one or more program source modules (source code or statements) that is usually created using the Text Editor.

Special Table Area — A section of memory used by system functions to contain data structures specific to the function (for example, file management table area).

Spooling — The process of queueing files of data for printing. The files are scheduled for printing according to the priority assigned the job issuing the print request. Files can be printed on special forms or in special formats as specified by the user.

Spooler Task — A task responsible for spooling a job's output data to job local files and enqueuing the files to be printed by the Spooler Job.

SSB — See Segment Status Block.

ST — See Status Register.

STA — See System Table Area.

Stage — The environment established to bid a task by using the System Command Interpreter. Specifically, the synonyms and logical names available to the task that is bid.

Station — An interactive terminal; for example, a video display terminal or a hard-copy device such as the 733 ASR terminal.

Status Register (ST) — A hardware register on the 990 computer that holds condition codes set by preceding operations, fault flags, mode control information, and the interrupt mask.

Subdirectory — a directory that is pointed to by another directory. Every directory on a disk except VCATALOG is a subdirectory. If directory A contains the name B and a pointer to directory B then B is said to be a subdirectory of A.

Supervisor Call (SVC) — A user task request for operating system services. A supervisor call is an XOP 15 instruction that performs a context switch into the operating system which then interprets the call and performs the desired service (if legal).

Supervisor Call Block — A list of necessary parameter values for a supervisor call. The size and content of the supervisor call block depend on the particular call being made.

Suspended Task — A task that was temporarily removed from the active list and from execution as a result of a supervisor call. When reactivated, suspended tasks are executed from the point of suspension.

SVC — See Supervisor Call.

Swap Directory Table — an in-memory data structure that represents each segment on the swap file.

Swap File — a file on the system disk in which segments that are not updateable are kept when they are reserved or in use but not in memory.

Swapping — The action of copying a segment from memory to a special system file (the swap file) on the system disk so that the memory it was occupying can be allocated to a segment of a higher priority task, or the action of copying a segment from the swap file into memory when the segment is needed again.

Symmetric Channel — A type of channel in which the channel owner task and requestor tasks issue simple Read and Write commands that must match each other. The Read command of one task is processed as soon as the other task issues a Write command and vice versa.

Synonym — A text string that functions as an alternative for another string. Usually a synonym is shorter than the text it replaces and is more convenient to use.

Sysgen — See System Generation.

System — An attribute of a segment that specifies the segment can be used only by a system task.

System Command Interpreter (SCI) — The user interface to the operating system. It prompts the user, accepts inputs, interprets them as commands, and directs activities to satisfy those commands.

System Command Interpreter Language — The language in which command procedures for the System Command Interpreter are written.

System Common — An area of memory accessible to all tasks through the Get Common Data Address supervisor call. The system common memory area is a system parameter supplied during system generation. It is accessed as one of the memory segments of each task that uses it.

System File — A disk file reserved for use by the operating system. The name of a system file begins with S$.

System Generation — An interactive process in which a new version of the operating system is configured to match a particular hardware installation. A set of static data structures is created that represents the configuration. Also, certain parameters supplied during system generation allow the fine tuning of system performance. Also see Command Mode, Inquiry Mode.

System Job — The job within which operating system tasks are executed.

System Log Reporting — The part of the system that reports hardware and task errors to a file and an optionally specified logging device. Any task can also write a message to the system log using the System Log SVC.

System Operator — The person who controls system start and restart, places information media into the input devices, removes the output, and performs other related functions.

System Program File — A program file containing tasks that are part of the DNOS package (including utilities). They are not necessarily system tasks.

System Table Area — Memory reserved for the operating system and used for system data structures and buffers. The size of the system table area is specified during system generation.

System Task — A task that executes in system memory space.

System Time Unit — A standard operating system measurement of 50 milliseconds.

T

Tape File — A set of records bounded by tape marks on magnetic tape. No End-of-File can appear embedded in a tape file.

Tape Volume — A magnetic tape reel that has been initialized.

Task — A program that executes under control of the operating system. At least one task exists for each job. A task consists of an address space, a program counter, a workspace pointer, and a status register. The address space of the task can consist of one or more segments. Segments can be dynamically exchanged with other segments during task execution, with a limit of three segments comprising the address space at any one time. Also see Procedure Segment, Task Segment.

Task-Local LUNO — A logical unit number that can be used only by the task that assigns it.

Task Parameters — A set of information (4 bytes) contained in a Bid Task SVC that is placed in the task status block and can be accessed through a Get Parameters SVC.

Task Segment — That part of a program that contains the initial portion of the program (transfer vector, optional data, and optional program code). Also see Program, Task, Procedure Segment.

Task State — The current disposition of a task. For example, a task can be in execution (executing state), suspended for any of a number of reasons (with separate states to describe these), or in any of several other states.

Task Status Block (TSB) — An internal data structure representing a task in the system that contains necessary information to describe the state of the task.

Template — A picture that includes descriptions of various fields of a DNOS data structure, their locations, meanings of flags, and comments.

Temporary File — A file that DNOS deletes automatically after all LUNOs assigned to the file are released. See Job-Temporary File.

Terminal — Any interactive user device. Also see Station.

Terminal Local File (TLF) — A file associated with a background task or a foreground task when using the System Command Interpreter in an interactive job. The file is used for communicating information from a command processor to the user.

Terminated Task — A task that has been removed from execution and from the active list. Termination occurs when the task completes normally, when the system detects a fatal error on the part of the task, or when a user directs the operating system to kill the task. When reactivated from the terminated state, a task is executed from its beginning.

Thrashing — The state of the system in which the overhead required to resolve resource contention occupies most of the system's time.

TILINE — The 990 computer asynchronous 50 megabit per second memory bus, used by the CPU, memory, disk and tape controllers. (TILINE is a trademark of Texas Instruments Incorporated.)

TILINE Peripheral Control Space — A range of TILINE addresses reserved for TILINE device controller interfacing.

Time-Out — Expiration of the time period during which a device must respond to remain an active device.

Time Slice — The amount of execution time allocated to a task when it is scheduled for execution. A preanswered parameter of the system generation utility is used to specify the length of a time slice.

Time Unit — See System Time Unit.

TLF — See Terminal Local File.

Transfer Vector — A pair of memory addresses in two consecutive words of memory. The first word contains the address of a 16 word area of memory, called a workspace. The second word contains the address of a subroutine entry point. Also see Context Switch.

TSB — See Task Status Block.

TTY — A line-oriented terminal, such as a teletypewriter.

TTY Mode — Line-oriented I/O access to a terminal. A VDT can be accessed in either TTY or VDT mode by the System Command Interpreter.

U

Unblocked File — A file in which each physical record contains one logical record. During data transfer to or from such a file, no internal buffering is required.

Unload — Refers to both the software action of preparing a disk cartridge or tape reel for removal and the act of physically removing the cartridge or reel.

Updateable — An attribute of a segment that specifies the segment can be written to its permanent file position.

User — Any person who uses a DNOS-based system.

User ID — An 8-character string that identifies a user.

V

VCATALOG — The highest level directory on each disk volume that specifies, either directly or indirectly, all files on the volume.

VDT — A video display terminal.

VDT Mode — A screen-oriented mode, with the ability to read and write fields at any position on the screen. Video display terminals can be used as hard-copy emulators (TTY mode) or can be used in the VDT mode to utilize their full power and intrinsic speed.

Volume — A logical device, such as a disk pack or magnetic tape reel, that can be uniquely identified by name, and that can store one or more logical files.

Volume Information — Data stored in track 0, sector 0 of every initialized disk volume, describing system information and the address of VCATALOG.

Volume Name — A character string that identifies a volume. It is used when installing and unloading the volume and can be used as part of the pathname for files contained within it. Disk volume names can have up to eight alphanumeric characters, but must begin with a letter.

W

WCS — See Writable Control Store.

Word — A group of binary digits that can be operated on as a single unit. The 990 has 16 binary digits in a word.

Workspace — A 16-word area of memory addressed as workspace registers 0 through 15. The active workspace is defined by the contents of the workspace pointer.

Workspace Pointer (WP) — The hardware register that contains the address of workspace register 0, and indicates the currently active workspace.

Workspace Register — A memory word that is accessible to an instruction of the computer as a general purpose register. It can be used as an accumulator, a data register, an index register, or an address register.

WP — See Workspace Pointer.

Writable — An attribute of a segment that specifies the segment can be modified when in memory. (This attribute is not available on the 990/10 system.)

Writable Control Store — A portion of computer memory that is separate from general computer memory. WCS can contain supplied microcode instructions that perform the operations of assembly language instructions.

X

XOP — A 990 assembly language instruction (extended operation) that generates a software interrupt.

Symbols

> — A symbol used to indicate that the digits that follow are base 16 (hexadecimal) digits. For example, >11 is the equivalent of a decimal 17.

— A symbol used in Pascal to indicate the digits which follow are base 16 (hexadecimal) digits.

Alphabetical Index

Introduction

HOW TO USE INDEX

The index, table of contents, list of illustrations, and list of tables are used in conjunction to obtain the location of the desired subject. Once the subject or topic has been located in the index, use the appropriate paragraph number, figure number, or table number to obtain the corresponding page number from the table of contents, list of illustrations, or list of tables.

INDEX ENTRIES

The following index lists key words and concepts from the subject material of the manual together with the area(s) in the manual that supply major coverage of the listed concept. The numbers along the right side of the listing reference the following manual areas:

- Sections — Reference to Sections of the manual appear as "Sections x" with the symbol x representing any numeric quantity.
- Appendixes — Reference to Appendixes of the manual appear as "Appendix y" with the symbol y representing any capital letter.
- Paragraphs — Reference to paragraphs of the manual appear as a series of alphanumeric or numeric characters punctuated with decimal points. Only the first character of the string may be a letter; all subsequent characters are numbers. The first character refers to the section or appendix of the manual in which the paragraph may be found.
- Tables — References to tables in the manual are represented by the capital letter T followed immediately by another alphanumeric character (representing the section or appendix of the manual containing the table). The second character is followed by a dash (-) and a number.

  Tx-yy

- Figures — References to figures in the manual are represented by the capital letter F followed immediately by another alphanumeric character (representing the section or appendix of the manual containing the figure). The second character is followed by a dash (-) and a number.

  Fx-yy

- Other entries in the Index — References to other entries in the index preceded by the word "See" followed by the referenced entry.

USER'S RESPONSE SHEET

Manual Title: DNOS Concepts and Facilities (2270501-9701) ____________________

____

Manual Date: 1 October 1982 ____________ **Date of This Letter:** ____________

User's Name: ____________________ **Telephone:** ____________

Company: ____________________ **Office/Department:** ____________

Street Address: ____

City/State/Zip Code: ____

Please list any discrepancy found in this manual by page, paragraph, figure, or table number in the following space. If there are any other suggestions that you wish to make, feel free to include them. Thank you.

Location in Manual	Comment/Suggestion
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CUT ALONG LINE

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