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**A New
Concept
in COBOL with
DECsystem - 10
from Digital
Equipment
Corporation**

A better way

The COBOL story has been told many times. The simple, English-like statements, ease of programming and data processing capabilities of the language are well-recognized throughout the computer industry.

Why, then, are we taking the time to tell you about DECsystem-10 COBOL? The answer will be found in the next few pages, and it is really quite simple.

We, at Digital feel we have a better story to tell!

DECsystem-10 COBOL

The DECsystem-10 family facilitates total data management capabilities through the implementation of full ANSI specifications (USA Standard COBOL X3.23 — 1968). The -10 COBOL compiler is made up of eight modular subsets, written in MACRO-10 assembly language, (modularity allows for extensions and modifications should they become desirable at a later date). It is full Level 4 including the following modules:

- Sequential access
- Random access
- Library
- Sort
- Segmentation
- Table handling
- Report Writer

An Indexed Sequential Access Mode is also supported for compatibility with other industry compilers.

DECsystem-10 COBOL has one big advantage over other industry compilers, however; the capabilities provided by the DECsystem-10 monitor.

- Batch and interactive timesharing modes
- On-line editing and debugging
- Ease of Conversion
- Wide choice of peripherals

BATCH OR TIMESHARING?

The COBOL programmer has a choice of either developing his applications in a timesharing mode or in a multiprogram batch mode. Under timesharing, a program can be written at a remote terminal, edited and debugged while the user is on-line, and run immediately. Turn-around time is greatly reduced because the programmer receives instantaneous results.

In contrast to the timesharing mode, the batch system performs all of the normal tasks required of the timesharing users

(i.e. logging in and out), with one additional advantage — it processes the jobs faster because there is no interactive dialogue.

Programs requiring large amounts of data or those that are lengthy can be entered into the batch system through a terminal, and the programmer can specify the processing that he requires, the necessary constraints (priorities, time limits, etc.) and the particular devices that are necessary to process the programs.

DECsystem-10 RESOURCES

The power of DECsystem-10 COBOL extends beyond that of the language itself by calling upon other resources of the DECsystem-10 monitor. A comprehensive set of utilities provides assistance throughout the implementation and execution of any COBOL programs.

These utilities, together with the monitor, handle the majority of functions normally associated with file structuring and management. This enables the programmer to proceed through the normal development, test, and implementation of his applications with minimal consideration for physical location of the records stored. For further aid in program development, DECsystem-10 COBOL prints out diagnostic messages on users' terminals at the points where errors are detected.

The powerful input/output structure of the DECsystem-10 processor assures maximum throughput of COBOL programs. Data channels service high speed disks, drums, and magnetic tape transports with direct access to core memory. High speed line printers and punched card equipment are standard options. In addition, the multi-programming features allow complete overlap of input/output operations and processing, thereby providing efficient utilization of the entire computing system.

Inter-device Transfer Program (PIP) — The Peripheral Interchange Program can be used to transfer COBOL data and program source files between any of the standard storage devices, eliminating the need for a series of device oriented utilities or a satellite computer. PIP can also perform merging, sequencing and minor editing functions.

SHAREABLE COMPILER AND OBJECT CODES

The DECsystem-10 COBOL compiler, like most of the system software, is divided into high and low segments so that most of its code can be shared by many users. The high segment of the compiler is reentrant; that is, it contains code that all COBOL users share. The low segment, containing tables, data names, procedure names etc., is unique to each user. The reentrant capability means that only one copy of the compiler must be resident in core at any one time to serve all the users, thus saving core space. The user can write his COBOL programs so that they are also shareable. This feature is advantageous if a great many people need to use the same program simultaneously.

Compilation speeds of the compiler vary from 2000 to 6000 statements per minute — most programs take only a few seconds. Object programs are also reentrant and can be shared. Key features include:

- statement level optimization
- dynamic expansion of user core area
- input/output device specification at run time

- call FORTRAN IV and assembly language (MACRO-10) subroutines
- CREF Cross Reference Listing produces a listing of every occurrence of a reference to each user-defined item, sorted by item name.

ON-LINE EDITING AND DEBUGGING

To aid the programmer in developing error-free programs, DECsystem-10 COBOL provides two editors.

TECO is a highly sophisticated and powerful text editor. It is character oriented, and thus enables one or more characters in a line to be edited (located, added, deleted, or replaced) without the user having to retype the line. Sequence file numbers are not required by TECO, nor are they created. TECO enables the programmer to simplify his editing task when complicated corrections must be performed such as changing or deleting a word that occurs repeatedly in a program.

EDITS is the newest of the DECsystem-10 COBOL editors. It is a simpler editor than TECO but just as powerful. It is page and line oriented rather than character. EDITS modifies within a line as well as completes lines. It can perform string searches or substitutions, and even though it is page oriented, the user can back up to lower line numbers of his file. Blocks of data can be transferred from one part of the file to another and lines or pages can be copied from another file. EDITS saves the current state of the editing operation with one command and makes minimal usage of central processor computation time.

During the debugging stage of a program, the user may call on COBDDT, an on-line debugging package that will enable him to follow the progress of his program:

1. By selectively displaying a paragraph name,
2. By causing the program to pause at any desired step during execution, and
3. By allowing him to examine and modify the data at will before continuing execution.

COBDDT provides the user with the following capabilities:

- Change the contents of a data-name
- Set up to 20 breakpoints in a program
- Continue from a breakpoint
- Display the contents of a data-name
- TRACE paragraphs and sections (Paragraphs and sections are traced as they are executed. Whenever a paragraph or section is entered, its name, enclosed in angle brackets is typed on the user's terminal).

EASE OF CONVERSION

The conversion time necessary to take COBOL programs from another computer and put them on the DECsystem-10 is minimal. Because the compiler is ANSI-standard, the features designed to work on a specific computer have been kept to a minimum, allowing the programs to be compiled on any computer having an ANSI compiler.

For those programs written in older versions of COBOL, source program conversion aids are provided, (written in COBOL) which scan and modify the source statements and flag any non-standard statements.

MODULE SUBSETS

Operating System

The COBOL operating system performs functions such as input/output and data conversion that are accomplished more readily outside the main object code. This collection of operating subroutines is loaded into the system together with the object code generated by the compiler.

Source Library Maintenance System

This system lists file entries or adds, replaces, and/or deletes source language data on a file. It can also add, replace or extract an entire file from the library.

Sort/Merge Package

The SORT/MERGE package permits a user to rearrange records or data according to a set of user-specified keys. The keys may be ascending or descending, alpha or numeric, and any size or location within a record. Multi-reel file devices may be specified. Input, output and merge devices may be any combination of up to six magnetic tape or disk devices.

Sorting progresses at a rate of 1000 to 5000 records per minute, using disk packs as scratch devices. Any other retrieval device may be used including magnetic tape, DECtape, or drums.

The SORT/MERGE package utilized by the internal SORT verb reference is the same one used by the stand-alone SORT program. When used as a utility, a single line usually suffices to specify all necessary parameters for a given sort.

MAP

At the request of the user, the COBOL compiler will produce a map of the user's files, data and procedure items, listing the key parameters of each item. These parameters include the source line

number at which the item is defined and the address of the item in the object program. In addition, the access mode, recording mode and labeling conventions are listed for each file, and the size and the usage is listed for each data item.

Report Writer

The report-writer program is the COBOL source program produced by the Report Generator from the specification file.

This program is compiled and then executed with the user's data to produce the report. The input to the report writer program is a data file that is assumed to be sorted. The output from the report writer program is the user defined report which, while normally output to the line printer, can be placed on any device.

INDEXED SEQUENTIAL ACCESS MODE (ISAM)

ISAM enables a minimum amount of programming while providing a large data file handling capacity. It is supported by the COBOL Object Time System which automatically handles all of the searching and movement of data.

Indexed sequential files are data files in which records are accessed through a hierarchy of indexes according to a key within each data record. This file type is commonly used for applications in which the programmer wishes to access records without regard to their locations in the file. The records are read, written, rewritten and deleted according to the key in each record.

For example:

- Payroll (key is employee number)
- Inventory Control (key is part number)
- Production Control (key is job or
batch number)

The indexed sequential file consists of two files. One is the data file where the actual data is contained, the other is the index file where the pointers to record keys within the data file are contained. The location of the record key within each record is specified by the user when he builds an indexed sequential file using the ISAM program.

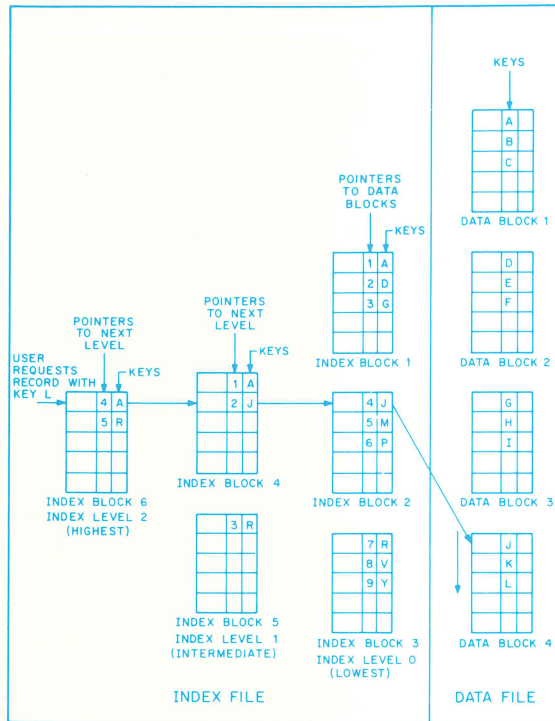
In order to build such a file, the user provides a sequential file and some necessary information to the ISAM program. The program then copies the data from the file and creates an index file to reference the data file.

All reading and writing of the index file (10 levels of indexing) is performed by the run-time operating system (LIBOL) — this does not involve the user. When using the indexed sequential files, the programmer need only specify which record is to be read, written, rewritten or deleted.

The operating system performs all searching, inserting, deleting, and updating of both the index and data files which reside on disk or drum.

Whenever records are added to the file, the index is automatically updated; additions to the file will not degenerate the file as with other computers. The common technique of "chaining" added records has been avoided. Whenever records have been deleted from the file, the empty space is used again for later additions. The net effect of the addition and deletion techniques significantly increases the time between major "overhauls" of the data files, because the time required to access a file is independent of the number of changes made to it.

(A special ISAM Program provides for automatic maintenance of sequential files).



Locating a Record in an Indexed Sequential File

WIDE CHOICE OF PERIPHERALS

The DEC-10 user has a wide choice of peripheral devices at his service whether he is operating in timesharing or in batch modes. Programs and data can be entered from interactive terminals, DECtape, paper-tape readers, card readers, magnetic tape, or disks. Also, programs and data can be entered from a remote station through any input device at that station. Program listings and program output can be printed on local or remote printers and on the user's interactive terminal. They can be stored on paper tape, DECtape, disk, and magnetic tape either at a remote station or the central station. The operating system allows the programmer to reference a device with a user-assigned

logical name as well as its physical name, thus allowing dynamic assignment of peripheral devices at run-time.

A SUMMARY OF DECsystem-10 COBOL FEATURES

- Batch Processing and Interactive Time Sharing Modes
- On-line program development, editing, debugging and tracing
- Re-entrant compiler and Object Code
- Standard monitor command language
- Ease of conversion of existing COBOL programs
- Source Library Maintenance System
- Sort/Merge Package
- Large program capacity
- Dynamic Core Expansion (1,920 million characters)
- Report Writer in compiler
- Program Generator Software
- FORTRAN IV or MACRO-10 subroutines callable
- High Level Statement Optimization
- Source Program Listing with CREF (Cross reference)
- Map and/or Object Program Listing
- Indexed File Service
- Automatic File Handling Procedures
- File Storage Transfer
- Rerun statements and programs
- Table searching

If you would like further information on how DECsystem-10 COBOL can implement your data management applications, contact your nearest Digital Equipment Sales Office. (Locations are listed on the back.)

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