DEC Datasystem 310

MANAGEMENT SUMMARY

Digital Equipment Corporation (DEC) announced its Datasystem 310 on January 15, 1975, along with two other packaged systems also based on the DEC PDP-8/A microcomputer; the CLASSIC (CLASSroom Interactive Computer) for education and the CMS/1 (Computational Minicomputer System) for engineering and scientific problem-solving. The Datasystem 310 is unique among the three packaged systems for its use of a COBOL-like language called DIBOL. Applications programs are completely compatible with those written in DEC Datasystem 340 DIBOL. DIBOL, the Datasystem 310's exclusive programming language, is treated separately in this report.

Single systems for end users will range in price from $12,000 to $30,000, when purchased from DEC. These systems are installed and supported by DEC field service. The company also makes the units available to volume purchasers at quantity-discount prices. Even more substantial discounts are available to OEM buyers, and some 32 of these were committed as of the announcement date to make tailored and/or turnkey business applications systems available to customers at negotiated prices. Initial DEC deliveries are projected for May 1975.

DEC bills the Datasystem 310 as "the lowest-cost fully programmable disk-based business computer system currently on the market." Since the system was announced only eight days later than IBM's System/32, it is fitting, and hopefully constructive as well, to compare the minimum Datasystem 310 and System/32 configurations and their prices.

DEC's Datasystem 310, based on the DEC PDP-8/A microcomputer, lowers the entry price for a fully programmable, diskette-based small business computer system to $12,000 (for end users, in single quantities). Customized and turnkey Datasystem 310's are available from more than 32 OEM suppliers.

CHARACTERISTICS

MANUFACTURER: Digital Equipment Corporation, Business Products Group, 146 Main Street, Maynard, Massachusetts 01754. Telephone (617) 897-5111.

VENDORS: Manufacturer and OEM suppliers. Contact DEC's Business Products Group to find the OEM supplier in your locale.

MODEL: DEC Datasystem 310.

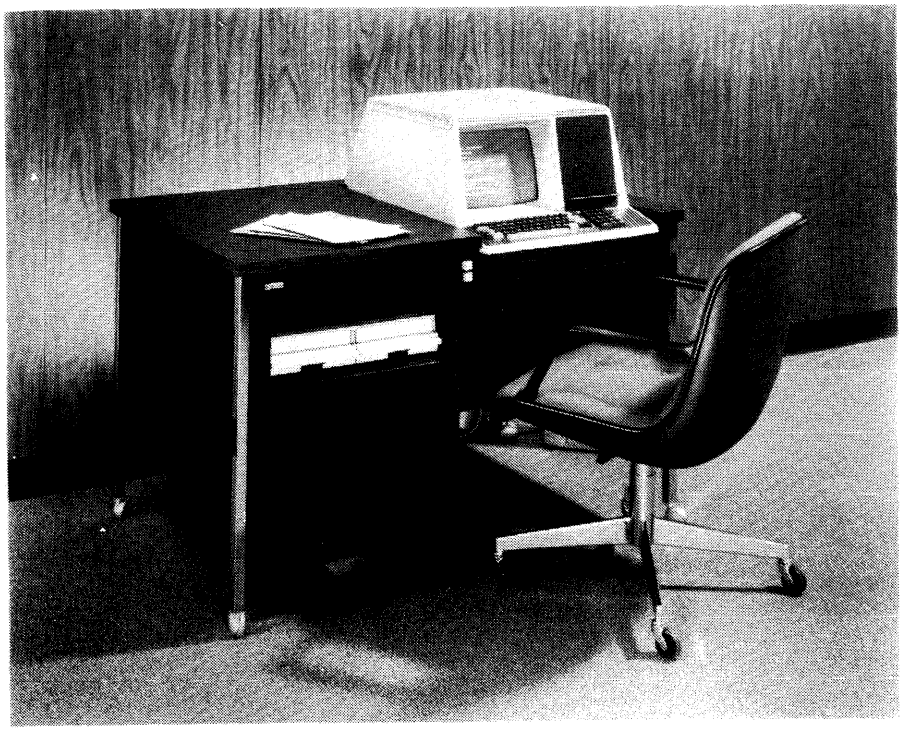
DATA FORMATS

BASIC UNIT: The PDP-8/A uses 12-bit words; programmers, however, see only 6-bit modified ASCII for numeric or alphanumeric data.

FIXED-POINT OPERANDS: The PDP-8/A uses 12-bit binary words; programmers, however, see the system as having fixed-point decimal capability only, with precision of 15 digits, due to the standard software.

FLOATING-POINT OPERANDS: None provided.

INSTRUCTIONS: One-word single-address machine instructions, as is common to the PDP-8 line. But since the only



The basic Datasystem 310 includes a PDP-8/A microcomputer with 16K 6-bit characters of 1.4-microsecond core memory, 960-character CRT display with typewriter keyboard and 10-key numeric keypad, and dual diskette drives with a total storage capacity of 670,000 6-bit characters. The COS 310 operating system, utilities, and DIBOL language, plus installation, are included in the single-unit purchase price of $12,000.

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PERIPHERALS TABLE

UNIT	DESCRIPTION	SPEED	HOW ATTACHED
DISPLAY*	CRT; 960 characters in 12 lines of 80, 64-character set, 9 x 5 inches	9600 bits/sec	Integrated
DISKETTE	Dual or quad; see Mass Storage	30K char/sec	Integrated
PRINTERS	LA-36 DECwriter; 132 columns, 64-character set, up to 6 copies, vertical format control	30 char/sec	Cabled
	LS-8F Serial Printer; 132 columns, 64-character set, up to 6 copies, vertical format control	165 char/sec	Cabled
	LE-8V Line Printer; 132 columns, 64-character set, up to 6 copies, vertical format control	300 lines/min	Cabled
KEYBOARD	Typewriter-style; 36 alphanumerics & 26 special characters, 10-key numeric pad separate	———	Integrated
COMMUNICATIONS	IBM 2780-compatible; see Communications Control		

*An electrolytic CRT copier is scheduled to be released in July 1975.

- DEC Datasystem 310—CPU with 16,384 6-bit characters of 1.4-microsecond main storage, 960-character CRT, console keyboard, dual diskette drives for 670K 6-bit characters of direct-access storage, desk, COS 310 operating system, and DIBOL compiler. Purchase price: $12,000.

- IBM System/32—CPU with 16,384 8-bit characters of 600-nanosecond main storage, 240-character CRT, console keyboard, single fixed-disk storage unit providing 5.054 million 8-bit characters of working mass storage, single diskette drive for data entry use, 40-character-per-second serial printer, desk, and System Control Programming. Purchase price: $33,100.

Is the foregoing comparison valid? Or even fair? In the absence of user experience, it's all that can be done, so let's compare further.

Immediately apparent is the fact that the Datasystem 310 is restricted in its disk capacity. It can have only two or four diskette drives providing 670K or 1340K 6-bit "bytes" (hereinafter called DECbytes), while the System/32 has a nonremovable platter providing disk storage for 5 million or 9.1 million bytes. Also, the IBM disk is much faster than the DEC diskettes. Average access time on the System/32 fixed disk (average head movement plus average rotational delay) is about 80 to 85 milliseconds, and data is transferred at the rate of 889,000 bytes per second. The comparable figures for the Datasystem 310's removable diskettes are 453 milliseconds and 30,000 characters per second. That's about five times slower in average access time and nearly 30 times slower in transfer rate.

The standard Datasystem 310 contains no printer. But a 30-character-per-second 132-column printer adds only $2,460 to the basic system price, which would then total

programming language available to users is DIBOL, users see the instruction format in terms of the DIBOL syntax, and the repertoire in terms of the DIBOL command list.

INTERNAL CODE: Binary, as in the PDP-8 line. But users make no reference to machine code; they see alphanumeric data in DIBOL data structure, coded in 6-bit modified ASCII.

MAIN STORAGE

TYPE: Magnetic core.

CYCLE TIME: 1.4 microseconds.

CAPACITY: 8K to 32K 12-bit words, in 8K increments (K=1,024). DEC also refers to capacities in "bytes" or characters. A DECbyte is *six bits;* hence, the capacities could be quoted as 16K to 64K six-bit bytes in 16K increments.

CHECKING: None.

STORAGE PROTECTION: None in hardware, but via operating system software. The basic COS 310 residency requirement is 4K words, and the operating system manages the memory resource for a single user.

RESERVED STORAGE: 4K words of memory for COS 310. The "system" diskette also has a reserved section for COS 310 and system utility programs.

CENTRAL PROCESSOR

GENERAL: The CPU is a DEC PDP-8/A microcomputer. It is programmed to act as a "black box" to users, and is not even visible to the user.

CONTROL STORAGE: None is accessible to users.

REGISTERS: The PDP-8-style "autoindex" registers are used by COS 310 and are not accessible to programmers. The CPU has the normal complement of PDP-8 registers for the operating system to use: 12-bit accumulator, general-purpose register, program counter, memory address register, memory buffer register, 3-bit operation code register, and 1-bit link carry register for arithmetic overflow. None of

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A fully expanded Datasystem 310 with 64K characters (32K 12-bit words) of core storage, a second set of dual diskette drives, a 300-lpm line printer, and the IBM 2780 emulation package costs $29,200 in single-unit quantities.

$14,260. Upgrading, IBM offers an 80-character-per-second serial printer in its System/32-A models or a 50-, 100-, or 155-lpm line printer in its System/32-B models. DEC offers the Datasystem 310 with an optional 165-character-per-second or 300-line-per-minute printer.

The System/32 has a single diskette drive, but it will normally be used only for data and program entry—into the system from another diskette-equipped unit, or from it to another system equipped with a diskette reader.

The Datasystem 310 appears to have the edge in high-level user programmability. It comes with a bundled DIBOL compiler, while IBM offers only RPG II for the System/32, and it is unbundled.

The System/32 seems to lead slightly at present in data communications capabilities because it offers IBM's new SDLC line protocol (delivery in mid-1976) as well as the familiar BSC. But it must be remembered that not many networks presently use SDLC, and that DEC has the capability in the future to add SDLC, or its own similar DCCMP, to the Datasystem 310's capabilities. Neither system currently supports more than one terminal; only IBM's can exist in a multipoint network; both support remote job entry in an IBM 2780-compatible mode; and both are capable of supporting only a single communications line.

System/32 applications are largely non-tailorable, and must be leased from IBM; an installation charge also applies. Even IBM's system utilities are unbundled. IBM provides only the basic operating system and an operations control language (OCL) gratis. DEC provides an operating system, language, utilities, and control language for the Datasystem 310 at no extra cost, and applications

these registers is accessible to DIBOL programmers. (The switch register has been eliminated, since there is no operator's console.)

INDIRECT ADDRESSING: Yes; single level.

INDEXING: Yes, through the autoindex registers. These eight registers are automatically incremented when implied in a memory reference instruction, but act as normal memory locations when addressed explicitly as memory.

INSTRUCTION REPERTOIRE: The CPU has the basic PDP-8 instruction set: 6 memory reference instructions, 4 interrupt control system instructions, 3 flag processing instructions, and 41 "operate" instructions for logical control. But only DIBOL is available to programmers. DIBOL has field manipulation instructions and add, subtract, multiply, divide, numeric content check, numeric field formatting, truncation, and rounding available in any combination in a single DIBOL statement. DIBOL also provides the system's I/O instructions, logical functions, and branching.

INSTRUCTION TIMINGS: Timings are given in *microseconds* for both CPU (machine-level) instructions and DIBOL operations on 15-digit operands:

	CPU	DIBOL
Load/store	1.4	100 average
Add/subtract	2.8	1,000
Multiply/divide	NA	2,000
Compare & branch	1.4	25-100*

* For 15 characters. The time can vary widely, since DIBOL permits the operation on fields 1 to 4096 characters in length.

INTERRUPTS: A single-line interrupt structure is provided. Software polls the interrupting device for its identification. Interrupts are handled by COS 310, and the programmer is not concerned with them.

PHYSICAL SPECIFICATIONS: Except for optional printers, the entire Datasystem 310 fits within a desk

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programs will be available, with support and documentation, through OEM suppliers of the system.

The DEC PDP-8/A microcomputer inside the Datasystem 310 is programmed to make the system behave as a DIBOL machine with decimal arithmetic, and also to provide a random-access disk-based environment. In other words, the CPU is a "black box." The operator sees a 15-digit, fixed-point, decimal business machine equipped with a CRT, keyboard, 10-key numeric pad, and two buttons: Power On and Load. Field service for the Datasystem 310 will come from DEC's pool of over 2,000 service representatives coast-to-coast.

DEC cites the Datasystem 310 as a cost-effectiveness breakthrough, stating that it lowers the entry-level price by 50 percent over the price possible with the technology of only one year ago. It sort of makes you wonder what will be available for the nation's bicentennial next year.

Use of the diskette certainly is an effectiveness breakthrough. It has 40 percent faster access per block than DECtape, permits random accessing of the data, and stores only 10 percent less data on-line.

COS 310 for the Datasystem 310 provides a compiler and editor for on-line program development and multi-volume file support, plus data file creation and maintenance and sort/merge utilities.

The entire system, except for the optional printers, fits within a desk-sized unit that is mounted on casters and plugs into a standard three-prong wall outlet. No special flooring is required, and any normal office environment is suitable for the system. □

measuring 30 inches high, 48 inches wide, and 30 inches deep, and weighing 400 pounds. No special environment is required; the system works in the normal office environment. The desk is mounted on casters, and the system plugs into a standard wall socket (single-phase, 3-wire grounded duplex, 110-120 volts AC, 60 Hertz). Power consumption is 1,000 watts. The optional printers vary in size and weight, are not caster-mounted, and obtain power from the desk unit. The printers connect to the Datasystem 310 via short cables.

INPUT/OUTPUT CONTROL

I/O CHANNELS: Six cycle-stealing channels on the Omnibus are used by the basic Datasystem 310. Six more are available for expansion. The channels operate at rates in accordance with the I/O device speeds.

SIMULTANEOUS OPERATIONS: Full peripheral overlap is provided by the hardware and COS 310. The keyboard and serial printers are buffered; diskette access is overlapped with serial or line printer output; and COS 310 includes a standard line printer spooler.

CONFIGURATION RULES: Systems are packaged. Minimum configuration is CPU with 8K words, CRT, two diskettes, and keyboard; maximum system is CPU with 32K words, CRT, four diskettes, keyboard, one printer, and IBM 2780 hardware and software emulation.

MASS STORAGE

Diskettes for the Datasystem 310 hold 335,000 six-bit DECbytes (260,000 standard eight-bit bytes) per drive. Average head movement time is 370 milliseconds, average rotational delay is 83 milliseconds, and data is transferred at the rate of 30,000 DECbytes (15,000 words) per second. The diskettes are standard (i.e., IBM-compatible) and available from many sources.

INPUT/OUTPUT UNITS

The characteristics of the Datasystem 310 I/O units are listed in the Peripherals Table on the second page of this report.

COMMUNICATIONS CONTROL

The Datasystem 310 can handle one communications line, with the speed of synchronous data transmission set by the modem used: 2000, 2400, or 4800 bits per second. The transmission code used is EBCDIC, and the line protocol is IBM 2780-compatible binary synchronous (BSC), full duplex. Leased or switches lines can be used, both with auto-answer. No m switched control is available. (Information to the contrary provided by DEC at the system's announcement was in error.) The languages supported are DIBOL for program development and IBM 2780 remote job entry conventions. Another Datasystem 310, a Datasystem 340, or an IBM System/360 or 370 computer can be interfaced. An IBM 2780 emulator software package is supported. Communications error control consists of a block check character with automatic retransmission upon detection of an error.

SOFTWARE

The operating system and other non-applications software discussed below are supplied by DEC.

OPERATING SYSTEM: The Datasystem 310 operating system is COS 310, a modified version (not a proper subset) of COS 300 for DEC's larger Datasystems. But any single-user DIBOL program written for a larger Datasystem will run on the Datasystem 310. COS 310 functions to make the PDP-8/A appear as a black box, control I/O operations, and handle the operator interface. It supports DIBOL. The operating system requires about 4K words of memory and resides with numerous utility programs, on about one-third of a diskette.

COS 310 supports named I/O devices in the packaged systems. It supports batch and interactive processing as well as interactive program development. It manages direct access to diskette data through user file directories. It provides direct printing or spooling for an optional line printer, cursor control for the CRT, and a buffer for the keyboard. It allows programs to be chained. COS 310 supports multiple-volume data files on diskette. The operating system also contains fixed-point decimal arithmetic routines.

The COS 310 MONITOR is split into a core-resident and a diskette-resident segment; it includes interactive job control and editor functions, and maintains a directory of all programs stored within the system. The EDITOR is an interactive, line-oriented program that also accepts input from the keyboard and accepts and stores batch-mode commands or control files for SORT, BUILD, or other programs. The COS 310 MONITOR and one or two key utilities occupy about one-fifth of a diskette. The remaining diskette space is available for compilation, etc.

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LANGUAGE: COS 310 DIBOL (Digital Business-Oriented Language) is comprised of data definition and procedure sections. It resides on a diskette and runs on a minimum Datasystem 310. It will support up to 28K words of user storage, which is the maximum storage in a Datasystem 310. Source code can be input from the console or from diskette, via job control statements. DEC quotes compile times for complex programs in the range of 10 to 20 seconds.

DIBOL object code, in executable form, resides on the system diskette and can be stored by name in the user's program library. DIBOL provides decimal arithmetic precision to 15 places, using one 6-bit "DECbyte" of memory to express each decimal digit. Further, the language offers program debugging from the console CRT, logical data files, program chaining, and an internal subroutine facility. Simple DIBOL commands are expressed in English statements, and can be classified according to type and function as follows:

Compiler commands–statement type defined.

Control commands–program execution sequence.

Data manipulation–calculations and data movement in main memory.

Data specification–size, type and position of data.

Debug facility–program step trace.

File control–data file open and close.

I/O control–data movement into and from memory.

DIBOL supports a six-bit ASCII character subset, and features data manipulation capabilities such as subscripting, array handling, rounding, truncating, and record overlaying. CALLs can be nested. There are useful utilities for DIBOL supported by COS 310.

UTILITIES: With the COS-310 SORT/Merge routine, the user can specify one to eight subfields in the sort key. The SORT utility also has a file merge capability. The system's editor is interactive, allowing various types of input. The BUILD utility creates data files from a data entry terminal. An UPDATE routine maintains master files.

DDT (DIBOL Debugging Technique) is an optional run-time DIBOL debugging feature. It lets the programmer stop execution at a given statement to examine variables, using their DIBOL labels. It is interactive.

DAFT (Dump and Fix Technique) is a selective file maintenance/dumping utility written in DIBOL. It searches a data file on a specified key, makes minor changes to a data file, prints or displays records or parts of records, searches for a specified record, skips or backspaces a requested number of records, and places a specified number of copies of a record on an output file.

CREF (Cross Reference) provides an alphabetic listing of symbols used in a DIBOL program, and also gives the program line numbers.

PATCH is used to update programs. It contains a check sum feature to verify the validity of the changes.

PRINT is an output utility for the optional printer. Written in DIBOL, it provides page counts, page headings, and field headings, and its data positioning commands are defaulted. It accumulates field totals, generates breaks at specified levels, and optionally ejects pages with summaries at breaks. Some computational routines are supported. PRINT is actually an output-oriented language that translates report parameters into a DIBOL program. If the DIBOL program is not exactly what the user wanted, he can modify it.

COMMUNICATIONS SOFTWARE: COS 310 supports an optional IBM 2780 Remote Data Communications emulator package.

PRICING

POLICY: Purchase only; maintenance is separately priced. Direct customers can have a $500 discount on the second and subsequent systems, in addition to volume discounts. A 4 percent discount applies to up to 4 systems, a 7 percent discount on 5 to 9, and a 10 percent discount on 10 to 14 systems. OEM discounts are greater. Hardware installation and software are included in the price.

EQUIPMENT: Systems are packaged, and their configurations and prices are shown in the following price list. A minimum system costs $12,000. A system with all possible options costs $29,200. ■

EQUIPMENT PRICES

PACKAGED SYSTEMS	Purchase Price	Monthly Maint.
Basic Datasystem 310: CPU with 8K 12-bit words of memory, dual diskettes, CRT/keyboard, desk, COS-310, DIBOL, and utilities	$12,000	$99
Basic Datasystem 310 with 30 cps printer	14,640	NA
Basic Datasystem 310 with 165 cps printer	18,200	NA
Basic Datasystem 310 with 300 lpm printer	22,500	NA
ADDITIONAL MEMORY		
Core module, 8K 12-bit words*	1,500	NA
Core module, 16K 12-bit words*	2,500	NA
ADDITIONAL DISKETTE DRIVES		
Pair of integrated diskette drives	NA	NA
PRINTER PRICES		
30 cps printer	2,460	NA
165 cps printer	6,200	NA
300 lpm printer	10,500	NA

NA–Not available; DEC declines to release these prices at this time.

*The original 8K words of memory can be replaced by 16K for $1,000.

SOFTWARE PRICES

	Purchase Price
IBM 2780 Emulator (with installation)	$ 700
IBM 2780 Emulator (without installation)	200