Cii Honeywell Bull 64/DPS Series

MANAGEMENT SUMMARY

Competitive with IBM's 4331 systems, and upward compatible with their own previously developed Level 64 environment, Cii-Honeywell Bull's new 64/DPS systems (Distributed Processing System) are designed to operate within CII-HB's DSE (Distributed Systems Environment) framework for data networks. Designed primarily for business data processing, the medium-scale 64/DPS comprises three models: 64/DPS-2, 64/DPS-4, and 64/DPS-6. All models incorporate a communications processor which controls 15 telecommunications lines with up to 32 terminals per line, and complementary communication processors allow a maximum of 45 communication lines. Up to two Datanet 7100 Front End Network Processors can be attached via the input/output channels enabling 64/DPS to host a DSA Network and to control up to 256 communications lines. A new service processor allows direct connection of a diskette unit and of a separate keyboard display console. In addition, coupled central systems sharing peripheral subsystems can be configured.

Memory, composed of 16K-bit chips, ranges from 512K to 3,144K bytes on the DPS-2 or DPS-4 and from 768K to 4,192K on the DPS-6. The memory has a read time of 630 nanosconds and a write time of 770 nanoseconds per 4 bytes.

64/DPS systems run under a subset of the General Comprehensive Operating System. DPS/64 GCOS provides COBOL, RPG, FORTRAN, PL/1, BASIC, and APL, two file management systems, a data base management system, communications control, a transaction processing system, interactive editing of source programs, and a standard complement of utility programs.

To help users migrate from other systems, CII-HB offers TRANSIT conversion software for the IBM System/3 and System/370 as well as for the older CII-HB/ ➢

Designed and built in France, the medium-scale 64/DPS systems, direct descendents of the Level 64, permit users to operate within a distributed processing network. Virtual-memory oriented, the three 64/DPS models can support up to 64 concurrent jobs under Release 1-E of the GCOS 64 operating system. Prices range from 35,000 FF to 160,000 FF.

CHARACTERISTICS

MANUFACTURER: Cii Honeywell Bull, 94 avenue Gambetta, B.P. 33, 75960 Paris, Cedex 20, France. Telephone 360 02 22. Telex 220 898 F.

MODELS: Series 60, Level 64—Models 64/20, 64/30, 64/40, 65/50, and 64/60; 64/DPS system—Models 64/DPS-2, 64/DPS-4, 64/DPS-6. The Level 64 systems are no longer actively marketed.

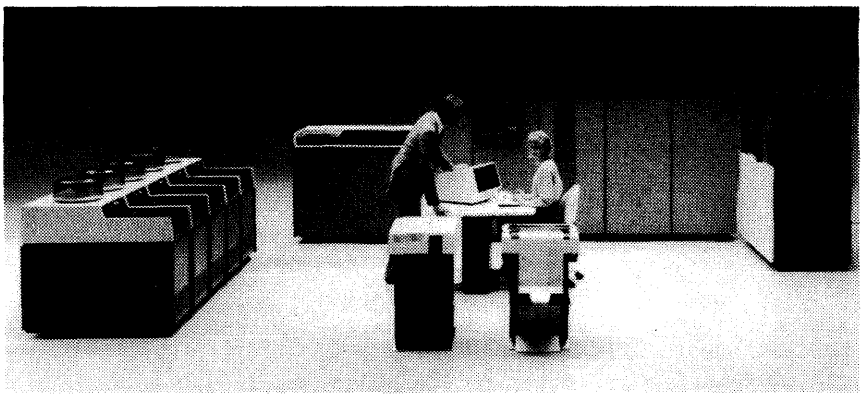
DATE ANNOUNCED: The first two models of the Level 64, the 64/20 and 64/40, were announced in April 1974. The remaining three, the 64/30, 64/50, and 64/60 were announced in April 1976. All three 64/DPS models were announced on March 29, 1979.

DATE OF FIRST DELIVERY: 64/20, December 1974; 64/30, December 1976; 64/40, December 1974; 64/50, December 1976; 64/60, December 1976; 64/DPS-2, October 1979; 64/DPS-4, October 1979; 64/DPS-6, November 1979.

NUMBER INSTALLED TO DATE: 2,100 systems worldwide as of January 1, 1981, including all Level 64 and 64/DPS models sold by CII-HB and Honeywell Information Systems.

DATA FORMATS

BASIC UNIT: 8-bit byte plus one parity bit. Data paths are four bytes (32 bits) wide. Data can be interpreted as binary, decimal, hexidecimal, or alphanumeric. Data bits are interpreted in groups of four (packed or unpacked decimal ➤



This 64/DPS Model 4 configuration consists of the central processing unit with one megabyte of main memory, five 200-megabyte disk drives, two magnetic tape drives (1600/6,250 bits per inch), an operator console/display with printer, and a 1000 line per minute printer. In addition, the 64/DPS-4 has a data communications processor with from 1 to 15 lines.

REFERENCE EDITION: This is a mature product line, and no significant further developments are anticipated. Because of its importance, coverage is being continued, but no future update is planned.

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CHARACTERISTICS OF THE LEVEL 64 AND THE 64/DPS SYSTEMS

	Model 64/20	Model 64/30	Model 64/40	Model 64/50
SYSTEM CHARACTERISTICS				
Date of introduction	April 1974	April 1976	April 1974	April 1976
Date of first delivery	December 1974	December 1976	December 1974	December 1976
Number of CPU's per System	1	1	1	1
Principal Operating System	GCOS 64	GCOS 64	GCOS 64	GCOS 64
MAIN STORAGE				
Type	MOS	MOS	MOS	MOS
Cycle time, nanoseconds	1000	1000	860/980	860/980
Minimum capacity, bytes	65,536	65,536	98,304	98,304
Maximum capacity, bytes	262,144	393,216	458,752	524,288
Bytes fetched per cycle	4	4	4	4
CENTRAL PROCESSOR				
Cycle time, nanoseconds	500	500	430	430
No. of registers	29	29	29	29
No. of instructions	195	195	195	195
CONTROL MEMORY				
Type	Bipolar	Bipolar	Bipolar	Bipolar
Cycle time	175	175	155	155
Capacity	40 to 64KB	40 to 64KB	40 to 64KB	40 to 64KB
Bytes fetched per cycle	4	4	4	4
INPUT/OUTPUT CONTROL				
Maximum channels	3	3	6	9
Maximum channel data rate, bytes per second	1,250,000	1,250,000	1,250,000	1,250,000
Total data rate (max.), bytes per second	3,750,000	3,750,000	4,080,000	4,080,000
CONFIGURATION				
Mass storage controllers (max.)	1	1	2	2
Drives per controller (max.)	4	8	8	8
Maximum disk capacity (megabytes)	400	800	1600	1600
Magnetic tape controllers (max.)	1	1	1	2
Magnetic tape transports (max.)	8	8	8	16
Unit record controllers (max.)	1	1	2	2
Unit record devices (max.)	5	5	8	8
Communications controllers (max.)	1	1	2	3
Communications lines (max.)	14	14	28	42

Honeywell Series 100 and Series 200/2000 systems. 64/DPS systems also can be microprogrammed to run Series 100/200/2000 programs concurrently with 64/DPS programs.

From a hardware standpoint, a 64/DPS computer is a network of firmware-driven processors. Input/output processors can be added or reprogrammed to handle new peripheral devices without affecting user programs. CII-HB has taken advantage of this architecture to periodically refine and enhance the systems without obsoleting existing user software.

The Level 64 family upgrades were announced on March 29, 1979. The DPS models have larger and faster main memories and new system software and remote maintenance capabilities, but the upgrade transition path is a smooth one. CII-HB's policy has been to introduce new facilities a few at a time, allowing users to absorb them before announcing more. All hardware upgrades within

data) or eight (alphanumeric EBCDIC), or in strings of 16 to 64 bits (binary digits). The strings can be interpreted as signed or fixed-point binary numbers or as floating-point operands with single (16-bit) or double (32-bit) precision formats. The optional scientific instruction set, used for floating-point operations, provides the capability for 128-bit quad words.

INTERNAL CODE: EBCDIC.

MAIN STORAGE

Memory is organized into consecutively numbered byte locations. Four-byte blocks are always accessed regardless of operand size. Halfword (16-bit) operands must begin on even-numbered byte locations, and full-word (32-bit) and double-word (64-bit) operands must begin on byte locations divisible by four.

STORAGE TYPE: Metal oxide semiconductor (MOS).

CAPACITY: See table.

CYCLE TIME: See table.

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CHARACTERISTICS OF THE LEVEL 64 AND THE 64/DPS SYSTEMS (Continued)

Model 64/60	Model 64/DPS-2	Model 64/DPS-4	Model 64/DPS-6	
				SYSTEM CHARACTERISTICS
April 1976	March 1979	March 1979	March 1979	Date of introduction
December 1976	October 1979	October 1979	October 1979	Date of first delivery
1	1	1	1	Number of CPU's per System
GCOS 64	GCOS 64-E	GCOS 64-E	GCOS 64-E	Principal Operating System
				MAIN STORAGE
MOS	MOS	MOS	MOS	Type
740/940	630/770	630/770	630/770	Cycle time, nanoseconds
196,608	524,288	524,288	786,432	Minimum capacity, bytes
786,432	3,145,728	3,145,728	4,194,304	Maximum capacity, bytes
4	4	4	4	Bytes fetched per cycle
				CENTRAL PROCESSOR
370	430	380	315	Cycle time, nanoseconds
29	29	29	29	No. of registers
195	195	195	195	No. of instructions
				CONTROL MEMORY
Bipolar	Bipolar	Bipolar	Bipolar	Type
145	100	100	100	Cycle time
40 to 64KB	40 to 64KB	40 to 64KB	40 to 64KB	Capacity
4	4	4	4	Bytes fetched per cycle
				INPUT/OUTPUT CONTROL
10	2 standard, 2 opt.	3 standard, 6 opt.	3 standard, 9 opt.	Maximum channels
1,250,000	1,250,000	1,250,000	1,250,000	Maximum channel data rate, bytes per second
4,250,000	4,100,000	5,200,000	5,200,000	Total data rate (max.), bytes per second
				CONFIGURATION
3	1	2	3	Mass storage controllers (max.)
8	9	18	27	Drives per controller (max.)
2400	4,600	10,000	15,400	Maximum disk capacity (megabytes)
2	1	2	2	Magnetic tape controllers (max.)
16	8	24	24	Magnetic tape transports (max.)
2	1	2	2	Unit record controllers (max.)
8	5	8	12	Unit record devices (max.)
3	1 (optional)	2	3	Communications controllers (max.)
42	15	30	45	Communications lines (max.)

Level 64 and 64/DPS central systems can be implemented on-site.

A minimum 64/DPS system would consist of the 64/DPS-2 central processor with 512K bytes of memory, a console with a display or serial printer, a mass storage processor, two 100-megabyte disk drives, a unit record processor, a 600-line-per-minute printer, and a 300-card-per-minute card reader or a diskette drive. Options include up to 3,144K bytes of memory, up to 2,000 megabytes of disk storage, up to eight tape drives, and a communications processor with up to 15 lines. Also available are diskette drives, faster printers and card readers plus card punches.

Through a series of field upgrades, a 64/DPS-2 can grow into a 64/DPS-6 with up to 4,192K bytes of memory, 15,400 megabytes of disk storage, 24 tape drives, and 45 communications lines. At both the 64/DPS-4 and 64/DPS-6 levels, the enhancements include a faster central processor.

CHECKING: One parity bit is appended to each byte, and an additional 6-bit checking code is appended to each 36-bit word. Single-bit errors are corrected automatically, and multiple-bit errors are detected and flagged for error-recovery routines.

STORAGE PROTECTION: A 4-level ring protection scheme is implemented in system firmware with supporting hardware registers. Data and instruction coding are compiled into separate segments. Each user program segment has an associated segment descriptor that is stored in tables in main memory. Within each segment descriptor are two 2-bit fields that specify the security level required by a user program to execute or write to a particular segment. Hardware also checks that data addresses generated during program execution do not exceed specified boundaries. The segment descriptors also contain two bits that override the ring protection scheme by denying execution or write access to a user program.

CENTRAL PROCESSOR

The 64/DPS systems are based on three versions of the same microprogrammed processor. Versions differ from each other

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SOFTWARE

GCOS 64 Release 1-E, a virtual memory, multi-tasking operating system, is implemented in hardware, firmware, and software. Parts of it reside in the memories of the input/output processors, enabling these controllers to function independently of the central processor.

The COBOL, RPG, FORTRAN, APL, and PL/1 compilers divide programs into variable-length segments. CII-HB says these segments are more efficient than fixed-length pages because programs can be divided into logical entities that require less swapping. Code is never put in the same segments as variables and data, so it never has to be written back to disk. The compilers also assign protection levels to the segments to prevent unauthorized or improper use.

GCOS schedules the execution of activities, the multiprogramming of job steps, and the concurrent execution of tasks within activities. The Transaction Driven System (TDS/64) takes advantage of this multi-tasking facility to run multiple Transaction Processing Routines as tasks within a single job step.

GCOS supports two file management systems and a data base management system. The Basic File Access System (BFAS) handles 360/370 DOS and DOS/VS direct, sequential, and indexed sequential file formats. The Unified File Access System (UFAS) handles indexed random, relative, and sequential files of variable-length records. The Integrated Data Store (IDS II) system is a subset of the data base management system developed for the Level 66 systems.

GCOS provides a two-level data communications control system that buffers applications programs from the nuts and bolts of network support and message handling.

The Basic Terminal Network Support (BTNS) system and the Front-End Network Processor Support (FNPS) system respectively support the Communications Processor and the Datanet 7100 front-end processor. They run in their own job slots and provide the interface between the network and the Message Access Method system which interfaces with the applications programs. BTNS and FNPS also provide an interface for the TDS/64 monitor.

A 64/DPS system can communicate directly with another 64/DPS system or with Level 6, Level 61, Level 64, DPS 7, Level 66, and 66/DPS systems or with any system linked to a DSA network.

In addition, 64/DPS systems can be configured into dual, coupled systems that can share the same data base and peripherals.

RELIABILITY/MAINTAINABILITY FEATURES

The 64/DPS CPU's have improved diagnostic capabilities that increase system availability by reducing diagnostic in processor cycle time, memory capacity, and peripheral configurability.

The processor is divided into two major subsystems, CPU and I/O. The CPU is organized into eight functional units: the scratch memory, the address control unit, the data management unit, the channel control unit, the panel management unit, the arithmetic and logic unit, the timer unit, and the control store controller. The scratchpad unit contains the register set and working space for micro-instruction execution. The address control unit contains the associative memory and address mapping logic. It generates all effective addresses by combining segment addresses with the relative addresses contained in instructions. The data management unit prefetches all instructions and data and passes them to the other functional units. The channel control unit is the link between the data management unit and the I/O subsystem. It aligns input and output data, stores transfer parameters, and provides I/O control functions. The panel management unit provides an interface to the system operator panel and to the maintenance panel and its special channel for diagnostic operations. The arithmetic and logic unit performs all arithmetic operations, both decimal and binary, and all logical operations on data. To increase reliability, the CPU has dual arithmetic and logic units running in parallel. All operations are performed concurrently and the results compared. The time unit consists of a 1-microsecond oscillator that drives three system timers: the processor timer, the internal timer, and the time-of-day clock. The control store controller extracts microinstructions from control storage and from main memory. It can address all ROM plus the first 64K bytes of main memory. Up to five microinstructions can be executed concurrently during one CPU cycle. The microprograms that perform central processing functions are separate from the input/output microprograms and have a lower priority for execution. I/O microprograms have priority levels within themselves, and the higher priorities are assigned to faster I/O devices.

REGISTERS: The 64/DPS CPU has 29 registers that are visible only to the operating software. These include sixteen 32-bit general-purpose registers, eight 32-bit base address registers, one 32-bit Instruction Counter, one 8-bit Status Register, one 32-bit Stack Register, one 28-bit base address, and one 8-bit Hardware Control Mask register. Eight of the 16 general-purpose registers can be used for address indexing. A CPU equipped with the optional Scientific Instruction Set also has four 64-bit scratchpad registers.

INSTRUCTION REPERTOIRE: All 64/DPS CPU's have a set of 195 instructions, including logical operations, editing functions, operations for address computations, and arithmetic instructions for performing decimal and binary operations on packed or unpacked data. Operands can be binary, fixed-point, or decimal in packed or unpacked format; bytes; byte strings; or bit strings. The optional Scientific Instruction Set adds 26 instructions to the standard set.

The instruction repertoire also can be extended by implementing the Series 100 or Series 200/2000 Program Mode (emulation) option. These firmware packages add the Bull 100 or Honeywell-Bull 200/2000 instruction set.

CONTROL STORAGE: The CPU's control storage consists of both bipolar read-only memory (ROM) and firmware routines stored in main memory. Routines from both sources are executed by the CPU. Read-only memory cycle time is 100 nanoseconds with four bytes fetched per cycle.

ASSOCIATIVE MEMORY: An associative memory stores the eight most recently used segment descriptors and their associated segment numbers. This feature increases CPU performance by reducing the time required to calculate effective addresses.

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and repair times on malfunctioning systems. The advent of CPU's with multiple processor units has enabled the computer industry to incorporate fixed diagnostic routines into one or more of the internal processing units that make up these CPU's. These diagnostic routines are added to the microcode of the processing unit and invoked only on special command, which can be initiated either remotely or locally.

CII-HB has implemented its Remote Maintenance System (RMS) in the 64/DPS CPU. RMS often permits field engineering personnel to diagnose hardware, firmware, software, and operational (human) problems without visiting the user site or taking the system down for maintenance.

Reliability and maintainability also are provided by five largely independent system features. Parity is checked on every access to mass storage or control storage and whenever data is transferred between any two system functional units. Main memory is error-correcting and detecting (EDAC) and appends a 6-bit error-correcting code to each 4-byte word. This code permits automatic correction of single-bit errors and flags multiple-bit errors after retrying the access. Main memory can be automatically reconfigured if a permanent error is diagnosed. Blocks of 32K bytes can be bypassed without re-initializing the systems. The 64/DPS CPU's also have redundant arithmetic and logic units that duplicate each operation and compare the results.

Internal diagnostics are performed by two units within the 64/DPS systems. The central processor cointains microprograms that check individual elements at initialization. The peripheral processors each have similar microprograms for performing self-tests.

The 64/DPS unit record processor also functions as a system diagnostic processor. If a failure is detected in either the central processor or a peripheral subsystem, diagnostic routines are loaded into the unit record processor read/write memory, enabling it to perform system tests and report results on the system console and remotely through RMS.

COMPETITIVE POSITION

As shown in the table, the 64/DPS models compete with the IBM 4331-1 and 4331-2, with the 64/DPS-4 falling below and the 64/DPS-6 falling above the 4331-2. Users of Level 64/60 systems who need more power are offered the DPS 7/60, which falls above the IBM 4341-1.

USER REACTION

Datapro's 1980 European survey of general-purpose computer users yielded 62 Level 64 and 10 64/DPS evaluations by French users.

FIRMWARE: In 64/DPS systems, all functions are executed under joint action of hardware, software, and firmware components. The firmware is largely used to increase operating flexibility without jeopardizing performance. It performs numerous functions such as task management, call procedures, addressing, and data protection, and initiates the appropriate servicing routines upon conditions such as completion of I/O operations, I/O errors, arithmetic overflow, timer runout, attempts to reference out-of-bounds segment locations, etc.

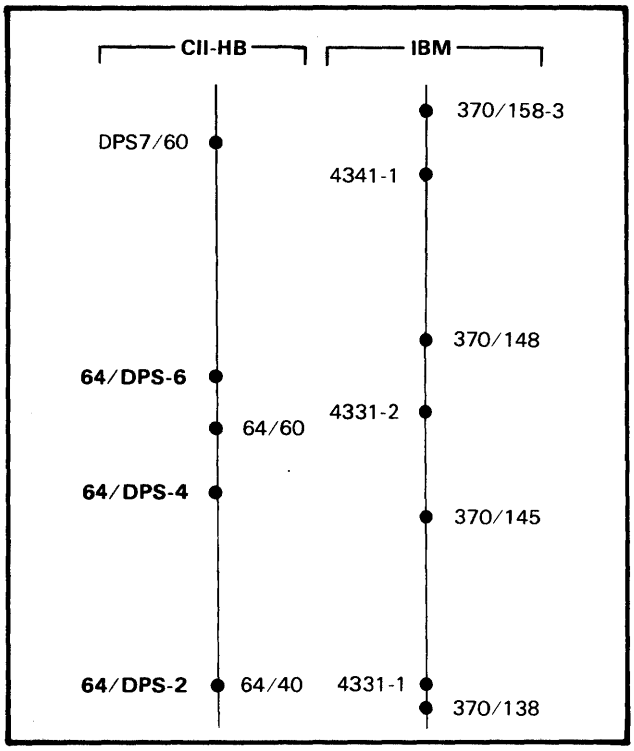
PROCESSOR: The central processor is capable of identifying and controlling a task or "process." A process is constituted by code and data segments. A program may be composed of several processes where each can be executed in parallel with the others. The distribution mechanism required for the parallel execution of processes is a firmware function capable of identifying numerous processes and executing them simultaneously as a function of hierarchical priorities.

CONSOLE: The console includes a keyboard, a system operator panel, a tape cassette drive for system diagnostics, and either a CRT display or a 30-cps printer. Optionally, the console can include both the display and the printer.

COMPATIBILITY FEATURES: The 64/DPS processors are compatible with earlier Level 64 models and are equipped with a standard compatibility feature that enables them to execute programs written for the older Series 100 and Series 200/2000 systems. The 100 Program Mode supports the execution of the Series 100 operating systems EDOS and ETOS. The 200/0 Program Mode supports the execution of the Series 200 operating systems Mod1 MSR and Mod1 TR and the Series 2000 operating system OS/2000.

A system may be upgraded in two ways. One is via kits which make it possible to add new power levels, rules of configurability and peripheral attachments, yielding onsite migration to a more powerful model. The second is via booster kits, providing a model with the power level of the next higher model. In this case, the model of the installed

COMPETITIVE POSITION OF 64/DPS SYSTEMS



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USERS' RATINGS IN TERMS OF WEIGHTED AVERAGES

	Ease of Operation	Reliability of Mainframe	Reliability of Peripherals	Maintenance Service		Technical Support			Manufacturer's Software			Ease of Programming	Ease of Conversion	Overall Satisfaction
				Responsiveness	Effectiveness	Trouble-Shooting	Education	Documentation	Operating Systems	Compilers and Assemblers	Applications Programs			
Model 64/20	2.8	3.1	2.5	2.5	2.8	2.3	2.3	2.4	3.2	3.0	2.8	2.9	2.7	2.7
Model 64/30	2.8	3.4	2.5	2.7	2.5	2.3	2.2	2.6	3.3	3.1	3.0	3.0	2.9	2.9
Model 64/40	3.3	3.4	2.8	2.4	2.6	2.3	2.3	2.2	3.2	3.3	3.0	3.1	3.2	3.0
Model 64/50	2.6	3.0	2.6	2.4	2.2	2.5	2.0	2.4	3.0	2.8	2.7	2.8	3.2	2.6
Model 64/60	2.8	3.6	1.9	2.4	2.1	2.7	2.4	2.1	3.5	3.0	2.3	2.6	2.6	2.7
Level 64 totals	2.9	3.3	2.5	2.5	2.6	2.4	2.3	2.3	3.2	3.1	2.8	2.9	2.9	2.8
64/DPS (all models)*	2.7	3.0	2.2	2.4	2.5	2.1	1.8	2.3	2.9	3.2	3.2	2.8	2.6	2.9

Basis for computing Weighted Averages is 4 for each user rating of Excellent, 3 for Good, 2 for Fair, and 1 for Poor.
*Population consists of seven 64/DPS-2's, two 64/DPS-4's, and one 64/DPS-6.

The Level 64 sample was distributed as follows:

Model 64/20	24 systems
Model 64/30	19 systems
Model 64/40	18 systems
Model 64/50	5 systems
Model 64/60	8 systems

The weighted averages of the Level 64 ratings in 14 performance categories are presented in the User's Ratings table.

Also included in the table are the 10 French ratings of the more recently announced 64/DPS systems.

The 64/DPS sample was distributed as follows:

Model 64/DPS-2	7 systems
Model 64/DPS-4	2 systems
Model 64/DPS-6	1 system

Because it is Datapro's policy not to publish ratings by fewer than three users, we have presented only the combined weighted averages in the table.

Five of the systems were leased, one was purchased, and four were rented.

The principal applications of the 10 users were:

Accounting	7
Government	4
Manufacturing	2
Payroll/Personnel	6

system remains unchanged, and it maintains its original rule of configurability and peripheral attachment.

The Service and Unit Record Processor (SURP) of an installed Level 64 system can be enhanced to the equal of a 64/DPS SURP. By means of the URK4300 Site-kit, the SURP is modified to support the new 64/DPS peripherals, and expansion of the SURP memory enhances the Communications Processor's functionality.

Modification of the SURP requires prior installation of the CPU enhancement and requires a substantial amount of installation time during which the system is not available. Installation of the optional URP may be an alternative preferred by users who cannot spare the time required for SURP-modification. The URP expands the configurability of peripherals and communications lines beyond the limits of an enhanced SURP.

The Disk Operating System Program Mode supports the execution of programs written for IBM System/360 systems running under DOS.

Program modes are implemented by hardware/firmware housed in the read-only storage of the central processor and by compatibility routines that reside in main memory. Machine instructions, such as I/O operations, that cannot be directly executed are passed to the compatibility routines for interpretation and execution.

A program mode session is regarded by the GCOS operating system as a single job. A session can be submitted to the system through the input reader and GCOS will schedule the job, allocate resources, and initiate the session alongside other jobs in the multiprogramming environment. Once the program mode is initiated, the operator communicates directly with the old operating system. He can simulate the action of switches and pushbuttons by using a "mode control language." Commands are entered through the 64/DPS console.

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Transportation	1
Banking/Finance	1
Engineering/Scientific	1
Medical/Health Care	2
Transaction Processing	3

None of the respondents planned to replace their present system in 1981. Of the users planning to acquire or implement additional software in 1981, three intended to acquire additional software from CII-HB and four planned to acquire proprietary software from other suppliers.

Asked about planned expansions, six of the users mentioned data communications, and two listed distributed processing.

Asked if they would recommend their present system to another user in the same situation, eight said they would, and two said they would not. One of the two explained that he had outgrown the system and planned to upgrade in the near future.

From a list of 10 possible advantages to the system, seven of the users indicated that the system was easy to expand and that the programs and/or data carried over from other systems (particularly Level 64) were compatible, as CII-HB had promised. Six of the users cited fast response time as a significant advantage.

The users were also requested to check a list of 10 possible problems they might have encountered with the system. Nine of the users said that the delivery and/or installation of the equipment was late, and three reported that the software was delivered late. Aside from these two, no significant problem appears to have been encountered.

The overall satisfaction rating of 2.9 indicates that the 64/DPS systems are living up to user expectations, both as an upgrade from the Level 64 and in terms of handling current workloads.□

PHYSICAL SPECIFICATIONS: The 64/DPS processors require operating conditions of 68 to 78 degrees F. with a noncondensing relative humidity of 40 to 60 percent; Honeywell recommends design conditions of 73 degrees F. ±5 degrees with a noncondensing relative humidity of 50 percent ±10 percent and a fluctuation rate of change of 2 percent. The power source must be 120/208 volts, three-phase ±10 percent of the rated voltage, with a frequency tolerance of 60 Hz ±0.05 Hz and with a harmonic content within acceptable limits. The three-phase cable cannot have a phase variation greater than five percent from the nominal 120 degree phase angle. The line voltage should have total harmonic content of less than six percent of the power in the fundamental frequency. The CPU/IMSP/IURP cabinet set measures 27.5 inches wide, 42.6 inches deep, and 40 inches high, and weighs 1125 pounds. The console and MTP measure 55 inches long, 27.5 inches deep, and 40 inches high and weighs 60 pounds. The CPU/IMSP/IURP/Console/MTP heat output is 27,300 BTU's per hour. Recommended overall space requirements for a small 64/DPS system is 27 feet by 19 feet; for a large layout, 24 feet by 32.5 feet.

INPUT/OUTPUT CONTROL

I/O CHANNELS: The Model 64/DPS-2 consists of a single central processor, an integrated mass storage processor (IMSP), and an integrated service and unit record processor (ISURP). The IMSP can attach up to nine disk pack drives, while the ISURP provides up to five device ports for such low-to-medium speed devices as diskette, card equipment, printers, and a cassette drive for use as an input or output device. The ISURP also allows the attachment of the console devices and the Data Communications Processor (DCP).

The Data Communications Processor (DCP) controls up to 15 lines in any mix of synchronous or asynchronous transmission modes at up to 19,200 bits per second. The DCP uses the unit record processor to relieve the CPU of all routine satellite terminal and line handling.

Two other channels are available as options to handle a magnetic tape processor (MTP), providing control of up to eight magnetic tape drives, and to provide for the eventual attachment of an additional peripheral processor.

The Model 64/DPS-4 initial configuration includes the IMSP and the ISURP. It can be expanded by adding one or two magnetic tape processors and one non-integrated, mass storage processor. In addition, a second non-integrated unit record processor (URP) can be added to provide three additional unit record ports. The additional mass storage processor can be used to provide an additional nine disk drives or to provide dual-access capabilities for the first nine drives. The second optional magnetic tape processor is used to provide dual-access capabilities through a dual-access magnetic tape processor. A maximum of 24 tape units can be attached. The additional URP permits the attachment of a second 15-line communications controller. Like the 64/DPS-2, the 64/DPS-4 requires a console device, a card reader or reader/punch, and a line printer.

The top-of-the-line 64/DPS-6 can attach up to 27 disk pack drives through the integrated mass storage processor and two additional, 9-drive free-standing mass storage processors. Its magnetic tape subsystem capabilities are identical to those of the model 64/DPS-4; up to 24 tape units can be attached either in single-access configuration or in dual-access configuration through an additional magnetic tape processor. A third 15-line communications controller can be attached to the additional URP; however this option is mutually exclusive with the third mass storage processor.

SIMULTANEOUS OPERATIONS: The 64/DPS peripheral processing subsystems operate concurrently with the central processor. Each subsystem operates under control of a microprogrammed peripheral processor. Each peripheral processor contains its own arithmetic and logic unit, read/write memory, and read-only memory and is attached to the central system through a high-speed channel. All four channels in the 64/DPS-2 can operate simultaneously at the maximum data transfer rate, producing a maximum total rate of 4,100,000 bytes per second. Input/output channel data rates in models 64/DPS-4 and 64/DPS-6 are limited only by processor memory speed. The maximum total data rate for each of these systems is listed in the Characteristics table. All devices and terminals attached to a unit record processor can operate simultaneously. Mechanical operations on a disk or tape subsystem, such as seek and rewind, can proceed simultaneously with a data transfer on the same subsystem.

MASS STORAGE

CII-HB currently offers three disk-pack drives for the 64/DPS systems. Capacities range from 100 million bytes to 635 million bytes per drive. Transfer rates range from 806,000 bytes/second to 1,200,000 bytes/second.

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MSU0405 MASS STORAGE UNIT: This unit uses packs with 12 disks and 19 recording surfaces to provide 100 million bytes of storage. Average seek time is 30 milliseconds, average rotational delay is 8.3 milliseconds. The transfer rate is 806,000 bytes/second. Rotational speed is 3,600 rpm. During data transfer on one drive, a simultaneous seek operation can be performed on all other drives on the same Mass Storage Processor. Features include the insertion of a checking code in each record during write operations and the provision of a "write protect" capability that allows individual disk packs to be limited to read operations. The drive uses Type M4451 disk packs. Recording format is 411 tracks, including seven spares.

MSU0455 MASS STORAGE UNIT: This unit uses packs with 12 disks and 19 recording surfaces to store up to 200 million bytes of data. Average seek time is 30 milliseconds, average rotational delay is 8.3 milliseconds. The transfer rate is 806,000 bytes/second. Rotational speed is 3,600 rpm. During data transfer on one drive, a simultaneous seek operation can be performed on all other drives on the same Mass Storage Processor. Features include offsetting of heads under system control when initial read attempts fail, the insertion of checking codes during write operations, and a write protect capability. The drive uses Type M4451 disk packs. Recording format is 822 tracks, including 14 spares.

MSU0555 MASS STORAGE UNITS: This unit comprises a cabinet housing two 635-megabyte fixed disk packs, yielding a total unformatted storage capacity of 1,270 million bytes. Each disk pack has 20 data surfaces, with 19,060 bytes per track and 1,676 tracks per surface. Average seek time is 33 milliseconds, average rotational delay is 8.3 milliseconds. The peak transfer rate is 1,200,000 bytes/second. Rotational speed is 3,600 rpm. Each pack is accessed individually by a direct attachment to the mass storage processor. The validity of recorded information is ensured by the insertion of characters of check information (EDAC code: Error Detection and Automatic Correction). In each block of data, data integrity is enhanced by the automatic detection of defective tracks and the bypassing of these areas when writing to disk. A write protect capability allows the user to protect the disk packs individually against inadvertent writing. On-line error and status reporting to the central system allows software-controlled diagnosis of the electronics. A built-in hardware diagnostic capability supports rapid off-line diagnosis and testing.

INPUT/OUTPUT UNITS

MAGNETIC TAPE UNITS: CII-HB currently offers eight tape drives for the 64/DPS. All can read/write in any of the following modes: 9-track, 1600 bpi, phase-encoded; 9-track, 800 bpi, NRZ; and 7-track, 200, 556, or 800 bpi, NRZ.

MTP 4101/4200 MAGNETIC TAPE PROCESSORS: The standard recording mode supported is 9-track, 1600 bpi, phase-encoded. Other modes are options. The controller includes a microprocessor, read-only memory, scratchpad memory, peripheral subsystem interface control, and device level interface control. Microdiagnostics are automatically initiated at power up, at system initialization, and when software detects a fault. Maximum throughput is 312 kilobytes/second.

MTP4300 MAGNETIC TAPE PROCESSOR: A two-channel version of the MTP4200, this controller supports up to eight Magnetic Tape Units. It can handle two data transfers simultaneously when equipped with a second channel and two of each option ordered. Maximum throughput is 312 kilobytes/second.

MTP4400/4500 MAGNETIC TAPE PROCESSORS: These units have the same specifications as the MTP4200 and 4300 respectively, with GCR (Group Coded Recording) capability (6250 bpi).

MTU0104/0105 MAGNETIC TAPE UNITS: These master/slave units operate at 18.75 inches/second and transfer data at 30 kilobytes/second at 1600 bpi. Each master unit can support two drives plus two slave drives. A maximum of eight drives can be connected by configuring two master and two slave clusters. Each drive can be equipped for either 9-track or 7-track recording.

MTU0200/0201 MAGNETIC TAPE UNITS: These master/slave units have the same specifications as the MTU0104/0105 units, except that they operate at 37.5 inches/second and transfer data at 60 kilobytes/second at 1600 bpi.

MTU0430 MAGNETIC TAPE UNIT: This unit operates at 75 inches/second and transfers data at 120 kilobytes/second at 1600 bpi. Error correcting features include read after write. Each drive can be equipped for either 9-track or 7-track recording, and up to eight drives can be connected to an MTP4300 controller.

MTU0530 MAGNETIC TAPE UNIT: This unit has the same specifications as the MTU0430, except that it operates at 125 inches/second and transfers data at 200 kilobytes/second at 1600 bpi.

The following three magnetic tape units must be attached to the MTP4400/4500 magnetic tape processors.

MTU0335 MAGNETIC TAPE UNIT: This unit operates at 37.5 inches/second with a maximum transfer rate of 234,000 bytes/second. Recording mode is 1600 bpi PE (Phase Encoded) or 6,250 bpi GCR (Group Coded Recording).

MTU0435 MAGNETIC TAPE UNIT: This unit has the same specifications as the MTU0335, except that it operates at 75 inches/second and can attain a maximum transfer rate of 469,000 bytes/second.

MTU0535 MAGNETIC TAPE UNIT: This unit has the same specifications as the MTU0335 and MTU0435, except that the operation speed is 125 inches/second, yielding a maximum transfer rate of 781,000 bytes/second.

UNIT RECORD PROCESSOR: This integrated controller has five device ports plus ports dedicated to the console and communications. On models 64/DPS-4 and 64/DPS-6, a second processor, the URP4300, can be added, providing three more device ports plus a second communications port. Each peripheral device connects to a device port via an addressing attachment.

CRU0301 CARD READER: This table-top unit reads at 300 cards/minute and has 1000-card input and output hoppers. Options include IBM and Honeywell mark sensing adapters.

CRU0501 CARD READER: This table-top unit reads at 500 cards/minute, but otherwise is the same as the CRU0301.

CRU1050 CARD READER: This unit reads at 1,050 cards/minute and has a 3,000-card input hopper and a 2,500-card output stacker. In addition to reading 80-column cards punched in either Hollerith or binary, the unit can be equipped to read 51-column cards and 40-column mark sense cards. Each column is read twice and, in Hollerith mode, characters are checked for validity. When an error is detected, the reader, under software control, can either offset the card in the stacker or stop.

PCU0120 CARD PUNCH: This unit punches 120 cards/minute and has a 1,600-card input hopper and a 1,500-card output stacker. Cards can be punched in Hollerith or binary. When an error is detected, the punch can be told either to offset the card in the stacker or to stop. The unit automatically skips leading blank columns at high speed, resulting in higher punching rates.

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DDU4050/4051 DISKETTE DRIVES: These diskette drives are connected to the 64/DPS CPU via the Service and Unit Record Processor or an additional Unit Record Processor. One diskette drive unit may be connected to each Unit Record Processor. The diskette is organized into 77 tracks with 26 sectors per track and 128 bytes per sector. Only 74 of the tracks are used for data. Total data capacity per diskette is 246,272 bytes. Rotational speed is 360 revolutions per minute, and the transfer rate is 32.2 kilobytes per second. The 4051 is a dual density version, providing 402,544 bytes of storage capacity.

PRU0615 LINE PRINTER: Rated at 600 lines/minute when using a 64-character set, this buffered unit uses interchangeable belts containing 480 characters. A belt can include a maximum of 240 different characters. When belts are changed, the operating system must be instructed to load a corresponding belt image into the printer's controller. Forms control, including selection of 6 or 8 lines/inch and skipping, is under program control. Line length is 132 positions, optionally 136 positions. Form widths can range from 4 to 19 inches, lengths from 4 to 16 inches. The unit can print an original and five carbon copies or 10 self-carbon copies.

PRU0845 LINE PRINTER: This is an 800 line/minute version of the PRU0615.

PRU1040/1045 LINE PRINTER: This is a 1,000 line/minute version of the PRU0615/0845.

PRU1600 PRINTER UNIT: Using an interchangeable print belt, this unit operates at speeds up to 1,600 lines/minute. The standard belt contains 63 OCR-B characters, but belts can contain as many as 240 different characters. To increase speed, special belts can be designed so that the most used characters are repeated at different frequencies according to their use. The belts are identified by a magnetic code recorded on their base, and the printer uses this code to make sure it has the correct belt image stored in its buffer. Belt images are loaded into the buffer by the operating system. CII-HB says the unit produces smear-free printing because the fingers containing the characters are so flexible that they are momentarily immobilized when struck by a hammer.

Parameters for number of lines per inch (6 or 8) and vertical form positioning, including skipping, are under program control. An overtemperature control, however, can slow the skipping speed or halt the printer if the operating temperature exceeds pre-set limits. Skipping speed normally ranges from 23.5 inches/second for one to three lines up to 90 inches/second for more than six lines.

Standard line length is 136 positions, optionally expandable to 160 positions. The pitch is 10 characters/inch. Forms can range from 4 to 18.25 inches in width and from 4 to 16 inches in length. By leaving the cabinet door open, forms up to 22 inches wide and 24 inches long can be stacked externally. The unit can print one original and up to five carbon copies or 10 self-carbon copies.

COMMUNICATIONS CONTROL

All 64/DPS systems are equipped with an Integrated Communications Controller that interfaces with the Service and Unit Record Processor. The controller supports up to 15 lines at speeds to 19,200 bits/second in any mixture of synchronous and asynchronous modes. On the 64/DPS-4, a second controller can be added, bringing the total number of lines supported to 30. On the 64/DPS-6, a third controller can be added, bringing the total number of lines to 45.

In addition to directly supporting terminals, a 64/DPS system can support one or more remote batch, interactive job entry, or transaction processing Mini 6 satellite systems. 64/DPS systems can also be configured into dual, coupled systems that can share the same data base and peripherals.

DATANET 7100: The DATANET 7102/7103 hardware, based on the Mini 6 architecture, provides access to the networking capabilities supported under CII-HB's Distributed Network Architecture (DSA) philosophy. The network software handles the following functions: front-end processing, concentration, switching, and network administration.

The DATANET 7102/7103 Front-End Processors (maximum of 2) are directly connected to the 64/DPS I/O channels. A 7102 or 7103 can be connected to two 64/DPS systems via two simultaneously active I/O channels, with dynamic network sharing.

The 7103 provides higher processing speeds and can support more lines than the 7102. The 7102 controls up to 48 lines, the 7103 up to 128 lines. All systems include a processor and main memory of up to 256K bytes; the Datanet 7103 also includes cache memory. MOS memory is based on 16K-bit chips providing a cycle time of 550 nanoseconds per two-byte word. Each word incorporates EDAC code that allows the detection and automatic correction of single-bit errors and the detection of double-bit and most other errors. One or two memory controllers may be present. Each supports up to 256K bytes, giving a maximum capacity of 512K bytes.

Using the DATANET 7100 as an interface, the 64/DPS will support the following types of terminals and operation:

- Asynchronous, character mode line procedure

  KSR 33/35
  TN 300/1200
  TTU/8124/8126
  DTU 7172 (DTU 7171 mode)

- VIP synchronous line procedure

  VIP 7001/7002
  VIP 7700/7760
  TTU 8221
  STS 2840

- QUESTAR-T Range

  DKU 7001/7005/7007
  DKU 7021/7042/7043

- Satellite Systems

  TTS 7800
  Mini 6 DSS
  61 DPS

SOFTWARE

OPERATING SYSTEM: The most recently released version of GCOS 64 is Release 1-E, which features enhanced microprogramming capability, extension of the Universal File Access System (UFAS), improved program development capabilities, and enhanced communications capabilities (all relative to Release 1-C).

GCOS 64 RELEASE 1-E: Release 1-E provides concurrent support for one batch job stream, one compatibility-mode job stream (Series 100 or Series 200/2000 emulation), a system input reader, a system output writer, communications, and a transaction processing system. Additional batch job streams can be run in place of other activities up to a maximum of five. The sixth job slot is always taken by the output writer.

Up to 64 jobs can be loaded under Release 1E. Based on their priorities, these jobs will be started as job slots become available. Jobs are divided into job steps (individual programs), and job steps into processes (tasks). Steps of a job

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are run sequentially, but processes within steps are executed in parallel whenever possible.

Automatic memory management is based upon variable length program segments rather than fixed length pages. The compilers automatically divide a program into segments, placing code (always re-entrant) and data into different segments. Optionally, the programmer can define the segments he wants. COBOL programs normally are segmented by section, FORTRAN programs at natural boundaries, and RPG II programs by logical functions.

GCOS 64 supports any combination of batch, interactive, or service activities, such as multiple output writers. Each program can be divided into job steps, each with its own separate set of segment tables. The maximum number of job steps in the system is 256, effectively providing the nucleus of a virtual memory system with multiple virtual spaces.

GCOS uses segment-relative addressing. Each address includes a segment number and a displacement number. When an address is referenced, GCOS first checks an associative memory containing the absolute addresses of the last eight segments referenced. If the segment is in real memory, GCOS places the real address in an index register. If the segment is on disk, GCOS brings it into real memory. If the segment's address is not in the associative memory, GCOS refers to a complete table of segments to locate it on disk and then brings it into real memory. If there is not enough space for the segment in memory, GCOS first tries to make adequate space by reorganizing memory. If this approach fails, GCOS will remove the least-active segment from memory to create space.

Each segment is protected by a four-level ring system. Rings are numbered 0 to 3, with 0 the most privileged level. Each possible use of the segment—read, write, or execute—is assigned a protection level. When an address is referenced, the appropriate protection level is compared to the current ring number of the central processor. Access is allowed only if the ring number is less than or equal to the protection level. Code is always assigned protection level 0, which effectively makes it unwritable and prevents accidental or unauthorized alterations. Rings 0 and 1 are reserved for system software, 2 and 3 for application programs.

64/DPS integrity features include error logging, file security, and recovery routines. Whenever the firmware of the 64/DPS system discovers an error, it notifies the appropriate routine. This notification takes place whether the firmware recovered the error or not, so that GCOS is always aware of the state of the system. The routines diagnose the error and update an error accounting area in memory. Error accounting information is used to keep track of the state of all system components and to update a permanent accounting file. This permanent file eases routine maintenance of the system; extensive error accounting information allows failing components to be identified and replaced before they cause problems.

GCOS 64 also includes a variety of file security aids. A save/restore utility is available for taking security copies of files, and both copies and saved generations of a file can be included in the system catalog.

GCOS includes a journal function to speed file recovery. The journal is used to save all the updates to a file since the last security copy was taken. The journal, together with the catalog and the restore utility, provides all the information needed to rebuild a damaged file to its correct state.

To reduce the possibility of a system failure, GCOS 64 provides a fast recovery facility in rerun support. Rerun support allows processing to be restarted immediately, either at the beginning of the job step or at the last checkpoint. The restart procedure includes automatic repositioning of the user's files and the recovery of all files and queues used by the system, including the input reader and output writer files. The output writer can restart printing at any specified block.

Job flow through the 64/DPS system is controlled by GCOS job management. The input reader reads the job input while other jobs are executing and translates the job control information into an internal format to speed job processing. A job scheduler schedules the execution of the job using a system of job classes and priorities within each class. Resources are allocated at file, volume, and device levels to each job step, and deallocated when each job step is completed. Job accounting information is collected at all stages of the job's passage through the system. Job accounting information, along with the results of the job, is provided by the output writer, asynchronously with job execution.

The file management routines of GCOS handle allocation and deallocation of space for files, automatic label checking, automatic volume recognition, control of multiple concurrent accesses to files, and control of multiple copies and generations of files through the catalog. Additionally, they provide various access methods to different file organizations and also file and volume utilities to support file housekeeping.

GCOS allocates resources to job steps rather than to whole jobs to ensure effective use of the available resources. Space is allocated for files, and files are assigned to programs at the start of the job step requesting them. The files are then unassigned, and space for temporary files is normally released as soon as the job step has completed.

When assigning a file, the user defines the file as either permanent or temporary. If the user wishes to retain a temporary file for several job steps, a parameter in the ASSIGN statement prevents the file space from being released until the end of the job.

To request space for a file, the user specifies the type of device, the identity of the volume, and the amount of space required. GCOS then searches the specified volume and automatically allocates any space available. Disk space need not be contiguous; GCOS can allocate space for a file using up to five separate areas on any one volume, and can spread the file over a number of volumes if required. On magnetic tape, GCOS supports any number of files on a single tape.

When a new file is created, file management automatically creates the appropriate labels, and these are subsequently checked every time the file is opened for processing. On disk, labels are stored in a special area called the volume table of contents (VTOC). On tape, the labels are created at the head and the tail of each file.

Disk files are sharable under 64/DPS GCOS. However, if file protection is required, multiple access can occur only in read mode.

Volume mounting and dismounting is controlled automatically by the system, and warnings are given if the wrong volume is used. This control is based on the volume label, which contains a unique identifier for each volume. When a volume is mounted, the automatic volume recognition feature reads its label and the identifier is stored. When space is requested or a file is opened on a specific volume, the file management system is aware of its status. If the volume is not mounted, an operator message is issued.

Among the file characteristics recorded in the file catalog are the generation number and copy number of each file. The records for different generations and copies of the same file are linked together, and the catalog automatically controls the numbering and deletion of file generations to maintain the number of generations specified by the user. Each record also

contains a list of the volumes on which that copy of the file resides.

To access the latest generation of a cataloged file, the user's program refers to a file by name. This program internal name is matched to the external name of the required file when the file is assigned to that program, and the external name is used to access the catalog. The catalog automatically provides the latest generation of the required file, and supplies the file access system with the identifiers of the volume(s) on which that generation resides. Since automatic volume recognition has recorded the address of the device on which each volume is mounted, and the file label indicates the extent of the file, access to the file is complete.

The main file access system of GCOS 64, the Universal File Access System (UFAS), replaces random, sequential, and indexed sequential files. UFAS satisfies all the requirements of the ANSI Mass Storage Task Group recommendations for sequential, relative, and indexed access. It is independent of device characteristics, file organization, media addresses, and media formats.

Programs can access data sequentially, randomly by key, directly, or directly by relative position on the same UFAS file. The access method can change every time the file is accessed. UFAS files can be indexed or non-indexed; if indexes are used, they can be multiple-level, and records with indexes can be intermixed with records without indexes. UFAS can handle fixed-length, variable-length, and dynamically variable records, and a UFAS file can contain a mixture of different record types.

The file organization of a UFAS disk file is based on control intervals and control areas containing embedded free space, thereby eliminating the need for overflow areas. When records are inserted into a UFAS file, they can be physically located in their logical positions on the file; access time is reduced and the need for frequent reorganization removed. In addition, the physical record sizes in a UFAS file are independent of the lengths of the logical records. When the file is moved from one medium to another, the physical record size can change to adapt to the new medium without affecting the file or the programs using it.

UFAS has been enhanced to include access to specific file items by any one of 15 characteristics without a prior sort. A new dynamic file extension facility allows extension of files as required.

In addition, GCOS 64 offers a very flexible method for file indexing called the Multiple Logic Data Store (MLDS), which has the following characteristics:

- Random access using the primary index and the symbolic key
- Random access using the secondary index (8 maximum) and the symbolic key
- Sequential access using the primary or secondary index and the symbolic key
- Physical sequential access (by record loading order) RPG II
- Random access by relative address (RPG II)
- Loading of records sorted on the primary key or unsorted
- Automatic update of the primary index at each insertion of a new record
- Independent creation of secondary indexes
- Each secondary index is an independent file
- Deferred update of secondary indexes
- Several logical records can have the same secondary key value
- Management of complementary records dependent on a primary record
- Creation of one or more secondary indexes for complementary records
- Creation of one or more secondary indexes for primary records
- Creation of one or more secondary indexes for primary or complementary records which meet a user-defined criterion
- Primary or secondary index at two levels
- Index (primary or secondary) input by logical record
- Intensive use of the hardware operation for key search
- Global or distributed primary index
- Compatibility with Levels 61 and 62
- Capability to catalog an access path to the file records (access authorization to an index)
- Independence of the file in relation to the medium by use of a type of relative addressing in the indexes
- MLDS is supported by the COBOL and RPG II languages.

GCOS also supports classical files with the Basic File Access System (BFAS). BFAS includes three subsystems:

- Basic Sequential Access, which supports sequential files on disk units EBCDIC code and on tape using either EBCDIC or ASCII code. Records can be fixed, variable, or undefined.
- Basic Indexed Sequential Access, which supports indexed sequential files on disk. Files can have up to six levels of index, with the highest-level index being resident in memory. Overflow space can be reserved within the prime data areas, on separate cylinders within the file.
- Basic Direct Access, which supports access by relative record number and by complete or partial physical address to disk-based files. Basic Direct Access includes a number of established randomizing algorithms.

A fourth set of access methods, the Honeywell File Access System (HFAS), gives full access to files in the format used on Series 200/2000 systems. HFAS includes all the features available with BFAS.

DATA COMMUNICATIONS SOFTWARE

The GCOS data communications software, together with the DPS/64 communications hardware and firmware, handles networks of up to 45 lines, with up to 32 terminals per line on the DCC4100 Integrated Communications Controller. A network can include switched, private, and direct-connect lines as well as a variety of terminal types.

GCOS provides two methods of interfacing the user programs with the communications controller.

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The *Message Access Method* handles a system of queues to provide a buffered interface between the data communications network and the user's programs, allowing serial or selective processing of messages.

The *Transaction Driven System (TDS/64-Standard Processor)* is a conversational system for handling a message entered by a user via a terminal, the initiation of a processing routine specific to that type of message, the processing of the message, and the response sent to the terminal. A library of mostly user-written transaction processing routines (TRP's) correspond to the various types of messages accepted by the system. TDS/64 can handle several dozen different transaction types in a single session. Time and memory space are optimized by utilizing a single copy of a TPR even though the requests for that TPR may come from different terminals. TDS/64 provides a batch interface allowing batch programs to interface with it as though they were terminals. This facility is particularly useful in debugging the transaction system without incurring real-time constraints. TDS/64 has access to all files supported by GCOS as well as concurrent access control, journalization, and file recovery of UFAS files. Security is provided through controlled file access and authority codes. All input messages to TDS/64 are journalized to guard against information loss.

The *Remote Batch Facility (RBF)* enables remote job entry from a Level 6 card reader, cassette, or disk file to a 64/DPS and output return to a Level 6 printer or disk file for later printing. RBF consists of RBF/6, which runs under GCOS 64, and RBF/64, which runs on the Level 6 under control of GCOS 6 Mod 400. RBF operates under synchronous transmission using two or four wire connection in half duplex mode up to 9600 bps. The 64/DPS host can support up to six Level 6 systems acting as RBF terminals each on a separate line and on a concurrent basis.

The *File Transaction Facility (FTF)* enables exchange of 64/DPS and Level 6 sequential disk files. FTF provides data compression during transmission, verification of transfer unit sequence number to ensure that units of file transfer are not lost or duplicated, and a file identification security feature. Up to five transmissions may be handled simultaneously by one copy of the 64/DPS utility program. Any number of users in groups of five may be connected serially. FTF operates under synchronous transmission with two-way alternative transmission on half/full duplex lines at up to 9600 bps. Support of multipoint and dedicated, switched, or direct connections is provided.

The *Data Entry Facility/Interactive Entry Facility (DEF/IEF)* provide a 64/DPS host in a distributed systems environment with a clustered, interactive, programmable terminal capability. In this case, IEF is configured as an extension of DEF. DEF/IEF operate under Level 6 GCOS Mod 400 and provide up to 14 VIP7200 Operator Display Stations emulating VIP7700s. The facilities provided for the VIP7200's are enhanced but similar to those of a clustered VIP7700 system. Data entry is interactive with 64/DPS applications. Each operator display station has independent access to all 64/DPS interactive systems, including TDS and IOF. DEF software can validate and preprocess data as it is entered from the VIP7200 before it is transmitted to the 64/DPS. IEF uses the Polled VIP Emulator to communicate with a 64/DPS utilizing synchronous VIP 7700 line protocol.

DATA BASE MANAGEMENT SOFTWARE

INTEGRATED DATA STORE II (IDS II): The IDS II data base management system includes a data description language for describing the data base and a data manipulation language for accessing data. Data relationships can be multi-level, multipath, tree, network, and compound network structures. For a complete description of IDS II, see report number 70E-480-01.

QUERY: The Query file inquiry system is a general-purpose system for handling data from terminals, although it is equally well-suited to use in batch mode. Query is available in two versions: inquiry only—which provides features for searching on selected criteria, sorts, calculations, printing standard or tailored reports, creation of sequential files internal to a procedure or for input to a high-level language program; and inquiry and update—where the inquiry-only verison is extended by the addition of a module which permits modification to user records. Query supports BFAS indexed sequential and sequential file organizations, UFAS indexed and sequential organizations and an IDS II Data Base.

PROGRAM PREPARATION FACILITIES

In addition to the high level languages (see separate listing below) DPS/64 systems under GCOS provide a static linker, an interactive text editing and operation facility (IOF), and program libraries. The static linker combines the output from language processor runs and program libraries to form an executable version of the program called a load module. The processor runs may be from the same or different language compilers.

IOF provides for the interactive use of the GCOS library maintenance routines including the text editor. The text editor permits the user to manipulate lines, characters, and strings of characters with a source data file. IOF also provides for the remote initiation of requests for batch job execution, remote status inquiry and control of job execution, remote scanning of job outputs with control of delivery, and interactive interface with multiple user programs.

GCOS 64 supports three types of program libraries along with maintenance routines for the libraries. Library types include source, compile unit (output from compilers), and load module.

PRODUCTIVITY AIDS

PREFORMS: PREFORMS is a screen formatting tool for the programmer that provides the following advantages: it saves programming time by eliminating the COBOL screen description, reduces debugging time by eliminating the manipulation of service codes, and saves time by automatically optimizing message lengths.

PREFORMS composes, stores, and modifies the forms of display screens for VIP 7700, VIP 7760, VIP 7001 and compatible terminals connected directly to the 64/DPS.

PREFORMS can also be used to generate forms for terminal screens connected to Mini 16 remote processors and for the Transactional Terminal System TTS 7800, considered a "virtual" VIP 7700.

FORMS: FORMS provides the programmer with the means to define, build and maintain forms that will be displayed during the execution of transactions. It also handles the display of forms at run time and the transfer of data between the program and the terminal. Running in batch or interactively (under IOF), FORMS creates screen files or lines of source COBOL that can be incorporated into transactions. The images of screens created in this manner are indpendent of the type of terminal used. It is therefore easy to transfer an application from one type of terminal to another, since personalization is automatic when the application is executed.

WORDPRO: WORDPRO provides functions for editing, formatting, and typesetting documents. An integral part of GCOS 64, WORDPRO creates and maintains documents in variable formats, from the simplest to the most complex (letter to complex technical presentation), simultaneously with any other data processing activity. Designed for people

with little or no experience in data processing or typesetting, WORDPRO provides them with an easy means of entering and editing text. The security available at the level of WORDPRO is the same as for all information processed in the 64/DPS. The documents residing in virtual memory receive the same protection as any other type of work, whether file or program.

PROGRAMMING LANGUAGES

Cii Honeywell Bull provides COBOL, RPG II, FORTRAN, BASIC, PL/1, APL and GPL (GCOS Programming Language) for the 64/DPS.

COBOL: 64/DPS COBOL conforms to ANSI 74 standards, including those of the MSTG (Mass Storage Task Group). An optional COBOL Data Communications Extension program module is available.

The 64/DPS COBOL language processor automatically segments the object programs it produces. Users classify each section of a program's Procedure Division by assigning it a status level between 0 and 99. Sections assigned to level 0 are permanent segments that cannot be overlaid. Sections assigned level numbers between 1 and 49 are fixed segments, and those given numbers above 49 are independent segments and will be selected for overlaying before fixed segments. Unassigned segments are given the default assignment of level 0, and multiple segments may be assigned to the same level. This last feature is important for segments that need to communicate with each other.

Users also control the segmentation process by specifying a maximum size for both procedure and data segments. The compiler produces segments as close as possible to these limits, but they are not regarded as absolute limits. The compiler insures that no data items are split between segments and will override the user-specified limits to reduce the swapping activity that would result. Segment sizes are specified in the Environment Division of the program, enabling fine tuning without the need to change the body of the program.

64/DPS COBOL data communications capabilities include the Message Access Method, which handles all message flow between user programs and the network by establishing queues and operating from these. The COBOL communications facility consists of a Communications Section to describe the queues, and ENABLE, DISABLE, SEND, and RECEIVE verbs to communicate, via the queues, with the network. The ENABLE and DISABLE verbs are used to open and close the connection between the Message Access Method and a given terminal. The RECEIVE statement causes a message from a specified queue to be passed to the program, and the SEND verb causes a message from the program to be placed in a specified queue. An ACCEPT MESSAGE COUNT statement can also be used to access counts of messages in the queues.

The COBOL Data Communications Extension (CTG/MCS) is an optional extension to the basic COBOL ANS 74 language processor that provides language and functions representing Level 1 support of the Communications Module of the 1974 COBOL ANSI standard. These standards are based on the recommendations of the Communications Task Group (CTG) to the CODASYL Committee, which were subsequently included in the CODASYL Journal of Development for the COBOL language. These language elements include such statements as SEND, RECEIVE, ENABLE, DISABLE, etc., and provide the required prerequisite to use of the Message Access Method (MAM) as well as TDS/64. In conjunction with Basic Terminal/Network Support (BTNS), MAM serves as the 64/DPS GCOS response to the CTG requirement that the COBOL program interface with a Message Control Supervisor (MCS). These products jointly provide the MCS attributes and functions necessary to conform with the ANS standards.

64/DPS COBOL is provided with two aids to program debugging. The first is through the use of debugging lines as defined by ANSI. The second is through the use of an interface to the GCOS Debugging Support Processor.

RPG: The *RPG II* language processors used in the 64/DPS system permits the interchange of data files among RPG II, FORTRAN, and COBOL programs. Object programs written in RPG II can also be linked with programs written in COBOL, FORTRAN, or other languages.

The RPG II compiler features automatic file manipulation and disk handling, support for sequential, indexed, and relative file organization, physical sequential reading of indexed files, relative access to index files, device independence of sequential files, dynamic table handling capabilities, and the use of standard data management access routines by object programs.

RPG provides support for sequential indexed, relative (indexed sequential), and direct file organization. File access can be physically sequential, sequential by key, direct by key, direct by relative address, or direct by absolute address. RPG also supports the Honeywell file access methods BFAS, HFAS, and UFAS.

RPG uses five files: two work files; a complete unit library for the generated program; and two input files, one for job control and one for input data. The processor accepts data from card, tape, or disk, and its output can be directed to any device supported by the GCOS output writer.

The RPG language processor features a fixed logic cycle that uses default values and specifications for certain control functions. The need to make many processing decisions (such as file selection, record input, input record formatting, and description of matching fields) is eliminated by the fixed logic cycle. Record selection and output are reduced to operations described by previously defined specifications rather than by individual procedural statements. During each cycle, the fixed logic presents the user with a single input record in the form required for calculations. Any number of output records can be produced by one cycle.

The 64/DPS RPG compiler adapts automatically to the amount of main memory available. If the allocated space is insufficient, GCOS automatic management facilities will allocate more space as it becomes available.

FORTRAN: 64/DPS FORTRAN meets the ANSI standard for FORTRAN IV and provides several Honeywell extensions including those designed to improve compatibility with FORTRAN Y (Series 6000).

The language processor consists of two packages, the FORTRAN compiler and the FORTRAN run-time package. FORTRAN requires the implementation of the scientific instruction set. The language processor executes either in compile-only environment (with or without the production of compile units) or in a compile-and-go environment in which the output is submitted directly to a linking loader and the resulting program is executed as part of the job stream.

64/DPS FORTRAN produces four levels of diagnostic messages. Level 1 diagnostics point out instances of code usage that could lead to less efficient execution. Level 2 diagnostics warn users of potential error conditions that could results from code usage. Level 3 diagnostics alert users to serious coding mistakes, and Level 4 diagnostics indicate fatal coding errors that would make further processing impossible. Level 4 diagnostics also cause the generation of the object program to be suppressed, but syntax checking continues. All other diagnostics do not affect compilation.

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The 64/DPS version segments the compiled output, generating a collection of "compile units" that each represent a program segment, subroutine, or data block. These compile units are written into a temporary library from which they can be cataloged into a permanent library or submitted to a linking loader for execution. The language processor further segments the compile units into code, local data, and global data. This segmentation process permits users to take advantage of the memory management facilities of GCOS and the 64/DPS hardware.

The FORTRAN library contains routines for many mathematical calculations plus run-time packages to handle FORTRAN functions such as STOP and PAUSE and dynamic error diagnostics.

BASIC: 64/DPS BASIC is an incremental compiler, checking syntax and generating object code at the input of each instruction. Under 64 GCOS, BASIC programs can be developed and executed in either batch or interactive mode. Interactive mode requires the Interactive Operating Facility (IOF). BASIC as implemented in the 64/DPS provides 38 standard mathematical functions and these facilities: GO SUB, used to branch to a subprogram within the program; RETURN, used to return from the subprogram to the main program after a GO SUB statement; and DEF, used to define single-line or multiline user functions. 64/DPS BASIC requires the FORTRAN math library.

PL/1: GCOS PL/1 meets the ANSI standard. Also, as developed for GCOS 64-E, PL/1 offers extensions designed to facilitate structured programming: for example, DO...UNTIL. It can also call for routines written in COBOL and manipulate standard GCOS 64-E files (BFAS, UFAS, MLDS). PL/1 is also able to manipulate processing of magnetic tapes containing ASCII files or files of a non-standard format or record through the facilities provided by GCOS 64-E data management.

APL: APL is a GCOS 64 processor which, like BASIC, is designed to be especially used by non-data processing personnel. It makes it possible to rapidly obtain results within good performance and efficiency conditions.

APL is implemented in a GCOS 64 interactive environment and from specialized terminals (for example, from the Anderson-Jacobson AJ 832 terminal).

GCOS 64 APL makes it possible to work on scalar variables, vectors, sets and tables with a maximum of 15 dimensions. The usual functions of APL are available and the user may define and integrate his own functions.

The debugging of programs is facilitated by the ability to display intermediate results, stop the execution of a function, or replace standard error messages with a sequence written in APL which explicitly describes the situation. Finally, the user may interrupt his work and continue later through a "save" function.

Files accessible by APL are sequential files which may be permanent or temporary and which may or may not be catalogued.

GPL: The GCOS Programming Language (GPL) is oriented toward the development of system software. In some ways similar to PL/1, GPL has a free format syntax capable of manipulating strings of bits and list structures and has powerful data declaration and manipulation capabilities.

GPL does not support the processing of floating point numbers. However, it contains instructions necessary for structured programming and also functions for the processing of indexes, bit strings, etc.

CONVERSION AIDS

The TRANSIT software package is a complete conversion package, containing automatic translators for files and source programs written in COBOL and RPG, as well as a comprehensive manual detailing all the steps necessary for complete conversion to a 64/DPS system. The TRANSIT conversion packages allow data files and RPG source programs from IBM System/3 and System/370 to be transferred to a 64/DPS system. In addition, users can migrate from ICL 1900 PLAN to COBOL 74. TRANSIT B and TRANSIT BS-1000 also allow conversion of foreign COBOL and RPG II programs to 64/DPS format. In addition, source COBOL and MiniCOBOL programs can be transferred from Honeywell's Series 200/2000 or Level 64 systems to 64/DPS systems.

REMOTE MAINTENANCE SYSTEM 64/DPS: RMS 64/DPS consists of a remote console interface adapter and software diagnostic interface modules combined to provide an extension to the system console for field engineers. The engineers are remotely located and connected via phone lines. Remote Maintenance System 64/DPS provides the ability to troubleshoot hardware and firmware problems as well as software bugs. With this facility, key diagnostic programs that operate under 64/DPS GCOS can be remotely executed and patching of many software difficulties can be accomplished without an on-site visit. Remote Maintenance System 64/DPS operates only when the system is in maintenance mode and provides documentation of all communications via the system console.

APPLICATIONS SOFTWARE

APPLICATIONS: GCOS supports several applications packages that can be run as stand-alone systems or as composite parts of user-designed systems. All of the following packages are written in COBOL and operate under the minimum 64/DPS GCOS configuration.

Distribution Inventory Management System (DIMS)—DIMS is a data-base oriented inventory management system with the following features: seasonal analysis and autoadaptive exponential smoothing forecasting techniques, choice of replenishment policies, order-quantity and service-level projection and optimization capabilities, and multiple warehouse capability.

Production Scheduling and Control System (PSC)—PSC provides production control capabilities for manufacturers including creation, storage, and updating of routing and work-center data in a centralized data base. The system generates cost information and schedules order flows, highlights over- and under-loads on a long-run basis, and produces a variety of reports.

Inventory Management System/64—IMS/64 is a transaction-oriented inventory management system that plans, schedules, and controls the flow of materials and the utilization of resources. The package consists of the following six subsystems: inventory reporting, bill of materials processing, requirements management and reporting, material requirements planning, resource inventory planning, and standard cost control. IMS/64 operates from a data base and produces a variety of reports concerning stock levels, orders, demands, and costs.

Sales Order Processing (SOP)—This package consists of three modules: the order entry module which accepts, validates, and fills orders based on substitution, minimum quantity, partial shipment, and back-order factors; the Billing and Shipment module which prepares warehouse documents and produces sales analysis reports; and the Inventory Accounting module which tracks the status of each item to allow the current stock to be checked.

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UTILITIES: 64/DPS GCOS provides utilities to assist users in managing data and testing software. The Sort routine can handle up to eight record classes. All files to be sorted must be on disk and organized as sequential, indexed, or relative. Output files are organized sequentially. The Merge routine can process up to five sequentially-organized disk input files and can handle up to eight record classes. Omitted records from either the sort or merge routine can be output to an exception file.

PRICING

EQUIPMENT: DPS/64 equipment is available for purchase or for rent under a 1-year, 3-year, or 5-year lease. The 1-year and 3-year basic monthly rentals entitle the user to 176 hours of central processor usage per month with on-call remedial maintenance between the hours of 8 A.M. and 6 P.M. on Mondays through Fridays. For scheduled usage beyond this period, with on-call maintenance service, the user pays an additional charge which is a fixed percentage of the monthly maintenance charge. Alternatively, the user can obtain on-call maintenance service at standard hourly rates.

SOFTWARE: Generally, the basic operating system, basic job management and file systems, programming tools such as linking and debugging aids, the job control language, and conversion aids are provided at no additional cost. A basic kit of documentation is also provided with the system. Monthly license fees are charged for language processors, utilities, application packages, communications software, and advanced job management and file systems. Extra charges also are levied for customer services, such as education, program development, system design, implementation and conversion, and network design.■

PRICING

	Purchase Price (FF)
64/DPS-2	
CPU with 1 megabyte memory Five 200-megabyte disk drives 600-lpm printer Diskette unit Two lines for keyboard/CRTs Software: GCOS, COBOL, TDS, IOF, MLDS, SORT/MERGE	40,000
64/DPS-4	
CPU with 1 megabyte memory Two 200-megabyte disk drives Two 635-megabyte disk drives 1000-lpm printer Diskette drive Two magnetic tape units Four lines for telecommunications processor Software: GCOS, COBOL, TDS, IDS II, IOF, SORT/MERGE	70,000
64/DPS-6	
CPU with 2 megabyte memory Eight 200-megabyte disk drives Two 635-megabyte disk drives 1000-lpm printer Diskette drive 1000-cpm card reader Two magnetic tape units Eight lines for telecommunications processor Software: GCOS, COBOL, IDS II, IOF, SORT/MERGE	86,000