Honeywell DPS 7 Series

MANAGEMENT SUMMARY

Introduced in the United States in 1981, the DPS 7 Series is based on a similar product developed by Cii Honeywell Bull in France. Recently Honeywell announced and began delivering revised versions of the DPS 7 and changed its model designations to DPS 7/35E, 7/45E, 7/55E, and 7/65E. The "E" models are nearly identical in functionality and appearance to the earlier DPS 7 models. New features include direct attachment of selected Level 62 mass storage units to assist Level 62 users in their migration to the DPS 7 and a new tape adapter with two new tape units.

PROCESSORS AND PERIPHERALS

The four DPS 7 models, the DPS 7/35E, 7/45E, 7/55E, and 7/65E, feature a single central processor with substantial use of microcoding to implement system functions. The two smaller systems have a central processor cycle time of 330 nanoseconds while the DPS 7/55E and the top-end DPS 7/65E have a 140-nanosecond cycle time. Main memory sizes range from one to three megabytes in the DPS 7/35E, one to four megabytes in the DPS 7/45E, and two to four megabytes in the DPS 7/55E and 7/65E. The memory read and write cycle times are 355 nanoseconds and 290 nanoseconds, respectively. The systems can have from two to eight high-speed channels, depending on the model. Each model can be field upgraded to the power level and capacity of any of the higher models.

DPS 7 systems are networks of specialized processors that operate simultaneously, and are composed of seven processing elements, a control store, and a processor bus. This processing "system" is connected with the central bus, which also services main memory and the input/output processors. Major system functions such as task management, addressing, and data protection are implemented in firmware, providing a further performance boost. Peripher- ▷

The Honeywell DPS 7 Series systems have been designed primarily to serve as either host processors or remote satellite processors in a distributed processing environment. Positioned as a medium-range family, these systems offer upward mobility within the family and a growth path for Level 62 and Level 64 users. Throughout the DPS 7 line, system upgrades can be performed on-site, without central processor swap-outs or major disruption of operations.

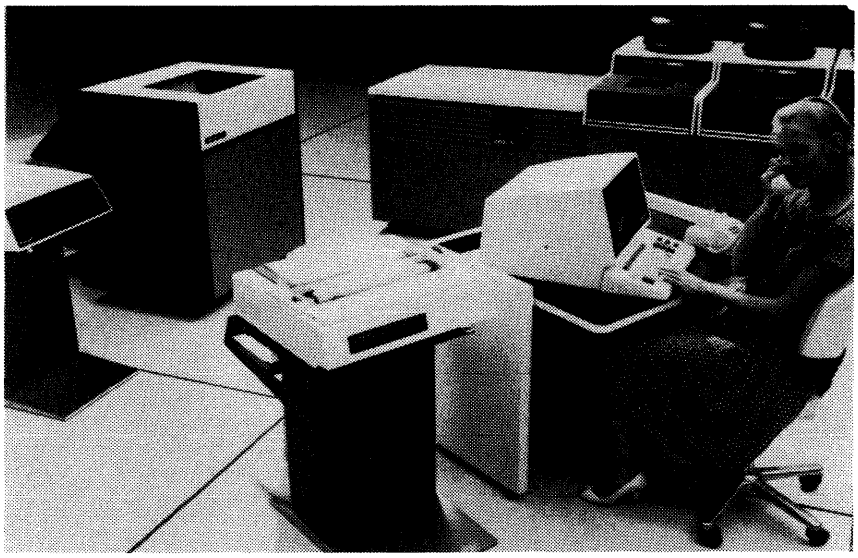
MODELS: DPS 7/35E, 7/45E, 7/55E, and 7/65E.
CONFIGURATION: From 1 to 4 megabytes of memory and up to 20.8 billion bytes of disk storage, 20 tape drives, 10 unit record devices, and 271 communications lines.
COMPETITION: Burroughs B 2900, B 3900, and B 5900; IBM System/38 and 4331–11 through 4341–1; NCR V–8500 Series; and Sperry System 80.
PRICE: Purchase prices range from $85,000 for the DPS 7/35E central processor subsystem to $215,700 for the DPS 7/65E.

CHARACTERISTICS

MANUFACTURER: Honeywell Information Systems, Inc., 200 Smith Street, Waltham, Massachusetts 02154. Telephone (617) 895–6000.

CURRENT MODELS: DPS 7/35E, 7/45E, 7/55E, and 7/65E.

PREVIOUS MODELS: DPS 7/35, 7/45, 7/55, and 7/65. ◀



A typical small DPS 7 configuration includes the operator console and printer plus (left to right) a diskette drive, high-speed line printer, the DPS 7/35 central processor, and three disk drives. The DPS 7 has from one to four megabytes of memory, and supports a wide variety of peripheral devices.

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al devices are connected to the I/O processors, which have their own control stores, logic units, and main memories. Each peripheral subsystem (processor and devices) is then connected to the CPU via a high-speed I/O channel. This distributed architecture enables various subsystems to operate simultaneously, without tying up the main processor.

A wide variety of I/O configurations is possible with the DPS 7. Each processor has an integrated Service and Unit Record Processor (SURP) that can handle five unit record devices (with an option for five more on an additional URP) and two optional communications modules that provide six communications lines each. Up to 20.8 billion bytes of on-line storage can be configured using separate mass storage processors and three different disk subsystems, including a 1.2-billion-byte dual-spindle unit, the MSU0555. As many as 16 tape drives can be connected to the DPS 7 via magnetic tape processors. From one to four additional tape units can be attached using a new tape adapter. The DATANET 8 front-end processor can be used with the DPS 7 to develop distributed networks that conform to Honeywell's Distributed Systems Architecture (DSA). Up to 256 communications lines can be connected this way. Details on the various DPS 7 I/O processors and peripheral subsystems are summarized in the Characteristics section of this report.

SOFTWARE

The DPS 7 operates under the General Comprehensive Operating Supervisor (GCOS). GCOS is a virtual memory, multitasking operating system, and is implemented in hardware, firmware, and software in all DPS 7 models. Parts of it reside in the memories of the input/output processors, enabling these controllers to function independently of the central processor. GCOS schedules the execution of activities, the multiprogramming of job steps, and the concurrent execution of tasks within activities. No reprogramming is necessary when migrating from the Level 64 to the DPS 7. Level 62 users have several transition tools available, and the DPS 7/55E and 7/65E can run Series 200/2000 emulation under control of GCOS. All applications currently available for the Level 64 can run unchanged on the DPS 7.

Highlights of GCOS include virtual memory techniques for support of up to 64 jobs; immediate step activation, designed to provide for the interactive execution of Cobol, Fortran, and RPG language processors, the linker and user object programs; an interactive program, checkout facility for interactive program debugging from a terminal; the Forms Management Utility for interactively creating, modifying, and storing screen formats to ease development of transactional applications; a comprehensive Query language facility; and multiple logic data store (MLDS), an indexed access method for transition from the IBM System/3 to the DPS 7. The GCOS Basic Operating System is provided under a standard no-separate-charge license. All other system software is licensed at a monthly fee.

DATE ANNOUNCED: DPS 7/35E—June 1983; DPS 7/45E, 7/55E, and 7/65E—April 1984.

DATE OF FIRST DELIVERY: Original models—1982; "E" models—December 1983.

DATA FORMATS

BASIC UNIT: 8-bit byte plus one parity bit. The data paths are four bytes (32 bits) wide.

Data can be interpreted as binary, decimal, hexadecimal, or alphanumeric. Data bits are interpreted in groups of four (packed or unpacked decimal data) or eight (alphanumeric EBCDIC), or in strings of between 16 and 64 (binary digits). The strings can be interpreted as signed for fixed-point binary numbers and also as floating-point operands with single- (16-bit) or double- (32-bit) precision formats.

INTERNAL CODE: EBCDIC.

MAIN STORAGE

Memory is organized into consecutively numbered byte locations. Four-byte blocks are always accessed regardless of operand size. Half-word (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.

TYPE: 64-bit MOS chips. Current Mode Logic (CML), a fast, low-power, low-heat technology is used. CML has a propagation time of one nanosecond per logic port. In addition, the DPS 7 uses a multilayer micropackaging technique that allows 10,000 to 15,000 functions per board.

CAPACITY: See Table 1.

CYCLE TIME: See Table 1.

CHECKING: Each item of data stored in memory units and in control store is accompanied by a Hamming code (seven bits for every four data bytes) which permits the correction of single-bit errors and the detection of double-bit errors. Data paths, and particularly, the bus, perform parity checks to ensure data integrity. All registers and calculation circuits include a key check.

STORAGE PROTECTION: The DPS 7 protects every segment individually with an automatic system of rings and protection levels. This protection system, implemented by hardware and firmware, protects segments on the basis of the information they contain rather than their physical location.

The main processor, while executing a process, may be at one of four levels of privilege, called "rings." Rings are numbered from zero to three, with zero being the most privileged. A ring number is allocated to each segment when it is created and, when the process is entered, the main processor adopts this ring number. Each segment is allocated three protection levels, one for each possible use: read, write, or execute. Each level can be anywhere within the range of zero to three. At every reference to an address in a segment, the protection level for the relevant type of use is checked against the current ring number of the main processor. Access is only allowed under the following conditions: for read and write access, the ring number is less than or equal to the protection level; for execute access, the ring number is within the range between the write and execute protection levels. At linking time, the programmer specifies protection levels; this feature controls access to process segments from other active programs.

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TABLE 1. CHARACTERISTICS OF THE DPS 7 SYSTEMS

	DPS 7/35E	DPS 7/45E	DPS 7/55E	DPS 7/65E
CENTRAL PROCESSOR				
Performance extension levels	3	2	1	—
Percent increase over base	40, 95, 190	41, 109	49	—
Relative performance	1.00	1.40	1.95	2.90
Cycle time (nanoseconds)	330	330	140	140
Upgradable to	7/45E, 55E, 65E	7/55E, 65E	7/65E	—
MAIN STORAGE (LSI MOS)				
Read cycle time, nanoseconds	355	355	355	355
Write cycle time, nanoseconds	290	290	290	290
Minimum capacity, bytes	1024K	1024K	2048K	2048K
Maximum capacity, bytes	3072K	4096K	4096K	4096K
Bytes fetched per cycle	4	4	4	4
CONFIGURATION				
I/O channels available	2-4	4-6	4-6	4-8
Mass storage processors (max.)	2	2	3	4
Disk drives (max.)	17	18	27	36
Magnetic tape processors (max.)	1	1	2	2
Magnetic tape adapters (max.)	1	1	1	1
Magnetic tape drives (max.)	12	12	20	20
Unit record processors (max.)	1	1	2	2
Unit record devices (max.)	5	5	10	10
Communications controllers (max.)	2	2	2	2
Communications lines (max.)	12	12	12	12
DATANET 8 Front End Network Processors (max.)	0	1	1	2
Communications lines supported by DATANET 8 (max.)	0	128	128	256

RELIABILITY/MAINTAINABILITY

Honeywell has implemented its Remote Support Facility (RSF) in the DPS 7 systems. RSF permits field engineering personnel to diagnose hardware, firmware, software, and operational (human) problems from the Honeywell Remote Technical Assistance Center concurrently with user production.

Parity is checked on every access to storage, whether mass storage or control storage. Further, parity is checked whenever data is transferred between any two system functional units. Main memory is error detecting and correcting (EDAC) memory that appends a six-bit error-correcting code to each four-byte word. This code permits automatic correction of single-bit errors and flags multiple-bit errors after retrying the access. All failing operations are retried up to eight times in order to continue processing.

The DPS 7 service and unit record processor (SURP) 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 SURP read/write memory, enabling it to perform system tests and report results locally on the system console and remotely to Honeywell field engineering support specialists through RSF.

DISTRIBUTED SYSTEM ENVIRONMENT

The DPS 7 systems have been designed to play a key role in Honeywell's Distributed Systems Environment (DSE), where computer power is either centralized or distributed to remote locations as needed by the individual organiza-

CENTRAL PROCESSORS

The four DPS 7 processor complexes are microprogrammed units built around a multiprocessor configuration involving the CPU, peripheral processors, and network processor. The workload is distributed among these three elements to provide simultaneous processing and data transfer. Current mode logic (CML) technology is used extensively in CPU and input/output controller logic circuits and is said to provide faster gate speeds and less power consumption than comparable emitter-coupled logic (ECL) or transistor-transistor logic (TTL) circuits.

DPS 7 central processors are in turn composed of seven subunits, a control store, and a high-speed processor bus. This processing "system" is connected to the central bus, which also services main memory and the input/output processors. Peripheral devices are connected to the I/O processors, which have their own control stores and main memories, which in turn are connected to the CPU via high-speed channels. This distributed architecture enables various subsystems to operate simultaneously, without tying up the main processor.

The seven components in the CPU include:

- **Pilot machine (PIM): The PIM retrieves microinstruction sequences from the control store and routes them to the appropriate subunits. Microprograms are composed of two or more 32-bit words, each protected by four parity bits.**
- **Address Calculation Machine (ACM): The ACM handles all address translations, includes the base registers and an associative memory that stores up to eight segment addresses, and also handles data protection by checking rings under GCOS.**
- **Data and Instruction Management Machine (DIM): The DIM provides the interface between the main memory and the other processor units and includes a 32-byte lookahead**

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tion. The layered data communications framework which manages the operation of these networks is called the Distributed Systems Architecture (DSA). The various DPS 7 systems are targeted either as host processors or remote satellite processors in a larger network. The DATANET 8 communications processor, which controls all activities in a DSA network, can be added to any DPS 7 system except the model 7/35. Additional remote processors, such as Honeywell's DPS 6 minicomputer, round out the implementation of the DSE.

COMPETITIVE POSITION

According to Honeywell, the DPS 7 processors are comparable in performance to the IBM 4331–11 through 4341–1. In terms of price and performance, the DPS 7 also competes with the IBM System/38, NCR V–8500 Series, Sperry System 80, and Burroughs B 2900, B 3900, and B 5900. The IBM System/38, NCR V–8500 Series, and Sperry System 80 offer twice the maximum memory capacity of the DPS 7. The IBM 4331 and 4341 models and the Burroughs systems have approximately the same memory capacity as the DPS 7 systems. The DPS 7 and most of its competitors are uniprocessor systems; however, the three Burroughs systems are available as multiprocessor systems with up to four central processors. Both Honeywell's DPS 7 and Sperry's System 80 are specifically designed for distributed processing applications and offer a wide range of I/O configurations.

ADVANTAGES AND RESTRICTIONS

Honeywell has positioned the DPS 7 to provide an upward-compatible growth path for Level 62, Level 64, and Series 200/2000 users. The use of current mode logic (CML) technology and an improved packaging technique reportedly doubles the DPS 7's performance over the earlier Level 64/DPS–330 while reducing the space it requires to one third. The DPS 7 fills the gap between the firm's DPS 6 family of 16- and 32-bit systems and its large-scale DPS 8 processors, a niche traditionally occupied by the Level 64. Honeywell has made the transition from Levels 62 and 64 and Series 200/2000 to the DPS 7 as easy as possible. Level 64 applications can move directly to the DPS 7 without modification. Level 62 and Series 200/2000 users have several transition aids available to make the change easier.

USER REACTION

In Datapro's 1984 survey of general-purpose computer users, 11 DPS 7 users reported on their systems. Five of the survey respondents had installed DPS 7/55 systems, two had 7/45 systems, and one each had a 7/35 and 7/65 system. The remaining respondents did not specifiy which model they were using. The average life of these systems was 25.3 months.

Nine of the users had upgraded to the DPS 7 from an older Honeywell system: seven from Level 64 systems and two from Level 62 systems. One user commented that moving from a Level 64 to a DPS 7 required no conversion, because the two systems use the same software, programming, and peripherals.

feature that allows it to begin interpreting another instruction while a previous instruction is still being executed.

- Arithmetic and Logic Machine (ALM): The ALM includes the data registers and executes fixed-point, decimal, and logic operations.
- Scientific Calculation Machine (SCM): The SCM executes floating-point operations.
- Timer: Using the main clock as a reference, the timer transmits a master frequency along the processor bus and also provides various types of information, such as real time, elapsed time, and process time.
- Maintenance Interface Machine (MIM): The MIM provides the interface between the main processor and the service processor for system initialization and testing.

CONTROL STORAGE: Control store contains firmware held in 32-bit words. Each word contains up to five instructions to be executed by the seven subunits during a single cycle. The sequencing of firmware instructions is controlled by the Pilot machine. Up to five microinstructions can be executed simultaneously by the subunits.

The control store of the main processor is implemented in firmware and normally contains 12K words (but can have up to 24K words) enabling the execution of the Series 200/2000 instruction set.

Firmware is also used in the DPS 7 to perform functions traditionally performed by software. These include task management, procedure calls, data protection, etc.

The main processor is capable of recognizing and controlling a task, a unit of a program more significant than a single instruction. A task is a sequence of interdependent instructions. A program can comprise a number of tasks, each able to execute in parallel with the others (multitasking). This parallel execution of tasks requires a dispatching mechanism. On traditional machines, this mechanism required software intervention. On the DPS 7, it is a built-in firmware function of the main processor.

The DPS 7 uses firmware-controlled semaphores to interpret external events such as physical input/output termination, peripheral interrupts, operator interrupts, and messages from terminals. Using semaphores, it also synchronizes the execution of competing processes, passes messages between processes, and controls competing demands for system services.

A semaphore is a group of words containing a counter and a pointer to an associated queue. When the semaphore counter is negative, all the resources associated with it are busy and processes are awaiting completion. When the counter is positive, all processes are satisfied and resources are free. When the counter is zero, all resources are busy but no processes are waiting. This mechanism can be used in any situation involving processes waiting for the completion of any operation.

REGISTERS: The DPS 7 systems use eight 32-bit Base Registers for internal address computation, sixteen 32-bit General Registers for data handling and indexing, four 64-bit Scientific Registers for floating-point data handling, one 32-bit Stack Register pointing to the stack associated with the running process, and one 28-bit Boundary Address Register holding the lowest absolute main memory address accessible by software.

ADDRESSING: Running under GCOS, the relative addressing mechanism is based on segmentation and its aim is to make optimum use of memory space. Each program

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The users' ratings of the DPS 7 systems are summarized in the table below.

	Excellent	Good	Fair	Poor	WA*
Ease of operation	3	8	0	0	3.27
Reliability of mainframe	7	4	0	0	3.64
Reliability of peripherals	6	5	0	0	3.55
Maintenance service:					
Responsiveness	2	9	0	0	3.18
Effectiveness	2	8	1	0	3.09
Technical support:					
Troubleshooting	0	8	3	0	2.73
Education	0	7	4	0	2.64
Documentation	0	7	4	0	2.64
Manufacturers software:					
Operating system	4	5	2	0	3.18
Compiler & assemblers	3	8	0	0	3.27
Application programs	0	6	2	2	2.40
Ease of programming	1	9	1	0	3.00
Ease of conversion	3	6	2	0	3.09
Overall satisfaction	2	8	1	0	3.09

*Weighted Average on a scale of 4.0 for Excellent.

The users' ratings show that they were generally well satisfied with their DPS 7 systems, particularly with the reliability of their mainframes and peripherals. However, they obviously saw a need for improvement in the application programs. In our survey, most systems received lower ratings in technical support than in other categories, and the DPS 7 systems were no exception.

All 11 of the survey respondents said the DPS 7 systems did what they were expected to do. Ten respondents said they would recommend the DPS 7 systems to other users. □

running under GCOS on the DPS 7 is executed as a collection of fully relocatable segments. A segment may reside in different places. As a program is being executed, its constituent segments may be moved around memory to make room for other programs, and, at a given point in time, some of its segments may even be temporarily removed from memory and placed on disk.

To avoid having to split a frequently used routine between two segments, segments can vary in size. Machine instructions used in the GCOS environment refer to segment-relative addresses, without reference to the physical location of the referenced operand. The absolute address is calculated as the instruction is executed using a segment descriptor and a displacement within the segment. High-speed registers assist in address development.

INSTRUCTION REPERTOIRE: The DPS 7 instruction repertoire consists of 221 instructions, including operations for address computations, and arithmetic instructions for performing fixed- and floating-point decimal and binary operations on packed or unpacked data. Operands can be binary, fixed- or floating-point, or decimal in packed or unpacked format; bytes; byte strings; or bit strings. In addition, the microcode of Models 7/55E and 7/65E can include the Series 200/2000 "Program Mode" option, and execute the Series 200/2000 instruction set.

INTERRUPTS: There are no interrupts as such. Any hardware or software event is handled through semaphores, combined with a masking feature used when high priority events occur.

CONSOLE: The DPS 7 console includes a console display (CRT), a keyboard, and a system operator panel. A pedestal-mounted diskette unit with a capacity of 492.5K bytes is also provided. A 120-cps printer (CSF4104) is required.

PHYSICAL SPECIFICATIONS: The DPS 7 processors require operating conditions of 50 to 100 degrees F. with a noncondensing relative humidity of 10 to 90 percent. The power source must be two-phase, 208 volts ±10 percent at 60 Hz ±0.05 Hz. The CPU cabinet set measures 54.3 inches wide, 33.5 inches deep, and 33.5 inches high, and weighs 838 pounds. Heat output is 17,000 BTU/hour.

INPUT/OUTPUT CONTROL

I/O CHANNELS: High-speed channels are provided with each DPS 7 processor. Channel throughput is rated at 1.25 million bytes per second. The DPS 7/35E has two channels expandable to four; the DPS 7/45E and 7/55E have four channels expandable to six; and the DPS 7/65E has four channels expandable to eight. A basic DPS 7 consists of a single central processor, a mass storage processor, and an integrated service and unit record processor.

The DPS 7 systems support four types of peripheral processors: unit record, mass storage, tape, and network. The integrated unit record processor supports the system console, card units, printers, diskette drives, and, optionally, a DCC4270 communications controller. Each peripheral processor in a DPS 7 system is a fully independent processor controlling the transfer of data in parallel with other peripheral processors. Each processor has its own read/write memory as well as an arithmetic and logic unit. It executes, in full independence, commands sent to it by the central processor. The first three processor types are microprogrammed and contain a special connection which allows the maintenance processor to check operation and diagnose errors. The network processor is programmed and has its own means of detecting faults.

UNIT RECORD PROCESSORS: Every DPS 7 system has one unit record processor called the Service and Unit Record Processor (SURP), which performs the following functions: unit record device and communications control, system console control, system initialization and reconfiguration, and maintenance control. The SURP also supports a Magnetic Tape Adapter (MTA4370) with up to four tapes. The largest DPS 7 systems can handle up to 10 unit record devices using a URP4375 Unit Record Processor in addition to the SURP.

MASS STORAGE PROCESSORS: Each DPS 7 system has at least one MSP4575 Mass Storage Processor. Depending on the DPS 7 model, up to 4 MSPs can be connected, controlling a total of up to 36 disk drives.

MAGNETIC TAPE PROCESSOR: Up to two MTP4275 Magnetic Tape Processors, connecting up to 16 tape drive units, can be supported on the DPS 7. The MTP4275 controls up to eight 7-track or 9-track tape units.

COMMUNICATIONS PROCESSOR: Up to 12 synchronous or asynchronous communications lines can be connected to the DPS 7 systems via two DCC4270 Data Communications Controllers.

SIMULTANEOUS OPERATIONS: The peripheral processing subsystems operate simultaneously 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 devices and terminals attached to a unit record processor can operate concurrently. Mechanical operations on a disk or tape

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TABLE 2. MASS STORAGE

Subsystems	MSU0402	MSU0452	MSU0555	MSU0390
Cabinets per subsystem	1	1	1	1
Disk packs/HDAs per cabinet	1 removable	1 removable	2 fixed	1 removable
Capacity	100MB	200MB	1200MB[1]	300MB
Tracks/segments per drive unit	—	—	—	—
Average access time, msec.	25	25	25	25
Average rotational delay, msec.	8.3	8.3	8.3	8.3
Data transfer rate	806,000 bytes/sec.	806,000 bytes/sec.	1,065,000 bytes/sec.	1,200,000 bytes/sec.
Controller model	MSP4575[2]	MSP4575[2]	MSP4575[2]	MSP4270[2]

[1]Per drive (formatted 8-bit bytes)
[2]Mass Storage Processor

subsystem, such as seek and rewind, can proceed simultaneously with a data transfer on the same subsystem.

CONFIGURATION RULES

A basic DPS 7 system includes from one to four megabytes of MOS memory, expandable in one-megabyte modules (CMM4701), two to eight channels, a Service and Unit Record Processor (SURP), and a Remote Maintenance Adapter. Each model can connect up to two DCC4270 Data Communications Controllers which support up to 12 synchronous or asynchronous lines. All models except the DPS 7/35E can connect one or two DATANET 8 Front-End Network Processors for up to 256 communications lines. An additional Unit Record Processor can be attached to the DPS 7/55E and 7/65E that can connect up to five additional unit record devices. The models 7/35E and 7/45E can configure one MTP4275 Magnetic Tape Processor (MTP) and up to eight tape drives. The 7/55E and 7/65E can have two MTPs and up to 16 tapes. Disk storage is supported through one to four MSP4575 or MSP4270 Mass Storage Processors. The maximum number of spindles on the DPS 7 systems ranges from 17 (DPS 7/35E) to 36 (DPS 7/65E) with a maximum on-line storage capacity of 20.8 billion bytes on the DPS 7/65E.

MASS STORAGE

MASS STORAGE UNITS: See Table 2.

INPUT/OUTPUT UNITS

MTP4275 MAGNETIC TAPE PROCESSOR: This processor handles 9-track tape with a recording density of 800 or 1600 bpi, 7-track tape with densities of 200, 556, or 800 bpi, and can simultaneously control up to eight tape units.

MTA4370 MAGNETIC TAPE ADAPTER: This adapter allows the attachment of from one to four 9-track tapes with a density of 1600 bpi.

MAGNETIC TAPE UNITS: See Table 3.

UNIT RECORD PROCESSOR: This integrated controller has five device ports plus a port dedicated to the console. A second processor, the URP4375, can be added, providing five more device ports. Each peripheral device connects to a device port via an addressing attachment.

PRINTERS: See Table 3.

CARD EQUIPMENT: See Table 3.

DDF4051 AND DDU4055/4056 DISKETTE DRIVES: These diskette drives are connected to the CPU via the Service and Unit Record Processor or an additional Unit Record Processor. One diskette drive unit can be connected to each Unit Record Processor. The DDF4051 is always connected to the SURP and must be specified with the initial system order. 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 DDF4051 diskette is 492,544 bytes. Rotational speed is 360 revolutions per minute, and the transfer rate is 32.2 kilobytes per second. The 4055 is a single-drive unit, providing 492,544 bytes of storage, and the 4056 is a dual-drive unit with a capcity of 985,088 bytes. The DDU4055 and DDU4056 are mutually exclusive with the MTA4370.

TERMINALS: The DPS 7 supports a wide variety of data terminals. Teleprinter terminals include the PRU1001/1003/1005 printers and associated TWU1001/1003/1005 keyboard units. These units operate at asynchronous line speeds of 110, 200, 300, or 1200 bps, depending on the model. The synchronous PRU1901/TWU1901 keyboard/printer unit is designed for speeds up to 4800 bps. Honeywell offers several choices of video display terminals: the VIP7100/7105/7200/7205 for asynchronous speeds up to 9600 bps; VIP7700R/7705R for synchronous speeds up to 4800 bps; VTS 7710/7740, VIP 7814 for synchronous speeds up to 9600 bps; and the VIP7804 for synchronous speeds up to 19,200 bps.

COMMUNICATIONS CONTROL

The DPS 7 can support two integrated data communications controllers (DCC4270) that connect up to 12 synchronous or asynchronous line attachments (DCA4270) at speeds up to 19.2K bps. Five different types of terminal protocols are supported: TTY (DCF4301), Honeywell VIP (DCF4302), BSC (DCF4303), BSC with transparency (DCF4304), and IBM 3270 (DCF4308). A polling extension (DCF4340) is available for synchronous lines with more than four terminals connected.

DISTRIBUTED SYSTEMS ENVIRONMENT

The DPS 7 is an integral part of Honeywell's Distributed Systems Environment (DSE), which places computer power where it is most needed. Typically the DPS 7 functions either as a host or a satellite processor within a network.

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TABLE 3. INPUT/OUTPUT UNITS

Magnetic Tape Units	Number of Tracks	Recording Density, Bits/Inch	Encoding	Tape Speed Inches/Sec.	Transfer Rate, Bytes/Sec.
MTU0320/0420	9	1600	PE	45 or 75	72,000/120,000
MTU0630	9	800/1600	NRZI/ PE	125	100,000/200,000
Printers	**Printing Speed**	**Print Positions**	**Horizontal Spacing, Chars./Inch**	**Vertical Spacing, Lines/Inch**	**Form Size, Inches**
PRU0615	600 lpm	136	10	6 or 8	3 to 15 wide
PRU0906	900 lpm	136	10	6 or 8	4 to 19 wide
PRU1205	1200 lpm	136	10	6 or 8	4 to 19 wide
PRU1600	1600 lpm	136 std.; 160 opt.	10	6 or 8	4 to 22 wide
Punched Card Equipment	**Columns**	**Speed Cards/Min.**	**Input Hopper Capacity**	**Output Stacker Capacity**	**Options**
CRU0301 Reader	80	300	1000	1000	Mark-sense facility for HIS or IBM modes
CRU0501 Reader	80	500	1000	1000	Mark-sense facility for HIS or IBM modes
CRU1050 Reader	80	1050	3000	2500	51-column read; mark-sense facility for HIS or IBM modes
PCU0120 Punch	80	100 to 400	1600	1600	
CCU0401 Reader/ Punch	80	600 rd.; 100-400 punch	1600	1600	

The layered approach in developing a communications network that utilizes the inherent processing power in the DPS 7 is called the Distributed Systems Architecture (DSA). DSA provides the following: 1) access to public and value-added data networks, 2) application program independence from areas such as network configuration and terminal characteristics, 3) standardized user interfaces to the network, and 4) centralized or distributed control functions, independent of the processing functions. A number of specialized software packages are part of DSA, as well as a Front-End Network Processor (FNP), the DATANET 8.

DATANET 8 FRONT-END NETWORK PROCESSOR: This system (DCU8010) was designed specifically for DSE/DSA networks and has 512K bytes of memory, expandable to 1536K, and up to 16 Channel Interface Bases, each of which supports up to 8 communications lines. All system components are connected to a Megabus, a high-speed data transfer link. The DATANET 8 is designed to handle DSE/DSA communications for a DPS 7 operating under GCOS. Up to two DATANET 8 processors can be configured with a DPS 7 system.

SOFTWARE

The DPS 7 operates under GCOS, the same monitor used on the Level 64/DPS–330, which supports batch, transaction, and distributed processing environments in addition to interactive timesharing. Components of GCOS are virtually identical on both the DPS 7 and Level 64/DPS systems; therefore, Level 64 users can migrate to the DPS 7 with no reprogramming or modifications required. The DPS 7/55E and 7/65E can also run Series 200/2000 emulation simultaneously with GCOS. Level 62 users have several transition tools available, including file transcription facilities and an automated transition assist when migrating from the Level 62 Transaction Processing System to the DPS 7 Transaction Driven System. All applications developed by Honeywell for the Level 64/DPS can run unchanged on the DPS 7.

The current update to GCOS, Release 0500, can support up to 64 concurrent jobs, consisting of a mix of batch, transactional, and timesharing activities. Release 0500 adds these additional features: 1) use of RPG for writing Transaction Driven System (TDS) transactions, 2) increased number of Level 6 or DPS 6 systems as remote batch stations, 3) interactive execution of language processors and user programs under IOF (interactive operations facilities), 4) a new query and update facility for I–D–S/II data bases (QUERY/64), 5) new tabling and indentation facilities for source language maintenance, 6) Multi Logic Data Store (MLDS), a data access method compatible with the Level 62 and IBM System/3, 7) improved system security, 8) improved interactive facilities via Immediate Step Activation, 9) additional facilities to improve system use by nontechnical personnel, such as user prompts and screen management tools, 10) support for Honeywell's Distributed Systems Architecture (DSA), and 11) support for "loosely coupled" DPS 7 systems for dynamic disk volume/file-sharing.

GCOS 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 known to the system is 256, effectively providing the nucleus of a virtual memory system with multiple virtual spaces.

GCOS is a virtual memory system that uses segment-relative addressing to optimize the use of main memory. All programs in a DPS 7 system are executed as fully relocata-

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ble segments. DPS 7 machine instructions refer to segment-relative addresses, without regard to the physical location of the referenced operands. A segment may reside anywhere in memory, and at different times may reside in different places. The addressing mechanisms are incorporated in system hardware and firmware, thus ensuring minimum overhead and maximum data integrity.

With GCOS, the segments of a program are defined by the compilers, and optionally, under the control of the programmer. Segments are variable in length, permitting segmentation to follow the logic of the program and ensuring that distinct elements, such as iterative loops, are not split between segments.

When a program is executed, it is first loaded into backing store on disk. GCOS automatically handles the allocation of main memory to the segments as they are referenced. Whenever a new segment is needed, GCOS searches main memory for a large enough space to load the segment. If there is no space large enough, GCOS will attempt to eliminate other segments in memory to create the needed space. The search begins with the least-used nonalterable segment, with the removal of a segment necessary only if it has been changed while in memory. This is applicable only to data segments. As a last resort, GCOS will relocate segments already in memory to produce one contiguous memory space large enough to hold the called segment. Instruction coding is reentrant and is never modified. Therefore, these segments never have to be rewritten and can be overlaid. Swapping and moving of the segments is invisible to the programmer, who has apparent access to a memory capacity equal to the size of the backing store.

GCOS protects each segment by an automatic system of rings and protection levels, similar to the large-scale Multics operating system. This protection system is implemented in the hardware/firmware of the DPS 7 systems, so it applies equally to GCOS software and to the user's own programs.

DPS 7 integrity features include error logging, file security, and recovery routines. Whenever the firmware of the DPS 7 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 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 before and after journal functions to speed file recovery. The journals are used to save all the updates to a file since the last security copy was taken. The journals, together with the catalog and the restore utility, provide all the information needed to rebuild a damaged file to its correct state.

To reduce the possibility of a system failure, GCOS 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 read and output writer files. The output writer can restart printing at any specified page.

Job flow through the DPS 7 systems 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, are 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 generation 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.

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 shareable under GCOS. However, if file protection is required, multiple access should be used only in read mode, unless the optional General Access Control product is installed.

The main file access system of GCOS, 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, and 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 nonindexed; 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 local records. When the file is moved from one medium to another, the physical record

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size can change to adapt to the new medium without affecting the file or the program using it. UFAS can access specific file items without a prior sort. A dynamic file extension facility allows extension of files as required.

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

- Basic Sequential Access, which supports sequential files on disk using 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.

Another set of access methods, the Honeywell File Access System (HFAS), gives full access from native GCOS programs to files in the format used on Series 200/2000 systems. HFAS includes all the features available with BFAS, and serves as a bridge between native and non-native user applications.

In addition to the GCOS operating system (SCS1300), two mandatory additions to GCOS are the GCOS Basic System Extension (SCS1301) and GCOS Access System Extension (SCS1302). The Basic System Extension module includes such elements as the input reader, output writer, text editor (batch), library maintenance (batch), and static linker. The Access System Extension includes BFAS, UFAS, IOF support, basic terminal network support (BTNS), message access method (MAM), and the virtual communications access method (VCAM).

The Forms Management Utility (SCU1611) is new with Release 0500 of GCOS. Operating in the IOF environment, it provides interactive definition of screen forms for use in transactional (i.e., TDS or DM-IV) applications written in either Cobol or RPG. It also provides for saving the screen form definitions as well as for subsequent alterations. Optionally, the utility can be executed in batch mode. Screen definition for use with the following terminals is provided: VIP7700, VIP7700R, VIP7760, VTS 7710, VTS7740, VIP7804, VIP7805, VIP7814 and IBM 3270 (Display Station 3277, Model 2).

The Multiple Logic Data Store (MLDS) is an indexed access method which runs under GCOS Release 0500. MLDS (SCD1615) provides upward compatibility for Level 62 GCOS RPG and Cobol programs that use indexed access, including secondary index and complementary records capabilities.

Interactive Operation Facilities (IOF) users who want to directly invoke the GCOS Cobol-74, RPG, and Fortran processors can use the Immediate Step Activation (SCP1605). It also calls in the static linker and user object programs, and is available with Release 0500.

The GCOS Interactive Program Checkout Facility (SCP1606) gives the IOF user the ability to interactively use the various functions of the GCOS Basic System Extension program checkout facility. It is also available with GCOS Release 0500.

Data Communications Software

The GCOS data communications software, together with the DPS 7 communications hardware and firmware, handle networks of up to 12 lines, with up to 32 terminals per line through the Data Communications Controller. DPS 7/45E, 7/55E, and 7/65E users can also select the DATANET 8 Front-End Network Processor. Up to two can be configured, with 128 lines each. A network can include switched, private, and direct-connect lines, as well as a variety of terminal types. DPS 7 communications software is designed to conform to Honeywell's Distributed Systems Environment (DSE).

The GCOS Message Access Method handles a system of queues to provide the interface between the data communications network and the user's programs. The Message Access Method transforms the random, time-dependent environment, allowing serial or selective processing of messages by ordinary Cobol programming techniques. It provides the standard Cobol MCS environment.

The Transaction Driven System (TDS) 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 (TPRs) corresponds to the various types of messages accepted by the system. TDS 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 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 realtime constraints. TDS has access to all files supported by GCOS and provides 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 are journalized to guard against information loss.

The Level 64 Remote Batch Facility (RBF) enables remote job entry from a Distributed System Satellite (DSS) to a DPS 7 system through the DCC (or optionally via a DATANET 8) with output return to a DSS. RBF consists of RBF/6, which runs under Level 64 GCOS, and RBF/64, which runs on the DSS under control of GCOS 6. RBF operates under synchronous or HDLC transmission using two- or four-wire connections in half-duplex mode up to 9600 bps. The DPS 7 host can support up to 15 DSS systems acting as RBF terminals on a concurrent basis. The DSS can be either a Level 6 or a DPS 6 minicomputer.

The File Transfer Facility (FTF) enables exchange of Level 64 and DSS sequential disk files. The FTF uses two software components: FTF/6 on the DPS 7, and FTF 64/DSS on the DSS. It is available with GCOS Release 0500.

The Distributed Network Supervisor (DNS) is the communications software designed for use in the DATANET 8 Front-End Network Processor (FNP) as well as other Distributed Systems Architecture (DSA) elements. DNS, along with the DATANET 8, DPS 7, and a host package called Front-End Network Processor Support (FNPS), controls the overall communications network. It provides the following functions:

- Network monitoring
- Software loading and dumping
- System data logging

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- Inline testing
- Software generation
- System order execution, called Node Administration (NAD), which is issued by the Node Operator Interface (NOI)
- A group of utilities which analyze the overall network operations

Data Base Management Software

Data Management IV (DM-IV) is a fully operational, on-line, integrated data management system. Data extraction and updating from data bases with various file organizations and data structures can be directly performed by persons who are not data processing professionals.

DM-IV is CODASYL-oriented and includes common data definition languages for describing schema and subschema views of integrated and/or indexed data files. The system offers several end-user services including the capability to satisfy unanticipated information requirements.

The DM-IV module enhances the DPS 7 systems' communications capabilities by combining the strengths of the TDS Transaction-Driven System and the I-D-S/II data base management system. DM-IV offers transaction processing users protected concurrent access to the data base and UFAS files. DM-IV provides for the consolidation and simplification of multiple and repetitive tasks such as organizing file systems and communications programs. The module also provides for the building of a multifaceted environment within a single system. A DPS 7 system with the DM-IV module in GCOS can support a communications network of 12 lines with up to 32 terminals per line; and, on the DPS 7/45E, 7/55E, or 7/65E, larger networks via the DATANET 8 Front-End Network Processor. The network can include switched and private lines as well as a mixture of terminal types.

Data Management 7 (DM 7) is an on-line, integrated data management system which includes all the tools necessary to develop, use, and administer an on-line transactional data base system. DM 7 (SCD1617) is a packaging of several complementary GCOS system software products which encompass the following system facilities:

- I-D-S/II (Integrated Data Store/II) provides the facilities to describe, access, and maintain an integrated data base.
- Data Base Administrator Aids provide the administrative tools needed for examining, maintaining, designing, and continually improving the efficiency of an I-D-S/II data base. The Aids can be executed in an interactive or batch environment.
- TDS (Transaction Driven System), which is described above, handles on-line transactional processing.
- The Forms Management Utility enables data terminal screen forms to be easily defined for use in the TDS environment using Cobol or RPG. Screen forms can be generated for use with the following terminals: VIP7814, VIP7804/5, VIP7700/R, VIP7760, VTS7710, VTS7740, and IBM3270.
- The Query Processor component of DM 7 provides an information retrieval facility for end users. The information can be displayed at a terminal or in a simple formatted report.

Integrated Data Store (I-D-S/II) is an enhanced version of I-D-S, a data base management system originally developed by GE. I-D-S/II was released in November 1975, and marked the beginning of an evolution of I-D-S toward conformance with the recommendations of the CODASYL Data Base Task Group. I-D-S/II is fully integrated with Honeywell's Cobol-74 compiler, and user interfaces are also implemented for Fortran.

The Query Processor (SCL1617) is an end-user-oriented subset of GCOS that aids in the selection and retrieval of information from user files and data bases. It uses a simplified language, and can access I-D-S/II integrated files, UFAS and BFAS sequential files, UFAS and MLDS indexed files, and BFAS indexed sequential files. An Update Option (SCL1620) permits updating of data from I-D-S/II integrated files as well as from UFAS sequential or indexed files.

The Query Driven System (QDS) is a terminal-oriented file inquiry update and report writing system for the DPS 7. QDS contains the interactive, report, and assistance modes of operation. The interactive mode is a prompted message command/response mode for terminal-based file search and updating. The report mode provides a capability for file processing and report generation by means of terminal-built queries using a procedural language. The assistance mode is the sign-on mode and is used for building queries that are later executed under the report mode.

QDS supports GCOS BFAS indexed sequential and sequential file organizations and UFAS indexed and sequential organizations.

Programming Languages

Cobol (SCL1601), a superset of Level 62 Cobol, is a full implementation of the ANSI specification X3/23-1974, and features automatic segmentation and optional data communications capabilities.

The Cobol Report Writer (SCL1608) is an option that provides the report writer module of the ANS 74 standard. The Cobol Data Communications Extension (SCL1603) 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 ANS Standard.

DPS 7 RPG (SCL1611) runs under GCOS, supports a high-level report generation language, and produces report-oriented programs from specifications furnished by the user. DPS 7 RPG can execute either in a batch- or transaction-oriented environment. It is directly compatible with Level 62 RPG, as well as most elements of IBM System/3 RPG.

DPS 7 Fortran (SCL1606) meets the ANSI standard for Fortran IV and contains routines for many mathematical calculations plus run-time packages to handle Fortran functions such as STOP and PAUSE and dynamic error diagnostics. It supports most elements of ANSI 77.

DPS 7 Basic (SCL1614) is an incremental compiler, checking syntax and generating object code at the input of each instruction. Under GCOS, Basic programs can be developed and executed in either batch or interactive mode.

Conversion Aids

GCOS includes an extensive set of programs and file conversion routines for Level 62 and IBM equipment, as well as program translators and file translators for older Honeywell equipment, particularly the Series 100/200/2000 product line.

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Remote Maintenance System/64

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 provides the ability to troubleshoot hardware and firmware problems as well as software bugs concurrently with user production. With this facility, key diagnostic programs that operate under GCOS can be remotely executed and patching of many software difficulties can be accomplished without an on-site visit. Remote Maintenance System/64 operates only when the console operator places the system in maintenance mode and provides documentation of all communications via the system console.

PRICING

EQUIPMENT: The following systems are representative of DPS 7 configurations. The quoted rental prices are for the basic one-year lease and include equipment maintenance.

BASIC DPS 7/35E: Includes CPU with 1024K bytes of main memory, mass storage processor, integrated service and unit record processor, integrated 8-inch diskette drive, data communications controller, integrated console control, console with CRT, support for three asynchronous communications lines, 300-cpm card reader, 600 megabytes of disk storage, and one 900-lpm printer. Purchase price is $236,241 and monthly maintenance is $1,207. The system can be leased for one year at $10,799 per month.

EXPANDED COMMUNICATIONS-ORIENTED DPS 7/55E: Includes 2048K bytes of main memory, four I/O channels, 1200 megabytes of disk storage via integrated MSP, one dual-density diskette drive (DDU4055), a tape subsystem with two 9-track, 1600 bpi tape drives, one 1200-lpm belt printer, three asynchronous and one synchronous communications lines with BSC support connected to the integrated communications controller, and one DATANET 8 FNP with two Channel Interface Bases for interface to DSA network. Purchase price is $452,161, the monthly maintenance costs $2,296, and the monthly one-year lease price is $13,638.

SUPPORT: Honeywell offers six categories of support products for the DPS 7 systems. These products include data services, system engineering, software, education, publications, and supplies.

Data services consist of machine time for predelivery production and checkout, and for overload/peakload situations. Processor time costs approximately $110.00 per hour; for off-line peripherals, $12.00 to $32.00 per hour.

System engineering falls into one of five billable support categories, as described in the following table. Field engineering managers are responsible for the degree of skill required to perform the job.

	Monthly Rates	Hourly Rates (4 hr. min.)
Principal or senior technical consultant	$17,431	$125
Project supervisor or technical consultant	14,230	102
Technical specialist	12,807	91
Systems analyst/senior programmer	10,672	77
Programmer	7,471	54

The GCOS basic operating system is provided to DPS 7 users at no additional cost. All other facilities, such as job management, file systems, conversion aids, language processors, utilities, applications packages, communications software, system maintenance, and system performance analysis are separately priced.

Education services include standard courses, advanced professional training, multimedia self-instruction courses so that customers can self-train as often as needed, site surveys to determine educational requirements, on-site classes, and clustered on-site classes to accommodate a group of users from an area. Prices vary from $126 per student per day for standard courses to $165 per student daily for the most sophisticated programs. Multimedia self-instruction courses can be purchased for prices ranging from $18 to $995.

CONTRACT TERMS: DPS 7 equipment is available for purchase or for lease under a one-year, three-year, or five-year term. The basic monthly lease charges entitle the user to unlimited 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 excluding Honeywell's published holidays. For scheduled maintenance beyond this period, the user pays an additional charge which is a fixed percentage of the basic monthly maintenance charge. As an alternative to scheduled extended maintenance, the user can obtain on-call maintenance service at standard hourly rates of $125 per manhour.

Honeywell's Distributed Maintenance Services is a term covering a variety of field engineering services, coordinated to assure maximum availability of the system. DMS includes a Response Center headquartered in Atlanta, Georgia, for toll-free 24-hour a day contact with Honeywell; the Technical Assistance Center, located in Newton, Massachusetts, which coordinates all activities and provides remote testing and correction facilities; a Logistics Inventory Data System, for rapid location of parts; Service Account and Field Engineering representatives; an Alert system to notify FE management of special problems; Remote Support Facility for remote troubleshooting and remote software and hardware correction; and tools for easy software updating by customers.

EQUIPMENT PRICES

		Purchase Price ($)	Monthly Maint. ($)	Monthly Charges 1-Year Lease ($)	3-Year Lease ($)	5-Year Lease ($)
PROCESSORS						
CPS4937	DPS 7/35E Central Processor; includes CPU with one megabyte of main memory, integrated service and unit record processor, diskette, remote maintenance adapter, two I/O channels, and console	85,200	208	3,593	3,351	2,988
CPS4947	DPS 7/45E Central Processor; includes CPU with one megabyte of main memory, integrated service and unit record processor, diskette, remote maintenance adapter, four I/O channels, and console	107,700	210	4,780	4,449	3,953

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		Purchase Price ($)	Monthly Maint. ($)	Monthly Charges 1-Year Lease ($)	3-Year Lease ($)	5-Year Lease ($)
CPS4957	DPS 7/55E Central Processor; includes CPU with two megabytes of main memory, integrated service and unit record processor, diskette, remote maintenance adapter, four I/O channels, and console	158,800	364	7,398	6,877	6,098
CPS4967	DPS 7/65E Central Processor; includes CPU with two megabytes of main memory, integrated service and unit record processor, diskette, remote maintenance adapter, four I/O channels, and console	215,700	562	9,408	8,748	7,759
PROCESSOR OPTIONS						
CMM4701	1-megabyte Memory Module	10,000	26	559	518	458
CPF4712	Peripheral Expansion Cabinet	13,808	47	516	482	429
CPF4713	H200/2000 Emulator for CPS4957/CPS4967	9,400	28	348	323	287
CPF4707	I/O Channel Expansion (for over 4 channels)	5,200	5	181	167	148
CPF4710	Two I/O Channels	9,200	4	290	270	236
CPK4981	Upgrade from 7/35E or equiv. power level to 7/45E power level	13,300	2	1,187	1,097	964
CPK4982	Upgrade from 7/45E or equiv. power level to 7/55E power level (minimum 2MB C.P. memory is required)	41,100	128	2,058	1,911	1,687
CPK4983	Upgrade from 7/55E or equiv. power level to 7/65E power level	56,900	198	2,010	1,871	1,661
CPK4987	Upgrade from 7/35E or equiv. power level to 7/55E power level (minimum 2MB C.P. memory is required)	54,400	126	3,245	3,008	2,651
CPK4988	Upgrade from 7/35E or equiv. power level to 7/65E power level (minimum 2MB C.P. memory is required)	111,300	324	5,255	4,878	4,312
CPK4989	Upgrade from 7/45E or equiv. power level to 7/65E power level (minimum 2MB C.P. memory is required)	98,000	326	4,068	3,781	3,348
CSF4104	Hardcopy Printer; 120 cps (mandatory)	4,100	70	364	343	310
CSF4102	Pedestal for CSF4104 (sit)	200	—	—	—	—
CSF4103	Pedestal for CSF4104 (stand)	200	—	—	—	—
MASS STORAGE						
MSP4575	Single-Channel Mass Storage Processor; includes one group of 3 device addresses	32,275	90	1,098	1,021	906
MSA4575	Group of 3 Additional Device Addresses	3,075	22	118	111	100
MSF4506	Series 200/2000 Read/Write Mode	2,352	6	80	74	66
MSU0402	100-megabyte Mass Storage Unit	20,805	113	880	824	757
MSU0452	200-megabyte Mass Storage Unit	19,000	113	1,012	931	880
MSU0555	1200-megabyte Mass Storage Unit	52,183	197	1,827	1,703	1,517
MSF0006	Dual Access Feature; for MSU0402/0452	2,070	13	89	83	76
MSF0014	Dual Access Feature; for MSU0555	4,140	23	176	164	147
MSP4270	Single-Channel Mass Storage Processor; includes eight device addresses for MSU0390	32,275	90	1,098	1,021	906
MSU0390	300-megabyte Mass Storage Unit	25,000	204	1,238	1,041	983
MSK4026	Upgrades MSU0402 from 100 to 200 megabytes	1,000	—	62	61	62
DISKETTE STORAGE						
DDF4051	Second Drive for Integrated Diskette Unit (factory option)	3,695	24	140	131	118
DDU4055	Single Diskette Drive; 492KB; requires pedestal	2,336	21	95	89	81
DDU4056	Dual Diskette Drive; 985KB; requires pedestal	3,833	32	152	144	130
DDF4052	Pedestal for DDU4055 or DDU4056; low for sitting	184	2	8	7	6
DDF4053	Pedestal for DDU4055 or DDU4056; high for standing	184	2	8	7	6
MAGNETIC TAPE EQUIPMENT						
MTP4275	Magnetic Tape Processor, single-access; addressing for eight devices	24,850	120	896	837	748
MTF4207	Translator Option	2,783	9	111	103	91
MTF4208	Pack/Depack Option	2,783	9	111	103	91
MTF4209	NRZI Option	3,728	24	162	151	136
MTA4370	Magnetic Tape Adapter on SURP (for MSU0320/0420)	5,500	43	215	202	182
MTU0320	Magnetic Tape Unit; 1600 bpi, 45 ips	15,100	120	592	556	502
MTU0420	Magnetic Tape Unit; 1600 bpi, 75 ips	16,895	140	668	627	567
MTU0630	Magnetic Tape Unit	14,815	130	593	557	505
MTF0636	9-Track, 1600/800 bpi, 125 ips (for MTU0630)	9,805	155	460	435	398
UNIT RECORD EQUIPMENT						
URP4375	Unit Record Processor and Cabinet	18,270	52	623	579	514
URA4351	Addressing for Printer PRU0615	400	2	15	14	13
URA4352	Addressing for Printers PRU0906/1205/1600	5,000	3	191	176	155
URA4354	Addressing for Card Readers CRU0301/0501/1050	3,645	12	126	118	104
URA4355	Addressing for Card Punch PCU0120	6,878	23	238	221	197
URA4356	Addressing for Card Reader/Punch CCU0400	7,088	28	285	266	235
URA4362	Addressing for Diskette Units DDU4055/4056 on URP4375	2,620	12	100	94	83
URA4363	Addressing for Diskette Units DDU4055/4056 on SURP	2,620	12	100	94	83

Honeywell DPS 7 Series

		Purchase Price ($)	Monthly Maint. ($)	Monthly Charges 1-Year Lease ($)	3-Year Lease ($)	5-Year Lease ($)
PRINTERS						
PRU1600	Belt Printer, 1600 lpm, 136 positions	64,940	538	2,910	2,735	2,472
PRF0022	24 Additional Print Positions for PRU1600	2,610	16	112	105	93
PRU1205	Belt Printer, 1200 lpm, 136 positions	34,500	428	1,903	1,793	1,629
PRU0906	Belt Printer, 900 lpm, 136 positions	29,500	381	1,666	1,570	1,428
PRU0615	Band Printer, 600 lpm, 136 positions	14,585	180	752	708	646
PRM4006	Adapter for PRU0615	500	2	18	17	15
PRB0703	Belt for PRU1600; 64 characters, OCR-B font, Series 200/2000	2,460	90	—	—	—
PRB0501	63-character, EBCDIC, OCR-B font belt	2,460	90	—	—	—
PRB0500	63-character, OCR-B font belt, Series 100	2,460	90	—	—	—
PRB0513	63-character, ASCII, OCR-B font belt	2,460	90	—	—	—
PRB0524	63-character, OCR-A numeric belt	2,460	90	—	—	—
PRB0549	63-character, OCR-A alphanumeric belt	2,460	90	—	—	—
PRB0600	94-character, uppercase/lowercase belt, OCR-B font	2,567	90	—	—	—
PRB703	Belt for PRU0906/1205; 64 characters, OCR-B font, Series 200/2000	NC	—	—	—	—
PRB3501	63-character, EBCDIC, OCR-B font belt	NC	—	—	—	—
PRB2501	Band for PRU0615, 63 characters, EBCDIC, OCR-B font	NC	—	—	—	—
PRB2502	63-character, OCR-B font band, Series 200/2000	NC	—	—	—	—
PUNCHED CARD EQUIPMENT						
CCU0400	Card Read/Punch; 600 cpm read, 100/400 cpm punch	28,185	219	914	894	868
CRU0301	Card Reader, 300 cpm	9,513	78	380	345	328
CRU0501	Card Reader, 500 cpm	19,500	114	684	638	568
CRF0006	(IBM) Mark Sense Option for CRU0301/0501	4,520	42	181	168	153
CRF0007	(HIS) Mark Sense Option for CRU0301/0501	4,520	42	181	168	153
CRF0030	Pedestal for CRU0301/0501; high for standing	184	—	—	—	—
CRF0031	Pedestal for CRU0301/0501; low for sitting	184	—	—	—	—
CRU1050	Card Reader, 1050 cpm	26,555	224	1,136	1,066	961
CRF0003	51-Column Option for CRU1050	2,079	6	75	69	62
CRF0005	Mark Sense (IBM/HIS) for CRU1050	7,787	53	256	234	221
PCU0120	Card Punch, 100 to 400 cpm	20,032	147	816	741	687
COMMUNICATIONS						
DCU8010	DATANET 8 Front-End Network Processor; includes 512KB memory, 256KB diskette, and up to 16 lines	29,000	135	1,123	1,049	937
DCM8005	Additional 512KB Memory	6,000	21	622	585	534
DCM8008	Additional 512KB Memory; requires DCM8005 and DCE8002	6,000	21	622	585	534
DCE8003	Processor Power Module Enhancement; requires DCE8002	7,400	40	293	274	245
DCE8002	Additional Lines, up to 64	3,000	5	106	98	86
DCE8004	Additional Lines, up to 128	5,000	10	179	166	147
DCE8005	Additional 256KB Diskette; one maximum	1,785	18	79	75	68
DCE8007	Level 64/DPS Host Connection	8,000	65	339	319	288
DCE8008	DPS 7 Host Connection; four maximum	8,000	65	339	319	288
DCF8007	Channel Interface Base, includes up to 8 channels (lines); 16 maximum	2,500	14	99	93	83
DCF8001	Console, 100-cps printer	2,065	40	105	100	92
DCF8009	Dual Asynchronous Channel, RS-422-A; 9600 bps	1,000	7	41	38	35
DCF8011	Dual Synchronous Channel; RS-232-C; 9600 bps	1,500	8	58	55	49
DCF8012	Dual Asynchronous Channel; RS-232-C; 9600 bps	1,000	5	39	36	32
DCF8014	Single Synchronous Channel; MIL-188-C; 9600 bps	1,000	6	40	37	33
DCF8015	Dual Asynchronous Channel; MIL-188-C; 9600 bps	1,000	7	41	38	35
DCF8016	Single Synchronous HDLC Wideband Channel; MIL-188-C; 56K bps	1,995	15	83	79	70
DCF8017	Single Synchronous HDLC Channel; MIL-188-C; 9600 bps	2,500	12	99	91	82
DCF8018	Dual Bisynchronous Channel; RS-232-C; 9600 bps	1,500	7	58	54	49
DCF8020	HDLC Channel, 19.2K bps	1,500	8	58	55	49
DCF8022	HDLC Wideband Channel, 56K bps	3,000	16	118	110	98
DCF8023	HDLC Wideband Channel (V.35), 56K bps	3,000	16	118	110	98
DCF8024	Direct Connect Capability; for use with RS-232-C channels only	350	2	14	13	12
DCF8026	Universal Modem Bypass; synchronous to 19.2K bps or asynchronous to 1800 bps	415	2	16	15	13
DCC4270	Additional Data Communications Controller	7,100	11	233	216	191
DCF4301	Terminal Support Type 1 (TTY)	53	—	1	1	1
DCF4302	Terminal Support Type 2 (VIP)	53	—	1	1	1
DCF4303	Terminal Support Type 3 (BSC)	53	—	1	1	1
DCF4304	Terminal Support Type 4 (BSC), with transparency	945	4	40	36	31
DCF4308	Terminal Support Type 8 (3270)	1,665	9	71	67	59
DCA4270	Synchronous/Asynchronous Line Attachment (up to 19.2K bps)	1,000	5	37	34	31
DCF4340	Polling Extension for DCA	546	1	21	19	17
DCF4270	Performance Expansion	4,284	8	142	131	116

Honeywell DPS 7 Series

SOFTWARE PRICES

		Monthly License Fee ($)	Monthly Software Support ($)
SCS1300	GCOS 64 Basic Operating System	NC[1]	[2]
SCS1301	GCOS 64 Basic System Extension	244	66
SCS1302	GCOS 64 Access System Extension	201	43
SCS1601	GCOS 64 Coupled Systems Support	85	27
SCS1602	GCOS 64 Dynamic Status Display	68	18
SCS1603	GCOS 64 Multivolume Backing Store	58	16
SCS1605	GCOS 64 System Access Rights	135	38
SCS1607	GCOS 64 General Access Control	104	28
SCU1613	GCOS 64 System Behavior Reporter	175	27
SCU1616	GCOS 64 System Behavior Reporter Extension	125	19
SCS1310	DPS 7 GCOS Entry System	1150	2
SCU1619	Transactional Context Restart Facility (TCRF)	55	15
SCL1601	Cobol-74	108	12
SCL1603	Cobol-74 Data Communications Extension	114	13
SCL1606	Fortran	106	9
SCL1607	Mathematical Library	138	17
SCL1608	Cobol Report Writer	49	5
SCL1611	RPG	65	9
SCL1614	Interactive Basic	201	6
SCS1606	GCOS 64 Interactive Resource Manager	158	43
SCL1617	Query Processor	185	55
SCL1620	Query Processor Update Option	98	27
SCL1623	Query Report Mode Option	100	30
SCP1601	Interactive Library Maintenance (LIBMAINT)	96	29
SCP1602	Interactive Text Editor	65	19
SCP1605	Immediate Step Activation	96	29
SCP1606	Interactive Program Checkout Facility	65	19
SCP7601	GCOS 64 Menu Driven Facility	65	10
SCC1617	Data Entry (DE/64—VIP7700 Mode)	167	69
SCD1611	Integrated Data Store II (I-D-S/II) Entry	335	21
SCD1615	Multiple Logic Data Store (MLDS)	51	19
SCU1603	Sort/Merge	71	13
SCU1604	Data Base Administrator Aids Set (Batch Utilities)	99	5
SCU1617	Data Base Administrative Aids Extension	37	5
SCU7604	Storage Analysis for UFAS Indexed Files	25	—
SCC1220	GCOS 64 Front-End Network Processor Support (FNPS). Requires SCC8020 and SNC 8024	15	5
SCC1603	TDS/64 Standard Processor	365	138
SCD1612	Data Management-IV (DM-IV) Entry	707	162
SCU1619	Transactional Context Restart Facility (TCRF)	55	15
SCU1611	Forms Management Utility	50	10
SCC1671	Preforms Batch Mode	25	8
SCC1672	Preforms Transaction Mode	52	15
SCJ1601	Remote Batch Facility/6 (RBF/6)	32	6
SCU1615	File Transfer Facility/6 (FTF/6)	51	5
SCU1618	GCOS 64 Distributed File Transfer (DFT). Requires SCC1220 for each DN8	15	5
SCM1620	Series 200/2000 Integrated Program Mode	NC[1]	16
SCD1607	Series 200/2000 File Access System (HFAS)	NC[1]	11
SCU1606	HFAS File Maintenance Utility Set	10	5
SCU1609	Series 200/2000 Volume Utility Set	10	5
SCU1614	System/3 Sort Adapter	NC[1]	11
SCV1600	Series 200/2000 Cobol to Cobol-74 Translator	NC[1]	11
SCV1605	Series 200/2000 File Translator	NC[1]	11
SCV1611	Series 100 Cobol to Cobol-74 Translator	NC[1]	11
SCV1612	Series 100 File Translator	NC[1]	11
SCV1614	System/3 Volume and File Translator	NC[1]	11
SCV1616	System/3 RPG-II to GCOS 64 RPG Translator	NC[1]	11
SCV1620	360/370 Cobol to Cobol-74 Translator	NC[1]	11
SCV7609	System/3 Cobol to Cobol-74 Translator	NC[1]	11
SCV7613	360 RPG to GCOS 64 RPG Translator	NC[1]	11
SCV7614	370 RPG to GCOS 64 RPG Translator	NC[1]	11
SCV7629	370 File and Volume Translator	NC[1]	11
SCC6902	Query Driven System (QDS)	506[3]	—
SNC8020	Distributed Network Supervisor (DNS)	490	86
SNC8021	Network Operator Interface (NOI). Requires SNC8020	10	5
SNC8022	Cross-Net Load/Dump Facility. Requires SNC8020 and SNC8031	10	5
SNC8024	DPS 7/GCOS 64 Host Connection. Requires SNC8020	42	7
SNC8028	Multiple Host Connection—Homogenous. Requires SNC8024	20	8
SNC8031	High-Level Data Link Control (HDLC) Primary Network Support (Point to Point). Requires SNC8020 or SNC8096	82	15
SNC8033	Primary Network Private Virtual Circuit Endpoint. Requires SNC8031	166	29
SNC8034	Primary Network Private Virtual Circuit Switching. Requires SNC8031	170	30
SNC8035	Primary Network Connection—Transpac/Limited (France); Maximum of 16 Virtual Circuits. Requires SNC8031	166	29

[1]Licensed for use without separate charge to users who have acquired their central processors/systems from Honeywell.
[2]Fee based on power of CPU.
[3]Software support provided with basic license.

Honeywell DPS 7 Series

		Monthly License Fee ($)	Monthly Software Support ($)
SNC8036	Primary Network Connection—Transpac/Extended (France); Greater than 16 Virtual Circuits. Requires SNC8035	20	5
SNC8037	Primary Network Connection—Telenet U.S.A. Requires SNC8031	166	29
SNC8038	Primary Network Connection—Tymnet U.S.A. Requires SNC8031	166	29
SNC8039	Primary Network Connection—Datapac Canada	166	29
SNC8040	Primary Network Connection—DDX-P Japan. Requires SNC8031	166	29
SNC8041	Primary Network Connection—AUSTPAC Australia. Requires SNC8031	166	29
SNC8044	Primary Network Connection—EDWP Switzerland. Requires SNC8031	166	29
SNC8045	Primary Network Connection—DN-1 Netherlands. Requires SNC8031	166	29
SNC8046	Primary Network Connection—EURONET European Economic Community. Requires SNC8031	166	29
SNC8047	Primary Network Connection—DATEX-P West Germany. Requires SNC8031	166	29
SNC8052	Primary Network Connection—PSS United Kingdom. Requires SNC8031	166	29
SNC8053	Primary Network Connection—NPDN(X.21) Basic, Scandinavia. Requires SNC8031	166	29
SNC8054	Primary Network Connection—NPDN(X.21) Extended, Scandinavia. Requires SNC8053	20	5
SNC8056	Extended X.25 Public Network Interface Support (Greater Than 16 Virtual Circuits). Requires SNC8037, SNC8038, SNC8039, SNC8040, SNC8041, or SNC8052	20	5
SNC8057	Asynchronous Terminal Support. Requires SNC8020	NC[1]	—
SNC8058	VIP Synchronous Terminal Support	NC[1]	—
SNC8067	Telenet Asynchronous Pad Support (U.S.). Requires SNC8037	20	5
SNC8068	Tymnet Asynchronous Pad Support (U.S.). Requires SNC8038	20	5
SNC8069	Datapac Asynchronous Pad (Canada). Requires SNC8039	20	5
SNC8065	TRANSPAC Asynchronous Pad Support (France). Requires SNC8035 or 8036	20	5
SNC8070	DDX-P Asynchronous Pad Support (Japan). Requires SNC8040	20	5
SNC8071	AUSTPAC Asynchronous Pad Support (Australia). Requires SNC8041	20	5
SNC8072	PPS Asynchronous Pad Support (United Kingdom). Requires SNC8052	20	5
SNC8074	EDWP Asynchronous Pad Support (Switzerland). Requires SNC8044	20	5
SNC8075	DN-1 Asynchronous Pad Support (Netherlands). Requires SNC8045	20	5
SNC8076	EURONET Asynchronous Pad Support (European Economic Community). Requires SNC8046	20	5
SNC8077	DATEX-P Asynchronous Pad Support (West Germany). Requires SNC8047 or 8036	20	5
SNC8096	Distributed Network Supervisor/Entry (DNS/E/7) for single-host networks only	396	70

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