Honeywell Series 60, Levels 66 and 68

MANAGEMENT SUMMARY

The Honeywell Series 60 product line was introduced in April 1974 as a consolidated computer family designed to provide a straightforward user migration path from the diversity of computer systems that had evolved through Honeywell's previous efforts and the 1970 acquisition of General Electric's computer operations. Prior to the introduction of the Series 60 family, Honeywell's computer offerings included the Series 2000 and Series 6000 systems, as well as the older Series 100, Series 200, Series 400, and Series 600 systems. The purpose of the Series 60 family was to provide a single migration path for users of all these different systems. To facilitate the transition, Honeywell also introduced an array of conversion aids that included both hardware and software facilities to enable users to preserve their software investments.

The Series 60 product line originally consisted of four system groups, designated "levels" to reflect their relative computing power. These four system groups were based on different processors and were even designed and manufactured in different countries. The common link between the diverse groups was the Generalized Comprehensive Operating System (GCOS) or an enhanced version of the Multics operating system.

In the United States, the April 1974 Series 60 product announcement included seven new processor models grouped into the four "levels" of computer power. These included the Model 62/60, a small-scale system and the only processor model in the original U.S. product line designed primarily to attract new computer users, and the ▷

The Level 66 and Level 68 computers were introduced in April 1974 as the upper end of the Honeywell Series 60 product line. The Level 66 systems complete the family of small, medium, and large-scale computers that include the Level 62 and Level 64 systems and are connected by the common thread of the GCOS operating system. The Level 68 Multics systems are large-scale virtual-memory systems designed especially for use in large time-sharing and data base applications.

CHARACTERISTICS

MANUFACTURER: Honeywell Information Systems, Inc., 200 Smith Street, Waltham, Massachusetts 02154. Telephone (617) 890-8400.

MODELS: Level 66, Models 66/05, 66/07, 66/10, 66/17, 66/20, 66/27, 66/40, 66/60, 66/80, and 66/85; Level 68, Models 68/60 and 68/80. (For coverage of the smaller Level 62 and Level 64 systems, see Report 70C-480-12.)

**BASIC UNIT:** 9-bit byte organized into 4-byte (36-bit) words plus one parity bit.

MAIN STORAGE

STORAGE TYPE: Metal oxide semiconductor (MOS).

CAPACITY: See table.

CYCLE TIME: See table.

CHECKING: A 5-bit error-correcting code is appended to each 36-bit word. Single-bit errors are corrected automatically, and multiple-bit errors are detected and flagged for subsequent error-recovery routines. ▶
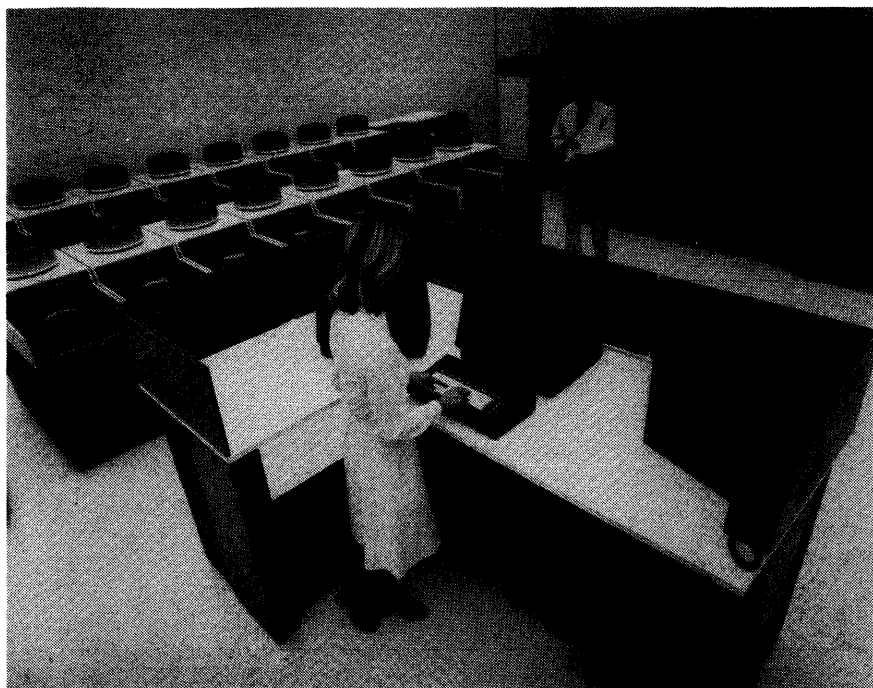
Honeywell's largest and most powerful computer, the Model 66/85, features new concepts in both system packaging and internal circuitry. All mainframe components (memory, power supplies, CPU, system controller, etc.) are housed in a walk-in enclosure (rear) for easy access. The Model 66/85 is constructed from Honeywell's current-mode logic circuits, which yield significantly higher circuit densities than those achievable with common TTL circuitry. Elements of a typical Model 66/85 system include (clockwise from left) sixteen 156-megabyte disk pack drives, a 1050-cpm card reader, a 1600-lpm line printer, the system enclosure, and the CSU6003 system console (foreground), which includes a CRT display/keyboard unit and the bar graph system activity meters to the right of the operator. Model 66/85 prices start at $2,518,331 or $59,653 per month (one-year lease).

Honeywell Series 60, Levels 66 and 68

CHARACTERISTICS OF THE LEVEL 66 AND 68 SYSTEMS (Continued)

	66/40	66/60	66/80	66/85	68/60	68/80
SYSTEM CONFIGURATION						
Primary application	Production	Production	Production	Production & time-sharing	Transaction & time-sharing	Transaction & time-sharing
No. of central processors	1 or 2	1 to 4	1 to 4	1 to 4	1 to 2	1 to 7
No. of system controllers	1 to 4	1 to 4	1 to 4	1 or 2	1 to 4	1 to 8
No. of I/O multiplexers	1 or 2	1 to 4	1 to 4	1 to 4 hi-speed+ 1 or 2 lo-speed	1 to 4	4
No. of multiplexer board slots	18 to 54	27 to 54	27 to 54	—	—	—
MAIN STORAGE						
Type	MOS	MOS	MOS	MOS	MOS	MOS
Cycle time, nanoseconds	1400	750	750	750	750	750
Minimum capacity, 36-bit words	131,072	196,608	262,144	524,288	262,144	262,144
Maximum capacity, 36-bit words	1,048,576	1,048,576	1,048,576	2,097,152	1,048,516	4,194,304
Error correcting	Yes	Yes	Yes	Yes	2	2
Integrated Control Unit (ICU) or Free-standing System (FS)	ICU or FS	ICU or FS	ICU or FS	ICU	FS	FS
CENTRAL PROCESSOR						
Relative speed	3.4	4.8	5.0	7.5	5.0	5.0
Extended (Business) Instruction Set	Yes	Yes	Yes	Yes	Yes	Yes
System control processor	None	None	None	Yes	None	None
Cache memory	Yes	Yes	Yes	Yes	Yes	Yes
Disk cache buffer	None	None	None	Yes	None	None
INPUT/OUTPUT CONTROL						
Channel data rates, bytes per second	1,060,000	1,060,000	1,060,000	—	1,060,000	1,060,000
Total data rate, bytes per second	2,700,000	4,050,000	4,050,000	16,000,000	4,050,000	4,050,000
No. of disk drives	32 per control	32 per control	32 per control	32 per control	32 per control	32 per control
No. of magnetic tape units	16 per control	16 per control	16 per control	16 per control	16 per control	16 per control

▷ price threshold for the company's large-scale multidimensional GCOS and Multics operating environments.

In a series of announcements made between June 1976 and January 1977, Honeywell restructured the Level 66 to significantly increase the power and capacity of the existing models and add models to the bottom and top of the line. Two new Model 66/05 systems with more processing power than the former Model 66/10 provide the lowest-priced batch-only Level 66 system (the CPS6050) and a completely new functionally integrated front-end network processor for multidimensional operation (the CPS6058). Three new models with enhanced time-sharing capabilities—Models 66/07, 66/17, and 66/27—have about the same processing power as the corresponding multidimensional models (i.e., the 66/05, 66/10, and 66/20) in batch mode operation and approximately twice as much processing power in the time-sharing mode. At the top of the line, with about a 50 percent increase in processing power over the older Model 66/80, the Model 66/85 uses micropackaging of the faster current mode logic (CML) circuits to conserve space and energy.

LEVEL 66 HARDWARE

Ten processor models are currently available within the Level 66. All are designed as upgrade machines for Honeywell's extensive Series 600/6000 customer base, for large Series 2000 installations, and for users of the older GE-400 Series processors. In addition, their price/performance makes them strong competitors against the ▷

▶ I/O complements than are possible with the I/O multiplexers found on the earlier Level 66 systems.

Honeywell also offers four front-end network processors (FNP) for use with all Level 66 and Level 68 systems to support its Distributed Systems Environment concept. All Datanet FNP's can access host-system mass storage subsystems through a nonsimultaneous switched channel incorporated in each mass storage processor.

Model 68/60 can have one or two central processors. Model 68/80 systems can have up to 10 central processors, 1 or 2 I/O multiplexers (1 of which is a spare for redundancy), and from 1 to 8 system controllers.

REGISTERS: In Level 66 processors, the processor registers that are available to the program include: one 72-bit accumulator (A and Q registers), 8 index registers, 8 address registers, 48 history registers, 1 fault register, 1 mode register, 1 base register, 1 indicator register, 1 instruction counter, 1 timer register, and 1 exponent register in each processor.

INSTRUCTION REPERTOIRE: Level 66 and 68 processor models have a comprehensive instruction set for performing data movement, binary arithmetic, shifting, logic, and control operations. The instruction set includes arithmetic facilities for performing variable-length fixed- and floating-point decimal arithmetic, and bit and byte string manipulation for processing bytes, BCD characters, packed decimal data, and bit strings.

CACHE MEMORY: Models 66/17, 66/27, 66/40, 66/60, 66/80, 66/85, 68/60, and 68/80 central processors employ a cache memory containing 512 four-word blocks of main memory. The cache contents are controlled by a four-level, set-associative address mapping technique and a first-in/first-out algorithm.

PROCESSOR MODES: There are two modes of processor operation for the Level 66—master and slave. The master ▶

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▷ units, eight magnetic tape units, and four unit record devices. The eight larger Level 66 central systems can all be equipped with the same types of input/output devices. To save space, cabinets, and energy, a unit record processor can be incorporated into an integrated control unit (ICU) or into a free-standing I/O multiplexer. Similarly, a mass storage processor can be integrated into an ICU.

A Level 66 unit record processor provides up to 8 ports for connection of either a 4000 or a 1050 cpm card reader, 100 to 400 cpm card punches, and 1100, 1200, or 1600 lpm printers. The mass storage processor can handle up to 32 single-channel spindles of direct-access storage, for a total of over 5 billion bytes of on-line direct-access storage. For dual-channel access, the total number of spindles for one mass storage processor is reduced to 16, or a total of 2.5 billion bytes of on-line mass storage. Two dual-channel mass storage processors can be cross-bar-connected to provide a 4-by-32 disk drive subsystem with a total capacity of 5 billion bytes. Multiple mass storage processors can be configured. A maximum of 16 magnetic tape units with transfer rates of up to 320,000 bytes per second can be accommodated by the magnetic tape processor. In addition, an optional document handler processor enables a Level 66 central processor to be configured with up to four MICR/OCR document readers.

Level 66 systems are intended for large-scale data base/data communications applications. Except for Models 66/05, 66/07, and 66/17, a Level 66 system can include from 1 to 4 Datanet 6600 Front-End Network Processors, with each of the larger models capable of connecting up to 380 communications lines.

All Level 66 central processors operate under the full multidimensional processing capabilities of the GCOS operating system. Programming languages include ANS COBOL-68 and COBOL-74, PL/1, FORTRAN, ALGOL, JOVIAL, BASIC, and the GMAP assembly language. Level 66 systems can also utilize an enhanced version of Honeywell's Integrated Data Store (I-D-S) for design and implementation of network-oriented data base management systems.

MODEL 66/05: Announced in June 1976, the Model 66/05 is the smallest and lowest-priced Level 66 processor. The 66/05 actually has better performance levels than those of the Model 66/10 prior to the June 1976 realignment of the Level 66 line. It uses the full-scale GCOS Level 66 operating system. With typical monthly rentals ranging from approximately $16,000 to $20,000, the Model 66/05 system fits nicely into a price range that went unfilled in the original April 1974 announcement of the Series 60 product line. In architecture and systems software, the 66/05 represents a downward extension of the Level 66 processors and operates under the full-function version of Honeywell's GCOS operating system.

The Model 66/05 achieves its economies through the use of an integrated control unit that contains the I/O multi- ▷

▶ INPUT/OUTPUT CONTROL

CONFIGURATION RULES: The *Model 66/05* can have one or two central processor units with an integrated system controller and I/O multiplexer. The I/O multiplexer contains 18 channel board function slots. Three channel boards are required to constitute a channel connection to a peripheral processor, an integrated or free-standing Datanet 6600 Front-End Network Processor (FNP) requires one board, and the console requires one or two (if memory is greater than one million bytes) boards. The unit record processor for the Model 66/05 can multiplex up to four logical channels to four separate unit record devices through a single channel of the I/O multiplexer. The special MSP0605 single-channel mass storage processor, for Model 66/05 only, can access up to eight MSU0402/0451 disk storage drives or up to four MSU0500 drives. A dual-channel magnetic tape processor can provide two simultaneous channels from the I/O multiplexer to up to eight magnetic tape units. Model 66/05 is available with a new functionally integrated front-end network processor as part of the central processing system (CPS6058), which offers limited communications (up to eight lines) for multidimensional operation, and is also available for local batch processing only (CPS6050), i.e., without an integrated FNP. Also, one can optionally add a Datanet 6616 FNP to connect up to 8 lines, a Datanet 6624 for up to 56 lines, or a Datanet 6632 for up to 380 lines to either the CPS6050 or CPS6058 central system.

The *Model 66/07* time-sharing system can have one or two central processor units with an integrated system controller and I/O multiplexer. The I/O multiplexer contains 18 channel board slots. Three channel boards are required to constitute a channel connection to a peripheral processor, the Datanet 6600 FNP requires one board, and the console requires one or two (for more than one million bytes of main memory) boards. The unit record processor for the Model 66/07 can multiplex up to four logical channels to four separate unit record devices through a single-channel of the I/O multiplexer. The 66/07 mass storage processor can be either integrated or free-standing; both can support up to 32 MSU0402/0451 disk drives. The integrated processor also supports up to 15 MSU0500 disk drives. A dual-channel mass storage processor can provide 2 simultaneous channels from the I/O multiplexer up to 16 disk storage devices. The single-channel magnetic tape processor can access up to eight magnetic tape units. A single Datanet 6616/6624/6632 connects up to 8/56/380 communications lines, respectively; in time-sharing mode, the system can have up to 180 lines connected at one time.

The *Model 66/10* can be configured as an integrated or free-standing system. When a central processor, a system controller, an I/O multiplexer, and possibly a mass storage processor and/or a unit record processor are integrated into a single unit called an integrated control unit (ICU), the system is defined to be an integrated system. In a free-standing system, all central processors, I/O multiplexers, and system controllers are free-standing units.

The Model 66/10 system can have one or two central processors and one or two I/O multiplexers. An integrated Model 66/10 can have one or two system controllers. A free-standing system can have up to one or more for a total of four system controllers. A Model 66/10 integrated I/O multiplexer contains 18 channel board slots and a free-standing I/O multiplexer contains 35 slots for connecting peripheral processors, consoles, and FNP's. The only restraints on connecting Model 66/10 peripheral subsystems or units are the number of channel board slots, the 24 logical channels per IOM, and the total I/O throughput. Up to four Datanet 6616, 6624, or 6632 FNP's can be configured to connect up to 8, 56, or 380 communication lines, respectively.

The *Model 66/17* time-sharing system can have one or two central processors and one or two I/O multiplexers. It can be configured as a free-standing or integrated system. ▶

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▷ (i.e., the 66/05) in batch mode and over twice as fast in time-sharing mode. The 66/07 is available only in an integrated control unit which contains the central processor, I/O multiplexer, and system control unit, and can also accommodate an integrated unit record processor and mass storage processor. The Model 66/07 comes in single or dual processor and single I/O multiplexer configurations. The mass storage processor is the same one that larger Level 66 models use, except that it is limited to a single channel or dual crossbarred channels and eight MSU0402/0451/0500 disk drive units. The single-channel magnetic tape processor can have up to eight MTU0410/0411/0412 magnetic tape units. The unit record processor can handle up to four 400 or 1050 cpm readers, 100-400 cpm punches, and 1100, 1200 or 1600 lpm printers. The Datanet 6616, 6624, or 6632 Front-End Network Processor can connect up to 8, 56, or 380 communication lines, respectively.

MODEL 66/10: The Model 66/10 provides about the same processing power as the older Honeywell Series 6000 Model 6025 or about 30 percent more processing power than the Model 66/05, and also offers expanded configuration ranges. The 66/10 can include from 393,216 to 4,194,304 bytes of main memory in a free-standing system and up to 2,097,152 bytes in an integrated system.

MODEL 66/17: The Model 66/17 was announced in June 1976 and is the middle member of the three concurrently introduced time-sharing models. It operates at about the speed of the Model 66/10 in batch mode and over twice as fast in time-sharing. It has the same configuration flexibility as the Model 66/10 except that it can have one Datanet 6616, 6624, or 6632 FNP which can connect 8, 56, or 380 communication lines, respectively.

MODEL 66/20: The Model 66/20 provides approximately 1.6 times the processing performance levels of the Model 66/10. One or two central processors can be configured. A Model 66/20 integrated system can include from 524,288 to 2,097,152 9-bit bytes of MOS main memory with a cycle time of 1.4 microseconds per eight-byte fetch (72 bits), and a free-standing system can include from 393,216 to 4,194,304 bytes.

MODEL 66/27: The Model 66/27 time-sharing system announced in June 1976, is the largest of the special time-sharing models of the Level 66. It operates at the speed of the Model 66/20 in batch mode and nearly twice as fast in time-sharing mode. One or two central processors and one or two I/O multiplexers can be configured. The Model 66/27 has a high-speed cache memory in each central processor. The Model 66/27 can have from 524,288 to 2,097,152 9-bit bytes of MOS memory with a cycle time of 1.4 microsecond per eight bytes in an integrated system, and up to 4,194,304 bytes in a free-standing system.

MODEL 66/40: The 66/40 provides approximately 1.6 times the performance level of the Model 66/20. The ▷

▶ multiplexer adapters or, optionally, to the high-speed multiplexer through a unit record processor. Software limits the number of front-end network processors and document handlers to four per system. Datanet 6624/6632/6678 front-end network processors can be configured.

The *Model 68/60 Multics* system can have one or two central processors, one or two I/O multiplexers with 24 input/output channels each, and one system controller for each 262,144 words of main memory. One Datanet 6600 FNP can be connected to the I/O multiplexer, and the system can support from 1 to 8 mass storage processors, each capable of attaching up to 32 disk drives. The Model 68/60 can accommodate one or two 8-drive magnetic tape processors and multiple unit record processors for controlling low-speed peripheral devices.

The *Model 68/80 Multics* system can have from one to seven central processors, one or two 24-channel I/O multiplexers, and from one to eight system control units. One free-standing system controller is required for each 262,144 words of main memory (maximum 2 million words). Up to four Datanet 6600 FNP's can be connected to each I/O multiplexer. Each mass storage processor can attach up to 32 disk drives, and each of 2 magnetic tape processors can attach up to 8 tape drives. The Model 68/80 accommodates multiple unit record processors for controlling low-speed peripheral devices.

SIMULTANEOUS OPERATIONS: In Level 66 and Level 68 systems, all installed processors and I/O multiplexers can operate simultaneously and independently, with interference occurring only when two or more of these units simultaneously attempt to access the same main storage module.

MAXIMUM I/O DATA RATES: In both Level 66 and Level 68 systems, each I/O multiplexer can handle an aggregate data rate of 2,700,000 bytes per second in Models 66/05 through 66/40 and 4,000,000 bytes per second in Models 66/60, 66/80, 68/60, and 68/80. The Model 68/85, with its system control processor, has an aggregate data rate of 16,000,000 bytes per second.

MASS STORAGE

MSU0402 MASS STORAGE UNIT: Provides storage for 78 million 9-bit bytes (117 million 6-bit characters) on one Honeywell Type 4451 removable disk pack, whose 12 disks have 19 recording surfaces with 411 tracks, including 7 spares, per surface. Average head-positioning time is 25 milliseconds, and average rotational delay is 8.3 milliseconds (3600 rpm). Data transfer rate is 716,000 9-bit bytes per second or 1,074,000 6-bit characters per second. Rotational position sensing and dual-access capability are available as options.

While data transfer is taking place on one MSU0402 unit, simultaneous seek operations can be performed on the other drives attached to a mass storage processor. Data protection is ensured by a validity check code in each record/sector, and write protection is a standard feature which prevents inadvertent writing on specified disk packs. Further data integrity is afforded by system-controlled offset track spacing, which permits recovering otherwise unrecoverable data.

Level 68 systems can operate up to 32 MSU0402 units from one MSP0601 mass storage processor, and 16 such processors can be configured for a total of 512 MSU0402 units in one Level 68 system. Level 66 systems can operate with one or two MSP0600/0601 mass storage processors. Two dual-channel MSP0600/0601 mass storage processors can be crossbarred to provide four simultaneously operating channels accessible to as many as 32 MSU0402 storage units. Each dual channel provides for simultaneous operation of two MSU0402 units. Dual-processor crossbarring provides simultaneous access to any two of up to 32 devices that are shared between the two processors. Alternatively, ▶

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▷ and system interface units for processors, multiplexers, and memory units. The dual system control processors have many functions including I/O control, maintenance processing, memory control, and system control. Due to the system control unit's increased power and flexibility, the Model 66/85 main memory capacity ranges from 2,097,129 to 8,388,608 bytes.

LEVEL 68 HARDWARE

The high-end members of the Honeywell Series 60 family, the Model 68/60 and Model 68/80, are the latest versions of Honeywell's Multics hardware and are aimed at the growing group of users who have requirements for the powerful virtual memory and on-line processing capabilities of the Multics operating system. Among the many advanced features of the Level 68 central processors are hardware for handling segmentation and paging in a virtual-memory environment, a high-speed cache memory for improved performance (in the Model 68/80 processor only), an associative memory for fast hardware access to the virtual memory and efficient address translation, and a ring structure for program and data protection to allow the creation of closed subsystems which are mutually exclusive and completely protected from each other.

The Model 68/60 was announced in January 1975 to make the advanced features of the Multics operating system available at rentals ranging from $35,000 to $65,000 per month. The 68/60 features the same central processor as the larger Model 68/80 system minus the 2048-word high-speed cache memory that is standard on the Model 68 80. As a result, the 68/80 provides approximately two-thirds of the processing power of a comparably configured Model 68/80. A Model 68/60 configuration can include one or two central processors and from one to four million bytes of main memory with a cycle time of 750 nanoseconds. The Model 68/80, announced as part of the original Series 60 family in April 1974, can have up to 16 million bytes of main memory, up to 7 central processors, and multiple free-standing peripheral processors.

Peripherals available for the Level 68 computer systems operating under Multics include up to 16 MSU0400 and MSU0451 or up to 15 MSU0500 Mass Storage Units per MSP0601 Mass Storage Processor, the MTU0400 and MTU0500 Magnetic Tape Units, 1600-lpm printers, a 1050-cpm card reader, a 100-cpm card punch, and the Datanet 6600 Front-End Network Processor for controlling up to 380 communication lines.

SYSTEM ARCHITECTURE

The Level 66 central processors are built on the time-tested architectural principles of the Honeywell 6000 Series and are completely compatible with the Series 600/6000 systems. Like the Series 6000, Level 66 machines employ a memory-oriented structure, with from one to four system controllers controlling communication between system components and servicing all demands on ▷

▶ for card equipment, printers, communications, and console equipment. The number of peripheral devices configured is limited by the number of ports available.

CRU1050 CARD READER: Reads 80-column or (optionally) 51-column punched cards serially by column at a 1050-cpm rate. The reader has a 3000-card input hopper and a 2500-card output stacker.

CCU0401 COMBINATION CARD READER AND PUNCH: Reads 80-column cards serially at 600 cpm and punches 80-column cards at 100 to 400 cpm depending on the number of columns punched per card. The input hopper capacity is 1200 cards, and the output hopper capacity is 1300 cards.

PCU0121 CARD PUNCH: Punches 80-column cards in Hollerith or binary code at a speed of 100 to 400 cpm depending upon the number of columns punched in each card. The input hopper has a capacity of 1200 cards, and the output stacker has a 1300-card capacity.

PCU0300 CARD PUNCH: Punches 80-column cards in Hollerith or binary codes at a speed of 300 cpm. The input hopper and output hopper have a capacity of 1200 cards each. An auxiliary hopper can hold an additional 100 cards on output.

PRU1100 LINE PRINTER: Prints 1100 lpm, using a print drum with a standard 63-character set. Has 132 print positions. Prints six or eight lines per inch, on continuous forms with up to six parts. Programmed operations include print and space, no space, space only, skip, skip to any of 15 coded positions, vertical line space, and error status reporting.

PRU1200 BELT PRINTER: Prints 1200 lpm, using a print belt/cartridge with a special 48-character set, and has a burst speed of 2300 lpm with a limited character set. Other character sets are optional, including sets with 63, 64, and 96 characters. The standard data format is 136 print positions per line (160 print positions optional), spaced 10 character per inch, with 6 or 8 lines per inch vertical spacing. The PRU1200 prints on single-part or multipart forms (one original and up to five carbon copies).

The print belt is packaged in a lightweight cartridge designed to facilitate removal, interchange, and storage. Each character on the print belt is mounted on a flexible "finger." During printing, the belt passes continually in front of the print hammers. When the character is struck, the flexibility of the finger causes the character to be immobilized at the moment of impact, reducing ribbon drag and improving print quality. The printer is equipped with an Automatic Standby feature that deactivates the operating mechanism of the printer when it is not being used. Programmed printer operations include recognition of belt type (48-, 63-, 64-, or 96-character set) from a code on the cartridge, print and space, space only, skip, vertical line spacing, and error status reporting. OCR-A and OCR-B belts are also available.

PRU1600 BELT PRINTER: Prints 1600 lpm, using a print belt/cartridge with a 48-character set, and has a burst speed of 2300 lpm with a limited character set. Optional character sets include sets with 63, 64, and 96 characters. The standard data format is 136 print positions per line (160 print positions optional), spaced 10 characters per inch, with 6 or 8 lines per inch vertical spacing. The PRU1600 prints on single-part or multi-part forms (one original and up to five carbon copies). Characters are produced by hammer strokes against flexible belt "fingers," each representing one character. The flexibility of the finger causes the character to be immobilized on impact, reducing ribbon drag and improving print quality. The printer includes an Automatic Standby feature that deactivates the operating mechanism when it is not being used. Programmed printer operations include recognition of belt type (48-, 63-, 64-, or 96-character set) from a code on the cartridge, print and space, ▶

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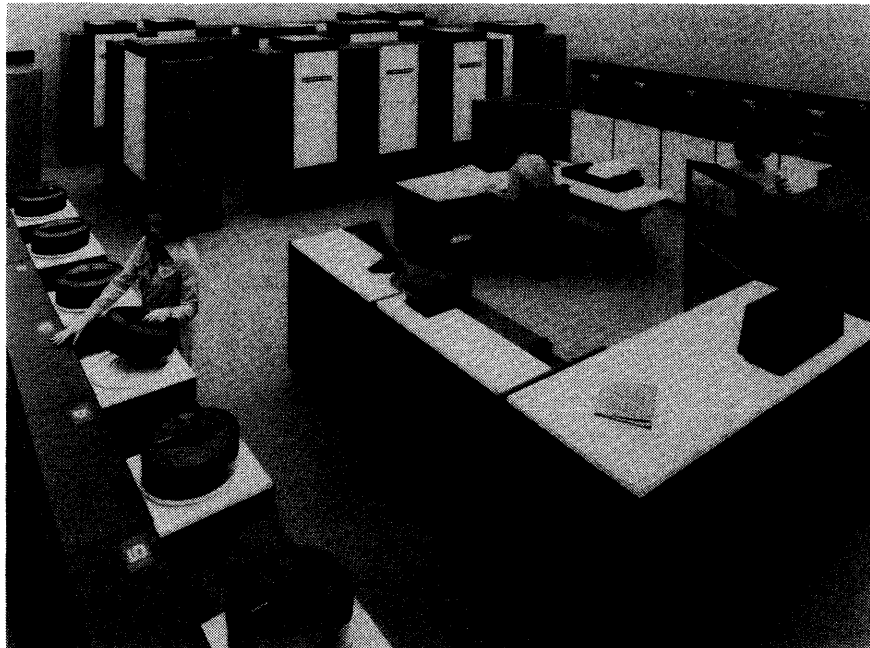
The Honeywell Model 66/60 represents the upper middle of the Level 66 mainframe line. This typical free-standing configuration includes (clockwise from top): the central processing system cabinets that house the CPU, power supplies, memory, system control units, and I/O multiplexers; eight 125-ips MTU0500 magnetic tape units; a 1200-lpm PRU1200 line printer; a free-standing unit record processor (foreground next to printer); a PCU0121 card punch; and a CRU-1050 card reader. Six drives of an eight-drive mass storage subsystem are also visible at left. The CSU6002 system console is at the center of the configuration.

▷ an associative memory for translation of virtual addresses to real memory addresses; program-addressable registers for preparing virtual-memory addresses; instructions for handling segmentation, paging hardware, and the system clock; hardware for interrupting a process in execution at any point, saving the processor status, and restoring the process at a later time; and hardware for implementing the Multics ring structure. The Model 68/60 and Model 68/80 systems utilize free-standing mass storage processors, magnetic tape processors, and unit record processors and standard Series 60 peripheral devices, plus a high-speed Bulk Store Subsystem.

The Model 66/85's distinctive system architecture largely accounts for its higher speed. The 66/85 processor uses Honeywell's new current-mode logic (CML) packages, which consist of LSI integrated circuits packaged 8 to 15 times more densely than conventional bipolar circuits. The other very significant Model 66/85 architectural difference is that the system control unit uses two parallel system control processors to control memory operation and monitor the system as a diagnostic processor. When two system control units are configured, all main memory connects to both system control units, giving increased availability.

All Series 60 systems incorporate features designed to enhance their reliability and availability. Extensive parity checking is performed on data transfers, and most central processors contain duplicate arithmetic and logic addressing circuitry that performs each operation in parallel and compares the results to ensure that the correct result has been obtained. Error diagnosis is performed by micro-programming and software routines in the peripheral processor units used with Level 64 and larger systems. The Level 64 and Level 66 main memories incorporate hardware that performs automatic single-bit error correction and detects and retries double-bit errors on all data transfers. In Level 66 systems, built-in hardware test ▷

conductor (MOS) memory in the basic FNP processor. A paging mechanism allows the addressing of up to 262,144 9-bit bytes with larger memory capacity.

Memory capacity is 49,152 9-bit bytes for the basic DCP6616 and DCP6624, and 65,536 9-bit bytes for the DCP6632. DCP6624 memory can be expanded to 65,536 9-bit bytes, while the DCP6632 offers extended memory options to 131,072 or 262,144 9-bit bytes. The processor memories have a one-microsecond cycle time with address-able word sizes of 6, 9, 18, or 36 bits. Data word lengths can vary, and different lengths can be mixed and packed in storage.

The 6600 input/output control (IOC) is bus-oriented and controls real-time concurrent servicing of local and remote devices. The IOC handles up to 16 connections with an aggregate data transfer burst rate of 500,000 words per second. The IOC operates independently of the processor and has 16 maskable priority interrupt levels with 16 maskable sublevels per level. It services a variety of terminals connected to the system's communications interface bases.

Communications lines interface the 6600 FNP's through two available bases: the general-purpose communications base (DCU6202) and the Type 1 or Type 2 asynchronous communications base. The DCU6202 communications controller can handle up to 32 concurrently operating transmission lines. It interfaces synchronous and asynchronous channels at speeds from 50 to 50,000 bps. Transmission can be simplex, half-duplex, or full-duplex in either two- or four-wire operation. One DCU6202 is standard for the DCP6616 and DCP6624. The DCP6632 can have two or three DCU6202 communications controllers. The DCP6616 has a limit of four channel groups, providing a total of eight synchronous and asynchronous communications lines.

The Type 1 and Type 2 asynchronous communications bases provide for time-division multiplexing, by character, between the FNP and asynchronous terminals with speeds up to 300 bps. The Type 1 base can be configured with up to 6 asynchronous channel groups with a maximum of 24 line terminations at 6.67, 10, or 15 cps and 17 line terminations at 20 or 30 cps. The Type 1 asynchronous communications base is standard with the DCP 6624 and DCP6632, and each FNP can contain a maximum of one.

The Type 2 asynchronous communications base is available only for the DCP6632 FNP. Each Type 2 base can be configured with up to 13 asynchronous channel groups. ▶

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▷ • Magnetic tape devices include conventional tape drives with 7- or 9-track capability for low- to medium-speed requirements, plus a high-speed, 9-track, phase-encoded unit for Level 66 systems with a data transfer rate of 320K bytes per second. A variety of densities (200, 556, 800, and 1600 bits per inch) and both NRZI and phase-encoding recording techniques are available.

• The PRU1200 and PRU1600 Belt Printers use an interchangeable belt cartridge with a set of 48, 64, or 96 characters and 132 or 160 print positions. Printing speeds using the 48-character set are 1200 and 1600 lines per minute for the PRU1200 and PRU1600, respectively. Both printers have a burst speed of 2300 lines per minute with a limited character set. Other printers are available with printing speeds of 400, 600, 800, and 1100 lines per minute.

• The DHU0800 Document Handler reads from either magnetically or optically encoded documents at an operational speed of up to 830 documents per minute. Up to four DHU0800 units can be attached to a Level 66 computer system through an optional document handler processor. The high-speed DHU1600 Document Handler reads MICR-encoded documents at a speed of up to 1625 documents per minute. The DHU1600 is supported by the Honeywell Check Handling Executive Control System (CHECS), which includes document entry and proof and transit subsystems for processing large volumes of MICR- and OCR-encoded documents on Level 66 systems.

• The Datanet 6600 Front-End Network Processors (FNP) are stored-program front-end communications processors for large-volume communications network environments. The three earlier models, the DCP6616, DCP6624, and DCP6632, differ only in main memory size and communications capacity. All three models can handle synchronous, asynchronous, and binary synchronous transmission modes and a wide variety of terminals with differing communications speeds and code sets. The DCP6678 FNP uses Honeywell's Level 6 minicomputer technology to provide connections for up to 96 mixed synchronous and asynchronous lines through appropriate interfaces. The DCP6678 provides twice the throughput of the DCP6632 FNP and has a memory capacity of 524,288 bytes.

SOFTWARE AND COMPATIBILITY

With the Series 60 announcement, Honeywell joined the ranks of unbundled computer manufacturers by announcing separate pricing for most of the software supplied with the Series 60 computer systems. Monthly equipment rental for a Series 60 system includes the operating system, including basic job management and file management systems, and programming tools such as link editors, debugging aids, the job control language, and conversion aids. Language processors and utilities, applications packages, and communications software are ▷

▶ **DATANET 6678 FRONT-END NETWORK PROCESSOR (FNP):** The Datanet 6678 FNP is code- and data-compatible with the previously announced Datanet 6600 FNP's. The DCP6678 has twice the processor speed of the DCP6632. Memory capacity is 131,072 9-bit bytes and can be expanded to 524,288 9-bit bytes in 131,072-byte increments. Data word lengths and input/output control are similar to those of the earlier Datanet 6600 FNP's described above.

Communications lines interface to the Datanet 6678 FNP through High Speed Multiline Controllers (HMLC). Each HMLC can interface up to 8 synchronous or asynchronous lines at speeds from 50 bps to 50,000 bps. The DCP6678 can be configured with up to 12 HMLC's for a total line connectability of up to 96 communications lines.

The following optional channels are available for use on the high Speed Multiline Controller:

• **Channel Interface, Synchronous RS-232C (DCF6611)—** for two channels, half- or full-duplex, synchronous, ASCII, operating at speeds up to 10,000 bps.

• **Channel Interface, Asynchronous RS232-C (DCF6612)—** for two channels, half- or full-duplex, asynchronous, operating at up to 9600 bps and utilizing 7- or 8-bit codes.

• **Channel Interface, Synchronous MIL-STD 188C (DCF6614)—**for one channel, half- or full-duplex, synchronous, ASCII, operating at up to 10,000 bps.

• **Bisynchronous Interface, RS-232C (DCF6618)—**for two channels in either binary synchronous or ANSI/ECMA mode; half- or full-duplex mode utilizing either ASCII or EBCDIC code and transparent or non-transparent operation at up to 10,000 bps.

• **Channel Interface, Broad-Band (DCF6619)—for one** channel interfacing to Bell type 301 and 303 modems, half- or full-duplex, operating at up to 50,000 bps.

• **HDLC Voice Grade, RS232-C (DCF6620)—High-level** data link control interface for one channel, half- or full-duplex, synchronous, bit-oriented, with transmission rates up to 10,000 bps; incorporates a 16-bit FCS to ensure data integrity and information control.

• **Channel Interface, Binary Synchronous Broad-Band (DCF6621)—**similar to DCF6619, but with additional capabilities for CRC, ASCII, EBCDIC, transparent, and non-transparent operation.

• **Channel Interface, Broad-Band, CCITT V.35 (DCF-6627)—**for one channel, half- or full-duplex, operating at up to 56,000 bps.

• **Auto Call Unit (DCF6613)—provides** the DCF6678 with the capability of automatically dialing remote locations; interfaces and controls two Bell System Model 801A or 801C (or equivalent) Automatic Calling Units; channels controlled must be on the same HMLC.

Any four of the above options can be connected to one High Speed Multiline Controller, except that Bisynchronous and HDLC can co-exist on the same HMLC. Six HMLC's are standard on the DCP6678; optionally, six more HMLC's can be configured in increments of one.

SOFTWARE

LEVEL 66 GCOS: This integrated operating system is the basis for all Series 60 Level 66 software. It has facilities for controlling concurrent local batch processing, on-line transaction processing, and time-sharing. Level 66 GCOS is based on GCOS 6000, the operating system support for the earlier Honeywell Series 6000 computers. ▶

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▷ There is no direct program compatibility between the Level 66 and Level 68 processors and other non-Honeywell product lines, as there is with the Level 62 systems. Honeywell's ANS COBOL and FORTRAN compilers, however, along with a variety of other software aids, should make conversion to the Level 66 or 68 systems a fairly straightforward task for most COBOL- and FORTRAN-oriented installations.

COMPETITIVE POSITION

In the medium-to-large-scale sector of the computer market, the Model 66/10 compares favorably with the IBM System/370 Model 148. The newer, entry-level Model 66/05 is a configuration-constrained system that is estimated by Honeywell to provide about 60 percent of the performance level obtainable from the Model 66/10 and is similar in performance characteristics to the IBM System 370/138. According to Honeywell, the larger Model 66/20, 66/40 and dual-processor Model 66/60 compete with the IBM System/370 Models 155, 158-3, and 168-3, respectively. The new Model 66/85 is estimated to yield throughput that is slightly below that of Burroughs' latest B 7800 system in a transaction processing environment, and approximately equal to that of Univac's 1100/80 system in the same type of environment.

USER REACTION

Datapro received usage information on 15 Honeywell Level 66 and Level 68 systems from 14 users in June 1977. These 15 systems included two Model 66/20's, two Model 66/40's, eight Model 66/60's, and three Model 68/80 Multics systems. All but one of the 15 systems were uniprocessor configurations; the exception had six 68/80 CPU's, any four of which were on-line at a time.

The primary usage of the Level 66 systems reported by 10 of the 14 users involved a mixture of business data processing, data communications, and data base management applications. Three used their systems for scientific/ engineering applications, and one had implemented a conversational time-sharing system with over 200 user terminals.

The three Level 68 systems were all employed in large-scale, high-performance, interactive time-sharing systems. One system was used almost exclusively for software development, one in a university setting for scientific/ engineering and administrative applications, and the third, the multi-CPU system, supported an evenly divided mixture of business data processing and scientific/engineering applications.

The systems had been installed for between 9 and 36 months, averaging about 23 months for the 15 systems. Memory sizes for the 12 Level 66 systems averaged 325K words, with 192K and 256K words the most frequently encountered sizes. The three Level 68 systems had main memories of 768K, 1024K, and 2048K words. None of the Multics systems employed bulk storage. ▷

▶ The execution of an activity or job may terminate either normally or abnormally under GCOS. Upon normal termination, GCOS writes an accounting record on the System Output File, itemizing the system resources used by the activity. Successive compilations of the same type are automatically run as a single activity to avoid repetitive deallocation and reallocation of the same system resources. If the activity is the last activity of a job, an EOJ message is issued to the operator console, and the job is released for punched card or printer output. Abnormal termination occurs when an activity tries to execute an illegal operation, when a hardware malfunction is detected, or upon request of the operator or a user program. An abnormal terminal can be accompanied by a memory dump and/or by special abort actions specified by the programmer.

GCOS includes an output collection mechanism and an output disbursing function (SYSOUT). The output files generated by all activities are collected within the GCOS file system and then batched on multiple printers and/or card punches. Printing and punching are performed concurrently with the processing of other jobs and the entry of still other jobs into the system.

GCOS is designed for use in both single-processor and multiprocessor configurations. In multiprocessor systems, the Dispatcher collects activities for all processors from a single queue. All processors execute both GCOS and user programs, but only the one designated to be the control processor responds to I/O interrupts. Each processor handles its own interrupts.

Remote access is a featured capability of GCOS in each of its processing dimensions: batch, transaction processing, and time-sharing. The communications control functions are performed by the Datanet 6600 Front-End Network Processor. Any Series 60 program that can be entered at the central computer site can also be entered remotely via a batch terminal or a keyboard terminal. Output can be routed to the originating terminal, one or more other terminals in the communications network, central-site card punches and printers, or the GCOS SYSOUT facility. A Communications Mass Store Link permits remote batch terminals to communicate directly with mass storage via the front-end communications processor, bypassing the central processor and main storage. User programs executing in the batch mode can establish communications with remote terminals to accept input or issue a remote inquiry request.

TRANSACTION PROCESSING SYSTEM (TPS): The Level 66 GCOS Transaction Processing System (TPS) invokes the loading and execution of the appropriate application programs for processing transactions received from remote terminals. The Transaction Processing System requires a front-end network processor and can accept transactions from terminals including Honeywell BTT 7340 Bank Teller Terminals; Teletype Models 33, 35, and 37; and the Datanet 760 and VIP Series 765, 775, 785, and 7700 Keyboard-Display Terminals.

The TPS is modular in design and consists of the Transaction Processing Executive, user-written Transaction Processing Applications Programs, the Transaction Input Interface at each remote terminal, and the Interslave Communication (INTERCOM) Facility. The Transaction Processing Executive Program (TPE) receives transactions from remote terminals, checks them for validity, and queues input transactions according to user-established priorities. TPE then initiates the appropriate Transaction Processing Applications Program for processing the transaction, and directs the output to the originating terminal. TPE also maintains a journal of input and output data to facilitate recovery activities. The Transaction Processing Applications Programs (TPAP's) can be written in any language processor supported by GCOS, including COBOL, FORTRAN, or GMAP, and are stored in the GCOS file system for activation as required. TPAP's can also request direct communication with a terminal to process a transaction in the interactive mode. ▶

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▷ among the lowest in the previous survey. These lower ratings seem to be traceable to early product life problems. In both cases, users felt that the vendor's technical personnel had not been sufficiently trained for the systems. The somewhat higher ratings in our latest survey indicate that this problem is diminishing, but nonetheless should still be addressed by Honeywell. In the case of the Multics systems, one user felt that the customer engineers were really Level 66-trained personnel that had been assigned to service Level 68 systems. One highly positive note sounded by a Multics user regarded Honeywell's recent addition of on-line diagnostics. Previously, subsystem checkouts could only be performed off-line.

Peripherals were singled out as a weakness in newly installed systems, despite the high overall rating for Peripheral Reliability. Break-in problems in magnetic tape units and disk drives were noted by several of the users.

Honeywell's compilers generally received good ratings, the exceptions being the more recently introduced ones. For example, both the PL/1 and BASIC compilers for the Level 68 received "excellent" ratings, while the COBOL-74 and most recent FORTRAN compilers were described as containing some initial bugs which, in time, will surely be eliminated.

The relational data base manager for the Multics systems was singled out by one knowledgeable user as the only truly relational data base manager on the market.

As compared to other general-purpose computer systems, the Level 66 and Level 68 drew above-average user ratings in nearly all of Datapro's 12 rating categories. Thus, it's clear that these systems are maintaining the well-earned reputation of the earlier Honeywell Series 6000 systems for being reliable, cost-effective computers supported by efficient software.□

▶ (GRTS). This interface includes both direct-access conversational and queued interfaces.

A Transaction Processing Routine (TPR) is the only other on-line component and is the actual user-developed application logic written in TDS-COBOL. This version of COBOL is simply an extension of the standard Level 66 IDS-COBOL with some specialized TDS verbs added to the language. The actual logic to process a single transaction can be placed in several small logical user-developed routines or TPR's. These routines are automatically called into execution by the TDS Executive on receipt of a transaction and executed in an area of memory controlled and protected by the TDS System. The Transaction Processing Routine contains the procedural logic to process the specific transaction, with TDS handling message management, resource allocation and optimization, data base access, journalization, and recovery/restart.

The system support software of the TDS system includes a librarian for program library maintenance, a test bed facility for testing TPR's, and a system generator program for executive table creation. These support software components perform all the necessary functions for the creation and maintenance of an on-line system.

TIME-SHARING: The Level 66 GCOS Time-Sharing System, in connection with a Datanet front-end processor, provides time-sharing computing services to multiple users at remote terminals. The system resources allocated to time-sharing can be dynamically varied under operator control. The time-sharing executive, operating as a slave activity under GCOS, suballocates storage and dispatches the processor to the programs of individual time-sharing users. It also performs various services for the time-sharing programs, including I/O control, file creation, cataloging, storage protection, and resource accounting.

Level 66 GCOS Time-Sharing users have a choice of five major programming languages: Extended BASIC, FORTRAN, JOVIAL, APL, and ALGOL. Time-sharing users can communicate directly with batch-mode facilities, permitting the development and testing of programs, data entry, control of batch program execution, and manipulation of results from remote terminals.

A Text Editor permits terminal users to create a body of text, edit it, save it, and print it in a specified format. Data Query is a system that permits selective retrieval of data from a data base structured and maintained by I-D-S, and includes a translator to generate the file structure and data-name dictionary. ACCESS is a conversationl file management system for creating, deleting, and maintaining catalogs and files and for assigning passwords and accessing criteria. The FDUMP facility can be used for inspection and maintenance of permanent files. The LODX routine permits execution of experimental user subsystems, including trace analysis and debugging of user programs from remote terminals. The Time Sharing Activity Report provides reports on the accumulated utilization of the time-sharing system resources.

The Time-Sharing system includes several user aids, including the HELP command to provide a detailed explanation of system error messages; a Command Loader for storing and accessing new subsystem; Command File Processing, a non-interactive processing mode in which user responses to terminal input requests are obtained from a file; and Deferred Processing, in which a predefined input file is used for responses and the resulting dialog is directed to an output file. An extensive library of time-sharing application programs is also provided, including programs for mathematics, statistics, business and finance, management science, engineering, and educational and tutorial applications. The Time-Sharing System has an open-ended design that enables users to add commands or subsystems, or to replace the standard time-sharing executive with one of their own design.

The GCOS Level 66 Time-Sharing System provides support for a variety of terminals, including the Teletype Models 33, 35, and 37; Honeywell SRT 301; Honeywell Models 765, 775, and 785 VIP and Datanet 760 Keyboard/Displays; GE TermiNet 300; Datel terminals; and the IBM 2741.

FILE SYSTEM: The GCOS File System provides powerful file management capabilities, including multi-level user catalogs, file sharing, and access control. The system employs a hierarchical, "tree-structured" design. A System Master Catalog lists the various User Master Catalogs, and each user may in turn define one or more levels of subcatalogs. Users may permit general sharing of their files or specify individual users who may access them, on either a read/write or read-only basis. Password access control can be imposed at any or all levels of the file structure. From the programmer's viewpoint, all file processing is performed at the logical level, with GCOS handling all physical I/O operations. If desired, users can request that their files be stored on specific types of devices. The File System will accommodate files organized under the I-D-S concept, described below, and also in sequential, indexed sequential, and random organization.

FILE MANAGEMENT SUPERVISOR: FMS provides a number of facilities to aid in the management and utilization of permanent files. It provides a variety of file protection ▶

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▶ specific view of the data base, and the other to examine data within the data base. The final facility provides a limited procedural-language capability to access a data base, perform retrieval qualified by programmer-defined parameters (including Boolean criteria), and generate formatted, multi-level reports on the results of the retrievals.

The DM-IV Procedural Language Processor (PLP) is an option of the DM-IV Query and Reporting Processor that extends its capabilities in two areas. The conversational data query facility can be used to load a data base and to modify already-existing data as well as to examine it—all in a conversational mode of operation. The Procedural Language Processor also extends the capabilities of the QRP procedure language, expanding it from a query and report generation facility into a fully developed, higher-level procedural language. This procedural language is functionally comparable to COBOL and other similar languages, and could be used as an alternative.

Each of the DM-IV processors—the Transaction Processor, the Query and Reporting Processor, and the Procedural Language Processor—is based on having the DM-IV Data Manager administer the data base. Further, the COBOL-74 facilities supplied as part of the Data Manager are necessary to the functioning of the Transaction Processor as well as to many of the data base description operations within the Data Manager. The facilities of the Procedural Language Processor are dependent upon the pre-existence of the Query and Reporting Processor within the system and are actually extensions of the functionality of the latter. There is, however, no dependence between the Transaction Processor and the other processors of the system, and they are linked only insofar as they access the same data bases.

MANAGEMENT DATA QUERY SYSTEM: MDQS is a data management system that permits interrogation of sequential, indexed sequential, or I-D-S/I file organizations. MDQS operates as a subsystem to GCOS in both batch and time-sharing environments. In order to implement MDQS, user and system directories are defined to identify the data base and the files associated with the data base. An optional Privacy File can be established for storing user identification and passwords associated with the records and data elements of the data base.

MDQS provides a Data Definition Language to permit description of the data base, including relationships and attributes of the data to be processed by MDQS procedures. A Procedural Language provides simple English commands for retrieving data, performing arithmetic computations on retrieved data, and selecting output for printing. In addition, the Procedural Language includes the ability to match transaction input to a master file, update data bases, accept terminal data input, audit data base changes, sort retrieval data, write files, print multiple reports, and redirect output to any terminal devices on the network, a file, or a central-site printer.

Two special subsystems of the full MDQS functionality are provided to assist non-professional users in accessing data files. The Conversational subsystem is an interactive prompting mode that guides the user through the data retrieval, sorting, and printing procedure. For users with update privileges, a data base can be browsed through and modified as a new data base is loaded. The Query subsystem provides a simple query capability with full report generation.

Other features within the language allow subscripting up to seven levels, automatic table lookup, data validation, procedural checkpoints, support of removable media, and parameterized input to either source or object procedures.

A user profile feature is available to the data base administrator for user control and establishment of site parameters for the MDQS system. A complement of utility programs is provided for updating directories, inserting and deleting file entries, and converting data files to MDQS format.

MDQS is available in two versions: MDQS/II, a data base retrieval and report generation system, and MDQS/IV, a system that offers all MDQS/II capabilities plus data base creation and maintenance features.

TOTAL ON-LINE TESTING: TOLT is an off-line test and diagnostic system that runs under GCOS. Its objective is to improve the system's reliability and availability through the use of on-line preventative and corrective maintenance techniques. TOLT monitors and saves all error status information, makes periodic surveillance checks of various hardware modules, and calls in specific diagnostic tests and on-line troubleshooting programs. TOLT and GCOS are designed to take full advantage of the various maintenance facilities of the Series 60 hardware: programmable voltage margins, programmable timing strobes, history registers, programmable channel wrap-arounds, parity and sequence checks, snapshot channel hardware, and a fault register.

The Honeywell Error Analysis and Logging System (HEALS II) is a software system that works in conjunction with TOLT, GCOS, and the Series 60 fault recovery hardware. The Instruction Retry feature attempts to recover from transient errors such as incompleted operations, parity errors, and illegal procedures. Errors associated with the Extended Instruction Set are logged by the HEALS Logging program but are not retried. The HEALS Logging program accumulates statistics on the results of instruction retry operations and processor and main memory errors. If an unrecoverable parity error occurs, a storage segment is reconfigured, and TOLTS is activated to test the malfunctioning segment. An Error Summary File contains summaries of processor errors and addresses and data associated with parity errors. Parity errors are analyzed in order to isolate malfunctioning bits. A Microprogrammable Peripheral Controller Statistics Report Program produces listings of errors associated with the controller and associated peripheral devices.

NETWORK PROCESSING SUPERVISOR: The Level 66 NPS is an extension of the Series 6000 NPS. It controls five types of remote processing in any combination: remote job entry, transaction processing, time-sharing, message switching, and direct program access. The information network, controlled by a combination of the Datanet 6600 Front-End Network Processor and the NPS software, can range in size from several terminals to a comprehensive, distributed information network with multiple host processing facilities. NPS interfaces with the following Honeywell computer systems as remote batch systems: Series 100, Series 200/2000, and Datanet 700 Remote Network Processors (for remote job entry or remote concentration). In addition, NPS provides the necessary binary synchronous communications discipline and interface to communicate with IBM 2780 remote batch terminals and System/360 and System/370 computers in remote job entry applications. NPS also provides powerful customization and parameterization facilities to facilitate implementation of additional terminal types and network protocols into the system.

LEVEL 66 COBOL-74: The COBOL compiler for Series 60 Level 66 systems provides the functional modules specified for ANS COBOL-74, including the Debug, Sort/Merge, and Report Writer facilities. Level 66 COBOL-74 uses ASCII as the standard internal code set and accommodates packaged decimal and 16-, 32-, and 36-bit binary standard numeric representations. Additional features include a communications facility that permits development and debugging of programs by remote users, support for the Data Manipulation Language specified by the CODASYL Data Base Language Task Group, and a "language mask" for selecting language elements to be recognized and compiled. COBOL-74 will run on a Series 60 Level 66 system with a minimum of 524,288 bytes of main memory.

APL/66 LEVEL II: A superset version of the APL programming language, APL/66 is an interactive system for use with large-scale Honeywell computers. APL is intended for applications requiring the manipulation of arrays of data ▶

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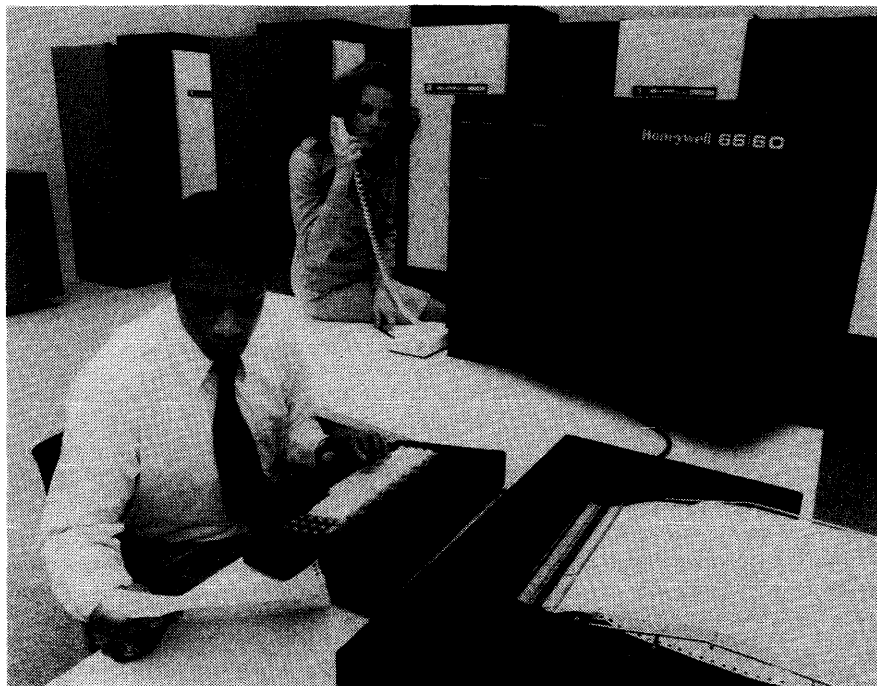
This photo shows details of the Model 66/60 console, the CSU6002, with its indicator and control panel that incorporates two 12-inch CRT display units (lower half of panel). The unit also includes the console keyboard and a 30-cps, 80-position serial printer. The Model 66/60 represents a mid-range system in the Series 60 Level 66 line, with prices for the basic central processing system starting at $1,646,301 or $35,318 per month. The central system cabinets in the background house the CPU, memory, system controller, and I/O multiplexer.

Multics administrative functions permit various users to define configurations, operating procedures, and the secondary storage quotas that are available to specified groups of users. These features, along with the Multics protection facilities, allow multiple operating environments to be established. Accounting procedures are available to measure each user's use of the system in each environment.

Users communicate with the system through a command processor, which interprets user requests and invokes the appropriate software component to perform the function, eliminating the need for users to deal with traditional job and control language. User modifications in the command processor can define restrictions to use of the system for specified users.

Languages available to Multics users include PL/1, FORTRAN, APL, BASIC, and the ALM assembly language. In addition, the system includes a wide variety of utility programs, including text editors, debugging aids, performance measurement tools, interuser communication facilities to permit messages to be transmitted among users, and on-line documentation of system software and user programs.

Multics also supports a comprehensive word processing system, WORDPRO, which includes editing, error correction, and formatting tools for the on-line preparation of documents. Multics also provides an interactive graphics system, supporting both static and dynamic terminals, that permits creation and manipulation of complex graphics structures.

The Multics Data Management System provides a comprehensive data base manager with two interfaces, one a version of GCOS I-D-S and the other a fully implemented relational data management system. An interactive end-user facility called Logical Inquiry and Update System (LINUS) and the RGL report generation language assist users of the Multics data base system in record retrieval, updating, and reporting functions.

MULTICS PL/1: A language processor designed for commercial, scientific, and system programming applications, it was developed on Honeywell equipment in conjunction with the Massachusetts Institute of Technology. Multics PL/1 is the language defined by the American National

Standards Institute's PL/1 standard. PL/1-compiled code is said to be extremely efficient and has been used to compile most of the Multics system software.

PL/1 is a block-structured language that allows both internal and external names. This feature facilitates the development and maintenance of modular PL/1 programs. All procedures are recursive and sharable. Multics PL/1 utilizes the full ASCII character set defined in American National Standards Institute standard X3.4-1968. Both upper case and lower case letters can be used to form names up to 256 characters long.

Multics PL/1 has eight data formats: arithmetic, string, locator, format, label, entry, file, and area data. These provide the language with considerable descriptive power. In addition to fixed-point and floating-point binary arithmetic, Multics PL/1 provides variable-precision true fixed-point and floating-point decimal arithmetic of up to 59 decimal digits directly supported by hardware. Structure variables (similar to the hierarchical descriptions of COBOL) enable the programmer to explicitly define data structures as any aggregate of elementary data formats.

PL/1 also has bit string and character string handling capabilities. Operations and functions are performed on either fixed- or variable-length strings. The extended instruction set of the central processor is fully utilized to perform character- and bit-string operations and picture editing, as well as decimal arithmetic and arithmetic base conversions. Arithmetic, string, or pointer variables declared with the "unaligned" attribute are packed into the minimum number of bits, giving the programmer complete control over the packing of structures and arrays. Through the use of pointer-valued Multics functions and PL/1-based variables, users can access any bit in the entire virtual memory.

Compilation and execution can be initiated through Multics batch processing or through interactive mode. Object modules are produced in such a way that no relocatable edit is required. The normal mode of operation is to execute with dynamic linking and loading so that unreferenced data and unused programs are never loaded into main memory. Relocatable object code permits the binding of separately compiled programs together into one segment which has fewer pages than its unbound components. An optional optimizer performs extensive optimization of common ex- ➤

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► tenance 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 of $45 per man-hour. Unlimited use is permitted for all peripheral devices and for central processors on a 5-year lease.■

EQUIPMENT PRICES

		Purchase Price	Monthly Maint.	Rental (1-year lease)*	Rental (5-year lease)*
MODEL 66/05 PROCESSORS & OPTIONS					
CPS6050	Central Processing System; includes CPU, integrated system controller, integrated input/output multiplexer with 18 channel function slots, and 98,304 words of memory	292,066	820	6,915	6,224
CPS6058	Central Processing System; includes CPU, integrated system controller, integrated input/output multiplexer with 18 channel function slots, front-end network processor, and 98,304 words of memory	322,684	966	7,714	6,917
CPU6005	Additional central processor for CPS6050/CPS6058; maximum of one	223,239	535	5,906	5,315
MODEL 66/07 PROCESSORS & OPTIONS					
CPS6070	Central Processing System; includes CPU, integrated system controller, integrated input/output multiplexer with 18 channel function slots, and 98,304 words of memory	382,066	1,043	8,788	7,909
CPU6007	Additional central processor for CPS6070; maximum of one	247,590	590	6,550	5,895
MODEL 66/10 PROCESSORS & OPTIONS					
CPS6110	Central Processing System; includes CPU, integrated system controller, integrated input/output multiplexer with 18 channel function slots, and 98,304 words of memory	426,791	1,444	9,547	8,592
CPS6120	Central Processing System; includes CPU, system controllers, free-standing input/output multiplexer with 35 channel function slots, and 98,304 words of memory	499,736	1,540	10,928	9,835
CPU6101	Additional central processor for CPS6110/CPS6120, maximum of one	261,408	610	6,915	6,224
CPS6100**	Central Processing System; includes CPU, integrated system controller, integrated input/output multiplexer with 10 channel function slots, and 81,920 words of memory	352,800	792	7,488	7,114
CPS6102**	Central Processing System; includes CPU, integrated system controller, integrated input/output multiplexer with 10 channel function slots, and 98,304 words of memory	379,140	857	8,014	7,630
CPS6106**	Central Processing System; includes CPU, integrated system controller, integrated input/output multiplexer with 10 channel function slots, and 131,072 words of memory	431,820	985	9,066	8,628
CPS6107**	Central Processing System; includes CPU, integrated system controller, integrated input/output multiplexer with 18 channel function slots, and 196,608 words of memory	537,180	1,246	11,170	10,624
CPS6108**	Central Processing System; includes CPU, integrated system controller, integrated input/output multiplexer with 18 channel function slots, and 262,144 words of memory	642,540	1,500	13,274	12,620
MODEL 66/17 PROCESSORS & OPTIONS					
CPS6170	Central Processing System; includes CPU, integrated system controller, integrated input/output multiplexer with 18 channel function slots, and 98,304 words of memory	564,291	1,667	12,393	11,154
CPS6180	Central Processing System; includes CPU, system controller, free-standing input/output multiplexer with 35 channel function slots, and 98,304 words of memory	631,236	1,763	13,774	12,397
CPU6107	Additional central processor for CPS6170; maximum of one	342,300	709	9,056	8,150
MODEL 66/20 PROCESSORS & OPTIONS					
CPS6210	Central Processing System; includes CPU, integrated system controller, integrated input/output multiplexer with 18 channel function slots, CPU addressing, IOM addressing, and 131,072 words of memory	782,028	2,117	16,391	14,752
CPS6220	Central Processing System; includes CPU, free-standing system controller, free-standing input/output multiplexer with 35 channel function slots, CPU addressing, IOM addressing and 131,072 words of memory	848,974	2,213	17,772	15,995
CPU6201	Additional central processor for CPS6210/CPS6220; maximum of one	436,800	760	11,555	10,400
CPS6200**	Central Processing System; includes CPU, integrated system controller, integrated input/output multiplexer with 10 channel function slots, CPU addressing, IOM addressing, memory addressing, and 81,920 words of memory	663,980	1,437	13,280	12,616
CPS6201**	Central Processing System; includes CPU, integrated system controller, integrated input/output multiplexer with 10 channel function slots, CPU addressing, IOM addressing, memory addresing, and 98,304 words of memory	690,320	1,501	13,806	13,115
CPS6202**	Central Processing System; includes CPU, integrated system controller, integrated input/output multiplexer with 10 channel function slots, CPU addressing, IOM addressing, memory addressing, and 131,072 words of memory	743,000	1,630	14,858	14,113
CPS6203**	Central Processing System; includes CPU, integrated system controller, integrated input/output multiplexer with 10 channel function slots, CPU addressing, IOM addressing, memory addressing, and 196,608 words of memory	848,360	1,890	16,962	16,109
CPS6204**	Central Processing System; includes CPU, integrated system controller, integrated input/output multiplexer with 10 channel function slots, CPU addressing, IOM addressing, memory addressing, and 262,144 words of memory	953,720	2,144	19,066	18,105
CPS6206**	Central Processing System; includes CPU, integrated system controller, integrated input/output multiplexer with 18 channel function slots, CPU addressing, IOM addressing, and 393,216 words of memory	1,226,770	2,514	24,558	23,320
MXF6002	IOM Data Rate Expansion; maximum of 1 for CPS6200 or CPS6204	23,720	38	516	459
MXF6003	IOM Expansion for CPS6200 or CPS6204; expands IOM from 10 channel function slots to 18	23,365	40	467	444
MODEL 66/27 PROCESSORS & OPTIONS					
CPS6270	Central Processing System; includes CPU, integrated system controller, integrated input/output multiplexer with 18 channel function slots, CPU addressing, IOM addressing, and 131,072 words of memory	919,528	2,289	19,200	17,280
CPS6280	Central Processing System; includes CPU, free-standing system controller, free-standing input/output multiplexer with 35 channel function slots, CPU addressing, IOM addressing, and 131,072 words of memory	986,474	2,385	20,581	18,523
CPU6207	Additional central processor for CPS6270; maximum of one	523,740	935	13,856	12,470

* Rental prices include maintenance.
**Available as replacement systems only.

AUGUST 1977

Honeywell Series 60, Levels 66 and 68

EQUIPMENT PRICES

		Purchase Price	Monthly Maint.	Rental (1-year lease)*	Rental (5-year lease)*
MODEL 68/80 PROCESSORS & OPTIONS (Continued)					
CPS6814**	Central Processing System; includes CPU, integrated system controller, integrated input/output multiplexer with 27 channel function slots, CPU addressing, IOM addressing, memory addressing, and 262,144 words of memory	2,235,840	3,878	46,094	43,794
CPS6816**	Central Processing System; includes CPU, integrated system controller, integrated input/output multiplexer with 27 channel function slots, CPU addressing, IOM addressing, memory addressing, and 393,216 words of memory	2,456,990	4,080	50,657	48,125
CPS6818**	Central Processing System; includes CPU, integrated system controller, integrated input/output multiplexer with 27 channel function slots, CPU addressing, IOM addressing, memory addressing, and 524,288 words of memory	2,615,810	4,195	53,831	52,235
CPS6824**	Central Processing System; includes CPU, free-standing system controller, free-standing input/output multiplexer with 35 channel function slots, CPU addressing, IOM addressing, memory addressing, and 262,144 words of memory	2,302,785	3,974	47,480	45,106
CPS6826**	Central Processing System; includes CPU, two free-standing system controllers, free-standing IOM with 35 channel function slots, CPU addressing, IOM addressing, memory addressing, and 393,216 words of memory	2,523,935	4,196	52,038	49,437
CPS6828**	Central Processing System; includes CPU, two free-standing system controllers, free-standing IOM with 35 channel function slots, CPU addressing, IOM addressing, memory addressing, and 524,288 words of memory	2,682,755	4,291	55,312	52,547
CPS6832**	Central Processing System; includes CPU, three free-standing system controllers, free-standing IOM with 35 channel function slots, CPU addressing, IOM addressing, memory addressing, and 786,432 words of memory	2,977,845	4,663	61,788	58,798
CPS6836**	Central Processing System; includes CPU, four free-standing system controllers, free-standing IOM with 35 channel function slots, CPU addressing, IOM addressing, memory addressing, and 1,048,576 words of memory	3,272,935	4,904	68,264	65,049
CPU6800**	Additional central processor unit for CPS6824 or CPS6836; maximum of three	1,352,333	2,359	28,123	26,765
CENTRAL PROCESSOR OPTIONS FOR MODELS 66/05 THROUGH 66/80					
CPA6001	Central processor addressing; required when an additional CPU is added to system (one for each system controller in system); at least one is required when adding a free-standing system controller to a system for redundancy	17,015	27	350	315
MXC6001	Free-standing system controller for fail-soft; memory not included; controls up to 262,144 words of memory; at least one CPF6001 and MXF6001 required	22,075	43	584	526
MXU6001	Free-standing input/output multiplexer with 35 channel function slots; for use when redundancy and/or additional channels are required (does not include channels)	175,055	253	3,609	3,249
MXA6001	Input/output multiplexer addressing; required when MXU6001 is used (one for each System Controller in system); also required when MXC6001 is used	17,015	27	350	315
MXF6002	IOM data rate expansion; maximum of 1 on integrated and 2 for free-standing input/output multiplexers	23,720	38	516	459
MXF6004	IOM expansion; 9 channel function slots (for use with CPS6403-CPS6408 and with CPS6604-CPS6608 only); maximum of one	33,975	51	701	666
MSF6005	IOM expansion; 19 additional channel function slots (for use with free-standing IOM; maximum of 1)	53,855	81	1,111	1,089
MXC6800***	Second System Controller; includes one locked Processor, two Processor Memory Panels, Panels, two 64KW Processor Memory, Processor Control Panel	421,650	1,170	10,260	8,265
CSU6001	System Console; includes IOM channel and keyboard/printer	36,239	64	718	681
CSF6001	Remote Display (23-inch) for CSU6001	2,246	13	125	107
CSU6002	System Control Center; includes IOM channel	57,138	208	1,505	1,290
MEMORY FOR MODELS 66/05 THROUGH 66/40					
CMM6000	32,768 words of main memory, max. of one	$39,774	129	1,052	947
CMM6001/2	65,536 words of main memory, max. of two	66,360	109	1,756	1,580
CMA6001/2	Addressing for CMM6001/2 memory	17,472	27	348	331
CMM6003/4	131,072 words of main memory, max. of two; CMM6003 available for CPS6220 only	97,440	100	2,578	2,320
CMA6003/4	Addressing for CMM6003/4 memory	26,292	55	696	826
CMM6005/6	262,144 words of main memory, max. of two	110,000	100	3,800	3,450
CMA6005/6	Addressing for CMM6005/6 memory	52,584	109	1,392	1,252
MEMORY FOR MODELS 66/60 AND 66/80					
CMM6010	65,536 words of main memory, max. of one	48,720	25	1,289	1,160
CMA6010	Addressing for CMM6010 memory	17,472	27	384	331
CMM6011/12	131,072 words of main memory, max. of two	97,440	50	2,578	2,320
CMA6011/12	Addressing for CMM6011/12 memory	26,292	55	696	626
CMM6013/14	262,144 words of main memory, max. of two; available for CPS6220 and CPS6820 only	110,000	100	3,800	3,450
CMA6013/14	Addressing for CMM6011/12 memory; available for CPS6220 and CPS6820 only	52,584	109	1,392	1,252
CMM6015/16	524,288 words of main memory, max. of two	220,000	200	7,600	6,900
CMA6015/16	Addressing for CMM6015/16 memory	105,168	400	15,200	13,800
MODEL 66/85 PROCESSORS, MEMORY, AND OPTIONS*					
CPS6851	Basic 66/85 System; includes one CPU, one system control unit, one memory control with 512K words of memory, one high-speed multiplexer, two high-speed channel groups, one low-speed multiplexer, two low-speed channel groups, one console, and one low-speed device adapter	2,518,331	5,500	59,653	48,053
CPS6852	Basic 66/85 System plus one additional CPU with 512K words of memory (two CPU's and 1024K words)	4,010,625	8,000	94,181	75,868
CPU6850	Second Processor, for upgrade to dual-processor configuration	850,000	1,955	20,255	16,317
CPA6800	Processor Port for dual-processor upgrade	11,700	27	279	224
MXC6800	Second System Control Unit; includes locked system control processor (SCP), two SCP memory controls, two 64K-word SCP memory units, and SCP control panel	421,650	1,170	10,260	8,265

* Rental prices include maintenance.
**Available as replacement systems only.
***The MXC6800 controller and 66/85 systems and peripherals are available on one-, six, and seven-year leases; prices quoted in last column are for seven -year lease.

Honeywell Series 60, Levels 66 and 68

EQUIPMENT PRICES

		Purchase Price	Monthly Maint.	Rental (1-year lease)*	Rental (5-year lease)*
MASS STORAGE (Continued)					
MSF0006	Dual Access Feature for MSU0402/0451	2,070	11	59	51
MSF0007	Remote Position Sensing Option for MSU0402/0451; required on Level 66, except optional on 66/05	2,025	11	58	51
MSF1023	Device Adapter for MSU0402/MSU0451	11,475	26	310	269
MSF1027	Nonsimultaneous Datanet Channel for MSU0402/0451	7,920	13	226	202
MSF1033	Drive Expansion for more than 16 MSU0402/0451 Single-Channel MSP's	12,690	13	355	308
MSF1035	Device Adapter for MSU0402/0451	11,475	26	310	269
MSF1038	Device Adapter for MSU0402/0451	NC	NC	NC	NC
MSA1027	Addressing Capability for MSU0402/MSU0451; one per four MSU's	6,300	15	173	151
MSA1030	Dual Channel Addressing Capability for four MSU0402/MSU0451's	210	NC	5	5
MSU0500	Dual Fixed Disk Mass Storage Unit, 940 million characters; includes disk and RPS	47,500	150	1,210	1,089
MSF0011	Dual Access Feature for MSU0500	4,140	20	118	102
MSF1024	Device Adapter for MSU0500	20,000	24	550	475
MSF1034	Drive Expansion for MSU0500; required for more than 8 MSU0500's	12,690	13	335	308
MSF1037	Device Adapter for MSU0500	NC	NC	NC	NC
MSA1029	Addressing Capability for MSU0500; one per two MSU's	6,300	15	173	151
MSF1019	Additional Nonsimultaneous Switched Channel; required when no MSU0500 is configured	7,920	13	226	202
MSF1026	Nonsimultaneous IOM Channel for MSU0402/0451/0500	7,920	13	226	202
MSF1028	Dual Simultaneous Channel; required when no MSU0500 is configured	13,000	50	736	662
MSF1036	Dual-Processor (MSP) Crossbar Switch	15,000	20	842	758
INPUT/OUTPUT UNITS					
MTP0601	Magnetic Tape Processor; Level 66 (1x8); includes IOM channel; for MTU0400/0411/0412/0500/0600	25,750	128	760	683
Magnetic Tape Processor Features for MTP0601:					
MTF1040	Switched Tape Channel (includes IOM channel)	7,920	5	235	210
MTF1042	Dual Simultaneous Channel for up to 2x16 operation; includes IOM tape channel and second channel adapter	41,580	154	1,229	1,097
MTA0303	Device Addressing Capability for MTU0410/0500	7,200	31	186	162
MTA1041	Device Addressing Capability for 4 MTU0410/0411/0412/0500, maximum 2 for 1x8, 4 for 2x16	210	NC	5	5
MTA1042	Device Addressing Capability for 4 MTU0410/0411/0412/0500/0600; maximum 2 for 1x8, 4 for 2x16	210	NC	5	5
MTF1045	Code Translation; ASCII to Level 66 six-bit code	900	NC	30	26
MTF1046	Code Translation; EBCDIC to Level 66 six-bit code	900	NC	30	26
MTF1047	Code Translation; EBCDIC to ASCII Code	900	NC	30	26
Magnetic Tape Drives:					
MTU0410	Magnetic Tape Unit (75 ips)	12,410	65	330	309
MTU0411	Additional Magnetic Tape Unit for MTU0412 (75 ips)	11,473	82	322	280
MTU0412	Magnetic Tape Unit, Cluster of Two (75 ips)	22,946	164	644	560
MTU0500	Magnetic Tape Unit (125 ips)	16,610	71	474	440
MTU0600	Magnetic Tape Unit (200 ips)	20,430	84	603	525
Magnetic Tape Drive Features for MTU0410/0411/0412/0500:					
MTF0012	Dual Density Option; 800/1600 bpi; 9-track	3,940	32	119	104
MTF0017	Full Density Option; 200/556/800/1600 bpi; 9-track	6,000	52	215	178
MTF0013	NRZI; 200/556/800 bpi; 7-track	6,000	52	215	178
MTF0016	NRZI; 556/800 bpi; 7-track	3,060	17	94	81
MTF0018	Cartridge Load (factory-installed only)	700	2	19	17
MTF0019	Cartridge Load (field-installable)	700	2	19	17
MTF0020	High-Altitude Blower (factory-installed only)	220	NC	5	5
MTF0021	High-Altitude Blower Kit (for field installation)	220	NC	5	5
MTF0022	DC Power-On Meter (factory-installable only)	220	NC	5	5
MTF0023	Tape Movement Meter (factory-installable only)	220	NC	5	5
Magnetic Tape Drive Features for MTU0600:					
MTF0612	9-Track 800/1600-bpi Density	3,940	32	119	104
MTF0618	Cartridge Load (factory-installed)	700	2	19	17
Unit Record Processors & Features:					
URP0600	Unit Record Processor, free-standing; includes basic 4-port adapter and IOM channel	25,319	35	620	589
URP0601	Unit Record Processor, integrated; includes basic 4-port adapter and IOM channel; for use with integrated control unit	19,562	26	479	456
URP0602	Integrated Unit Record Processor for use with free-standing IOM; includes basic 4-port adapter and IOM channel; limits IOM capacity to 35 channel function slots	19,562	26	479	456
URF0040	Unit Record Addressing capability; 4 additional port attachments; expands URP to maximum of 8 ports; also required if printer types are mixed in one subsystem (PRU1200 and PRU1600 are considered one type in this definition)	936	2	22	20
URF0041	Dual Switched Channel; includes IOM channel; maximum of one	8,474	13	204	177
URA0052	CRU1050 Addressing capability; one required for each CRU1050	7,209	32	201	190
Printers:					
PRU1100	Printer (1100 lpm)	36,820	282	1,114	965
PRU1200	Printer (1200 lpm)	44,420	338	1,296	1,126
PRU1600	Printer (1600 lpm)	64,940	470	1,988	1,730
PRF0022	24 Additional Print Positions for PRU1200 or PRU1600	2,610	13	74	65

* Rental prices include maintenance.

Honeywell Series 60, Levels 66 and 68

EQUIPMENT PRICES

		Purchase Price	Monthly Maint.	Rental (1-year lease)*	Rental (5-year lease)*

DATANET 6000 FRONT-END NETWORK PROCESSORS (Continued)

		Purchase Price	Monthly Maint.	Rental (1-year lease)*	Rental (5-year lease)*
DCP6624	Processor; 48K-byte memory, IOM channel peripheral subsystem adapter; general purpose communications base, asynchronous communications base—type 1, console	81,780	195	1,843	1,603
DCP6632	Processor; 64K-byte memory, IOM channel and peripheral subsystem adapter; two general-purpose communications bases, asynchronous communications base—type 1, console	124,874	298	2,813	2,446
DCP6678**	Processor for Model 66/85 only; includes 64K words of memory, system support controller, direct interface adapter, and 6 channel interface bases	190,870	450	4,230	4,010

OPTIONS FOR DATANET 6600 PROCESSORS OTHER THAN DCP6678

		Purchase Price	Monthly Maint.	Rental (1-year lease)*	Rental (5-year lease)*
DCU6201	Asynchronous Communications Base—Type 2; maximum of 52 lines up to 110 bps; for speeds over 110 bps the number of lines is reduced	24,800	123	572	512
DCU6202	General-Purpose Communications Base; maximum capacity 32 lines	30,000	152	702	625
DCF6001	Asynchronous Speed Adapter for general-purpose communications base (110, 134.5, 150, 300, 1050, 1200, 1800 bps)	240	NC	5	5
DCF6002	Asynchronous Speed Adapter for general-purpose communications base (50, 110, 150, 200, 300, 600, 1200 bps)	240	NC	5	5
DCF6003	Additional Bit Rate Option for Asynchronous Speed Adapter—50 bps	240	NC	5	5
DCF6004	Additional Bit Rate Option for Asynchronous Speed Adapter—75 bps	240	NC	5	5
DCF6005	Additional Bit Rate Option for Asynchronous Speed Adapter—134.5 bps	240	NC	5	5
DCF6006	Additional Bit Rate Option for Asynchronous Speed Adapter—200 bps	240	NC	5	5
DCF6007	Additional Bit Rate Option for Asynchronous Speed Adapter—600 bps	240	NC	5	5
DCF6008	Additional Bit Rate Option for Asynchronous Speed Adapter—1,050 bps	240	NC	5	5
DCF6009	Additional Bit Rate Option for Asynchronous Speed Adapter—1,800 bps	240	NC	5	5
DCF6038	Additional Bit Rate Option for Asynchronous Speed Adapter—2,400 bps	240	NC	5	5
DCF6010	Communications Channel Interface; Asynchronous (two channels); EIA RS-232C	3,120	12	74	63
DCF6011	Communications Channel Interface; Asynchronus (two channels); current interface	2,650	11	66	54
DCF6012	Communications Channel Interface; General-Purpose (one channel); MIL STD 188C	3,190	12	76	66
DCF6013	Communications Channel Interface; Synchronous (two channels); ASCII	3,600	14	85	74
DCF6014	Communications Channel Interface; Synchronous (two channels) with Auto Call Unit	3,800	14	90	80
DCF6015	Communications Channel Interface; Binary Synchronous with CRT (one channel)	3,920	23	92	82
DCF6016	Communications Channel Interface; Broad-Band (19,200 to 50,000 bps); one channel	4,020	16	102	90
DCF6017	Communications Channel Interface; General-Purpose (one channel)	3,120	17	74	63
DCF6018	Communications Channel Interface; General-Purpose with Auto. Call Unit (one channel)	3,360	19	80	68
DCF6019	High-Level Data Link Control Channel (one channel)	1,446	7	36	32
DCF6020	Direct Connect Capability—Asynchronous	440	5	11	11
DCF6021	Direct Connect Capability—Synchronous	968	5	24	21
DCF6022	Speed Adapter for Asynchronous Communications Base—Type 1 and Type 2 (50/75/100/200 bps)	240	NC	5	5
DCF6023	Speed Adapter for Asynchronous Communications Base—Type 1 and Type 2 (50/75/110/200 bps)	240	NC	5	5
DCF6024	Speed Adapter for Asynchronous Communications Base—Type 1 and Type 2 (75/110/150/300 bps)	240	NC	5	5
DCF6025	Speed Adapter for Asynchronous Communications Base—Type 1 and Type 2 (110/134.5/150/300 bps)	240	NC	5	5
DCF6026	Asynchronous Channel Group, EIA and Auto Call (3 channels and one Auto. Call)	3,920	23	92	82
DCF6027	Asynchronous Channel Group, EIA Interface (four channels)	3,600	14	85	74
DCF6028	Asynchronous Channel Group, Current Interface (four channels)	2,450	14	60	49
DCF6029	Asynchronous Channel Group, MIL STD 188C (four channels)	3,920	22	92	82
DCF6030	Computer Monitor Adapter	11,000	35	282	254
DCF6031	Line Transfer Device	24,341	73	589	519
DCF6032	Line Expansion Function, Asynchronous; six lines between data set & 2 Communications Bases)	2,169	5	53	47
DCF6033	Line Expansion Function, Asynchronous, six communications channel interfaces between Communications Base and 2 data sets	2,169	5	53	47
DCF6034	Line Expansion Function, Asynchronous or Synchronous, four lines between Communications Bases	2,169	5	53	47
DCF6035	Line Expansion Function, Asynchronous or Synchronous, four lines between groups of data sets	2,169	5	53	47
DCF6036	Line Expansion Function, Current Interface—24 lines	2,169	5	53	47
DCF6037	Network Processor Control Console and Adapter	6,160	3	162	141
DCF6041	Direct Interface Adapter	14,630	34	322	284
DCF6043	Peripheral Subsystem Adapter; not applicable to DCP6624 and DCP6632; must be ordered when NPS is to be used with DHP0701 and DCP6616	13,200	47	291	261
DCF6048	Broadband MIL STD 188C Channel	4,700	33	102	87

OPTIONS FOR DCP6678 FRONT-END NETWORK PROCESSOR

See note under "Datanet 6600 Front-End Network Processors."

		Purchase Price	Monthly Maint.	Rental (1-year lease)*	Rental (5-year lease)*
DCM6603	64K words of memory	24,870	106	616	570
DCF6601	Peripheral Interface Adapter; maximum of two per processor	7,070	31	176	163
DCF6602	Additional Direct Interface; maximum of one	7,070	31	176	142
DCF6608	Basic Teleprinter Console Device	3,640	28	104	84
DCF6606	Heavy-Duty Console Device and Stand; required for NPS operation	7,345	31	180	145
		1,501	7	38	30
DCF6609	Channel Interface Base; accommodates all channel types except HDLC	1,501	7	38	30
DCF6611	Dual Synchronous Channel Package, EIA-RS232C; available with CPS6058 processor	1,450	6	36	29
DCF6612	Dual Asynchronous Channel Package, EIA-RS-232C; available with CPS6058 processor	590	4	16	13
DCF6613	Automatic Call Unit, Dual Channel	1,180	4	28	23
DCF6614	MIL STD 188C Synchronous Channel; available with CPS6058 processor	1,501	7	38	30
DCF6618	Dual Binary Synchronous Channel Package; available with CPS6058 processor	1,450	6	36	31
DCF6619	Broadband Channel; available with CPS6058 processor	3,056	10	72	58
DCF6620	HDLC Voice-Grade Channel	2,573	9	62	50
DCF6621	Bisynchronous Broadband Channel	3,056	10	72	58

* Rental prices include maintenance.
**Price in last column is for 7-year lease.