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## UNIVAC 90/60 and 90/70



*The UNIVAC 90/60, designed and priced to be an attractive alternative to the IBM 370/135, offers from 131K to 524K bytes of MOS main memory with a cycle time of 600 nanoseconds per 4-byte access. The same memory is used in the faster UNIVAC 90/70.*

### MANAGEMENT SUMMARY

The UNIVAC 90/70, an updated version of the 9700, became the nucleus of UNIVAC's new Series 90, announced in October 1973. Designed to upgrade the UNIVAC 9000 Series product line, the new Series 90 computers will incorporate the original architectural features of the 9700, including a writable control storage and relocation hardware. In addition, all 90/70 and subsequent Series 90 systems will be delivered with MOS (metal oxide semiconductor) main memory, replacing the plated-wire memory delivered with the original 9700's. The announcement reflects a continuation of UNIVAC's shift from plated-wire to solid-state technology.

The second member of the Series 90, the 90/60, was introduced at the same time as the 90/70. The 90/60 is a somewhat slower and lower-priced version of the 90/70, designed to fill the price/performance gap between the 9480 and the 9700.

The UNIVAC 90/60 and 90/70 are the first two members of the UNIVAC Series 90, a family of byte-oriented IBM-compatible systems designed as a growth path for UNIVAC 9000, UNIVAC Series 70, and IBM 360/30 and 360/40 users. Both systems will run under the OS/7 operating system. The 90/60 and 90/70 are priced to compete with the IBM 370/135 and 370/145, respectively.

### CHARACTERISTICS

**MANUFACTURER:** UNIVAC Division, Sperry Rand Corporation, P.O. Box 500, Blue Bell, Pa. 19422. Telephone (215) 646-9000.

**MODELS:** UNIVAC 90/60 and 90/70.

#### DATA FORMATS

**BASIC UNIT:** 8-bit byte. Each byte can represent 1 alphanumeric character, 2 decimal digits, or 8 binary bits. Two consecutive bytes form a 16-bit "halfword," four consecutive bytes form a 32-bit "word," and eight consecutive bytes form a 64-bit "doubleword."

**FIXED-POINT OPERANDS:** Can range from 1 to 16 bytes (1 to 31 digits plus sign) in decimal mode; 1 halfword (16 bits) or 1 word (32 bits) in binary mode. Certain operations use a doubleword (63-bit integer field plus sign) in binary mode.

**FLOATING-POINT OPERANDS:** Optional floating-point hardware provides for addition, subtraction, multiplication, division, loading, storing, and sign control of short or long format operands. The short format provides 24-bit precision and is represented by one word, which uses bit 0 for the sign, bits 1 through 7 for the exponent, and bits 8 through 31 for the fraction. Long format is represented with a doubleword which provides 56-bit precision; the long format is similar to the short format except that the fraction is contained in bit positions 8 through 63. A guard digit is carried by the hardware for intermediate "place holding" during addition/subtraction, multiplication, comparison, and halving.

**INSTRUCTIONS:** 2, 4 or 6 bytes in length, specifying 0, 1, or 2 main storage addresses, respectively.

**INTERNAL CODE:** EBCDIC or ASCII, depending upon setting of a mode bit in the program status word by certain processor instructions. The processor is sensitive to zone fields and edit control characters.

#### MAIN STORAGE

**STORAGE TYPE:** MOS (metal oxide semiconductor).

**CAPACITY:** 90/60—From 131,072 to 524,288 bytes in eight sizes: 131K, 163K, 196K, 229K, 262K, 327K, 393K, or 524K. 90/70—From 131,072 to 1,048,576 bytes in nine sizes: 131K, 196K, 262K, 393K, 524K, 655K, 786K, 917K, or 1,048K bytes.

**CYCLE TIME:** 0.6 microsecond per 4-byte access in both models.

**CHECKING:** Parity bit with each byte is generated during writing and checked during reading, with additional parity

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▷ Three additional models are expected to be added to the Series 90, at approximately six-month intervals. Datapro expects that at least one larger model will join the Series 90 family to provide a growth path for users of the large UNIVAC 9000 Series and Series 70 systems; and, more imminently, a smaller model will be announced for upgrading users of the 9200 and 9300 systems.

Announcement of the Series 90 indicates that UNIVAC intends to provide an attractive growth path for its 9000 Series and RCA Series customer base within the framework of an enhanced 9000 Series systems architecture, and that attempts to merge the byte-oriented 9000 Series with the incompatible large-scale 1100 Series are somewhere off in the future.

### THE UNIVAC 90/70

The UNIVAC 90/70 was originally announced as the UNIVAC 9700 in November 1971 and was first delivered one year later, in Austria. To date there are about 6 systems installed in Europe and 12 in Japan. In North America, meanwhile, prospective users have tended to wait until the 90/70 could be delivered with OS/7, the advanced Series 90 operating system, instead of the earlier OS/4. Consequently, there is currently only one 90/70 user in Canada and two in the U.S., with several more systems currently being shipped.

The 90/70, operating under OS/7, is viewed by UNIVAC as a direct competitor for the System/360 Model 145 operating under OS/MFT, the usual upgrade for IBM DOS users. In benchmark tests performed by UNIVAC under the less sophisticated OS/4, the 90/70 has already demonstrated a capability for throughput performance 13 to 25 percent faster than the IBM System/370 Model 145 under Release 27 DOS. UNIVAC originally announced MOS memory and price reductions to keep the then-9700 system price-competitive with the lower 370/145 memory prices that IBM announced in February 1973. All 90/70 systems will incorporate the new MOS memory, and will be available for delivery by the end of 1973. Like the System/370 Model 145, the UNIVAC 90/70 will be available with up to 1048K bytes of semiconductor main memory. UNIVAC has also made floating-point arithmetic standard on the 90/70, along with an instruction set comparable to that of the standard IBM System/360 Model 50.

The basic performance of the 90/70 central processor can be roughly judged by instruction mix comparisons performed by UNIVAC. On a scale that ranks the IBM 360/50 as 1, the 370/145 equals about 2, and the 90/70 rates about 2.2 to 2.3. The 90/70 thus ranks as a viable and somewhat less costly alternative to the 370/145. The 90/70 is also about 10 to 15 percent more powerful than a UNIVAC Series 70/6; although the 90/70's raw power is

▶ generation and checking provided on the channels and memory busses.

**STORAGE PROTECTION:** The standard Storage Protection feature uses 16 keys to provide read and/or write protection for 2048-byte blocks of storage. An interrupt is generated whenever a read or write instruction is attempted in an unauthorized storage location.

**RESERVED STORAGE:** The first 640 bytes of main storage are reserved to hold specific operating information.

### CENTRAL PROCESSORS

**REGISTERS:** The programmer has access to sixteen 32-bit general registers that are used for indexing, base addressing, and as accumulators. (A second full set of 16 registers is used by the operating system.) Four double-word floating-point registers are standard.

Sixteen additional standard program relocation registers in low-order main storage serve as base registers for the program modules in main memory; two of these registers are reserved for the operating system. These program relocation registers act with other relocation hardware to facilitate the OS/7 rollout/rollin capability.

**INDIRECT ADDRESSING:** The 90/60 and 90/70 use 3 nonprivileged instructions to provide an indirect addressing function for up to 8 levels. These instructions also assist in relocation and permit branching to subroutines while bypassing the operating system.

**CONTROL STORAGE:** In addition to main storage, a fast writeable control storage of from 2K to 6K 72-bit words (16K to 48K bytes) is available for the microprograms used to support integrated emulation, floating-point hardware, microdiagnostics, and the native-mode instruction set; UNIVAC has priced each of these to include the control storage required for its own microprogram support. The floating-point hardware is included in the basic 90/60 and 90/70 prices. The cycle time of this separate MOS memory is 80 nanoseconds per 72-bit word access. Data is loaded into the writeable control storage via a cassette prepared by UNIVAC support personnel.

**INSTRUCTION REPERTOIRE:** All 132 nonprivileged instructions of the IBM System/360 instruction set are provided, including an add immediate instruction, 3 indirect addressing function instructions, an emulation aid instruction, and optional floating-point instructions. The standard instructions handle fixed-point binary arithmetic and decimal arithmetic using variable-length operands in packed formats, and include instructions for packing and unpacking, radix conversion, editing, loading, storing, comparing, shifting, branching, and logical operations, as well as instructions for handling ASCII or EBCDIC characters.

**INSTRUCTION TIMES:** All times are estimated, for register-to-indexed-storage (RX) instructions, and are given in microseconds.

	90/60	90/70
Binary add/subtract (32 bits):	3.0	1.50
Floating-point add/subtract (short):	7.08	5.58
Floating-point multiply (short):	13.10	11.60
Floating-point divide (short):	30.00	28.50
Floating-point add/subtract (long):	7.73	6.23
Floating-point multiply (long):	36.50	35.00
Floating-point divide (long):	73.05	71.55
Decimal add (2-address, on signed 5-digit fields):	13.20	11.70
Compare (RX)	3.0	1.5

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➤ not much higher, it can still be a reasonable upgrade for 70/6 users because of the greater power of OS/7 as compared to TDOS. Datapro expects the not-so-immediate future to hold an even more powerful member of the Series 90 for users to grow to.

As the prototype of the new Series 90 family of computer systems, the 90/70 incorporates features, such as writeable control storage, relocation hardware, and semiconductor storage, which UNIVAC expects to include in subsequent models of the Series 90. Another feature is indirect addressing, which allows the user to communicate with re-entrant system software routines under control of the supervisor without the occurrence of an interrupt.

The 90/70's main memory capacity spans a wide range from 131K to more than one million bytes. In addition to monolithic integrated circuits and MOS memory, the 90/70 uses a separate writeable control storage for microprograms. Thus, the 90/70's architecture is similar in many respects to that of the IBM System/370, except that additional control storage in the 90/70 does not use up any main memory capacity, as it does in the IBM 370/145.

The 90/70 delivers about three times the internal performance of the 9480, together with new features that make it comparable to the IBM System/370 Model 145.

The Series 9000 instruction repertoire has been expanded from the previous subset of IBM System/360 instructions to include, in the 90/70, the complete set of available System/360 Model 50 instructions. The UNIVAC 90/70 also features an optional high-speed Operating System Storage Facility (OSSF) to contain up to 12 million bytes of non-resident operating system segments. The OSSF is a fixed head-per-track disc storage facility and uses a dedicated channel which does not cause interference with other multiplexer or selector channel operations.

Another enhancement available exclusively with the 90/70 is the Communications Intelligence Channel (CIC), an optional channel with programmable message control logic for control of up to 128 half-duplex or 64 full-duplex lines.

The standard 90/70 configuration is equipped with one selector channel and one multiplexer channel. The basic multiplexer channel contains physical connections for 8 peripheral subsystems and a total of 15 subchannel addresses. Two optional features, the Subchannel Expansion feature and the Interface Expansion feature, permit the multiplexer channel to be expanded to a total of 15 physical connections and 63 subchannels. Three additional selector channels can be added, for a total of four selector channels in the 90/70 system.

**THE UNIVAC 90/60**

The newly announced medium-scale 90/60 system is basically a scaled-down version of the 90/70. Offering an ➤

➤ Branch on condition (RX)	1.2	1.2
Move (SI)	3.6	2.1
Load (RX)	3.3	1.5
Store (RX)	3.3	1.8
Supervisor call (RR)	0.3	0.3

**EMULATION:** Integrated emulation features are available for IBM System/360 DOS and IBM 1401, 1440, and 1460 systems. Series 70 TDOS, DOS, 301, and 501 systems can also be emulated. Up to two emulations can proceed concurrently with other UNIVAC 90/60 and 90/70 native-mode processing under the supervision of OS/7. See the "Utility Routines" entry in the Software section of this report for further information.

**INPUT/OUTPUT CONTROL**

**I/O CHANNELS:** The basic 90/60 Processor has one standard multiplexer channel. It can physically connect up to 7 low-speed systems and a Data Communication Subsystem (DCS) for a total of 15 subchannel addresses. Two Subchannel Expansion features provide an expansion capability of addressing up to 63 subchannels. The maximum aggregate multiplexer channel transfer rate is 175,000 bytes per second.

One selector channel is standard on the UNIVAC 90/60, and two additional selector channels can be added. The 90/60 selector channels perform in the same manner as the 90/70 selector channels (below). The second selector channel is housed in the processor cabinet, and the third requires the Channel Expansion Cabinet.

One multiplexer channel is standard on the 90/70. It can physically connect up to 7 low-speed subsystem controllers and a Data Communications Subsystem (DCS) for an aggregate of 15 subchannel addresses. The Subchannel Expansion feature provides an additional 16 subchannels. A second Subchannel Expansion feature provides 32 more subchannels for a total of 63 subchannel addresses. The Expanded Interface feature can be added to provide up to 8 additional physical controller connections for a total of 16 controllers if the Subchannel Expansion feature has been added; otherwise, up to 7 additional controllers can be attached, not to exceed 15 physical subsystems. The maximum aggregate multiplexer channel transfer rate is 175,000 bytes per second.

One selector channel is standard on the UNIVAC 90/70, and three more can be added. Eight high-speed device controllers can be attached to each selector channel for a maximum throughput of 1.11 million bytes per second per channel on a data path 4 bytes wide. Each control unit can attach up to 16 I/O devices. Only one device can transfer data to or from main memory along a given selector channel at a time. Thus, simultaneous access of two or more high-speed devices requires that each be connected to a different selector channel. The second selector channel is housed in the processor cabinet, and selector channels 3 and 4 require the Channel Expansion Cabinet.

The UNIVAC 90/70 also provides for direct memory attachment of the optional OSSF (Operating System Storage Facility) through the OSSF Control Channel.

A Direct Control feature (not supported under OS/4) is used to provide a special interface between two UNIVAC 90/60 or 90/70 processors and includes two instructions for transfer of control information between the processors.

**CONSOLE:** The Series 90 System Console consists of a keyboard with operator controls and a Uniscope 100 CRT display unit. The standard mode of operation provides for display of messages on the CRT screen; hard copy is provided by the Console Printer as an optional feature under OS/7, but is required for operation under OS/4. Under OS/7, those error messages which are printed on the console printer with OS/4 are written on magnetic tape for subsequent high-speed printing at the system manager's convenience. The hard-copy Console Printer operates at up to 30 cps and connects to the processor via the multiplexer ➤

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➤ estimated 2.2 times the processing power of the UNIVAC 9480, it is intended to serve as an upgrade system for users of smaller UNIVAC 9000 Series and Series 70 systems who may not require all the features available on the 90/70. The 90/60 central processor is approximately 40% slower than the 90/70 in instruction execution time, with a comparable reduction in central processor price. However, the 90/60 uses the same MOS memory as the 90/70 and supports nearly the same array of peripheral devices.

In addition to its orientation toward smaller members of the UNIVAC 9000 Series and 70 Series customer base, the UNIVAC 90/60 appears to be aimed directly at the thousands of System/360 Model 30's and 40's remaining in the IBM customer base. Based on instruction mix comparisons performed by UNIVAC, the 90/60 is estimated to provide approximately 60 percent more internal processing power than the IBM 370/135 at approximately the same cost. UNIVAC therefore considers the 90/60 as an alternative to the IBM 370/135 for users of the 360/30 and 360/40 systems.

Like the 90/70, the 90/60 offers an instruction repertoire that includes the complete set of available System/360 Model 50 instructions. This feature, unavailable with the UNIVAC 9400 or 9480, should make the 70/60 more attractive as an upgrade system for both System/360 and Series 70 users.

Moreover, the 70/60 offers a main memory capacity comparable to that of the 370/135. MOS main memory is available for the 70/60 in amounts ranging from 131K to 524K bytes.

The UNIVAC 90/60 incorporates the same architectural features as its predecessor, the 90/70. These include microprogrammed processor control, writeable control storage, MOS memory, and relocation hardware. Indirect addressing is also available with the 70/60.

The two systems differ in their instruction execution times. In addition, certain optional features available with the 90/70 are not supported on the 90/60. These include the high-speed Operating System Storage Facility (OSSF) and the Communications Intelligence Channel (CIC).

The 90/60's input/output capabilities are slightly more curtailed than those of the 90/70. One multiplexer channel is standard, but optional Subchannel Expansion features allow the number of subchannel addresses to be increased to 63. UNIVAC has thus expanded the communications line handling capabilities to a total of 30, using the DCS Communications Controllers, on both the 90/60 and 90/70. Users who require more communications lines will have to utilize the Communications Intelligence Channel, which is available only on the 90/70. The 90/70 Expanded Interface feature, which allows the

➤ channel; it uses one physical controller connection on the multiplexer. The System Console can be switched by the Multiple Channel Switch to operate on a selector channel for diagnostic purposes if required.

The 9000 Series Channel Adapter, which provides either a multiplexer or selector interface to a UNIVAC 9200/9300/9400 or 90/60 or 90/70 subsystem, is housed in the System Console.

A Multiple Channel Switch (MCS) is available to provide a capability for switching a subsystem or string of subsystems from a multiplexer or selector channel on one processor to the same type of channel on another processor or the same processor. Included with the basic MCS is cabinetry, a power supply, an operator's panel, and space for 5 additional MCS Expansion switches.

**CONFIGURATION RULES:** High-speed peripheral devices, such as Uniservo 12, 16, or 20 Magnetic Tape Units or 8411, 8414, or 8440 Disc Drives, must be connected to a selector channel. Up to eight control units can be connected to each selector channel.

Low-speed devices, including Data Communications Subsystems, card readers, line printers, and the System Console, are normally connected to the multiplexer channel, which can accommodate up to 16 control units and 63 subchannel addresses.

**SIMULTANEOUS I/O OPERATIONS:** Concurrently with computing, the 90/60 and 90/70 Processors can control multiple I/O operations with a combined data rate of up to 175,000 bytes/sec on the multiplexer channel, plus one I/O operation with a data rate of up to 1.11 million bytes/sec on each selector channel. Dedicated channels for the OSSF and the CIC transfer data at up to 624,000 and 60,000 bytes/sec, respectively, on the 90/70.

### MASS STORAGE

**UNIVAC 90/70 OPERATING SYSTEM STORAGE FACILITY (OSSF):** Provides a dedicated auxiliary storage device consisting of a head-per-track single-spindle disk subsystem interfaced directly to main memory via the independently functioning OSSF Control Channel. Each OSSF has an 8.34-millisecond average access time, stores 3 million bytes, and can transfer data at a maximum of 624,000 bytes per second. Certain randomly organized user files can be assigned to the OSSF, permitting an improvement in file access times for those sequential files which otherwise would have shared an 8414 or 8440 disk. According to UNIVAC, the addition of the OSSF permits accesses from 3 to 4 times as fast as an 8440, with an increase in processor throughput estimated by UNIVAC to be about 20 percent. The OSSF comes with a special channel. This channel can be shared by up to three additional OSSF expansion files, for a maximum storage capacity of 12 million bytes. The OSSF is supported only under OS/7.

**8411 DISC DRIVE:** Provides interchangeable disc-pack storage of moderate capacity. Each disc pack contains six 14-inch discs, weighs 10 pounds, holds up to 7.25 million bytes of data, and is compatible with the IBM 1316 Disk Pack used in IBM 2311 Disk Storage Drives. One read/write head serves each of the 10 recording surfaces. Up to 36,250 bytes (10 tracks) can be read or written at each position of the comb-type access mechanism. Average head movement time is 75 milliseconds, average rotational delay is 12.5 milliseconds, and data transfer rate is 156,000 bytes per second. Record lengths are variable.

Up to eight 8411 Disc Drives (58 million bytes) can be connected to a Disc File Control, and up to eight controls can in turn be connected to each UNIVAC 90/60 or 90/70 selector channel. The following options are available: File Scan, which permits searching of data areas as well as record keys; Record Overflow, which permits records longer than one track (3625 bytes); and Dual Channel,

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*This view of a fairly small, disc-oriented UNIVAC 90/70 configuration shows the CRT-equipped System Console in the foreground and the Central Processor at left rear.*

▷ number of physical controllers on the multiplexer channel to be expanded to 16, also is not available on the 90/60. A total of three selector channels, one standard and two optional, are available on the 90/60, compared to the 90/70's maximum of four.

The 90/60 will have available the same complement of software as the 90/70. Without the OSSF, and with a smaller main memory capacity, performance of OS/7 on the 90/60 will necessarily be curtailed in comparison to the 90/70, but no information is yet available from UNIVAC comparing the performance of the two Series 90 systems using OS/7.

A user can field-upgrade a 90/60 system to a 90/70 by adding the 90/70 Upgrade Feature with no penalty under any UNIVAC contract.

In comparison to the two-year interval which occurred between initial announcement and U.S. delivery of the original 9700 with OS/7, UNIVAC demonstrated the 90/60 in operation with OS/7 shortly after its announcement. The 90/60 is scheduled to be available for delivery in January 1974.

### PERIPHERAL EQUIPMENT

A broad range of peripheral devices is available for the 90/60 and 90/70, including top-of-the-line printers, tapes, and disc drives. The Uniservo 20 Magnetic Tape Unit (320,000 bytes per second) and the 8440 Disc Storage Facility (up to 952 million bytes on-line) provide high-performance data storage and retrieval capabilities which far exceed those of the smaller models in the Series 9000. Other specific enhancements, in addition to the OSSF, include a Communications Intelligence Channel ▷

▶ which allows two different computers or two different selector channels on the same computer to non-simultaneously access an 8411 subsystem. File Scan and Record Overflow, however, are not supported under OS/4. The 8411 is the UNIVAC equivalent of the IBM 2311.

**8414 DISC DRIVE:** Provides large-capacity random-access storage in interchangeable 11-disc packs which are compatible with the IBM 2316 Disk Packs used in the IBM 2314 Direct Access Storage Facility. Each pack stores up to 29.17 million bytes of data. Up to 145,880 bytes (20 tracks) can be read or written at each position of the comb-type access mechanism. Average head movement time is 60 milliseconds, average rotational delay is 12.5 milliseconds, and data transfer rate is 312,000 bytes/sec. Record lengths are variable.

From two to eight 8414 Disc Drives can be connected to a Disc Control, providing from 48.4 to 233.4 million bytes of on-line storage. Up to eight Disc Controls, in turn, can be connected to each selector channel. The File Scan and Record Overflow features are standard, and the Dual Channel capability is optional. File Scan and Record Overflow, however, are not supported under OS/4. With addition of the 8411 Capability option, any combination of up to eight 8411 and 8414 drives can be connected to the Disc Control. The 8414 is the UNIVAC equivalent of the IBM 2314.

**8424 DISC DRIVE:** Provides double the storage per disc pack of the 8414. This is a double-density version of the 8414; it has two drives per unit, each drive holding a 58-million byte disc pack. A disc pack has 406 (instead of 203) tracks on each of the 20 surfaces used for data recording. The access arm is faster than that of the 8414 (30 versus 60 milliseconds average), but the latency timing and data transfer rates are the same. A 5024-99 Controller is used on a Series 90 system to control up to four dual drives, for an on-line capacity of 466 million bytes.

Options for the 8424 include Dual Access (which is used on each drive when two controllers are employed and read/write, etc., simultaneity is required) and Dual Channel (two channel connections for the same controller, with access controlled by an operator's switch). The 8424's standard File Scan and Record Overflow features are not supported under OS/4. ▶

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➤ (available with the 90/70 only), an integrated IBM 1401, 1440, and 1460 emulation feature, and floating-point hardware; the latter two features are supported by microprograms in the writeable control storage. (The Uniservo VIC tape drive, while supported under UNIVAC system software, is no longer in production and can be obtained on an as-available basis only.)

UNIVAC announced a new family of high-speed line printers, the 0770 Printers, in April 1973. The new printers utilize a horizontally moving print band and combine various convenience, maintenance, and availability features. The three models differ only in their speeds, offering 48-character printing rates of 800, 1400, and 2000 lines per minute. The 0770 Printers, each of which contains an integral control unit, can connect directly to a 90/60 and 90/70 via the multiplexer channel. They will effectively replace the older 0768 line of drum printers.

To date, UNIVAC has not announced an equivalent to either the IBM 3420/3803-2 Magnetic Tape Subsystem, which reads and records data at a density of 6250 bits per inch, or the new double-density version of the IBM 3330 Disk Storage.

### SOFTWARE SUPPORT

Software support for the UNIVAC 90/60 and 90/70 consists of the full program library for the earlier UNIVAC 9400 plus two operating systems: OS/4, which is essentially an expansion of the current UNIVAC 9400/9480 operating system; and the advanced OS/7, which will fully implement the new hardware features of the 90/60 and 90/70.

OS/7 uses 90/60 and 90/70 relocatability hardware in a way that, UNIVAC feels, obviates the need for virtual memory operation in many cases. Nonetheless, Datapro has learned that UNIVAC will cover all the bases with an announcement, probably in the spring of 1974, of a virtual memory operating system for the 90/70. The new software will be targeted directly at the prospective market for IBM's OS/VS2, and will depend on use of an optional hardware address translation facility for the 90/70 Central Processor. The new operating system is being developed by the team that worked on Series 70 VMOS when that product line belonged to RCA; the system will thus also provide a bridge out of the Series 70 for 70/46 and 70/3 users. UNIVAC's approach to virtual memory will use a content-addressable memory scheme, and UNIVAC privately expresses confidence that the system will prove more efficient to operate than IBM's has.

UNIVAC has not disclosed any plans for providing a virtual memory capability for the 70/60 and subsequent smaller members of the Series 90. At present, UNIVAC management believes that OS/7 is functionally as rich, if ➤

➤ **8440 DISC SUBSYSTEM:** Provides fairly rapid random access to very large quantities of data stored in interchangeable 11-disc packs. Each pack stores up to 119.3 million bytes. Data is recorded in 406 tracks on each of the 20 recording surfaces. Average head movement time is 30 milliseconds, average rotational delay is 12.5 milliseconds and data transfer rate is 624,000 eight-bit bytes/second. Record lengths are variable, with each track capable of holding up to 14,910 eight-bit bytes. Standard features include Angular Position Sensing, which increases channel availability by reducing delays during record search times; Programmed Servo Offset, which permits the heads to be moved slightly away from their normal positions in attempts to recover data during search and read operations; and Error Correction Code, which permits automatic correction of many recording errors. These features, and the standard File Scan and Record Overflow features, are supported only under OS/7.

An 8440 subsystem consists of a control unit and from one to four 8440 Disc Storage units, each containing two independent disc drives. Up to four control units, each controlling up to eight drives, can share a single I/O channel interface. A dual-access subsystem can be configured by adding a second control unit and installing a Dual Access feature in each 8440 Disc Storage unit.

The 8440 Disc Subsystem was announced with the UNIVAC 1110 system in November 1970. After encountering serious delays in developing the subsystem, UNIVAC turned to an outside supplier. A set of revised and improved specifications for the 8440 subsystem was issued in January 1973, and customer shipments of the improved equipment (as described above) began later the same month.

### INPUT/OUTPUT UNITS

**UNISERVO 12 MAGNETIC TAPE UNIT:** A medium-speed tape drive that reads and records data on standard 1/2-inch tape in IBM-compatible phase-encoded or NRZI format. Available in both 9-track and 7-track versions. Tape speed is 42.7 inches per second, forward or backward. The standard 9-track version has a recording density of 1600 bpi (in phase-encoded mode) and a data rate of 68,320 bytes per second; the optional Dual Density feature permits operation at 800 bpi (in NRZI mode) at a data rate of 34,160 bytes per second—the same speed as the Uniservo VIC. The 7-track version can operate at 200, 556, or 800 bpi, with corresponding data rates of 8,540, 23,740, or 34,160 characters per second. The Data Conversion feature, for 7-track drives, converts each group of four 6-bit characters from tape into three 8-bit bytes in main storage, and vice versa.

From 1 to 16 Uniservo 12 Tape Units can be connected to a Uniservo 12 tape control, and up to 8 controls can in turn be connected to each UNIVAC Series 90 selector channel. Optional features enable the tape control to be connected to two selector channels, permitting simultaneous read/read, read/write, or write/write tape operations, with bimodal (7- or 9-track) compatibility.

With addition of the Uniservo 16 Capability option, any combination of up to sixteen Uniservo 12 and Uniservo 16 drives may be connected to the Uniservo 12 Control. A Uniservo 12/16 Control is also available which includes the Uniservo 16 Capability as a standard feature.

**UNISERVO 16 MAGNETIC TAPE UNIT:** A high-speed tape drive that reads and records data on standard 1/2-inch tape in IBM-compatible phase-encoded or NRZI formats. Available in both 9-track and 7-track versions. Tape speed is 120 inches per second, forward or backward. The standard 9-track version has a recording density of 1600 bpi (in phase-encoded mode) and a data rate of 192,000 bytes per second; the optional Dual Density feature permits operation at 800 bpi (in NRZI mode) at a data rate of 96,000 bytes per second. The 7-track version operation at 200, 556, or 800 bpi, with corresponding data rates of 24,000, 66,720, or 96,000 characters per second. ➤



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▷ not richer, than the virtual memory operating system available on competing IBM System/370 models. Thus, UNIVAC's initial marketing thrust for the anticipated virtual memory operating system appears to be directed at the larger user, whose increased requirements in the areas of program preparation and interactive processing will justify the additional hardware costs associated with these systems. However, future availability of the virtual memory operating environment for smaller Series 90 systems remains a distinct possibility.

OS/7 was announced in November 1971, with the original 9700 system, and was originally scheduled for delivery in March 1973. But that operating system's delivery slipped by nearly a year, which obviously impacted the 9700 marketing effort. A version of OS/7 finally was demonstrated by UNIVAC on the new 90/60 system in October 1973. Release 1 of OS/7 is scheduled for "beta test" at a customer site in December 1973, and UNIVAC is aiming for official release in January 1974.

Although Release 1 of OS/7 will incorporate the full multiprogramming capabilities of the operating system plus support of the IMS/90 Information Management System and the initial version of ICAM, support for the features that will give the 90/70 the capability to demonstrate its full potential will come later. Release 1.5, scheduled for June 1974, will include support for expanded ICAM, the Communications Intelligence Channel (CIC), the 8440 Disc Subsystem, and the new DMS/90 Data Base Management System, which also is scheduled for delivery in June 1974. In addition, Release 1.5 will include the capability to run IBM System/360 emulation under control of OS/7. Release 2.0, scheduled for the first quarter of 1975, will provide support for the OSSF.

Information management software, which is making a significant contribution to the marketing success of the UNIVAC 1100 system, is also receiving strong emphasis in the new UNIVAC Series 90. IMS/90, an on-line information storage and retrieval system, was previously announced as IMS/7 and has been renamed to fit into the numbering scheme of the new Series 90 family. DMS/90, a generalized data base management system, was introduced with the 90/60 and 90/70. DMS/90, like DMS 1100 for the UNIVAC 1100 Series, was designed to meet the recommendations of the 1971 Report of the CODASYL Data Base Task Group.

### COMPATIBILITY

With an instruction set comparable to that of the IBM System/360 Model 50, both the 90/60 and the 90/70 offer a high degree of compatibility with the targeted IBM 360/30 and 360/40 systems and also with the Spectra and Series 70 computers. This, together with appropriate software support, will make these systems almost completely compatible with System/360 DOS. This compatibility will

▶ From 1 to 16 Uniservo 12 and Uniservo 16 Tape Units can be connected to a Uniservo 12/16 Control, or any combination of 1 to 16 Uniservo 12, 16, or 20 Tape Units can be connected to a Uniservo 20 Control, and up to 8 tape controls can in turn be connected to each selector channel. Optional features enable the tape control to be connected to two selector channels, permitting simultaneous read/read, read/write, or write/write tape operations.

**UNISERVO 20 MAGNETIC TAPE UNIT:** A high-speed tape drive that reads and records data on standard 1/2-inch tape in IBM-compatible formats. Available in a 9-track version only. Tape speed is 200 inches per second, forward or backward. The Uniservo 20 has a recording density of 1600 bpi (in phase-encoded mode) and a data rate of 320,000 bytes per second. Standard features include a power window, automatic tape threading, and a wrap-around cartridge.

From 1 to 16 nine-track, 800 or 1600 bpi Uniservo 12, 16, and/or 20 Tape Units can be connected in any combination to the Uniservo 20 Control Unit, and up to 8 tape controls can in turn be connected to each selector channel. With the 7-Track Capability and 9-Track Addition feature, Uniservo 12 and 16 Tape Units in the Uniservo 20 subsystem may be 7- or 9-track. Two or more control units may be used in the Uniservo 20 Subsystem to provide simultaneous dual access for read/write, read/read, and write/write operations on any appropriately equipped Uniservo 16 or 20 Tape Units connected to the control units. Each control unit in a simultaneous dual access system has its own power supply and independent access path to provide increased reliability. Individual tapes cannot be switched off-line without removing all the tapes connected to that controller from service.

**600-CPM CARD READER:** Reads 80-column cards serially by column at 600 cpm. Can be equipped to read 51- or 66-column short cards or UNIVAC 90-column cards. Reads in either EBCDIC or card-image mode. Has a 2400-card feed hopper and two 2000-card stackers; ASCII translate is optional. Connected via a shared multiplexer subchannel. Multi-read error checking is a standard feature.

**1000-CPM CARD READER:** Identical with the 600-cpm unit except for its greater speed.

**250-CPM CARD PUNCH, 0604-99:** Punches 80-column cards in row-by-row fashions at 250 cpm, in either EBCDIC or card-image mode. Has a 1000-card feed hopper and two 1000-card output stackers, with program control of stacker selection. Can be equipped with a pre-punch read station, giving the unit read/punch capabilities. Connected via the multiplexer channel.

**PAPER TAPE SUBSYSTEM:** Consists of a 300-char/sec F1033-02 reader, 110-char/sec F1032-02 punch, and 0920-02 control unit in a single cabinet. Reads and punches 5-, 6-, 7-, or 8-level tape. Spoolers are optional for both the reader and punch take-up. Connected via the multiplexer channel.

**0770 PRINTERS:** Printing speeds for 48-character sets are 800 lines per minute for Model 0770-00, 1400 lines per minute for Model 0770-02, and 2000 lines per minute for Model 0770-04. The respective skipping speeds for these three models are 50, 75, and 100 inches per second. All can have character sets from 24 to 384 characters in size, and all have 132 print positions as standard. An optional feature for all models can increase the number of print positions to 160 without affecting the printing speed. All have a single-space print time of 8.75 milliseconds, line spacings that are operator-selectable at 6 or 8 lines per inch, and forms dimensions from 3 to 22 inches wide and up to 24 inches long. The printers use a new horizontal print band technique. Their control units have a standard Series 90 interface.

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▷ also extend to IBM Program Products, which can be licensed by individual 90/60 and 90/70 users, and to other IBM applications software in the public domain.

The present customer base of UNIVAC 9400 and 9480 systems, running under OS/4, is also a powerful consideration in 90 Series product planning. UNIVAC has installed about 600 of the 9400 and 9480 systems to date, with approximately 150 more systems on order. Most of these users (60 to 70 percent, UNIVAC hints) are on 5-year contracts, but at least one version of that contract allows upgrade to a larger system without penalty. UNIVAC points out that there are presently a total of about 5,000 users of the 9000 Series computers.

A number of attractive conversion aids to help bring users to the 90/60 and 90/70 already exist, and more are in the offing. The OS/4 nucleus is imbedded within OS/7, allowing for a straightforward conversion of UNIVAC 9400 or 9480 programs to the 90/60 or 90/70. Series 70 programs can be run on the 90/60 and 90/70 using the SMOOTH (Spectra Mode of Operation Through Hardware) emulator, and Series 70 communications programs will run under OS/7 without recoding. SMOOTH will become especially important because the Series 70/45 represents a sizeable customer base that is or soon will be ripe for conversion. SMOOTH is scheduled for release in the fourth quarter of 1973.

Upward compatibility of source programs written for smaller Series 9000 machines, as well as for System/360 and real-memory System/370 computers, is expected to be excellent. Many IBM assembly-language programs should run on the 90/60 and 90/70 after compilation on the UNIVAC systems without recoding. The only types of programs which almost invariably will require recoding are those using communications software. Input data files may require conversion from competitive systems, and this work can be done by UNIVAC at a Customer Support Facility.

In addition, emulation capabilities are provided for IBM 360 DOS users. IBM 1401, 1440, and 1460 programs being emulated on a System/360 can be run on the UNIVAC 90/60 and 90/70 Series by using the integrated 1400 Series Emulator. Emulators also are available for the Series 70 (formerly RCA) Model 301 and, on the 90/70, for the Model 501. The emulators, previously available in a free-standing mode of operation, will be offered as an integrated part of OS/7. Emulated programs, therefore, can be run as jobs within the multiprogramming environment of OS/7. A maximum of two separate emulators can operate concurrently under OS/7. A free-standing version of the 360 Emulator will continue to be supported.

In recognition of the necessity to ease "executive anxiety" on the part of UNIVAC 90 Series prospects who may contemplate conversion from some other vendor's ▷

▶ The three 0770 Printers have the following features in common: all use interchangeable print band cartridges; all can identify the cartridge type under program interrogation to ensure that the operator has placed the proper band in the printer for that run; all use a program-loaded vertical format buffer in place of a paper tape format loop; and all have swing-out print carriages, easy ribbon replacement without rewinding, simplified line finding, lighted print areas, automatic print gap (forms thickness) adjustment, powered, program-controlled top covers, automatic power forms stackers, and enhanced acoustical covers to reduce operating noise.

**2703 OPTICAL DOCUMENT READER:** Reads printed numeric data from individual documents ranging from 2.75 to 4.25 inches in height and 2.00 to 8.75 inches in length. Basic speed of 300 six-inch documents per minute can be increased to 600 dpm by an optional feature. Other options permit reading of vertical pencil marks and of standard 80-column punched cards. The Modulus-10 Check Digit option compares a computed modulus-10 check digit with a check digit printed on the document. Character set consists of the digits 0-9 and four special symbols, in either UNIVAC H-14, OCR-A, or OCR-B (ECMA) font. Has a 2000-document feed hopper and three 1000-document stackers. Connected via the multiplexer channel.

**90/60 CHANNEL ADAPTERS:** Permit any of the following small-to-medium-scale UNIVAC data processing systems to be connected to the 90/60 via their respective multiplexer or selector channels: 1004/1005, 9200, 9200 II, 9300, 9300 II, 9400, 9480, 90/60, or 90/70.

**90/70 CHANNEL ADAPTERS:** Permit any of the following small-to-medium-scale UNIVAC data processing systems to be connected to the 90/70 for communication via their respective multiplexer or selector channels: 9200, 9200 II, 9300, 9300 II, 9480, 90/60 or 90/70.

Each attachable processor can function as an I/O subsystem providing peripheral capabilities. For details of the smaller Series 9000 computer systems, please refer to Reports 70C-877-01 and 70C-877-02.

### COMMUNICATION CONTROLS

**COMMUNICATIONS INTELLIGENCE CHANNEL (CIC):** An independently operating channel with programmable message control logic is available as an option for specialized message control of up to 128 half-duplex or 64 full-duplex lines. The CIC is functionally similar to a multiplexer channel that is dedicated to communications devices, and transfers data at a maximum throughput rate of 60,000 bytes per second to and from the terminals which are connected to it. It is supported only under OS/7 and only on the 90/70.

**DATA COMMUNICATIONS SUBSYSTEMS:** Remote communications devices can also be connected to a UNIVAC Series 90 system by means of from one to four Data Communications Subsystems. The DCS-1, DCS-1C, DCS-4, and DCS-16 subsystems can accommodate 1, 1, 4, and 14 half-duplex or full-duplex lines, respectively. Each DCS is connected directly to a multiplexer subchannel. Any combination of up to 4 DCS's can be connected to a UNIVAC 90/60 to 90/70, subject to a limit of 30 lines maximum.

Each DCS consists of a single Line Terminal Controller, plus a Line Terminal and Communications Interface for each connected line. Numerous models of line terminals and interfaces permit asynchronous and/or synchronous transmission over a wide range of communications services at speeds of 75 to 250,000 bits per second. The DCS-1C is a Binary Synchronous Data Communications Subsystem that enables a Series 90 computer to communicate with an IBM System/360 computer, using either EBCDIC or ASCII code and either Transparent or Nontransparent mode. The free-standing 8577-02 DCS Cabinet used with the DCS-1 or DCS-1C houses up to 4 of these units in any combination. The DCS-4 or DCS-16 includes its own free-standing cabinet and power supply. ▶



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➤ computer to the new 90/60 and 90/70 systems, UNIVAC has initiated a free conversion support program. This program will be administered through Customer Support Facilities located near key concentrations of UNIVAC 90 Series prospects and customers. Use of these facilities is primarily intended for conversion of eligible user DOS software, which will usually consist of source programs whose language specifications conform to ANSI standards.

Five-year lease prices of the 90/70 and 90/60 are designed to make these systems an attractive alternative to users considering a 370/135 or 370/145. UNIVAC's purchase prices and five-year rental rates for the 90/60 can range up to 16 percent lower than IBM's purchase prices and Extended-Term Lease Plan prices for comparably equipped 370/135 systems. UNIVAC 90/70 prices are the same as those of the original 9700, and the purchase prices and five-year rental prices are approximately 15 to 25 percent lower than those of comparable 370/145 systems that are purchased or leased on the IBM Extended-Term Lease Plan. A further price advantage results to Series 90 users from UNIVAC's fully bundled software and support policy, which now includes conversion support at the Customer Support Facilities.

## USER REACTION

It is fair to say that the 9700 marketing campaign got off to an extremely slow start, at least in the United States and Canada. A contributing factor probably was the comparative ease with which the UNIVAC sales force, experienced as they are in 1100 Series sales, could sell new accounts on 1106 system with the field-proven 1100 Operating System as an alternative to an IBM 370/145. On the Series 70 front, likewise, the larger ex-RCA machines were readily available to those Series 70 users wishing upgrades (although UNIVAC was bound by an agreement not to sell Series 70 systems to new accounts).

What the 9700 lacked was a demonstrable operating system that could utilize the full processing power of the 9700 hardware, and possibly also a visible means of upward growth within the 9000 Series family.

UNIVAC has taken several steps to resolve these problems and give additional credibility to its new Series 90 product line. The 90/60 was demonstrated running under OS/7 shortly after its announcement, and 90/60 systems are to be available for shipment in January 1974. UNIVAC claims that this typifies a new policy for future product releases, thus eliminating long lead times between initial announcement and delivery of a new system. The company also is committed to providing suitable upgrade capabilities within the framework of the 9000 Series system architecture.

UNIVAC states that the sales picture for the 90/70 has improved considerably, and that approximately half a ➤

➤ **COMMUNICATIONS TERMINALS:** The Uniscope 100 Display Terminal (Report 70D-877-05), the DCT 500 (70D-877-02), the DCT 1000 (70D-877-03), and the DCT 2000 (70D-877-01) are available for use with the UNIVAC Series 90. Please refer to the indicated DATAPRO 70 Peripherals reports for complete coverage of these devices.

## SOFTWARE

**OPERATING SYSTEMS:** Two operating systems are available for the UNIVAC 90/60 and 90/70: OS/4, an enhanced version of the UNIVAC 9400 Disc Operating System; and OS/7, a new operating system developed to fully utilize the 90/70's hardware. Essentially similar language processors are available for both operating systems which range in size from about 20K to 48K bytes.

Programs developed for either OS/4 or the UNIVAC 9400 or 9480 are upward-compatible at the source level with OS/7 language processors. Those programs, however, must be recompiled in order to run under OS/7.

**OS/4:** Provides essentially the same facilities as the UNIVAC 9400 DOS and is disc-oriented; no tape-oriented version is available. Enhancements which have been made to 9400 DOS consist of modifications to support the Series 90 console and the extra channels and larger memory of the Series 90. OS/4 requires at least two disc drives, a processor with 131K bytes of main memory, a card reader, and a printer (or a smaller UNIVAC computer connected as an I/O subsystem). Minimum resident memory requirement for OS/4 is about 24K bytes.

The system control facilities of OS/4 are divided into four main categories: Supervisor, Job Control, Data Management, and Message Control.

The Supervisor resides in main storage and schedules and coordinates all activities within the system. Its functions include interrupt handling, I/O scheduling and initiation, job time allocation, operator communication, job accounting, and control of multiprogrammed operations. Up to five independent programs can be executed concurrently if sufficient memory and peripherals are available. The Supervisor provides five different priority levels, three of which are available for users' programs.

The OS/4 Job Control routine controls transitions between job steps, suspension or cancellation of jobs, restarting of jobs, and termination of jobs. It receives its instructions from control cards which constitute a "job stream." Job streams can be stored in disc files for subsequent selection and execution.

Data Management provides comprehensive input/output control facilities, including record blocking and unblocking, I/O buffering, data validation, and label processing. These facilities are provided by subprograms which are generated as part of the operating system and referenced by macro-instructions in users' programs. Nonsequential files in disc storage can be accessed by either the Direct (random) Access Method, in which the user must specify the relative or absolute address of the desired disc record, or the Indexed Sequential Access Method, in which the user need only specify the key of the desired record. In a multiprogramming environment, the Data Management routines can be shared by all programs, thereby reducing main storage requirements.

The OS/4 Message Control Program provides macro-instructions that enable the user to generate custom-tailored message control and message processing routines to handle communications input/output. Messages of fixed or variable length can be queued in main and/or disc storage, and the generated routines can perform functions such as code translation, message sequencing, time stamping, and error checking. Main memory requirements for the Message Control Program routines range from 20K bytes for an ➤

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➤ dozen orders for the new 90/60 system have already been received. Sales of the Series 90 should further improve when OS/7 proves itself in the field.

At this writing, two 90/70 systems have been installed in the United States. One U.S. user, who has had a 90/70 installed and running under OS/4 for several months, described the performance of the mainframe and peripheral devices as "excellent for a new piece of equipment." Although the user does not intend to install OS/7 until he orders peripherals which require OS/7 support, he expressed satisfaction with the performance and capabilities of OS/4. He described the transition from 9400 DOS to OS/4 on the 90/70 as "extremely smooth," and was pleased with the level of UNIVAC support.

Datapro also contacted a Canadian user, who has had a 90/70 installed since April 1973. Although that system was purchased, it has been installed in UNIVAC's Toronto office and is scheduled to be transferred to the user's site in January 1974, replacing a much older UNIVAC computer. The user indicated that the reliability of the mainframe and peripherals was satisfactory, and that installation of OS/4, aside from a few small start-up problems, went "very well." OS/7 is scheduled for implementation of this system when it becomes available. In addition, this user described himself as "quite happy" with the support provided by UNIVAC for this system. Other users can currently be found in Austria, Belgium, Japan, Yugoslavia, and the United Kingdom. □

➤ entry-level system to 36K bytes for use of the complete facilities, not including buffering.

UNIVAC 90/60 AND 90/70 OPERATING SYSTEM (OS/7): Provides additional facilities beyond those of OS/4, which include multiprogramming with up to 14 concurrent variable-length jobs, swapping to an optional Operating System Storage Facility (OSSF), improved data management facilities and system cataloging procedures, job accounting, and automatic integrated emulation of the IBM 1401, 1440, and 1460, System/360 DOS, and UNIVAC Series 70. An Information Management System (IMS/90) and a Data Base Management System (DMS/90) have also been announced. Release of OS/7 is scheduled for January 15, 1974.

OS/7 is a disc-oriented system that requires a minimum configuration consisting of a processor with 131K bytes of main memory, either two disc drives and a magnetic tape unit or three disc drives, a card reader and a printer (or a smaller UNIVAC computer connected as an I/O subsystem). At least 56K bytes are required for the minimum operating system residence. The System Control facilities of OS/7 are divided into four main categories: Supervisor, Job Control, Data Management, and Communications.

The Supervisor resides in main storage and consists of the system modules which perform storage management, task management, I/O control, timer service, program management, system recovery, spooling control, record and file protection, control of diagnostic and debug aids, system console management, and the subroutine linkage table. At the time the supervisor is generated (SYSGEN), the number of priorities and initial time-slice lengths for each priority

level are specified. These priorities are recorded in a system switch list, which is managed by the Task Manager routine. Priorities may be changed for a given job at run time within limits which are also established at SYSGEN time.

Software operating efficiency can be improved through attachment of the dedicated Operating System Storage Facility (OSSF). According to UNIVAC, the OSSF will typically yield about a 20 percent increase in throughput. This head-per-track disc connects through its own Control Channel directly to the processor and is managed by the Supervisor. OSSF files are accessed using the System Integrated Access Method (SIAM) and include OS/7 transient routines and overlays, parts of the System Catalog, OS/7 checkpoint information, and scratch areas for sorts and language processors. Program relocation and input and output spooling are also controlled by the Supervisor. Output writers to remote devices allow batch programs to service remote users, thus providing a Remote Job Entry capability.

The OS/7 Job Control routine controls transitions between job steps, suspension or cancellation of jobs, restarting of jobs, and termination of jobs. It receives its instructions from control cards which constitute a "job stream." Job streams are stored in disc files for subsequent selection and execution. The Job Control routine also performs job accounting, catalog management, and device allocation.

Data Management provides comprehensive interface facilities between user programs and the hardware-oriented I/O control performed by the Supervisor. File organization methods supported consist of Sequential, Direct (random), Indexed Sequential, and System Integrated access methods. Library and work files on the OSSF as well as on other disc or tape devices are supported by the System Integrated Access Method (SIAM), while other user files are written under control of SAM, DAM, or ISAM. Re-entrant logical I/O control modules provide for record blocking and unblocking, I/O buffering, data validation, and label processing. Another important function of Data Management allows the user to take advantage of capabilities in the Supervisor for checkpoint/restart and audit trails for reconstruction and recovery. Main memory requirements for Data Management vary from 14K to 25K bytes.

The Integrated Communications Access Method (ICAM) provides routines for network definition and control, message handling, logical record interfacing, and handling of communications over the Data Communications Subsystem (DCS) or the Communications Intelligence Channel (CIC). By supplying a set of parameters which define the network to ICAM, a Message Control program is generated. The Message Control program interfaces with the Supervisor routines that physically control communications I/O, thus allowing the user to communicate with the network at a GET and PUT level. Message Control is the major communications routine; it provides initiation and control of message flow, message queuing, line control, buffering, reformatting and code conversion, polling, error detection and correction, and interfacing with IMS/90. Additional lines and terminals can be added to the system by regenerating the Message Control program, with no change to user programs. Optional functions provide for keeping message statistics for traffic analysis, audit trails, and support for automatic store-and-forward message switching. Memory requirements of the basic communications routines are 21K to 31K bytes, and 31K to 49K bytes are required for the advanced communications routines.

COBOL: UNIVAC offers two COBOL compilers for use under OS/4. Basic COBOL requires a system with 131K bytes of main storage and includes the minimum American National Standard COBOL language facilities (i.e., Level 1 of the Nucleus, Sequential Access, Segmentation, and Table Handling modules). Extended COBOL requires a system with 131K bytes of main storage and two disc drives. It includes the following facilities of ANS COBOL: Level 2 of

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► the Nucleus, Sequential Access, and Table Handling modules, and Level 1 of the Random Access, Sort, and Segmentation modules.

The OS/7 COBOL compiler conforms to DOD Level 4 requirements. It includes the ANS Level 2 Nucleus, Sequential Access, Sort, Segmentation, and Library modules, and a Level 3 implementation of the Table Handling module. The Report Writer Feature has not been included. Memory requirement for OS/7 COBOL is 48K bytes on a minimum 131K-byte system.

**FORTRAN:** An OS/4 FORTRAN compiler is available for operation on the minimum 131K UNIVAC 90/60 or 90/70 system. It includes all the language facilities of full American National Standard FORTRAN, and is 360 FORTRAN F compatible. In addition, there are more than 20 useful language extensions, such as direct-access I/O statements and the ability to handle arrays of up to 7 dimensions.

**FORTRAN:** An OS/4 FORTRAN compiler is available for operation on the minimum 65K UNIVAC 9700 system. It includes all the language facilities of full American National Standard FORTRAN, and is 360 FORTRAN F compatible. In addition, there are more than 20 useful language extensions, such as direct-access I/O statements and the ability to handle arrays of up to 7 dimensions.

The OS/7 FORTRAN Compiler offers extended capabilities over those of the OS/4 compiler, plus source-code compatibility with IBM System/360 Level G FORTRAN except for the DUMP and PDUMP Statements. OS/7 FORTRAN requires about 40K bytes of main memory.

**ASSEMBLER:** The OS/4 Assembler permits programs to be coded in a symbolic assembly language that is very similar to, though not totally compatible with, the Assembler languages for the UNIVAC 9200/9200 systems and the IBM System/360. It is directly compatible with the UNIVAC 9400 BAL.

The OS/7 Assembler includes all of the nonprivileged instructions of the IBM System/360 Model 50. Programs written for the UNIVAC 9400 or IBM System/360 Assembler can be assembled using the OS/7 Assembler without change. Memory requirement for the OS/7 Assembler is 40K bytes. The Assembler produces relocatable object modules which can be written on either disc or tape. These object modules can be linked to other modules prior to being loaded and executed. A macro-instruction facility simplifies the inclusion of precoded subprograms.

**REPORT PROGRAM GENERATOR:** The OS/4 RPG is designed to accept UNIVAC 9200/9300/9400 RPG source programs for generation and execution of a 90/60 or 90/70. It is available for the minimum UNIVAC 90/60 or 90/70 with 131K bytes of main storage. The generated RPG object programs can be recorded on tape, disc, or punched cards to eliminate the need for re-generation of the program before subsequent report runs. The object programs are relocatable modules that can be linked to other programs and stored in disc or tape libraries.

OS/7 RPG offers the same capabilities as the OS/4 version, plus source-code compatibility with IBM System/360 DOS RPG. Memory requirement for OS/7 RPG is 20K bytes.

**INFORMATION MANAGEMENT SYSTEM (IMS/90):** Provides OS/7 users with an on-line information storage and retrieval capability utilizing the Message Control program and the Data Management handlers for standard file access methods. After initiating a dialog with IMS/90, passwords are used to control access to restricted information. A free-form query/update language, supported by either CRT or hardcopy terminal devices, permits users to retrieve and display information from files, generate and display lists of qualified data, and add, delete, or change files. The defined record management capabilities permit a new record to be

created from selected portions of multiple files. IMS/90 also facilitates applications programming by providing communications interfacing, application program scheduling, data management, system security, and recovery of files and messages. Main memory requirement for IMS/90 is about 40K bytes, which includes the user-terminal language processor called UNIQUE.

**DATA MANAGEMENT SYSTEM/90 (DMS/90):** DMS/90 is UNIVAC's newly announced data base management system for large Series 90 installations operating under OS/7. Like DMS-1100 for the UNIVAC 1100 Series computers, DMS/90 is a comprehensive data base management system developed according to the specifications of the 1971 Report of the CODASYL Data Base Task Group. Its functional capabilities, therefore, are similar to those provided by DMS-1100, although there is no compatibility between the two systems on the machine level.

DMS/90 is designed to satisfy the need for standardized data management techniques that provide: (1) separation of the data definition and data manipulation functions, (2) an acceptable degree of data independence, and (3) data base protection and integrity. DMS/90 has three principal components: a Data Description Language, a Data Manipulation Language, and a Data Management Routine.

The Data Description Language (DDL) is a stand-alone language whose record descriptions are compatible with those of COBOL. The DDL input provided by the data manager completely defines the data base. The data base description, or "schema", is composed of areas, records, and sets. A DDL Translator converts the DDL syntax into a series of tables which are maintained in a catalogued file in mass storage for later interpretation by the Data Management Routine.

The concept of "areas" in DDL provides the means for associating the data base with the physical mass storage devices in which it resides. A "set" is simply a named collection of records. The records in a set can be ordered through keys (DIRECT), based on values (CALCULATED), or based on owner occurrence (VIA). A given record can be both an "owner record" of, and a "member record" in, one or more sets, and a different ordering procedure can be used in each set.

The application programmer can only access a data base through a "subschema" which has to be provided for him by the data base administration staff. The subschema is made available to a program by an INVOKE declarative statement. Since the programmer cannot touch any data not invoked as a subschema, data privacy and integrity is assured, at least at the application program level.

The imperative data manipulation statements for control, retrieval, and modification, and the INVOKE declarative, are referred to collectively as the Data Manipulation Language (DML). It is the procedural language used by individual programmers to access the data base. It is used in connection with a host language - usually COBOL - which describes the procedures for processing the data once it has been accessed. The functions of DML can be generally described by listing its commands: OPEN, CLOSE, FIND, GET, MODIFY, STORE, DELETE, INSERT, REMOVE, IF, ON-ERROR, PRIVACY, LOG, and DEPART. The programmer inserts the appropriate DML commands into the syntax of his COBOL source program. A DML Preprocessor then converts the DML commands into a COBOL-compatible format and adds the necessary record descriptions and communication areas. The altered syntax is passed on to the COBOL compiler, which produces an executable program called a "run unit."

The Data Management Routine (DMR), the key operational component of DMS/90, maintains the data base and preserves its integrity. No run unit is allowed direct access to the data base; instead, all DML commands are funneled through the Data Management Routine. In addition to its storage and retrieval functions, DMR includes save data, ►

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► rollback, and recovery routines that prevent loss of data through hardware failures, software bugs, or erroneous input.

DMS/90 can be used with any host language that supports a CALL macro or its equivalent. Since the DML processor is available only for ANS COBOL, user communication with DMS/90 from other host languages is through arguments passed via CALL statements. The DMS routines are not re-entrant and require approximately 50K bytes of main memory at execution time.

**UTILITY ROUTINES:** An OS/4 or OS/7 Sort/Merge program capable of using disc and/or tape drives is available. It can sort fixed or variable-length records into either ascending or descending sequence, and includes provisions for the user's own coding. Disc-only sorts require enough disc capacity to hold all the records to be sorted plus sort control information. Tape-only sorts require 3 to 14 tape units, with no more than 6 tapes used for string collating. Tape/disc sorts use the disc to increase the length of the strings before collation is done on tape. The program's operation can be controlled by parameters entered either when the sort is generated or at run time. Up to 255 noncontiguous key fields can be specified, using shared input devices, if desired, and reserved output devices. The COBOL SORT verb generates a linkage to the Sort/Merge utility program.

A Linkage Editor combines object modules produced by the COBOL, FORTRAN, RPG, or Assembly language translators into "load modules" which are suitable for loading and execution under operating system control.

Library Service routines facilitate the creation and maintenance of various types of libraries on tape and disc for OS/4 or OS/7.

Other available utility programs for either the OS/4 or OS/7 operating system include data transcription routines, comprehensive data utilities to copy data from any input device to any output device, file maintenance routines, a dynamic (snapshot) dump, a terminal (postmortem) dump, and tape and disc listing programs.

For use under OS/4, UNIVAC offers a simulator for the UNIVAC 1050 and translators for IBM 1400 Series Auto-coder and SPS and for IBM System/360 BAL.

Under OS/7, the IBM System/360 Assembler language is fully compatible with the UNIVAC 90/60 and 90/70 Assembler. IBM System/360 DOS and IBM 1401, 1440, and 1460 compatibility is handled through microprogrammed integrated emulation for certain time-consuming operations and supported by software sub-routines for other emulated operations. More than one object program for a System/360 DOS system or a 1401, 1440, or 1460 can be run concurrently with other OS/7 operations without reprogramming, using the IBM disc, tape, and unit record files. UNIVAC claims a 90/70 emulation performance of 5.0 times native 1401 performance and 2.5 times native 1460 performance. These estimates are roughly similar to those claimed for the IBM System/360 Model 40 and System/370 Model 145. Performance estimates for the 90/60, and for both the 90/60 and 90/70 emulating an IBM System/360 DOS environment, are not yet available. UNIVAC 90/60 and 90/70 software support required in conjunction with the special hardware compatibility features and microcode occupies from 45K to 60K bytes of main memory.

The Series 70 Mode of Operation Through Hardware (SMOOTH) runs under OS/7 on the 90/60 and 90/70 and supports TOS, TDOS, and DOS batch operations, while communications programs can be run under a version of COS that is fully incorporated into OS/7.

**APPLICATION PROGRAMS:** Programs announced to date include an advanced Pert Management Control System

(MCS), Linear Programming, UNIS (bill of materials, inventory control, planning and scheduling), APT (automatically programmed tools), PROFITS (on-line bank teller transaction processing), LINCO III (typesetting and line justification), NEWSCOMP (on-line newspaper text editing and typesetting), WIMS (Wholesale Inventory Management System), UPACS (UNIVAC Patient Accounting System — a hospital accounting package), CLEAR II (County Law Enforcement Applied Regionally — an on-line data base management system for state and local government), and BMD (Biomedical Programs — a collection of general-purpose statistical and mathematical programs for research and management problems). The 90/60's and 90/70's announced compatibility with IBM System/360 DOS user programs will permit the use of most of the existing System/360 application programs.

### PRICING

**EQUIPMENT:** All necessary control units and adapters are included in the indicated prices for the following typical configurations, and the quoted one-year rental prices include equipment maintenance.

**UNIVAC 90/60 SMALL TAPE/DISC SYSTEM (USING OS/4):** Consists of 131K Processor (with standard selector, multiplexer, floating-point hardware, and storage protection feature), Console, 600-cpm Card Reader, 250-cpm Card Punch, 800-lpm Printer, two Uniservo 12 (68KB) Tape Units with control, and two 8414 disc drives (29 million bytes each) with control. Monthly rental and purchase prices are \$12,824 and \$507,781, respectively. The five-year lease cost would be \$10,576 per month.

**UNIVAC 90/60 SMALL TAPE/DISC SYSTEM (USING OS/7):** Consists of a 196K Processor (with standard selector, multiplexer, floating-point hardware, and storage protection feature), Console, 600-cpm Card Reader, 250-cpm Card Punch, 800-lpm Printer, two Uniservo 12 (68KB) Tape Units with control, and two 8414 disc drives (29 million bytes each) with control. Monthly rental and purchase prices are \$14,693 and \$568,801, respectively. The five-year lease cost would be \$12,161 per month.

**UNIVAC 90/60 MEDIUM TAPE/DISC SYSTEM (USING OS/7):** Consists of 262K Processor (with two selectors, one multiplexer, storage protection, floating-point hardware, and emulation features), Console, 600-cpm Card Reader, 1400-lpm Printer, four Uniservo 12 (68KB) Tape Units and control, and three 8424 Disc Drives (58 million bytes each) with control. Monthly rental and purchase prices are \$18,575 and \$704,941, respectively. The five-year lease cost would be \$15,405.

**UNIVAC 90/60 LARGE TAPE/DISC SYSTEM (USING OS/7):** Consists of a 393K Processor (with two selectors, one multiplexer, storage protection, floating-point hardware, and emulation features), Console, two 2000-lpm Printers, two 1000-cpm Card Readers, 250-cpm Card Punch, six Uniservo 16 (192 KB) Tape Units and control, and two 8424 Disc Drives (58 million bytes each) with control. Monthly rental and purchase prices are \$24,424 and \$919,099, respectively. The five-year lease cost would be \$20,266.

**UNIVAC 90/70 SMALL TAPE/DISC SYSTEM (USING OS/4):** Consists of 131K Processor (with standard selector, multiplexer, floating-point hardware, and storage protection feature), Console, 600-cpm Card Reader, 250-cpm Card Punch, 800-lpm Printer, two Uniservo 12 (68KB) Tape Units with control, and two 8414 Disc Drives (29 million bytes each) with control. Monthly rental and purchase prices are \$16,287 and \$625,453, respectively. The five-year lease cost would be \$13,356 per month.

**UNIVAC 90/70 SMALL TAPE/DISC SYSTEM (USING OS/7):** Consists of 196K Processor (with standard selector, multiplexer, storage protection, floating-point hardware, and emulation features), Console, 600-cpm Card Reader, 250-cpm Card Punch, 1400-lpm Printer, two Uniservo 12

## UNIVAC 90/60 and 90/70

► (68KB) Tape Units with control, and two 8424 Disc Drives (58 million bytes each) with control. Monthly rental and purchase prices are \$17,382 and \$659,243, respectively. The five-year lease cost would be \$14,299 per month.

**UNIVAC 90/70 MEDIUM TAPE/DISC SYSTEM (USING OS/7):** Consists of 393K Processor (with two selectors, one multiplexer, storage protection, floating-point hardware and emulation features). Console, 600-cpm Card Reader, 250-cpm Card Punch, 1200/1600-lpm Printer, four Uniservo 12 (68KB) Tape Units with control, and six 8424 Disc Drives (58 millions bytes each) with control. Monthly rental and purchase prices are \$22,781 and \$817,623, respectively. Monthly rental on the 5-7 year plan would be \$18,749.

**UNIVAC 90/70 LARGE TAPE/DISC SYSTEM (USING OS/7):** Consists of 655K Processor (with four selectors, one multiplexer, storage protection, floating-point hardware, emulation, and two OSSF memory devices), Console, two 1000-cpm Card Readers, two 1400-lpm Printers, a 250-cpm Card Punch, eight Uniservo 20 (320KB) dual-access tape units with two controllers, and four 8440 Disc Drives (119 million bytes each) with control. Monthly rental and purchase prices are \$41,499 and \$1,520,809, respectively. The monthly cost under a five-year lease would be \$34,384.

**SOFTWARE AND SUPPORT:** UNIVAC has not "unbundled" to date, so the equipment prices listed above

include all of the UNIVAC software described in this report and all normal educational courses and professional assistance. UNIVAC Customer Support Facilities will provide conversion support, demonstrations, and benchmark processing for UNIVAC 90/60 and 90/70 customers and prospects. This support, also, is included without additional charge.

**CONTRACT TERMS:** The standard UNIVAC use and service agreements allow unlimited use of the equipment (exclusive of the time required for remedial and preventive maintenance). There are no extra-use charges. The basic maintenance charge covers maintenance of the equipment for nine consecutive hours a day, Monday through Friday. Extended periods of maintenance are available at extra cost.

**LONG-TERM LEASES:** In addition to the basic 1-year agreement, UNIVAC offers an extended-term 5-year lease for 90/60 and 90/70 systems at significantly lower monthly rates. Under the 5-year "level-payment" agreement, the monthly equipment charge is 80% of the 1-year rental rate shown in the accompanying price list. Under a 5-year "reducing-payment" agreement, the monthly charge is 90% of the 1-year rental rate during the first year, 85% the second year, 80% the third year, 75% the fourth year, and 70% the fifth year. Maintenance is not discounted under these plans. ■

## EQUIPMENT PRICES

		Purchase Price	Monthly Maintenance	Rental (1-year lease)*
<b>90/60 PROCESSOR AND MAIN STORAGE</b>				
3024-97	90/60 Processor (includes a Multiplexer Channel, 2 Interval Timers, Storage Protection, a Selector Channel, Floating Point Control, and 131,072-byte Memory)	\$295,584	\$600	\$6,158
7025-85	Storage; 32,768 bytes (expands main storage from 131,072 to 163,840 bytes)	16,800	62	350
F1775-97	Storage; 32,768 bytes (expands main storage from 163,840 bytes to 196,608 bytes, from 196,608 bytes to 229,376 bytes, or from 229,376 bytes to 262,144 bytes.)	16,800	62	350
7025-84	Storage; 65,536 bytes (expands main storage from 262,144 bytes to 327,680 bytes)	31,200	100	650
F1775-96	Storage; 65,536 bytes (expands main storage from 327,680 to 393,216 bytes.)	31,200	100	650
7025-97	Storage; 131,072 bytes (expands main storage from 393,216 bytes to 524,288 bytes.)	62,400	200	1,300
F2007-00	90/70 upgrade; converts a 90/60 Processor to a 90/70 Processor	118,332	300	3,567
<b>90/70 PROCESSOR AND MAIN STORAGE</b>				
3024-99	90/70 Processor (includes a Multiplexer Channel, 2 Interval Timers, Storage Protection, a Selector Channel, Floating Point Control, and 131,072-byte Memory)	413,916	900	9,725
7025-99	Storage; 65,536 bytes (expands main storage from 131,072 to 196,608 bytes)	33,600	125	700
F1775-98	Storage; 65,536 bytes (expands main storage from 196,608 to 262,144 bytes)	33,600	125	700
7025-98	Storage; 131,072 bytes (expands main storage from 262,144 to 393,216 bytes)	62,400	200	1,300
7025-97	Storage; 131,072 bytes (expands main storage from 393,216 to 524,288 bytes)	62,400	200	1,300
7025-96	Storage; 131,072 bytes (expands main storage from 524,288 to 655,360 bytes)	62,400	200	1,300

\*Rental prices do not include equipment maintenance.

UNIVAC 90/60 and 90/70  
EQUIPMENT PRICES

		<u>Purchase Price</u>	<u>Monthly Maintenance</u>	<u>Rental (1-year lease)*</u>
<b>90/70 PROCESSOR AND MAIN STORAGE (Continued)</b>				
7025-95	Storage; 131,072 bytes (expands main storage from 655,360 to 786,432 bytes)	62,400	200	1,300
7025-94	Storage; 131,072 bytes (expands main storage from 786,432 to 917,504 bytes)	62,400	200	1,300
7025-93	Storage; 131,072 bytes (expands main storage from 917,504 to 1,048,576 bytes)	62,400	200	1,300
<b>90/60 AND 90/70 PROCESSOR FEATURES</b>				
F1519-00	Expanded interface; expands multiplexer to 15 sub-systems (16 if F1518-00 is present). Available on 90/70 Processor only.	5,508	15	135
F1518-00	Subchannel Expansion; expands multiplexer up to 31 subchannels	1,836	5	45
F1337-00	Selector Channel; 833KB; 8 subsystems (includes channel programming and storage protection; Selector Channels 3 and 4 require 1916-00 Channel Expansion Cabinet)	8,975	25	220
1916-00	Channel Expansion Cabinet (for third and fourth F1337-00 Selector Channels)	8,772	25	215
F1335-00	Direct Control; interface for another 9000 Series processor plus 2 instructions for transfer of control information	3,672	10	90
F1591-00	Programmable Emulator; provides programmable control for any one of the following emulators using special hardware instructions: 301, SMOOTH, 360, or 1400	0	0	0
F1591-01	Programmable Emulator Expansion; provides programmable control for concurrent operation of two emulators (F1591-00 is required)	10,375	50	250
4014-99	System Console; includes Uniscope 100 CRT; may be expanded by addition of one 0772-00 Printer and up to 6 multichannel switches	20,810	70	510
0772-00	Console Printer; 30 cps (required for OS/4)	10,200	45	250
2519-00	Multiple Channel Switch; 1 switch plus cabinetry for five F1541-00 expansion switches	6,936	20	170
F1541-00	MCS Expansion; one switch	3,264	10	80
F1001-00	Channel Adapter 9000 Series Subsystem; provides 900 Series subsystem interface through respective multiplexer or selector channels	3,700	15	85
<b>MASS STORAGE</b>				
8405-99	OSSF; includes controller for 4 OSSF disc drives and one 3-million-byte head-per-track disc; 8.34-millisecond rotational delay	85,680	250	2,100
8405-04	OSSF Expansion; one 3-million-byte head-per-track disc; 8.34-millisecond rotational delay	26,520	100	650
8411-00	Disc Drive; 7.25 million bytes; 156KB/sec transfer rate	19,920	80	415
F1211-00	Disc Pack (for 8411 Disc Drives)	300	0	15
5024-00	Disc File Control (for up to 8 8411 drives)	20,010	85	460
F1043-00	Dual Channel Feature (for 5024-00); permits simultaneous access to the control from 2 selector channels	3,700	15	85
F1098-00	Record Overflow Feature (for 5024-00)	435	0	10
F1099-00	File Scan Feature (for 5024-00)	1,525	0	36
8414-92	Two 8414 Disc Drives; 58 million bytes; 312 KB/sec transfer rate	33,000	130	820
8414-94	Four 8414 Disc Drives; 116 million bytes; 312 KB/sec transfer rate	66,000	260	1,540
8414-96	Six 8414 Disc Drives; 174 million bytes; 312 KB/sec transfer rate	99,000	390	2,160
8414-98	Eight 8414 Disc Drives; 232 million bytes; 312KB/sec transfer rate	132,000	520	2,680
8414-85	Single 8414 Disc Drive (for configuration expansion); 29 million bytes; 312 KB/sec transfer rate	16,500	65	410
F1214-00	Disc Pack (for 8414 Disc Drives)	440	0	20
5024-02	Disc Control (for up to eight 8414 drives)	26,400	90	550

\*Rental prices do not include equipment maintenance.



## UNIVAC 90/60 and 90/70

## EQUIPMENT PRICES

MASS STORAGE (Continued)		Purchase Price	Monthly Maintenance	Rental (1-year lease)*
F1043-00	Dual Channel Feature (for 5024-02); permits access to the control from 2 selector channels	3,700	15	85
1371-99	Dual Access Feature (for 5024-02); permits simultaneous 2-channel access when used with 2 Disc Controls	2,160	5	45
1343-02	8411 Disc Capability (for 5024-02); allows attachment of 8411 drives to 5024 control in any combination with 8414 drives	1,920	10	40
<b>INPUT/OUTPUT UNITS</b>				
0861-00	Uniservo 12 Master Tape Unit; 9-track; 1600 bpi, 68.32 KB/second	14,650	107	353
F0934-99	Simultaneous Single-Density Feature (for 0861-00); requires 2 controls	3,265	16	78
F0934-01	Simultaneous Dual-Density Bi-Modal Feature (for 0861-00); requires F0934-99 and F0935-00 to give simultaneous access to dual density bi-modal (7- or 9-track) slaves attached to same master unit; control units each require F0826-00 and F 1028-95)	3,700	16	89
F0935-00	Dual Density Bi-Modal Feature (for 0861-00); control must have F0823-99; if 7-track slaves are present, control must also have F1028-95	2,175	10	52
0861-01	Uniservo 12 Slave Tape Unit; 9-track; 1600 bpi, 68.32 KB/second (3 slaves may be used with 1 master unit)	11,745	74	283
0861-04	Uniservo 12 Master Tape Unit; 7-track; 200, 556 or 800 bpi; 8.54, 23.74, or 34.16 KB/second	12,699	107	306
F0934-98	Simultaneous Single-Density Feature (for 0861-04); requires 2 control units which each must contain F0823-99	3,265	16	78
F1041-00	7- to 9-Track Conversion Feature (for 0861-04); converts to 0861-00	1,951	0	47
F104-01	Simultaneous 7- to 9-Track Conversion Feature (for 0861-04 with F0934-98); converts to 0861-00 with F0934-99	1,960	0	47
0861-05	Uniservo 12 Slave Tape Unit; 7-track; 200, 556, or 800 bpi; 8.54, 23.74, or 34.16 KB/second (3 slaves may be used with 1 master unit)	10,440	74	252
F1042-00	7- to 9-Track Conversion Feature (for 0861-05); converts to 0861-01	1,305	0	31
5017-99	Uniservo 12 Non-Simultaneous Control (for up to 16 Uniservo 12 drives); 9-track; 1600 bpi	22,165	90	510
5017-00	Uniservo 12/16 Non-Simultaneous Control (for up to 16 Uniservo 12 and/or 16 drives); 9-track; 1600 bpi	22,825	100	550
F1131-99	Uniservo 16 Capability (for 5017-99)	1,660	10	40
F1029-99	Simultaneous Single-Density Access (for 5017-99); provides second control module	13,487	60	325
F1029-00	Simultaneous Single-Density Access (for 5017-00); provides second control module	15,147	70	365
F0823-99	7-Track NRZI (for 5017-00 or 5017-99)	4,785	15	110
F0826-00	9-Track NRZI (for 5017-00 or 5017-99)	4,785	15	110
F1028-95	Bi-Modal (7- or 9-Track) NRZI (for 5017-00 or 5017-99 with F0826-00)	3,480	10	80
F1028-96	Bi-Modal (7- or 9-Track) NRZI (for 1017-00 or 5017-99 with F0823-99)	3,480	10	80
F0825-00	Non-Simultaneous Dual Channel Feature (for 5017-00 or 5017-99)	3,700	15	85
0862-00	Uniservo 16 Magnetic Tape Unit; 9-track 1600 bpi; 192 KB/second (requires 5034-00 control)	18,675	110	450
0862-02	Uniservo 16 Magnetic Tape Unit; 7-track; 200, 556, or 800 bpi; 24, 66.72, or 96 KB/second (requires 5034-00 or 5017-00 control)	18,675	110	450
F0936-99	Simultaneous Feature (for 0862-00 or 0862-02); requires 2 controls	870	0	20
F0937-00	Dual-Density Feature (for 0862-00); control(s) must contain F0826-00 or F1028-96	2,175	0	50
F1040-00	7- to 9-Track Non-Simultaneous Conversion Feature (for 0862-02); converts to 0862-00	0	0	0
F1040-01	7- to 9-Track Simultaneous Conversion Feature (for 0862-02 with F0936-99); converts to 0862-00 with F0936-99	0	0	0

\* Rental prices do not include equipment maintenance.

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EQUIPMENT PRICES

INPUT/OUTPUT UNITS (Continued)		Purchase Price	Monthly Maintenance	Rental (1-year lease)*
0864-00	Uniservo 20 Magnetic Tape Unit; 9-track; 1600 bpi, 320 KB/second	38,400	140	800
F1510-00	Dual Access and Simultaneous Feature (for 0864-00); requires 2 controls	2,175	10	50
5034-00	Uniservo 20 Non-Simultaneous Control (for up to 16 9-track; 1600 bpi (requires 2 controls for dual access)	43,200	90	900
F0823-98	7-Track NRZI (for 5034-00); adds bi-modal 7- or 9-track capability to control; may not be used with F0826-99	5,280	15	110
F0826-99	9-Track NRZI (for 5034-00); adds dual-density 800 or 1600 bpi to control; may not be used with F0823-98	6,240	20	230
F1028-97	Bi-Modal (7- or 9-track) NRZI (for 5034-00 with F0826-99)	4,320	10	90
F1028-98	Bi-Modal (7- or 9-track) NRZI (for 5034-00 with F0823-98)			
0604-99	Card Punch and Control; 250 cpm	15,660	96	378
F0875-00	Read/Punch Feature (for 0604-99)	4,970	50	121
0716-95	Card Reader and Control; 600 cpm	9,752	55	235
0716-99	Card Reader and Control; 1000 cpm	13,680	90	299
F1487-00	Short Card Feature; 51 columns	1,425	10	38
F1487-01	Short Card Feature; 66 columns	1,425	10	38
F1488-00	Validity Check Feature	720	0	15
F1498-00	Alternate Stacker Fill Feature	480	0	10
F1530-99	Dual Translate; additional ASCII translator	960	5	21
0770-00	Printer, 800 lines per minute	43,370	210	1,045
0770-02	Printer, 1400 lines per minute	51,875	275	1,250
0770-04	Printer, 2000 lines per minute	73,455	350	1,770
F1533-00	160 Print Positions	3,530	15	85
F1534-00	Expanded Character Set Control (required for other than 1536-00 or -01 Print Cartridges)	2,285	5	55
F1536-00	48-character alphanumeric Business	400	—	20
F1536-01	48-character alphanumeric Scientific	400	—	20
F1537-00	94-character ASCII	400	—	20
F1537-03	64-character universal ISO OCR-B	400	—	20
F1537-04	64-character universal OCR H-14	400	—	20
F1537-05	58-character COBOL-FORTRAN-Business	400	—	20
F1537-06	177-character international	400	—	20
F1537-09	24-character Numeric	400	—	20
F1537-11	68-character universal OCR-A	400	—	20
F1537-12	68-character universal OCR-B	400	—	20
F1537-13	68-character universal 77L	400	—	20
2703-00	Optical Document Reader; 300 dpm	42,000	187	918
F1108-00	600-dpm Speed Upgrade (for 2703-00)	10,560	32	231
F1163-00	Modulus 10 Check Digit (for 2703-00)	960	5	21
F1106-00	Mark Read — EBCDIC (for 2703-00)	7,920	37	173
F1106-01	Mark Read — ASCII (for 2703-00)	7,920	37	173
F1149-00	Punch Card Read Feature (for 2703-00); requires F1106-00 or -01	2,640	10	57
F1154-00	Validity Check Feature (for 2703-00); requires	480	0	10
<b>DATA COMMUNICATIONS SUBSYSTEMS</b>				
F1395-00	Voice-Grade Communications Interface (for Series 90 Processor); coordinates a BSC line and a 201A, 201B, 202C, or 202D type modem at up to 19,000 bits/second	720	5	15
F1395-01	Telpak Communications Interface (for Series 90 Processor); coordinates a BSC line and a 301B, 303B, 303C, or 303D type modem	1,920	5	42
8577-02	DCS Cabinet; provides power supply and housing for up to 4 DCS-1 or -1C	2,772	5	60
F1000-00	Line Terminal Control-1 (for DCS-1); controls 1 duplex line	4,570	16	110
8575-00	Line Terminal Control-4 (for DCS-4); controls 4 duplex lines	10,500	44	254
8575-01	Line Terminal Control-16 (for DCS-16); controls 14 duplex lines	22,185	96	535
F1537-00	Line Terminal Control 1C (for binary synchronous; not supported by UNIVAC software)	6,000	26	131

NOTE: Numerous line terminals, communications interfaces, and optional features enable the above controls to accommodate a wide range of communications facilities and equipment.

\* Rental prices do not include equipment maintenance.