

UNIVAC Series 70

MANAGEMENT SUMMARY

With the formal takeover of RCA's American, Canadian, and Mexican computer customer base on January 1, 1972, for \$70 million plus ongoing royalties, UNIVAC culminated more than three months of intricate negotiations that followed RCA's announcement to withdraw from the general-purpose computer business. At the time of the takeover, the installed Series 70 base consisted of some 520 accounts with more than 900 computer systems. About 260 of these accounts had second-generation (RCA 301, 501, 601, and 3301) equipment; about 15 had out-of-production small-scale systems (70/15 and 70/25); and about 40 others had the special-purpose 1600. Of the remaining 575-plus Series 70 computers, the overwhelming majority were Spectra systems, while just about 10 percent were RCA's "new" Series 70/2, 3, 6, or 7 computers.

UNIVAC's basic marketing strategy for the Series 70 was formulated prior to the effective takeover and hasn't required much modification during the intervening years: 1) keep the Series 70 customers happy and keep them on Series 70 equipment as long as they remain satisfied; and 2) when they outgrow the Series 70 systems, provide "bridge" products and other conversion aids to move them to existing UNIVAC Series 90 or 1100-type systems or to other yet-to-be-announced UNIVAC products. A major feature of the strategy has included the upgrading of installed systems with additional higher-performance

The Series 70 product line, which UNIVAC acquired from RCA in January 1972, consists of 18 processor models spanning two generations. It includes both general-purpose and special-purpose computers, as well as some well-proven virtual memory systems. Though the Series 70 equipment is no longer in production, UNIVAC has been outstandingly successful in preserving the former RCA customer base.

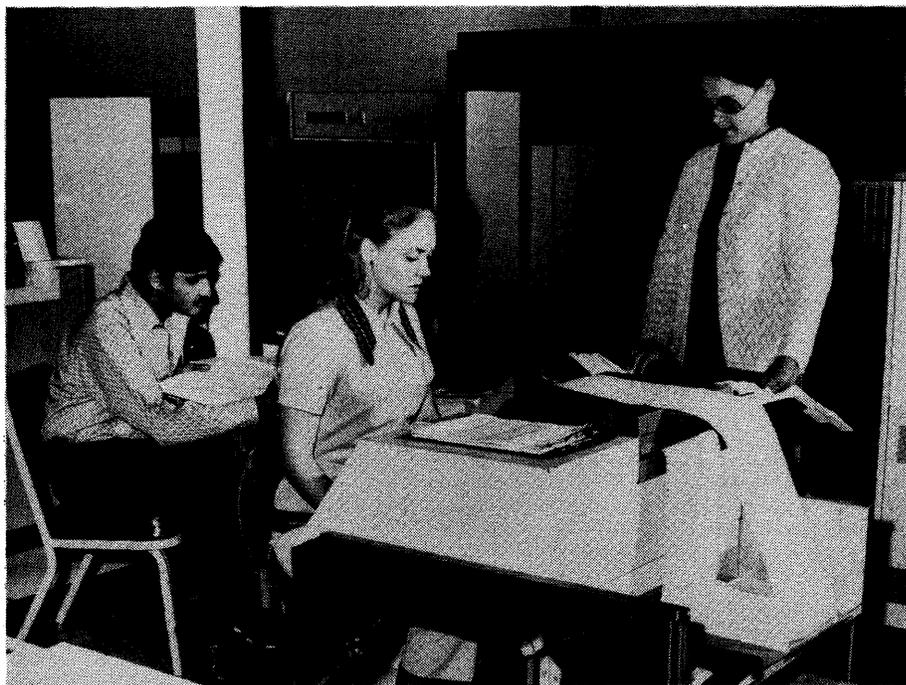
CHARACTERISTICS

MANUFACTURER: Sperry Univac Division, Sperry Rand Corporation, P.O. Box 500, Blue Bell, Pennsylvania 19422. Telephone (215) 542-4011.

MODELS: UNIVAC Series 70/2, 70/3, 70/6, 70/7, 70/35, 70/45, 70/46, 70/55, 70/60, and 70/61. (Note that the 70/15, 70/25, 1600, and older RCA 301, 501, 601, and 3301 computers are also part of the Series 70 customer base and are described briefly in the Management Summary of this report.)

DATA FORMATS

BASIC UNIT: 8-bit byte. Each byte can represent 1 alphanumeric character, 2 BCD digits, or 8 binary bits. Two consecutive bytes form a "halfword" of 16 bits, while four consecutive bytes form a 32-bit "word."



At the top of the Series 70 line is the 70/7, a virtual memory system that can be equipped with up to 2 million bytes of core storage with a cycle time of 765 nanoseconds per 4-byte access. VMOS, the operating system developed for the Series 70 virtual memory computers, has been adopted (under the name VS/9) as the principal operating system for the UNIVAC 90/60 and 90/70 computers.

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

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Series 70 products during the life of the Series 70 installations. Under the initial agreement reached between RCA and UNIVAC, RCA agreed to continue manufacturing Series 70 hardware for several years under a complicated structure of royalty payments, OEM relationships, and service agreements.

Immediately upon concluding the takeover agreement with RCA, UNIVAC purposefully set about earning the confidence of its newly acquired customers by displaying a firm commitment to the continued support and enhancement of the major systems in the RCA product line. During the first nine months of 1972, UNIVAC issued new releases of each of the three main Series 70 operating systems, added several software applications packages, substituted high-performance UNIVAC tape and disc drives for several undelivered RCA peripherals, staffed up with about 2500 former RCA employees (experiencing better than a 90 percent acceptance rate on job offers to key personnel), and announced its intention to develop a series of conversion aids from Series 70 systems to other UNIVAC computers. Each of these moves had some effect in the retention of more than 90 percent of the customer base during the initial period. In fact, nearly 70 RCA-built computers worth over \$90 million were shipped during the first 9 months of UNIVAC's Series 70 operations; about half of these replaced previously installed equipment, while the rest were additions to existing installations.

As of June 1973, RCA ceased manufacturing new Series 70 components. Then, in August 1973, RCA removed itself completely from Series 70 activities by concluding an amended agreement with UNIVAC for the remaining payment for its former computer business. All former provisions for revenue sharing were abandoned in the final contract in favor of the payment to RCA of a lump sum of \$36.7 million in three final cash installments. All remaining revenues from the Series 70 systems accrue solely to UNIVAC.

Although the Series 70 is no longer being actively marketed, and system components are supplied only on an as-available basis, UNIVAC appears to have experienced little difficulty in placing the relatively small number of Series 70 computer systems that have been replaced by other UNIVAC or competitive computer systems, primarily as upgrades or additions to current Series 70 installations. As a result, at this writing, UNIVAC estimates that over 76 percent of the systems originally acquired in the January 1972 negotiations are still installed, representing a retention rate that exceeds even UNIVAC's most optimistic expectations.

No doubt UNIVAC's continued attention to the Series 70 operating systems has played an important role in keeping the customers satisfied. Since 1972, UNIVAC has issued three new releases of DOS, two new releases of TDOS, and four new releases of the Virtual Memory Operating System (VMOS). Furthermore, UNIVAC states that it will continue to support the Series 70 software as long as Series 70 customers continue to use it.

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.

FLOATING-POINT OPERANDS: 1 word, consisting of 24-bit fraction and 7-bit hexadecimal exponent, in "short" format; or 2 words, consisting of 56-bit fraction and 7-bit hexadecimal exponent, in "long" format.

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

INTERNAL CODE: EBCDIC (Extended Binary-Coded Decimal Interchange Code). The Series 70 processors can alternatively use 8-bit ASCII, but little software support is provided for this code.

MAIN STORAGE

STORAGE TYPE: Magnetic core.

CAPACITY: See table. On the newer processors (70/2, 3, 6, 7, 60, and 61), the basic unit of standardized main memory is a free-standing, independently testable bank of 262,144 bytes. Each of these banks consists of two 131,072-byte modules. (The 65KB 70/2 memory consists of one effective half of one 131KB module.) In a multiple-processor installation, each 262KB bank can be manually switched from one processor to another processor of the same or a different model.

CYCLE TIME: See table.

CHECKING: Parity bit with each byte is generated during writing and checked during reading.

STORAGE PROTECTION: Protection against both unauthorized reading and writing, in 2048-byte blocks, is standard in the 70/2, 3, 6 and 7. The optional Memory Protect feature for the 70/35 or larger processors guards against inadvertent overwriting of data in specified 2048-byte blocks of storage. Store and Fetch Protection, which protects against unauthorized reading as well as writing, is available for the 70/45 Type II Processor.

CENTRAL PROCESSORS

INDEX REGISTERS: The programmer has access to sixteen 32-bit general registers, used for indexing, base addressing, and as accumulators, plus four 64-bit floating-point registers. (There are four sets of registers in all—one for each processor state—but only one set is normally accessible to the programmer.)

INDIRECT ADDRESSING: Up to three levels for the "real" memory systems, with a fourth level provided for virtual systems to address into the "backing store."

INSTRUCTION REPERTOIRE: Each Series 70 system has from 140 to 154 standard instructions (see table), including add, subtract, multiply, and divide in four different modes: fixed-point binary, variable-length decimal, and "short" and "long" floating-point. Other instructions handle loading, storing, comparing, shifting, branching, radix conversion, code translation, editing, packing, unpacking, logical operations, etc. In addition, the time-sharing or virtual storage 70/3, 70/46, 70/7 and 70/61 Processors can include up to 128 microprogrammed special functions.

INSTRUCTION TIMES: See table. Note that the instruction execution timings can be improved through changes in the microprograms for the 70/3, 70/46, 70/7, or 70/61.

OPTIONAL FEATURES: The following features are available:

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CHARACTERISTICS OF THE CURRENT UNIVAC SERIES 70 SYSTEMS

| | 70/2 | 70/3 | 70/6 | 70/7 | 70/35 | 70/45 Type I | 70/45 Type II | 70/46 | 70/55 | 70/60 | 70/61 |
|--|------------|------------|------------|------------|----------------|-----------------|------------------|------------|-----------|------------|------------|
| SYSTEM CHARACTERISTICS | | | | | | | | | | | |
| Maximum no. of central processors supported by standard software | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Principal operating systems | DOS, TDOS | VMOS | DOS, TDOS | VMOS | TOS, DOS, TDOS | DOS, TDOS | DOS, TDOS | VMOS | DOS, TDOS | DOS, TDOS | VMOS |
| Typical system monthly rental* | \$14,000 | \$25,000 | \$25,000 | \$40,000 | \$10,000 | \$18,000 | \$21,000 | \$33,000 | \$30,000 | \$34,000 | \$46,000 |
| Date of announcement | Sept. 1970 | Sept. 1970 | Sept. 1970 | Sept. 1970 | Sept. 1965 | Dec. 1964 | July 1968 | April 1967 | Dec. 1964 | April 1969 | Sept. 1969 |
| Date of first delivery | May 1971 | Aug. 1971 | Sept. 1971 | Nov. 1971 | Mar. 1967 | April 1966 | Sept. 1969 | Nov. 1968 | Jan. 1967 | July 1970 | Feb. 1971 |
| Number currently installed** | 61 | 6 | 19 | 5 | 105 | 196 | 115 | 33 | 13 | 13 | 8 |
| MAIN STORAGE | | | | | | | | | | | |
| Cycle time, microseconds | 1,440 | 1,440 | 0,765 | 0,765 | 1,440 | 1,440 | 1,440 | 1,440 | 0,840 | 0,765 | 0,765 |
| Bytes accessed per cycle | 2 | 2 | 4 | 4 | 2 | 2 | 2 | 2 | 4 | 4 | 4 |
| Minimum capacity, bytes | 65,536 | 131,072 | 131,072 | 131,072 | 32,768 | 65,536 | 65,536 | 262,144 | 65,536 | 131,072 | 262,144 |
| Maximum capacity, bytes | 262,144 | 262,144 | 2,097,152 | 2,097,152 | 65,536 | 524,288 | 524,288 | 262,144 | 524,288 | 1,048,576 | 1,048,576 |
| Main storage type | core | core | core | core | core | core | core | core | core | core | core |
| Interleaving | none | none | none | none | none | none | none | none | none | none | none |
| Storage protection | standard | standard | standard | standard | optional | optional | optional | optional | optional | optional | standard |
| CENTRAL PROCESSOR | | | | | | | | | | | |
| No. of hardware instructions | 145 | 151 | 153 | 159 | 144 | 144 | 145 | 151 | 144 | 153 | 159 |
| Registers, total/general-purpose | 128/16 | 128/16 | 128/16 | 128/16 | 128/16 | 128/16 | 128/16 | 128/16 | 128/16 | 128/16 | 128/16 |
| Read-only memory (ROM) size, 54-bit words | 2,048 | 2,048 | 3,072*** | 3,072*** | 1,024 | 2,048 | 2,048 | 2,048 | none†† | 3,072*** | 3,072*** |
| ROM cycle time, microseconds/word | 480 | 480 | 255 | 255 | 480 | 480 | 480 | 480 | none | 255 | 255 |
| Max. virtual memory size, bytes | none | 6,500,000 | none | 13,000,000 | none | none | none | 6,500,000 | none | none | 13,000,000 |
| No. of interrupts | 32 | 32 | 32 | 32 | 32 | 32 | 32 | 32 | 32 | 32 | 32 |
| Floating-point hardware | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes |
| Decimal instructions | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes |
| Divide hardware | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes |
| Indirect addressing | 3 levels | 3 levels† | 3 levels | 3 levels† | 3 levels | 3 levels | 3 levels | 3 levels† | 3 levels | 3 levels | 3 levels† |
| Processor states | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| INSTRUCTION TIMES (decimal, in microseconds): | | | | | | | | | | | |
| Add, unsigned, unpacked (5 digits) | 72.54 | 83.94 | 45.41 | 48.39 | 134.28 | 72.54 | 72.54 | 83.94 | 40.40 | 45.41 | 48.39 |
| Add, signed, packed (5 digits) | 22.02 | 22.50 | 12.07 | 12.07 | 47.64 | 22.02 | 22.02 | 22.50 | 9.72 | 12.07 | 12.07 |
| Multiply, unsigned, unpacked (5 digits) | 134.80 | 136.72 | 51.83 | 54.46 | 273.96 | 134.80 | 136.72 | 136.72 | 78.20 | 51.83 | 54.46 |
| Multiply, signed, packed (5 digits) | 84.28 | 84.76 | 23.51 | 24.11 | 187.32 | 84.28 | 84.28 | 84.76 | 47.52 | 23.51 | 24.11 |
| Divide, unsigned, unpacked (5 digits) | 134.47 | 136.39 | 53.11 | 55.74 | 239.28 | 134.47 | 136.39 | 136.39 | 47.48 | 53.11 | 55.74 |
| Divide, signed, packed (5 digits) | 83.95 | 84.43 | 24.79 | 25.38 | 152.64 | 83.95 | 83.95 | 84.43 | 16.80 | 24.79 | 25.38 |
| I/O CONTROL | | | | | | | | | | | |
| Maximum aggregate I/O data rate, bytes/second | 1,388,000 | 1,388,000 | 5,240,000 | 5,240,000 | 694,000 | 520,000 | 1,388,000 | 1,388,000 | 775,000 | 5,240,000 | 5,240,000 |
| No. of selector channels | 2-4 | 2-4 | 2-6 | 2-6 | 0-2 | 0-3 | 0-4 | 0-4 | 0-6 | 2-6 | 2-6 |
| Trunks per selector channel | 2 | 2 | 3 | 3 | 2 | 2 | 2 | 2 | 2 or 3 | 3 | 3 |
| Max. selector channel data rate, bytes/second | 694,000 | 694,000 | 900,000 | 900,000 | 694,000 | 465,000 | 694,000 | 694,000 | 700,000 | 900,000 | 900,000 |
| No. of multiplexer channels | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Trunks per multiplexer channel | 9 | 9 | 16 | 16 | 8 | 9 | 9 | 9 | 9 | 16 | 16 |
| Max. devices on multiplexer | 256 | 256 | 248 | 248 | 192 | 256 | 256 | 256 | 256 | 248 | 248 |
| Max. multiplexer channel data rate, bytes/second | 72,000 | 72,000 | 216,000 | 216,000 | 33,000 | 72,000 | 72,000 | 72,000 | 163,000 | 216,000 | 216,000 |
| EMULATOR OPTIONS AVAILABLE | | | | | | | | | | | |
| IBM 1401/1440/1460 | yes | yes | yes | yes | yes | yes | yes | no | no | no | no |
| IBM 1410/7010 | no | no | yes | yes | no | yes | yes | no | no | yes | no |
| RCA 301 | no | no | yes | yes | yes | yes | yes | no | no | no | no |
| RCA 501 | no | no | yes | yes | no | yes | yes | no | no | no | no |

*Includes maintenance.
 **As of October 1972.
 ***72-bit words.
 †One additional level of indirect addressing is provided for the virtual memory or "backing store."
 ††Hard-wired control logic only.

▷ The original long-range plans for retention of the RCA accounts were based on the assumption that the majority of Series 70 systems eventually would be upgraded to the architecturally similar UNIVAC 90/60 and 90/70 systems operating under the OS/7 operating system. After some consideration of the potential of both operating systems, however, UNIVAC instead promoted VMOS to the status of primary software support for the larger Series 90 computers, renaming it VS/9. Based on Release 11 of VMOS, VS/9 will also be available for Series 70/7 systems, and it adds data base management capabilities in the form of DMS-90 to the software repertoire of the larger Series 70 computers.

As the terms of the final settlement with RCA should make plain, UNIVAC clearly is in no hurry to spur these lucrative Series 70 accounts into a hasty conversion to other UNIVAC equipment. The company is counting on the continued availability of adequate software and support, combined with the effects of a sluggish economy, to keep a large proportion of these systems installed and

▶ The Elapsed Time Clock provides a program-controlled timer which is counted down at a constant rate and generates an interrupt when the count reaches zero.

Direct Control permits control and synchronizing information to be transferred between up to six Series 70 Processors and/or special external devices located up to 500 feet from one another. The feature consists of two special instructions and six external-signal lines.

VIRTUAL MEMORY: Dynamic address translation facilities enable users of the 70/3 or 70/46 and 70/7 or 70/61 Processors to program as if they had 6.5 million and 13 million bytes, respectively, of main memory at their disposal. The drum-type 70/560 Virtual Memory Storage Systems hold 2048-byte or 4096-byte "pages" of data, permitting rapid swapping of program segments into or out of main memory. The 70/3 or 70/46 uses a translation memory, consisting of an integrated-circuit array of 512 two-byte words with a 90-nanosecond access time, to translate virtual addresses used by the programmer into effective main memory addresses. The 70/7 or 70/61 uses an 8-register associative memory to perform the translation function.

INTERRUPT SYSTEM: 32 levels of priority interrupts, individually maskable in each processor state. Each of the

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▷ generating revenue. Based upon its success thus far, UNIVAC may well turn the RCA computer fiasco, one of the most dismal events in recent business history, into an outstanding success story.

The full Series 70 product line includes two generations of computer systems that are represented by 18 different processors designed by RCA Corporation from 1958 through 1970. Second-generation systems include the small-scale 301, the medium-scale 501 and 3301, and the large-scale 601. Third-generation Series 70 gear includes members of three distinct families: Spectra 70, RCA Series, and the 1600 System. Each of these systems is discussed briefly below, followed by detailed discussions of the Spectra 70 and RCA Series.

The medium-scale 501 was RCA's first widely used commercial computer and was also one of the industry's first fully transistorized general-purpose computers. The 501 was announced in 1958 and delivered the following year. The 501 was followed by the 301, a small-scale business data processing system that competed quite effectively against the IBM 1401. Rounding out the Series 70 second-generation computer line were the 3301, a medium-scale processor that has been used effectively in numerous real-time and data communications systems, and the 601, a large-scale computer that made a negligible impression in the EDP marketplace. Many, though not all, of the remaining second-generation Series 70 systems are installed in various government accounts.

THE SPECTRA 70 SERIES

RCA's Spectra 70 announcement in December 1964 rocked the industry with a family of computer systems and software that offered a high degree of data and program compatibility with the IBM System/360. These "carbon copies" of IBM computers that had been introduced just eight months earlier offered significant price and/or performance advantages over the corresponding IBM products in most (though not all) cases. The product planning philosophy for the Spectra 70 line was, in essence, "If you can't lick 'em, join 'em."

The Spectra 70 line initially included four central processor models: the 70/15, 70/25, 70/45 Type I, and 70/55. During the next five years, the 70/35, 70/45 Type II, 70/46, 70/60, and 70/61 were announced, so that the full line-up of Spectra models includes nine processors.

Despite the large number of processors, dozens of peripheral devices, and a wide array of software facilities, the Spectra 70 line did not span nearly as broad a range of processing capabilities as the System/360. The top-of-the-line 70/60 and 70/61 Processors are slower than the System/360 Model 65—not to mention IBM's still faster Models 75, 85, and 195. At the other end of the size range, little interest was shown in serving the small-scale computer user; the small 70/15 and 70/25 were dropped from new production by 1970 and were generally marketed only for use in conjunction with larger Spectra 70 computers. ▶

▶ four processor states has an independent set of operating registers.

EMULATORS: The Series 70/2, 3, 6, 7, 35, 45, and 60 processors can be equipped with extra-cost "emulators" that enable them to execute programs written for earlier IBM or RCA computers. See the table for the specific emulation capabilities of each processor. Each emulator consists of an Emulator Control Program in core storage and an emulator Microprogram that resides in the processor's read-only memory. In general, emulation requires a Series 70 system with I/O devices equivalent to those of the system to be emulated, and with more core storage capacity and processing power. Only the more common peripheral devices (such as magnetic tape units, card readers, punches, and printers) can be emulated.

Internal speeds of the Series 70 processors in emulation mode range from about 0.9 to 4.2 times as fast as the original computers, depending upon the pair of machines involved.

70/97-20 KEYBOARD AND PRINTER CONSOLE: Provides system control facilities by means of an I/O typewriter and a set of control switches packaged in a free-standing unit. Connects to the multiplexer channel of any Series 70 processor. A run-time recorder is an optional feature.

INPUT/OUTPUT CONTROL

I/O CHANNELS: One multiplexer channel, which can accommodate a number of simultaneous low-speed I/O operations, is standard. Selector channels, which can handle one I/O operation at a time, can also be used with any Series 70 model. See the table for details of the I/O channel possibilities.

CONFIGURATION RULES: Most Series 70 peripheral devices can be connected to either a multiplexer or selector channel on any Series 70 processor. Each channel has a number of trunks, and each trunk can accommodate one peripheral device or control unit. See the table for details.

Switching devices are available to connect a standard I/O trunk on each of two to four Series 70 processors to one I/O device, or to connect two to four devices to one trunk.

SIMULTANEOUS I/O OPERATIONS: Concurrently with computing, a Series 70 can control a maximum of one high-speed I/O operation per selector channel and one low-speed I/O operation per multiplexer trunk. Alternatively, the multiplexer channel can operate in the "burst" mode and handle a single higher-speed operation.

MASS STORAGE

70/560 DIRECT ACCESS STORAGE SYSTEMS: Provide fast, drum-type direct-access storage for the 70/3 or 70/7 virtual memory systems. Three models are available. Model 70/560-005 has 512 tracks and stores up to 2.097 million bytes. Model 70/560-008 has 800 tracks and stores up to 3.277 million bytes. Model 70/560-016 has 1600 tracks and stores up to 6.554 million bytes. For all three models, average rotational delay is 8.6 milliseconds and data transfer rate is 333,000 bytes per second. Each system includes the required controller and attachments.

70/564 DISC STORAGE UNIT: Provides interchangeable disc-pack storage. 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 ▶

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▷ The strength of the Spectra 70 (as well as the newer RCA Series, for that matter) is in the medium-scale area, where the general-purpose Spectra 70 processors are well suited to handle a broad range of business and scientific applications. For medium-scale installations that require data communications or time-sharing, the Spectra segment of the Series 70 displays an even stronger hand with a versatile array of communications controllers, terminals, and software.

Unfortunately, from the all-important marketing standpoint, the Spectra 70 was only modestly successful at best and did not accomplish its primary objective of significantly penetrating IBM's System/360 market. As a spur to the then-growing RCA sales force, and as part of a grand design aimed at the planned 1972 introduction of a powerful new series of computers, the RCA Series was announced in September 1970, just three months after IBM unveiled the first two members of its new System/370 product line (Models 155 and 165).

THE RCA SERIES

The biggest surprise about RCA's new family of four medium-scale computers was the fact that comparatively little of the hardware and software was really new.

The almost unavoidable conclusion to have been drawn from the Spectra 70 sales performance was that IBM's position in the marketplace is so strong that most users who want IBM-style equipment will elect to buy it from IBM rather than from an alternate supplier—even when the alternate supplier is a nationally-known manufacturer with a product line offering (in many cases) significant price/performance advantages. The RCA Series market strategy, however, consisted primarily of reducing the prices on Spectra 70 equipment that was, for the most part, already available and proven in use, based on RCA's assumption (or hope) that "the progress of the computer business in the 1970's will be determined more by the specific needs of the user than by further radical changes in technology." That the fundamental premise in that strategy was questionable was pointed out with deft finality just one week after the new series was announced: IBM introduced the 370/145, exhibiting radical improvements in technology that ended all hopes that the RCA Series might buy two years of time for RCA. The subsequent release of the 370/135 in March 1971 sent the marketing efforts for the RCA Series into a tailspin from which no recovery could be made.

The new line included four central processor models, currently designated simply 70/2, 70/3, 70/6, and 70/7 (originally the RCA 2, 3, 6, and 7). Although some architectural changes had been made, the four newer processors had essentially the same functional character-

▷ **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/sec. Record lengths are variable. Up to eight 70/564 units can be connected to a 70/551 Random Access Controller. A dual-channel switch, cylinder overflow, and file scan are optional features.

70/567 DRUM MEMORY UNIT: Provides fast random-access storage and retrieval for program segments, file directories, tables, etc. Two models store up to 4.13 million or 8.26 million bytes in 800 or 1600 tracks with a maximum data capacity of 5161 bytes each. Record lengths are variable. Average access time is 8.6 milliseconds, and data transfer rate is 333,000 bytes per second. Up to 8.26 million bytes of drum storage can be connected to a 70/551 Random Access Controller. A dual-channel switch, cylinder overflow, and file scan are optional features. (Note that the 70/560 is a packaged 70/567 plus controller.)

70/568 MASS STORAGE UNIT: Provides economical large-capacity storage at the expense of slow access times and mechanical complexity. Stores up to 537 million bytes of data on magnetic cards 16 inches long by 4.5 inches wide. The 70/568 unit accommodates 8 removable magazines, and each magazine contains 256 cards. Each card has 128 tracks capable of holding up to 2,048 bytes each. Record lengths are variable. Average random access time is 508 milliseconds, and data transfer rate is 70,000 bytes per second. Up to eight 70/568 units can be connected to a 70/551 Random Access Controller. A dual-channel switch, cylinder overflow, and file scan are optional features.

70/590 DIRECT ACCESS STORAGE SYSTEM: Provides high-speed, medium-to-large-capacity random-access storage in interchangeable 11-disc packs which are compatible with the IBM 2316 packs used in the IBM 2314 Direct Access Storage Facility. Consists of a controller and from 4 to 16 independent on-line disc pack drives, each capable of storing up to 29.17 million bytes. Total on-line storage capacity of the 16-drive 70/590-16 unit is 466.8 million bytes. Each drive has a comb-type access mechanism that can read or write up to 145,880 bytes (20 tracks) at each of its 200 positions. 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. An optional Multi-Channel Switch allows the 70/590 System to be shared by two selector channels on the same or different processors. A spare drive is provided with each group of eight units. The 70/590 attaches to a standard interface trunk on the selector channel.

8519 DIRECT ACCESS STORAGE SYSTEM (DASS): Provides high-speed, medium-to-large-capacity random-access storage in interchangeable 11-disc packs which are compatible with the IBM 2316 packs used in the IBM 2314 Direct Access Storage Facility. Consists of a controller, a self-contained selector channel, and from 2 to 8 independent on-line disc pack drives. Total on-line storage capacity of the 8-drive 8519 unit is 233.4 million bytes. Each drive is functionally similar to those of the 70/590 DASS above, except that the 8519 Controller checks the parity bits instead of stripping them off as in the 70/590 Controller. The 8519 is Series 70's answer to IBM's 2319 DASD, and is available only for the 70/2, 3, 6, and 7.

8440 DISC SUBSYSTEM: Provides fairly rapid access to extremely large quantities of data stored in interchangeable 11-disc packs. Each of the 19 data recording surfaces has 406 addressable tracks, and each track holds 14,503 bytes, for a total capacity of 112 million bytes per pack. Up to 275,557 bytes (19 tracks) can be read or written at each position of the comb-type access mechanism. Average head movement time is 35 milliseconds, average rotational delay is 12.5 milliseconds, and data transfer rate is 624,000 bytes per second. ▶

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istics as the earlier Spectra 70/45, 70/46, 70/60, and 70/61, respectively. The 70/45 Processor had been by far the most popular member of the Spectra 70 line since its introduction in 1964, while the 70/46, 70/60, and 70/61 were gaining only moderate market acceptance. Prices for the new processors and main memories ranged from about 15 to 35 percent lower than their Spectra 70 counterparts. Deliveries of the 70/2 began in May 1971, while the 70/3, 6, and 7 were initially delivered in the fall of 1971, during and after the period of time when RCA pulled out of the general-purpose computer business.

Along with the new central processors, most of the same peripheral equipment was offered at the same prices as in the Spectra 70 product line. The peripherals had been renumbered by changing the "70/" prefix to an "8". The largely unchanged peripheral equipment prices, coupled with the large reductions in processor and memory prices, typically led to overall system rental and purchase prices from 8 to 25 percent below those of the equivalent Spectra 70 configurations.

The RCA Series and Spectra Series equipment shared the same software support. Prior to the takeover by UNIVAC, that support consisted of the Disc, Tape, Tape/Disc and the planned OS/70 Operating Systems for "real" memory computers, and the Time-Sharing Operating System and Virtual Memory Operating System for "virtual" memory computers, as well as a wide selection of language processors and application packages.

One novel aspect of the RCA Series release was the Guaranteed Conversion Program for certain IBM computer users. Under that plan, RCA proposed to convert a given set of user programs for a stipulated price and within a specified time. Liquidated damages up to a maximum of \$45,000 would be paid to the customer over a 90-day period if the conversion was not made required. As a stratagem, this policy did its share to stimulate interest in the RCA Series computers, but almost no work was done directly under Guaranteed Conversion contracts.

THE RCA 1600 SYSTEM

Rounding out the Series 70 is the 1600 Communications System. Although used primarily for special-purpose dedicated processing requirements, the 1600 is a very flexible system with extensive potential. Its core memory sizes range from 8K to 65K bytes, and the cycle time for an 18-bit word operation is 1.6 microseconds. Twenty-nine flexible instructions and 16 general-purpose registers are available for programming use. Instruction execution times range from 1.7 to 4.1 microseconds. A variety of console typewriters, magnetic tape devices, and random access units, as well as Standard Interface Converters, can be attached to the system.

An 8440 subsystem consists of a UNIVAC 5033 control unit and from one to eight 8440 disc drives. The optional F1482 Dual Access feature allows dual controllers to handle concurrent read/write, read/read, or write/write operations on two of the drives in a subsystem. The F1470 Dual Channel option (multi-channel switch) permits non-simultaneous operation on two selector channels of one processor, or operation on one selector channel on each of two processors. File scan and record overflow are included as standard features on the 8440. The disc packs used with the 8440 are not compatible with those with the IBM 3330, IBM 2314, or UNIVAC 8414 drives.

The 8440 subsystem can be connected only to the 70/6, 7, 60, or 61 Processors through use of a Standard Interface Converter (SIC). Each SIC connects to a trunk on a standard selector channel and can handle up to three 5033 controllers. A second SIC is required for dual channel capability.

INPUT/OUTPUT UNITS

70/432, 70/442, 70/445 MAGNETIC TAPE UNITS: Available in 9-track and 7-track versions, both of which record on standard 1/2-inch tape in IBM-compatible formats. Characteristics of the 9-track versions are as follows:

70/432: 800 bpi; 30,000 bytes/sec at 37.5 inches/sec.

70/442: 800 bpi; 60,000 bytes/sec at 75 inches/sec.

70/445: 800 bpi; 120,000 bytes/sec at 150 inches/sec.

The 7-track versions have the same tape speeds and offer a choice of three recording densities: 200, 556, or 800 bpi. Thus, they offer data rates ranging from 7,500 to 120,000 characters/second.

The 70/432 and 70/442 are dual-drive models (two tape drives per unit), while the 70/445 is a single-drive unit. All models can read in both the forward and reverse directions, and no pinch rollers are used. Controllers capable of handling up to 8 or 16 tape drives and either 1 or 2 I/O channels are available:

| Controller | Number and Type of Tape Units | Characteristics |
|------------|--|---|
| 70/472 | eight or sixteen 70/432, 70/442, or 70/445 units | 9-track only; dual access option |
| 70/473 | eight or sixteen 70/432, 70/442, or 70/445 units | 7- or 9-track mixed modes; dual access option |

70/451, 70/453 MAGNETIC TAPE UNITS: These models record on standard 1/2-inch magnetic tape at 1600 bpi in the IBM-compatible phase-encoded mode. Each unit contains two tape drives. Peak data rates are 60,000 bytes/sec for the 70/451 and 120,000 bytes/sec for the 70/453. Both models can read in both the forward and reverse directions, and no pinch rollers are used. Several models of 70/476 controllers capable of handling up to 8 or 16 tape drives and either 1 or 2 I/O channels are available.

70/441 MAGNETIC TAPE UNIT: This dual-drive unit provides compatibility with the RCA 381 and 382 Hi-Data Magnetic Tape Groups. It uses 1200-foot reels of 1/2-inch tape. Tape speed is 50 inches per second. In the 381 mode, density is 333 bpi and data rate is 16,600 characters per second. In the 382 mode, density is 500 bpi and data rate is 25,000 characters per second. Several models of 70/463 Controllers capable of handling up to 8 or 16 tape drives and either 1 or 2 I/O channels are available. The 70/441 is out of new production and is provided on an "as available" basis only.

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➤ Available since 1968 on a special-order basis, the 1600 was not formally released for commercial marketing until 1970. With direct interfaces to other Series 70 processors, the 1600 is well suited to handling communications front-end requirements. Typical system rentals span a wide range—from about \$1,700/month to more than \$5,000/month—because of the many uses to which this versatile system has been put. As a front-end machine or as the nucleus of various special-purpose systems (controller for the former RCA Videocomp, etc.), the 1600 has been extensively installed. Based upon operating statistics taken from these installations, the 1600 currently sports an unusually high track record for reliability. The 1600 continues to be available from UNIVAC. Although marketing plans for the system are not clear, the rate of field returns has been very low, and it seems likely that most of the 100-plus 1600's that have been shipped since 1968 will remain in use considerably into the future.

PROCESSOR MODELS

The characteristics and orientation of the current Series 70 processor models and the systems built around them are summarized in the following paragraphs and in the accompanying table. The four RCA Series central processor models (70/2, 70/3, 70/6, and 70/7) have the same basic data structure and instruction sets as the older, Spectra Series processors. Monolithic integrated-circuit logic is used, as one would expect, together with conventional magnetic core main memories. Processor operations are controlled by microprograms in read-only memories.

The principal hardware characteristics of the newer RCA Series products can be summarized as follows:

- Standardized main memory modules replace the integrated main memories of the Spectra processors. These modules can be manually switched from one processor to another of the same or different models. (For example, a single 262K-byte module could be switched between a 70/2 and a 70/6 Processor.) UNIVAC maintains that this standardization has led to lower manufacturing costs, greater system flexibility, and improved maintainability.
- High-speed drum-type storage units, with capacities ranging from 2.1 million to 6.5 million bytes, provide fast random-access storage that facilitates page-swapping operations in the "virtual" systems.
- The 70/6 and 70/7 Processors can have up to 2 million bytes of core memory, whereas the 70/60 and 70/61 Processors were limited to a maximum of 1 million bytes.
- The Uniservo 16 and 20 Magnetic Tape Units have data transfer rates of 192,000 and 320,000 bytes per second, respectively, bettering the speeds of the IBM 2420 drives while costing substantially less.
- New horizontal-train printers, with speeds of 600 and 1200 lines per minute, offer improved vertical alignment and sharper print quality.

➤ **UNISERVO 16 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 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.

A Uniservo 16 subsystem on the Series 70 consists of up to 16 tape units in any combination of Uniservo 16 and 20 models that are connected to a single or dual Uniservo 20 Model 5034 control unit. Optional features include Dual Access (F1319) for simultaneous read/read, read/write, or write/write operations by two controllers. The Uniservo 16 subsystem can be connected only to the 70/6, 7, 60, or 61 Processors through use of a Standard Interface Converter (SIC). Each SIC connects to a trunk on a standard selector channel and can handle up to three controllers. A second SIC is required for dual-channel capability.

UNISERVO 20 MAGNETIC TAPE UNIT: A high-performance tape drive that uses standard 1/2-inch tape and matches the performance of the IBM 2420 Model 7. Data is recorded in the 9-track mode at 1600 bpi. Tape speed is 200 inches per second, forward or backward, yielding a data transfer rate of 320,000 bytes per second. Operational conveniences include a power window, automatic tape threading, and wrap-around tape cartridge loading.

A Uniservo 20 subsystem on the Series 70 consists of 1 to 16 Uniservo 16 or 20 Tape Units. One Uniservo 20 Tape Unit must be present in the first position when connecting Uniservo 16 drives. The subsystem can be connected to a single- or dual-channel control unit. The Uniservo 20 subsystem can be connected only to the 70/6, 7, 60, or 61 Processors through use of a Standard Interface Converter (SIC). Each SIC connects to a trunk on a standard selector channel and can handle up to three Model 5034 controllers. A second SIC is required for dual-channel or dual-access capabilities.

70/232 CARD READER: Reads 51- or 80-column cards serially at 300 cpm, or at 600 cpm when an optional feature is installed. EBCDIC is the standard code, and column binary is optional. Other optional features permit optical reading of either vertical or slanted pencil marks.

70/234 CARD PUNCH: Punches and read-checks 80-column cards at 100 cpm. Contains a full-card buffer. EBCDIC is the standard code, and column binary is optional.

70/236 CARD PUNCH: Punches and read-checks 80-column cards at up to 300 cpm. Contains a full-card buffer. EBCDIC is the standard code, and column binary is optional. A 1000-card input hopper and two 850-card stackers can be loaded and unloaded while the punch is operating.

70/237 CARD READER: Reads 80-column cards serially, on demand, at up to 1435 cpm. EBCDIC is the standard code, and column binary is optional. A 2000-card input hopper and two stackers can be loaded and unloaded while the reader is operating. Optional features permit reading of either vertical or slanted pencil marks.

70/221 PAPER TAPE READER/PUNCH: Reads 5-, 6-, 7-, or 8-level punched tape at 200 characters per second and punches it at 100 characters per second. Handles strips or 1000-foot reels. Can read and punch simultaneously by time-sharing one multiplexer trunk. Available options include EBCDIC mode and 6-level advanced sprocket holes.

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- ● Emulators for the IBM 1401, 1440, and 1460 are available for all four processors, and the 70/6 and 7 can also be equipped to emulate the IBM 1410/7010, RCA 301, or RCA 501.
- The 8519 Direct Access Storage Facility is available to give large-capacity random-access storage similar in capacity and configuration rules to IBM's 2319 facility.

The 70/35, 70/45-II (or 70/2), 70/55, and 70/60 (or 70/6) Processors constitute the heart of the Series 70 line. All are general-purpose computers suitable for a wide range of applications, and all are fully compatible at the hardware level. With respect to their internal speeds and prices, these processors generally fall into the gaps between the IBM System/360 processors where their model numbers might lead one to expect them to fall. (For example, the 70/45 is faster and slightly more expensive than the System/360 Model 40, but slower and less costly than the Model 50.)

The 70/45 and 70/55 were members of the original Series 70 line, announced in December 1964. The great majority of currently installed Series 70 processors are 70/45's. The 70/35, a slowed-down version of the 70/45 at a substantially lower price, was introduced nine months later. The 70/60 was announced as a top-of-the-line general-purpose processor in March 1969.

Two models in the original Spectra line—the 70/15 and 70/25—have since been discontinued, although about a dozen of these systems are still actively in use. The 70/15 is the smallest member of the line. Although it had modest general-purpose computing capabilities, it was marketed almost exclusively as an I/O processor or remote communications terminal. The 70/15 had a severely restricted instruction set, a maximum core storage capacity of only 8K bytes, and only one I/O channel. Moreover, no direct-access devices could be connected to the 70/15 Processor. The 70/25, on the other hand, was a general-purpose computer, but its marketability was hampered by a restricted instruction set that precluded full compatibility with the larger Spectra 70 processors. As a result, the 70/25 was replaced in the Series 70 lineup by the fully compatible and similarly priced 70/35.

The 70/46 Time-Sharing System, announced in May 1967, was billed as the first "four-dimensional" data processing system. Its design facilitates the handling of local batch processing, remote batch processing, interactive time-sharing, and intercommunication among the remote terminals. It can service up to 48 remote users while concurrently processing up to 14 independent batch-mode jobs. The 70/46 Processor is an upgraded version of the 70/45. It includes built-in logic that facilitates program segmentation and paging. The 262K-byte main memory is divided into pages of 4K bytes each. Dynamic address translation facilities enable each user to program as if he had a one-million-byte virtual memory at his disposal. A magnetic drum permits rapid swapping of program segments into and out of core memory. The 70/46 design provides a good balance between interactive and batch-

➤ 70/224 HIGH-SPEED PAPER TAPE READER: Reads 5-, 6-, 7-, or 8-level punched tape at up to 1000 characters per second. Handles 1000-foot reels. Offers same options as the 70/221, above.

70/242 MEDIUM-SPEED PRINTER: Prints up to 625 lpm using the standard 64-character print drum. Available with either 132 or 160 print positions. Skipping speed is 27 inches per second; an optional Dual-Speed Form Advance feature provides a skipping speed of 75 inches per second on skips of more than 8 lines. Contains a full-line buffer.

70/243 HIGH-SPEED PRINTER: Prints up to 1250 lpm using the standard 64-character print drum, or up to 833 lpm when equipped with an extended character set of 96 graphics (including lower-case letters). Available with either 132 or 160 print positions. Skipping speed is 75 inches per second. Contains a full-line buffer.

70/246 TRAIN PRINTER: Similar to the IBM 1403 Model N1 Printer. Rated printing speed is 1100 lpm with the standard 48-character horizontal "train" of engraved slugs. Contains 132 print positions and a full-line buffer.

70/248 BILL FEED PRINTER: An adaptation of the IBM 1404 Printer. Prints on continuous forms (at up to 600 lpm) or on individual 50- or 80-column cards fed one or two at a time. Peak speed is 800 cards per minute when printing 1 line per card on cards fed in "two-up" fashion. Has a 48-character set and 132 print positions. Can print up to 25 lines of data on a card. Requires a 70/249 Bill Feed Printer Control.

70/272-10 MICR SORTER-READER CONTROLLER: Permits either of the following magnetic ink character readers to be connected to a Series 70 system: Burroughs B 103 or B 116.

70/300 STANDARD INTERFACE SWITCHES: Manual or program-controlled devices used to switch standard Series 70 interface trunks. Can be used either to switch one I/O subsystem between two processors or to switch one processor channel position between two I/O subsystems ("one-by-two"). The 70/350 Switch Controller can operate up to eight 70/310 Basic Switches under program control, and can be shared by up to four processors. Up to four 70/350 Switch Controllers can be attached to a Communication Line Switch Adapter (CLSA) Model 70/356 for manual or automatic switching of groups of communication lines to one of two sets of Series 70 buffers. With the 70/356 CLSA and 70/350 controller, a variety of different unit switches can be attached for teletypewriter units (70/325), data sets (70/326), or data gathering units (70/327).

DIGITAL PLOTTERS: Incremental plotters that enable a Series 70 computer to produce output data in graphic form are available from California Computer Products, Inc. and Benson-Lehner Corp.

COMMUNICATION DEVICES

70/627 DATA EXCHANGE CONTROL (DXC): Connects two Series 70 processors, up to 200 feet apart, permitting direct memory-to-memory data interchange via a selector or multiplexer trunk on each of the two processors. Either processor can originate transmission or request data.

70/653 COMMUNICATION CONTROL: Permits single-channel remote communication with another Series 70 computer or with an RCA 301 or 3301 computer equipped with data communications equipment. Transmission can be via the public telephone network at 250 char/sec, a leased voice-band line at 300 char/sec, or a broad-band channel at 5100 char/sec. Connects to a Series 70 selector or multiplexer channel. ➤

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- ▷ mode processing capabilities in a medium-scale system that is both fast and flexible.

The 70/61, announced in September 1969, provides all the facilities of the 70/46 plus about three times its processing power. Like the 70/46, the 70/61 is oriented toward users who need both interactive and batch-mode processing capabilities. The 70/61 Processor bears the same relationship to the general-purpose 70/60 Processor as the 70/46 bears to the 70/45. Despite its three-fold speed advantage over the 70/46, the 70/61 is still not a really large-scale computer; its internal speeds are substantially lower than those of the System/360 Model 65, for example.

COMPATIBILITY

The Series 70 compatibility picture has four important dimensions:

- Compatibility with the IBM System/360 and 370.
- Compatibility within the Series 70 family.
- Compatibility with older RCA and IBM computers.
- Compatibility with other UNIVAC computers.

Designed to provide compatibility with the IBM System/360, the Series 70/2 through 70/7 and 70/35 through 70/61 processors naturally have many hardware characteristics in common with the System/360. They have a large, complex instruction repertoire that enables them to perform four different types of arithmetic: fixed-point arithmetic in either fixed-length binary or variable-length decimal mode, and floating-point arithmetic on either one-word or two-word operands. In addition, they can perform radix conversions, code translations, and conversions between the packed (2 decimal digits per byte) and unpacked (1 digit per byte) data formats. They enable the programmer to make use of sixteen 32-bit general registers that can serve as accumulators, index registers, or base address registers. They use a base-plus-displacement addressing scheme that permits direct addressing of up to 16 million bytes of core storage. And finally, they have a comprehensive interrupt system that enables them to respond to a variety of special conditions, both internal and external.

There are, however, at least two significant hardware differences between the Series 70 and System/360 processors. First, although the machine instructions used by applications programmers are the same in both lines, the "privileged" instructions—which are normally reserved for operating system use—are quite different. Second, whereas the System/360 processors have one set of general registers, the Series 70 processors have four sets—one for each of four processor states. As a result, the Series 70 processors can service interrupt conditions more efficiently than the IBM processors, in which it is necessary to save and restore the contents of multiple registers each time an interrupt is processed. The general registers are located in

- ▶ **70/656 COMMUNICATION CONTROLLER—SINGLE CHANNEL:** Permits remote communication, in ASCII synchronous transmission mode, with any of the following equipment: another suitably equipped Series 70 computer, an IBM System/360 with a 2701 or 2703 controller, Series 70 standard synchronous devices, or the AT&T Collect Message Distribute System. Operates via either dialed public networks or private lines, at half-duplex transmission rates of 250, 300, 2400, 5100, 6250, or 28,800 char/sec. Connects to a selector or multiplexer channel. The processor program must handle all line and error control functions.

70/668 COMMUNICATION CONTROLLER—MULTI-CHANNEL (CCM): Permits connection of multiple low-speed and medium-speed remote terminals to the multiplexer channel of any Series 70 processor. Can be equipped, via appropriate buffers, to handle a broad range of communication services, speeds, and codes. Transmission speeds can range from 6 to 300 char/sec. Three models are available, with capacities for 16, 32, or 48 buffers. Each buffer handles one half-duplex line; a full-duplex line requires a pair of buffers. One 70/668 CCM can service a mixture of up to 16 different types of buffers with a maximum total data rate of 6000 bytes/sec.

70/700 SERIES COMMUNICATIONS BUFFERS: Provide the physical interfaces between the 70/668 CCM and the data set(s) or communications line(s). The buffers are located in the CCM cabinet and interface to Teletype Model 28, 32, 33, and 35 teletypewriters (70/710 or 70/712); AT&T 403A data sets or 70/510 VRU's (70/715); EIA asynchronous data sets (70/720); EIA synchronous data sets (70/721); Synchronous Transmit/Receive IBM-type terminals (70/722); EDGE Demodulator Line Concentrators (70/724); Data Gathering System Line Concentrators (70/725); and Time Generators (70/780).

70/510 VOICE RESPONSE UNIT: Provides audio responses, in recorded human-voice form, to digital inquiries from pushbutton telephones. The basic unit handles 10 lines and can be expanded, in 10-line increments, to a maximum of 50 lines. Two models are available, with 31 or 63 sound tracks for storage of recorded words or phrases. Each track can be used to store either one phrase (up to 1.5 seconds in length), the same word recorded three times, or three different words. Thus, a vocabulary of up to 189 words, selected by the user, can be stored in either male or female voice form. The 70/510 VRU works in conjunction with a 70/668 CCM. The 70/510 is out of new production and is provided on an "as available" basis only.

70/630 DATA GATHERING SYSTEM: An on-line data collection system that permits both fixed and variable data to be transmitted to a Series 70 system from multiple remote input stations. Transmission speed is 120 char/sec over either twisted-pair conductors (up to 30 miles long) or leased voice-grade lines. A variety of input stations permit data to be entered from plastic badges, 80-column cards, keyboards, and/or scales or counters. A total of up to 384 on-line DGS input stations can be serviced by a single 70/668 CCM. Alternatively, up to 256 input stations can be connected to a 70/674 DGS Controller, an off-line unit that records the transmitted data on magnetic tape for later computer processing. The 70/630 is out of new production and is provided on an "as available" basis only.

70/740 DATA TERMINAL: Provides remote batch printing capability, with optional card input capability via the 70/741 Card Reader (below). Various models provide a choice of peak printing speeds (either 300 or 600 lines per minute), with a choice of either 80 or 132 print positions and either the Series 70 or ASCII set of 64 printable characters. Transmission is in ASCII synchronous mode, at

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▷ an extension of core storage in the 70/35, and in a high-speed "scratchpad" memory unit in all the faster Series 70 processors.

Compatibility with the System/360 line is also achieved through compatible source languages that are all essentially the same as their System/360 counterparts. As a result, most System/360 source programs can be assembled or compiled and executed on a Series 70 processor with little or no need for program changes. System/360 object programs, however, cannot be executed directly on a Series 70 because of the differences in the "privileged" instructions; reassembly or recompilation is always necessary.

As a further step toward System/360 compatibility, a System/360 mode of operation (supplied as a no-extra-cost feature) enables a 70/2, 3, 6, or 7 Processor to directly execute most System/360 DOS object programs. This feature is an emulator that resolves the differences in privileged instructions that have previously precluded direct machine-level interchange of programs between System/360 and Series 70 computers.

Among the Series 70 Models 70/2 through 70/7 and 70/35 through 70/61, there is a high degree of data and program compatibility at the hardware level. Any two of the general-purpose processors equipped with equivalent storage, features, and peripheral devices can execute the same programs and produce the same results (provided only that the programs are valid ones and do not depend on any fixed relationships between internal processing and input/output times). The virtual-memory systems can directly execute object programs written for the general-purpose "real" memory models under TDOS, though the converse is not necessarily true. Source-language programs can be freely interchanged between the virtual and "real" systems, for the most part, with only minor changes required for Assembly-language programs under DOS.

To facilitate conversions from older RCA and IBM computers to the Series 70 line, RCA developed a series of emulators. These extra-cost features use a combination of microprograms in read-only memory and specialized software to enable various Series 70 processors to execute programs written for the second-generation RCA 301, RCA 501, or IBM 1400 Series computers (see accompanying table).

As a "bridge" for conversion to other UNIVAC products, a series of conversion aids has been released:

- The Series 70 Mode of Operation Through Hardware (SMOOTH) consists of two emulators that run on the UNIVAC 90/60 and 90/70. One runs under a stand-alone Mini-Exec and fully supports TOS, TDOS, DOS, and COS operating under either TDOS or DOS. It supports TOS, TDOS, and DOS batch operations only, while communications programs can be run under a version of COS that is fully incorporated into VS/9. Stand-alone emulation of the RCA 301 and 501 is also

▶ up to 9600 bits per second. Connects to a Series 70 processor via a 70/656 or 70/668 Communication Control. Facilities for unattended operation are standard.

70/741 CARD READER: Provides remote 80-column card input at up to 300 cpm when used with a 70/740 Data Terminal (above). Off-line data transcription from cards to printer is also possible.

70/750 MODULAR VIDEO DATA SYSTEM: Consists of a 70/759 Video Data Controller, up to six 70/756 Video Data Generators, and from two to eight 70/751 Video Data Terminals connected to each 70/756 VDG by up to 500 feet of cable. The 70/759 VDC can be connected either directly to a Spectra 70 multiplexer channel or via a remote communications link that terminates in a 70/668 CCM at the computer site. The 70/751 VDT displays alphanumeric data on the face of a 12-inch rectangular CRT. Display capacity is 270 to 1080 characters, depending upon the number of VDT units connected to the 70/756 VDG. Ninety-six different characters, including both upper and lower case letters, can be displayed. Input data can be entered from either a keypunch-style or typewriter-style keyboard.

8752-100 VIDEO DATA TERMINAL: Displays alphanumeric data on the face of a 12-inch rectangular CRT. Can display up to 1080 characters at a time, in 20 lines of 54 characters each. Character set consists of 64 ASCII letters, numerals, and symbols. The 8752-100 VDT is a self-contained, desk-top unit that is normally connected via a remote communications link, to a 70/668 CCM at the computer site. Transmission speed is 120 char/sec over either the public telephone network or private voice-grade lines. Messages can be entered via the unit's keyboard and verified on the display screen before transmission.

8752-200 VIDEO DATA TERMINAL: This improved stand-alone CRT display unit incorporates all the features of the earlier 8752-100 VDT (above) plus such new capabilities as: transmission speeds from 300 to 2400 bits per second in either asynchronous or synchronous mode; a separate buffer for printing, which frees the display screen and keyboard and accommodates fast serial printers; an optional upper-and-lower case keyboard (96 characters); optional expanded display capacities of 1620 or 1782 characters; and simplified maintenance features.

UNISCOPE 100: Displays alphanumeric data on a 10-by-5-inch screen in 12 lines of 80 characters each or 16 lines of 24 characters each. The character set consists of 64 ASCII characters. Input data can be entered through a typewriter-like keyboard. The optional Model 610 Tape Cassette System provides two independent cassette tape recorders with up to 700,000 characters of data storage per cassette. An optional Communications Output Printer prints at 30 characters per second using a 63-symbol print set. Data transmission is in synchronous or asynchronous mode at speeds of up to 9600 bits per second.

SOFTWARE

OPERATING SYSTEMS: Software support for the Series 70 line is furnished at a number of distinct levels. Users of the general-purpose Series 70/2, 70/6, 70/35, 70/45, 70/55, and 70/60 Processors can choose the Disc Operating System and Resource Management System (DOS/RMS), Tape Operating System (TOS), or Tape/Disc Operating System (TDOS). Extensions of the most widely used of these systems, TDOS, are available to support communications-oriented installations.

Specialized Virtual Memory Operating System (VMOS) software support is provided for the Series 70/3, 70/7, 70/46, and 70/61. VS/9, the most recent version of VMOS,

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- provided on the 90/60 and 90/70 through a combination of microcode and software. The 301 capability was released in October 1974, and the 501 emulator in March 1975 as Type III software.
- COS and Series 70 ANS COBOL-68, FORTRAN IV, RPG, Interactive FORTRAN, and BASIC have all been placed directly under VS/9 as "native" software for the UNIVAC 90/60 and 90/70. In addition, plug-compatible versions of the Series 70 Communication Controller-Multi-Channel (CCM) were released for the 90/60 and 90/70 to permit Series 70 communications programs to be executed on these UNIVAC systems in native mode.
 - Data translators for VS/9 will provide automatic Series 70 disc file translation, and VS/9 will accept standard Series 70 magnetic tapes.
 - 1100 Series language translators are available as Type III (unsupported) software for Series 70 ANS and Spectra COBOL, BAL, FORTRAN, and RPG. A flow analysis and documentation tool (BALAN) is provided for Assembly-language programs. Data translation via magnetic tape is also provided for conversion of user files from the Series 70 to the 1100 Series.

SOFTWARE

UNIVAC furnishes a well-tested complement of supporting software for the Series 70 line. There are four distinct general-purpose "real memory" operating systems, of which two—DOS and TDOS—are widely used and have extensions to support communications-oriented installations. In addition, a virtual memory operating system is provided for the 70/46, 70/61, 70/3, and 70/7 virtual systems. At each operating system level, UNIVAC furnishes appropriate language translators, service programs, and utility routines. The highest practical degree of source-language compatibility with the IBM Assembler, COBOL, FORTRAN, and RPG languages has been maintained.

With the takeover by UNIVAC, Series 70 software development plans were carefully re-evaluated. In the light of this close scrutiny, UNIVAC decided to drop the heavily touted OS/70, RCA's answer to IBM's full OS/MFT and OS/MVT. In place of OS/70, Disc Operating System (DOS) users were given DOS/RMS, an advanced version of DOS; Tape/Disc Operating System (TDOS) users were given upgraded versions of TDOS that supplied nearly all the functions of OS/70; and Virtual Memory Operating System (VMOS) users have continued to receive the benefits of ongoing virtual memory developments.

In the intervening years, UNIVAC has continued to supply Series 70 users with new releases of the three major operating systems, incorporating both support for UNIVAC-supplied peripherals and enhanced functional characteristics. Although no further significant enhancements are planned for the DOS and TDOS "real memory" operating systems, UNIVAC promises continued full support for this software as long as users require it.

- announced for the UNIVAC 90/60 and 90/70 computers in January 1975, is also available for use on Series 70/7 systems. (Note that each of these virtual memory machines can also be run in a "real" mode and can operate under the "real" operating systems listed above.)

PRIMARY OPERATING SYSTEM: POS is a tape-resident operating system that consists of a Control System and a File Control Processor (FCP). The Control System controls and coordinates the execution of all programs, while the FCP is a generalized I/O control system. In conjunction with the Supervisor, the FCP controls I/O operations at both the logical and physical levels. An assembly-language programmer can choose to work at either the logical record level or at the physical level; in the latter case, he must specifically provide for all blocking, buffering, and I/O device functions.

The language translators available under POS are an Assembly System, a COBOL compiler, and a Report Program Generator (RPG). Other POS facilities include a tape Sort/Merge routine and a useful complement of library maintenance, diagnostic, and utility routines. The Peripheral Control Program (PCP) permits concurrent operation of up to three data transcription routines under POS.

PRIMARY COMMUNICATIONS ORIENTED SYSTEM: PCOS is closely related to POS and is designed specifically to control data communications processing on a 70/15 or 70/25 system by allowing the user to write his own communications programs. It consists of a Supervisor, a Peripheral Control Program, Snapshot Macros, and Program Loaders. Language translators and other required software facilities are "borrowed" from POS as needed. PCOS, directed by macros, controls a single user-written communication Program utilizing up to eight 70/668 CCM controllers. Concurrently, it can control the execution of up to six independent data transcription routines. PCOS is provided with Type III (local) programming support.

DISC OPERATING SYSTEM AND RESOURCE MANAGEMENT SYSTEM: DOS/RMS is a disc-resident operating system that provides multiprogramming control of up to six concurrent programs. Minimum configuration requirements are a 32K processor, two disc drives, card reader, printer, and console typewriter. Among the distinguishing features of DOS/RMS over its unaided DOS predecessor are input/output spooling, priority job scheduling, automatic resource allocation, and dynamic memory management. DOS/RMS consists of three groups of components: a Control System, which monitors and controls the processing environment; a Language System, which provides a choice of four programming language translators; and a Utility System, which simplifies testing and production operations.

The DOS/RMS Control System consists of an Executive, a File Control Processor, and a Monitor. The Executive requires 10,000 bytes of core storage and handles interrupt control, I/O scheduling, error recovery, program loading and termination, memory allocation, and console control. The Executive permits concurrent execution of up to six independent programs, provided that sufficient memory space and peripheral devices are available. The File Control Processor is a generalized I/O system that works in conjunction with the Supervisor to control I/O at both the logical and physical levels. The generated FCP occupies approximately 4000 bytes and can handle both sequential and random processing. The Monitor is a non-resident routine that controls stacked-job processing of successive programs, without operator intervention, on the basis of control statements in an input job stream. Up to six such job streams can be handled concurrently if the necessary hardware facilities are available.

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▷ VMOS, in particular, has been the subject of much attention from UNIVAC software development and evaluation personnel. In July 1971, only a few months before RCA's abrupt decision to abandon its computer operation, the release of VMOS Version 7 solved many of the vexing reliability problems that had plagued early users of this pioneering virtual memory operating system. In subsequent releases, UNIVAC continued to add improvements to the operating system, adding new recovery techniques, tuning the scheduling algorithm, and modifying the paging and memory management facilities for more efficient operation. Then, in a surprise move, UNIVAC announced in February 1975 that, after careful benchmark testing and evaluation, all further development of OS/7 had been halted and VMOS (rechristened VS/9) would replace OS/7 as operating support for the UNIVAC 90/60 and 90/70 systems and the target upgrade system for the majority of installed Series 70 computers. UNIVAC claims that the close similarities between the architecture of the 90/60 and 90/70 and the Series 70/7, combined with the availability of VS/9 for the 90/60 and 90/70, should allow programs to be interchangeable between these systems. What's more, the high degree of compatibility of DOS and TDOS COBOL, FORTRAN, and RPG with their VS/9 counterparts should permit conversions from smaller Series 70 computers to be made with relative ease.

USER REACTION

Datapro's 1974 survey of users of general-purpose computer systems attracted 14 responses from subscribers using UNIVAC Series 70 equipment. Nine of these responses reported on 70/45 systems, and since multiple-computer installations were included, a total of 17 70/45 systems were represented. Eight of the 70/45 systems were running under the TDOS operating system, seven were performing RCA 301 and 501 emulation, one was using DOS, and one was operating under the 360 mode of operation. The remaining Series 70 equipment represented in this survey included one 70/46 executing VMOS, one 70/55 executing TDOS, two RCA 2 systems (one operating under DOS and the other under TDOS), and one RCA 7 executing VMOS.

The ratings supplied by these Series 70 users in 11 important performance categories are tabulated below. In addition, Datapro conducted telephone interviews with 11 of the 14 respondents in May 1975 in order to ask more detailed questions about their recent experiences with their equipment and any plans they may have for upgrading the equipment. Here's how these 14 users rated their Series 70 computer systems:

| | <u>Excellent</u> | <u>Good</u> | <u>Fair</u> | <u>Poor</u> | <u>WA</u> |
|----------------------------|------------------|-------------|-------------|-------------|-----------|
| Ease of operation | 3 | 7 | 3 | 1 | 2.9 |
| Reliability of mainframe | 5 | 5 | 3 | 0 | 3.2 |
| Reliability of peripherals | 0 | 8 | 5 | 1 | 2.5 |
| Maintenance service: | | | | | |
| Responsiveness | 6 | 6 | 2 | 0 | 3.3 |
| Effectiveness | 3 | 7 | 4 | 0 | 2.9 |
| Technical support | 2 | 8 | 2 | 2 | 2.7 |

▶ The language translators available under DOS/RMS are an Assembly System, COBOL and FORTRAN compilers, and a Report Program Generator. The DOS Utility System includes a disc Sort/Merge program and routines to perform library maintenance, system service, data transcription, diagnostics, and job accounting functions. Four different types of libraries can be maintained: core image, relocatable modules, source statements, and macro instructions.

Version 17 of DOS was released in March 1975 and contains numerous enhancements to both the operating system and its language translators. These include the capability to read and write full tracks for ISAM files on Model 70/590 disc pack drives, improved file integrity through file locking procedures for work files used by Sort/Merge and all language translators, the ability to call a catalogued job stream through Monitor JCL commands, and some additional flexibility in the management of memory and tape and disc peripherals. Several enhancements were also added to the DOS Spool routine, including concurrent output writing to multiple card punches and printers. Also released were performance improvements for the DOS FORTRAN IV and COBOL compilers, including code optimization and Boolean functions in FORTRAN and faster COBOL compilation speeds.

TAPE OPERATING SYSTEM: TOS is a magnetic tape-resident operating system with Type I (centralized) programming support that can control the concurrent operation of up to six independent programs. TOS, however, provides no support for random access or data communications. Minimum configuration requirements are a 64K processor, five tape drives, card reader, and console typewriter. Like DOS/RMS, TOS consists of a Control System, a Language System, and a Utility System.

The TOS Control System consists of an Executive, a File Control Processor, and a Monitor. The Executive requires 16,000 bytes of core storage and handles interrupt control, I/O scheduling, error recovery, program loading and termination, memory allocation, and console control. It can also supervise the concurrent execution, under a priority system, of up to six programs, provided that sufficient memory space and peripheral devices are available. The File Control Processor (FCP) is a generalized I/O system that requires approximately 4000 bytes and handles the processing of sequential files at both the physical and logical I/O levels. The Monitor controls all program preparation runs, including assembly, compilation, linkage edits, and/or library maintenance. Activated by an operator type-in, the Monitor operates under control of the Executive and initiates the operations specified by control cards in an input job stream. The Monitor can also be used to control the execution of production programs.

The language translators available under TOS are an Assembly System, COBOL and FORTRAN compilers, and a Report Program Generator.

The TOS Utility System includes a tape Sort/Merge program, an Automatic Integrated Debugging System (AIDS) that facilitates program testing, and routines to perform data transcription, diagnostic, and library maintenance functions.

TAPE/DISC OPERATING SYSTEM: TDOS is an extended and considerably more powerful version of the Tape Operating System described above. Minimum configuration requirements are a 64K processor, one disc drive, three magnetic tape drives, card reader, printer, and console typewriter.

TDOS provides all the facilities and functions of TOS, and a TOS user can move up to TDOS without reprogramming or recompiling. In addition, TDOS provides: (1) support for ▶

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| | Excellent | Good | Fair | Poor | WA* |
|--------------------------|-----------|------|------|------|-----|
| Manufacturer's software: | | | | | |
| Operating system | 3 | 5 | 4 | 2 | 2.6 |
| Compilers and assemblers | 5 | 5 | 4 | 0 | 3.1 |
| Applications programs | 1 | 3 | 2 | 1 | 2.6 |
| Ease of conversion | 4 | 3 | 6 | 0 | 2.9 |
| Overall satisfaction | 3 | 6 | 4 | 0 | 2.9 |

WA—Weighted Average on a scale of 4.0 for Excellent.

Nearly all of the 11 users interviewed stated that they thought UNIVAC has done a good job of providing support and services to its recently adopted RCA customers. Possibly because RCA's withdrawal from the general-purpose computer market was so dramatic, most of these individuals were pleasantly surprised at UNIVAC's swift assurances of continued support. In many installations, the same RCA personnel stayed on as UNIVAC employees, so that little disruption was experienced. Eight of the 14 users who responded to the Datapro survey stated that UNIVAC's maintenance and technical support have been satisfactory or better and in some cases represented an improvement over the services provided by RCA. They used adjectives such as "real good," "satisfactory," and "beautiful" to describe their relationship with UNIVAC. It wasn't unanimous, however, and the remaining six respondents expressed some dissatisfaction, particularly in the area of software support. It was observed that over the years RCA support personnel quite naturally have tended to move into supporting UNIVAC's current product line in order to gain more opportunities to advance in the UNIVAC organization.

What about the future prospects for these Series 70 users? Of the 11 individuals who participated in follow-up telephone interviews with Datapro, two Series 70/45 users stated that their systems were still handling the workloads satisfactorily under the new versions of TDOS, and saw no reason for a change in the near future. One additional 70/45 system is being upgraded to a UNIVAC 1106 system, and another is being upgraded to a UNIVAC 90/60. Two installations had already made the decision to convert to IBM System/370 equipment, and three other Series 70 users said that eventually they probably would replace the Series 70 systems with IBM equipment. Reasons cited for the moves to IBM included the high level of compatibility between System/370 and RCA systems, the availability of IBM applications programs and other IBM-compatible software, and the conviction that IBM systems offer long-range growth potential and the desired level of support. Of the remaining two Series 70 users who were interviewed, one was upgrading to a large-scale Honeywell system and the other was undecided as to which equipment would replace his Series 70 system at the expiration of his long-term lease.

Only two VMOS users were represented among the 14 respondents to Datapro's survey. Since this virtual memory operating system, under the name of VS/9, will play a prominent role in UNIVAC's future marketing of the 90/60 and 90/70 systems, Datapro conducted telephone interviews with five additional VMOS installations;

mass storage devices; (2) more efficient operation, particularly in a multiprogramming environment, through the use of discs as library storage media; and (3) a sophisticated data communications control system (the MCS, described below). TDOS is provided with Type I (centralized) programming support.

TDOS provides the capability to run up to 14 independent jobs concurrently. (A TDOS "job" is defined to be a job stream or "monitor session" consisting of any number of job steps or programs.) Input spooling with priority job scheduling or simple first-in/first-out scheduling is a standard feature of TDOS, with optional concurrent output spooling.

Other features include: detailed job accounting statistics on the number of I/O commands issued to each device by job step; catalogued Job Control Language; disc library maintenance routines for the disc compilers; expanded data edit facilities for random-access devices; multiple configuration support for up to three versions of the Resident Executive on SYSRES.

Release 23, distributed in June 1974, is the most recent major enhancement of TDOS. It offers more flexibility in the use of the Output Writer, including the capability to use an unlimited number of card punches and printers and to route an output class to magnetic tape, to a specific output device, or to multiple output devices for more efficient processing. New SYSOUT commands provide for console display of output files queued for processing by the Output Writer and permit operator intervention to defer output file processing or to delete specified output files. Release 23 also includes support for the Uniservo 16 and 20 Magnetic Tape Units, improved handling of defective disc tracks, and on-line diagnostic programs for all disc and tape peripherals.

Emulation of RCA 301 and 501 systems can be performed under control of TDOS instead of in stand-alone mode. An RCA 501 can be emulated by a 70/6, 70/7 (in 70/6 mode), or 70/45, while an RCA 301 can be emulated only by a 70/6 or 70/7 (in 70/6 mode).

MULTICHANNEL COMMUNICATIONS SYSTEM: MCS is a modular software system designed to operate under control of the TDOS Executive and facilitate the implementation of a data communications system. It consists of three major components: Communications Interrupt Analysis (CIA), Multichannel Communication Program (MCP), and Communications User Program (CUP). CIA and MCP are software subsystems, supplied by RCA, that perform the functions of interrupt analysis, line servicing, message acknowledgement, buffering, queuing, error handling, code translation, and logging. The CUP is a user-written application program that interfaces with TDOS by means of macros.

VIRTUAL MEMORY OPERATING SYSTEM: VMOS is the primary operating system for the Series 70/3, 7, 46, and 61 Virtual Memory Computers. Designed to control concurrent local and remote processing in the batch, interactive, and communications modes, VMOS is an outgrowth of RCA's earlier Time-Sharing Operating System (TSOS) that features a data management system, better RPG, COBOL and FORTRAN compilers, additional utility routines, "spooled" remote input and redirectable output capabilities, and a text processing routine called Autoform.

VMOS controls the overall processing environment by allocating the system's resources, controlling the scheduling and execution of all tasks, servicing all interrupts, managing virtual memory by controlling the "swapping" of pages between main and drum memory, and initiating error recovery procedures. Spooling of card input and printer

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▷ they included two 70/46 systems and three 70/7 accounts. On the whole, these individuals described themselves as very satisfied with the VMOS operating system. Typical workloads for a 70/46 system were described as managing from 10 to 15 interactive terminals plus one to three concurrent batch jobs, while a 70/7 with a million bytes of memory was handling 40 to 50 interactive terminals concurrently with executing six to seven batch jobs. Both 70/46 and 70/7 users expressed satisfaction with the amount of data processing that could be accomplished for their dollar investment in hardware; in fact, one user stated that he was getting "every penny's worth out of the machine."

These VMOS users stated that the reliability and the stability of the operating system have improved dramatically under UNIVAC's management, and that new releases, after initial shakedowns, have worked well. When queried about areas in which the operating system could be improved, they singled out more sophisticated remote job entry facilities, support for a wider selection of remote batch terminals and IBM-compatible terminals, a front-end communications processor, improved job accounting, and a shared (multi-thread) data base management system as desirable additions. Users at educational institutions also expressed a need for APL and a computer-aided instruction language. On the positive side, these users were pleased with enhancements that have improved the operating system's throughput and its ease of use, such as a more powerful text editor to facilitate program preparation.

There was some question about the possibilities for upgrading large 70/7 systems, since none of the interviewed 70/7 users regarded the UNIVAC 90/70 as a sufficiently powerful system to serve as a meaningful upgrade for a 70/7. But all five of these VMOS users concurred with UNIVAC's decision to support VMOS on the 90/60 and 90/70—in the words of one, "to recognize the value of what they had bought." And four out of five expressed a definite intention to stay with the operating system as long as suitable hardware is available to enable them to upgrade their systems.

In taking over the RCA customer base, UNIVAC's top management set a goal of retaining at least 50 percent of the Series 70 customers into the mid-70's—an objective that appears to have been met handily. The second phase of the Series 70 strategy is aimed at moving as many as possible of the satisfied Series 70 customers over to UNIVAC gear. The next few years will see more of these systems become eligible for upgrading as long-term contracts expire and workloads surpass processor capacities. UNIVAC's recent commitment to VS/9 may provide just the right upward growth path required to keep many of these adopted RCA customers in the UNIVAC fold. □

▶ **output on disc or tape drives improves hardware utilization; additional spooling facilities permit input from remote terminals to be spooled and processed in batch mode and give a high degree of control to the operator for redirection of "spoolout" files as well as flexible forms control commands. A Command Language is used for communication**

between VMOS and the system's users, operator, and administrator.

The VMOS data management system features improved catalog management techniques for faster access, improved channel utilization through queuing of requests for seek operations on random-access devices, use of the same physical block size in all random-access devices, handling of errors on an exception basis, and the ability to pass files from program to program. The VMOS Information Processing System (IPS/70) permits integration of all user data into a data base and controls accessing of the data base by multiple user programs.

A priority task scheduler designed to allow multiple levels of prioritization is included in VMOS. A basic central processor time-slice is given to each batch task in the input queue, and a special longer time-slice is given to the highest-priority task, in addition to putting that task at the head of the queue. A percentage-of-core parameter or a relative-frequency parameter can be used to divide the basic system resources between batch and interactive jobs and establish relative priorities between the batch and interactive workloads. Interactive jobs can be subjected to a fixed delay period specified at Sysgen time to limit CPU-bound interactive jobs from excessive use of the system resources.

Other noteworthy features of VMOS include: Dynamic Alternate Track Assignment, used in conjunction with the File Reconstruction System (FRS) and Error Recovery to recover from disc errors; a Random Access Volume Initializer (VOLIN); Tape Mark Positioning Control with non-standard and omitted label options; Catalog Display Program; dynamic step-down of dual-channel disc and tape controls for maintenance; and Remote Batch Processing features designed for error recovery, orderly terminal shut-down, and accounting statistics.

VMOS provides language processors for both batch and conversational use. The batch-mode Assembler and COBOL and FORTRAN compilers are themselves pageable and produce pageable object programs. The RPG and Sort/Merge programs operate in conventional batch (non-paged) mode. Also usable in the background batch processing mode are a number of applications modules, including PERT, Simscript, Network Analysis, Transportation Model, ECAP, and civil engineering, statistical-biomedical, and mathematical routines.

Conversational languages supported under VMOS include Extended BASIC, IFOR (an interpretive, compile-and-go FORTRAN IV processor), PI-FORTRAN (a fast "shorthand" FORTRAN), and Desk Calculator. A COBOL Syntax Checker (COBSYN) permits rapid detection and correction of COBOL programming errors by users at remote terminals. An Interactive Debugging Aid (IDA), usable in either conversational or batch mode, facilitates testing and modification of programs written in Assembly Language, COBOL, or FORTRAN. Code II (COBOL Test File Generator) is used to create test files on public disc as part of the COBOL program development subsystem. Finally, for the larger 70/7 computer only, UNIVAC offers two additional compilers: FAST FORTRAN, designed to provide rapid compilation and effective diagnostic facilities in a conversational environment; and Interactive COBOL, designed to enable terminal users to construct, check, test, and modify programs using the full ANSI COBOL language plus IBM extensions.

Extended VMOS communications capabilities, also available only for the larger 70/7 computer, include: (1) dynamic message buffering; (2) bulk message storage and a store-and-forward capability; (3) an intercept facility that returns undelivered messages to the sender; (4) a tape ▶

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- ▶ logging capability that enables a record of all message traffic to be maintained; and (5) extended terminal support facilities.

Since January 1972, UNIVAC has issued three new releases of VMOS that were designed to increase the system's reliability, add new recovery techniques, and improve its scheduling algorithm and memory management techniques. Release 11 of VMOS was distributed to Series 70 users in November 1974, and was subsequently announced in February 1975 as VS/9 for the UNIVAC 90/60 and 90/70 systems. VS/9 permits a removable disc pack drive to be used as the backing store for paging operations and includes a unified Random Access Volume Support, support for the Uniscope 100 Display Terminal, Communications-Oriented Software (COS), and the DMS/90 data base management system.

COMMUNICATIONS ORIENTED SYSTEM (COS): COS is a modular communications system designed to operate under control of the VS/9 Executive for managing communications message traffic. Each installation-tailored Communications Control Program (CCP) is generated through the use of COS macro calls, and performs functions including message handling, message queueing, logging and journaling, and passing of messages to user-written Communications User Programs (CUP's) through GET and PUT commands. Each CCP can control up to six CUP's in a multi-tasking mode, in which one CUP acts as the control CUP and receives the highest program priority. Both pageable and nonpageable CUP's can be intermixed in a CCP environment. Automatic message switching can be implemented either directly under control of the CCP or with a CUP if additional message processing is performed. COS supports the Uniscope 100 display with the optional Model 610 Tape Cassette System as a remote terminal. Computer-to-computer communications in the binary synchronous mode is performed via a Communications Controller Multichannel attached to the multiplexer channel of each central processor.

DATA MANAGEMENT SYSTEM/90 (DMS/90): Originally announced for the UNIVAC 90/60 and 90/70 systems, DMS-90 was made available for use on Series 70/7 systems under VS/9 in February 1975. DMS/90, a comprehensive data base management system, is described in detail in Report 70C-877-06.

COBOL: UNIVAC offers COBOL compilers under six of the Series 70 operating systems: POS, DOS, TOS, TDOS, and VMOS. All except the POS version use essentially the same source language as IBM's OS/360 COBOL F, which includes many of the facilities of ANS COBOL but also has numerous incompatibilities and restrictions with respect to the standard language. POS COBOL uses a subset of the language elements supported in the larger compilers; among the features excluded from the POS version are the Sort, Report Writer, and Random Access modules. An ANS COBOL Level D is also provided for use with either DOS/RMS or TDOS.

FORTRAN: UNIVAC offers FORTRAN compilers for operation under DOS, TOS, TDOS, and VMOS. All use the FORTRAN IV source language, and all include all the facilities of ANS FORTRAN.

Recent enhancements to the FORTRAN compilers include more efficient FORMAT processing, Boolean functions, and list-directed READ, WRITE, PRINT, and PUNCH statements.

BASIC: Compilers for the BASIC language are offered only under VMOS. The UNIVAC compilers accept a source language similar to the version currently used in Honeywell (formerly GE) time-sharing systems.

REPORT PROGRAM GENERATORS: UNIVAC offers RPG's at nearly all of the Series 70 software support levels: POS, DOS, TOS, TDOS, and VMOS. Upward compatibility at the source-language level is preserved among all versions. The RPG's use data from user-prepared specification sheets to generate object programs which perform common business data processing functions. In addition to their basic report-writing functions, RPG programs can update files, perform various types of calculations, and accommodate user-coded routines to handle functions that cannot be programmed efficiently in the RPG language.

ASSEMBLERS: Assembly Language is the standard symbolic programming language used to write machine-oriented programs for all models of the Series 70. UNIVAC therefore furnishes Assembly Systems at all support levels.

UTILITY ROUTINES: Sort/merge programs are offered at all Series 70 support levels. All are generalized programs which are controlled by user-supplied parameters, and all can accommodate either fixed or variable-length records in blocked or unblocked form. Magnetic tape and/or disc drives are used, depending upon the orientation of the particular operating system.

Each software level also includes an appropriate complement of data transcription, diagnostic, and other utility routines.

APPLICATION PROGRAMS: A modest complement of generalized business and scientific application programs is available for the Series 70 line. The principal ones, and the operating systems under which they are supported, are as follows:

| Type I* | TDOS | DOS/RMS | VMOS |
|---|------|---------|------|
| Biomedical Programs | X | | X |
| Coordinate Geometry | X | | |
| Digital Terrain Model | X | | |
| Flow Simulator | X | | |
| Hardy Cross Gas Distribution Analysis | X | | |
| Hardy Cross Water Network Program | X | | |
| IBM 1401 Simulation Program | X | | |
| Scientific Subroutine Series 70 (with more than 400 programs and subroutines) | X | X | X |
| Curved Beam Analysis | X | | |
| Rigid Frame Analysis | X | | X |
| Structural Section Properties | X | | X |
| Variable Inertia Beam Analysis | X | | |
| Test of Hypothesis Series | | | X |
| VMOS Applications Library (with about 600 programs and subroutines) | | | X |

*Type I software is provided with full UNIVAC centralized programming support. (Former Type II software is now considered to be Type I.)

| Type III** | TDOS | DOS/RMS | VMOS |
|-------------------------------|------|---------|------|
| Highway Profile Program | X | | |
| NASA PERT Time II | X | | |
| OCRCA Data Management System | X | | |
| Sales Forecasting and Control | X | | |
| Series 70 Linear Programming | X | | |
| Statistical Series | X | | X |
| Traffic Progression Analysis | X | | X |

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| Type III** | TDOS | DOS/RMS | VMOS |
|--|------|---------|------|
| User Language/1 (UL/1) | X | | |
| 500 Bus Transient Stability | X | | |
| 1000 Bus Fault Analysis | X | | |
| Automatic Conversion Routine | | X | |
| Educational Accounts Payable | | X | |
| Educational Accounts Receivable | | X | |
| Educational Payroll System | | X | |
| Manufacturing Data Base System | | X | |
| Statistical Analysis of Test Answers | | X | |
| Student Scheduling Application System | | X | |
| Continuous Systems Simulation | | | X |
| Electronic Circuit Analysis Program | | | X |
| FORTRAN Sort | | | X |
| Interactive Linear Programming | | | X |
| Princeton Interactive Programmed Tools | | | X |
| Princeton Interactive FORTRAN | | | X |
| Transportation Linear Programming | | | X |

**Type III software is supported by local Series 70 personnel and has no centralized maintenance support.

PRICING

EQUIPMENT: The following systems are representative of the types of Series 70 configurations that are being widely installed and are supported by the standard UNIVAC software. Obviously, they comprise only a small sampling of the many configuration possibilities within the Series 70 line. All necessary control units and adapters are included in the indicated prices. The quoted rental prices include equipment maintenance and are for standard 1-year leases.

70/2 TAPE/DISC SYSTEM: Consists of 65K 70/2 Processor with two Selector Channels, two 70/564 Disc Storage Units, three 70/442 Magnetic Tape Units (each containing two 60KB tape drives), 70/237 Card Reader, 70/236 Card Punch, 70/243 Printer, and 70/97 Console. Monthly rental and purchase prices are approximately \$14,000 and \$610,695, respectively. For purchased systems only, monthly maintenance is \$2,098.

70/3 VIRTUAL MEMORY SYSTEM: Consists of 262K 70/3 Processor with two Selector Channels, 70/560-005 Direct Access Storage System, 70/590-004 Direct Access Storage System (4 drives), two 70/442 Magnetic Tape Units (each containing two 60KB tape drives), 70/237 Card Reader, 70/236 Card Punch, 70/243 Printer, and 70/97 Console. Monthly rental and purchase prices (exclusive of the data communications and remote terminal equipment normally used in a system of this type) are approximately

\$22,540 and \$927,285, respectively. For purchased systems only, monthly maintenance is \$2,825.

70/6 TAPE /DISC SYSTEM: Consists of 262K 70/6 Processor with four Selector Channels, 8519-004 Direct Access Storage System (4 drives), eight 70/445 Magnetic Tape Units (each containing one 120KB drive) and dual-channel tape control, 70/237 Card Reader, 70/236 Card Punch, 70/243 Train Printer, and 70/97 Console. Monthly rental and purchase prices are approximately \$30,689 and \$1,282,200, respectively. For purchased systems only, monthly maintenance is \$3,850.

70/7 VIRTUAL MEMORY SYSTEM: Consists of 524K 70/7 Processor with four Selector Channels, 70/560-016 Direct Access Storage System, 8519-008 Direct Access Storage System (8 drives), two 70/442 Magnetic Tape Units (each containing two 60KB tape drives), 70/237 Card Reader, 70/236 Card Punch, 70/243 Printer, and 70/97 Console. Monthly rental and purchase prices (exclusive of the data communications and remote terminal equipment normally used in a system of this type) are approximately \$41,934 and \$1,821,135, respectively. For purchased systems only, monthly maintenance is \$4,586.

70/45 (Type II) TAPE/DISC SYSTEM: Consists of 64K 70/45-II Processor with two Selector Channels, two 70/564 Disc Storage Units, three 70/442 Magnetic Tape Units (each containing two 60KB tape drives), 70/237 Card Reader, 70/236 Card Punch, 70/243 High-Speed Printer, and 70/97 Console. Monthly rental and purchase prices are approximately \$16,927 and \$720,015, respectively. For purchased systems only, monthly maintenance is \$2,282.

SOFTWARE AND SUPPORT: UNIVAC has not "un-bundled" to date, so the equipment prices listed in this report include all of the Series 70 software described in this report and all normal educational courses and professional assistance.

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 (included in all rental prices quoted above) 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 extended-term leases for the Series 70 systems at significantly lower monthly rates. All Series 70 equipment except the 70/2, 3, 6, and 7 Processors are eligible for the long-term leases. Under a 3-year "level-payment" agreement, the monthly equipment charge is 85% of the 1-year rental rate shown in the accompanying price list. Under a 5-year "level-payment" agreement, the monthly charge is 75% of the 1-year rental rate. Under a 5-year "reducing-payment" agreement, the monthly charge is 85% of the 1-year rental rate during the first year, 80% the second year, 75% the third year, 70% the fourth year, and 65% the fifth year. UNIVAC offers a standard purchase option credit that is the lower of 75 percent of the monthly rentals paid to date or 9 months system rental. ■

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EQUIPMENT PRICES

| | | Purchase Price | Monthly Maint. | Rental (1-year lease)* |
|--|---|-------------------|-------------------|------------------------------|
| 70/2 PROCESSORS AND MAIN STORAGE | | | | |
| 70/2-001 | Processor (for 65K Memory) | \$ 175,000 | \$ 265 | \$ 3,286 |
| 70/2-002 | Processor (for 131K or 262K Memory) | 212,500 | 318 | 4,505 |
| 5003-002 | Direct Control Feature | 9,700 | 13 | 206 |
| 5043-002 | Selector Channels 1 & 2 | 12,500 | 53 | 265 |
| 5044-002 | Selector Channels 1, 2, & 3 | 18,750 | 79 | 397 |
| 5045-002 | Selector Channels 1, 2, 3, & 4 | 25,000 | 106 | 530 |
| 5006-002 | 1401 Emulator | 6,300 | 11 | 95 |
| 8000-011 | Memory; 65,536 bytes | 37,500 | 53 | 795 |
| 8000-013 | Memory; 131,072 bytes | 75,000 | 106 | 1,590 |
| 8000-015 | Memory; 262,144 bytes | 150,000 | 212 | 3,180 |
| 70/3 PROCESSORS AND MAIN STORAGE | | | | |
| 70/3-001 | Processor (for 131K Memory) | 282,500 | 424 | 5,459 |
| 70/3-002 | Processor (for 262K Memory) | 282,500 | 424 | 5,989 |
| 5003-003 | Direct Control Feature | 9,700 | 13 | 206 |
| 5040-003 | Selector Channels 1 & 2 | 12,500 | 53 | 265 |
| 5041-003 | Selector Channels 1, 2, & 3 | 18,750 | 79 | 397 |
| 5042-003 | Selector Channels 1, 2, 3, & 4 | 25,000 | 106 | 530 |
| 5006-003 | 1401 Emulator | 6,300 | 11 | 95 |
| 8000-013 | Memory; 131,072 bytes | 75,000 | 106 | 1,590 |
| 8000-015 | Memory; 262,144 bytes | 150,000 | 212 | 3,180 |
| 70/6 PROCESSORS AND MAIN STORAGE | | | | |
| 70/6-001 | Processor (for 131K Memory) | 435,000 | 530 | 8,586 |
| 70/6-002 | Processor (for 262K Memory) | 435,000 | 530 | 9,222 |
| Expansion Features for 70/6-002 Processor: | | | | |
| 5073 | For expansion from 262K to 393K | 120,000 | — | 1,908 |
| 5074 | For expansion from 262K to 524K | 120,000 | — | 2,544 |
| 5075 | For expansion from 262K to 655K | 180,000 | — | 3,180 |
| 5076 | For expansion from 262K to 786K and above | 180,000 | — | 3,816 |
| 5003-006 | Direct Control Feature | 9,700 | 13 | 206 |
| 5057-406 | Selector Channels 3 & 4 | 67,500 | 84 | 1,431 |
| 5058-606 | Selector Channels 3, 4, 5, & 6 | 135,000 | 169 | 2,862 |
| 5064-006 | 301 Emulator | 25,200 | 42 | 382 |
| 5065-006 | 501 Emulator | 25,200 | 42 | 382 |
| 5026-006 | 1410/7010 Emulator | 25,200 | 42 | 382 |
| 5081-006 | 1401 Emulator | 25,200 | 42 | 382 |
| 8000-013 | Memory; 131,072 bytes | 75,000 | 106 | 1,590 |
| 8000-015 | Memory; 262,144 bytes | 150,000 | 212 | 3,180 |
| 70/7 PROCESSORS AND MAIN STORAGE | | | | |
| 70/7-001 | Processor (for 262K Memory) | 525,000 | 742 | 11,130 |
| Expansion Features for 70/7-001 Processor: | | | | |
| 5077 | For expansion from 262K to 393K | 120,000 | — | 1,908 |
| 5078 | For expansion from 262K to 524K | 120,000 | — | 2,544 |
| 5079 | For expansion from 262K to 655K | 180,000 | — | 3,180 |
| 5080 | For expansion from 262K to 786K and above | 180,000 | — | 3,816 |
| 5003-007 | Direct Control Feature | 9,700 | 13 | 206 |
| 5057-407 | Selector Channels 3 & 4 | 67,500 | 84 | 1,431 |
| 5058-607 | Selector Channels 3, 4, 5, & 6 | 135,000 | 169 | 2,862 |
| 5064-007 | 301 Emulator | 25,200 | 42 | 382 |
| 5065-007 | 501 Emulator | 25,200 | 42 | 382 |
| 5026-007 | 1410/7010 Emulator | 25,200 | 42 | 382 |
| 5086-007 | 1401 Emulator | 25,200 | 42 | 382 |
| 8000-013 | Memory; 131,072 bytes | 75,000 | 106 | 1,590 |
| 8000-015 | Memory; 262,144 bytes | 150,000 | 212 | 3,180 |
| 70/35 PROCESSORS AND MAIN STORAGE | | | | |
| 70/35-D | Processor (32K) | 152,775 | 258 | 2,644 |
| 70/35-DC | Processor (49K) | 189,735 | 334 | 3,529 |
| 70/35-E | Processor (65K) | 213,885 | 361 | 4,153 |
| 5001-35 | Memory Protect | 6,405 | 8 | 135 |
| 5002-35 | Elapsed Time Clock | 2,575 | 3 | 54 |

* Rental prices do not include equipment maintenance.

UNIVAC Series 70
EQUIPMENT PRICES

| | | <u>Purchase Price</u> | <u>Monthly Maint.</u> | <u>Rental (1-year lease)*</u> |
|--|-----------------------------------|---------------------------|---------------------------|---------------------------------------|
| 70/35 PROCESSORS AND MAIN STORAGE (Continued) | | | | |
| 5003-35 | Direct Control | \$ 10,185 | \$ 14 | \$ 216 |
| 5005-35 | 301 Emulator | 20,370 | 28 | 434 |
| 5006-35 | 1401 Emulator | 16,590 | 22 | 89 |
| 5030 | Selector Channel (1 channel) | 8,975 | 13 | 190 |
| 5031 | Selector Channel (2 channels) | 14,070 | 19 | 296 |
| 70/45 (Type II) PROCESSORS AND MAIN STORAGE | | | | |
| 70/45-E | Processor (65K) | 274,995 | 464 | 5,817 |
| 70/45-F | Processor (131K) | 356,475 | 602 | 7,544 |
| 70/45-FE | Processor (196K) | 460,950 | 776 | 9,730 |
| 70/45-G | Processor (262K) | 549,990 | 929 | 11,640 |
| 70/45-H | Processor (393K) | 717,780 | 1,118 | 15,304 |
| 70/45-J | Processor (524K) | 865,830 | 1,286 | 18,475 |
| 5002-45 | Elapsed Time Clock | 2,575 | 3 | 54 |
| 5003-45 | Direct Control | 10,185 | 14 | 216 |
| 5005-45 | 301 Emulator | 25,465 | 35 | 538 |
| 5006-45 | 1401 Emulator | 25,465 | 35 | 538 |
| 5007-45 | 501 Emulator | 33,130 | 45 | 702 |
| 5019-45 | Elapsed Time Clock | 6,195 | 7 | 131 |
| 5026-45 | 1410 Emulator | 28,035 | 38 | 591 |
| 5036-45 | 301/501 Emulator | 43,315 | 58 | 916 |
| 5043-45 | Selector Channel (2 channels) | 59,325 | 81 | 1,255 |
| 5044-45 | Selector Channel (3 channels) | 88,985 | 120 | 1,884 |
| 5045-45 | Selector Channel (4 channels) | 118,650 | 160 | 2,511 |
| 5046-45 | 1401/1410 Emulator | 40,740 | 54 | 864 |
| 5056 | Memory Store and Fetch Protection | 9,870 | 14 | 209 |
| 70/46 PROCESSORS AND MAIN STORAGE | | | | |
| 70/46-G | Processor (262K) | 698,565 | 1,180 | 14,777 |
| 5001-46 | Memory Protect | 6,405 | 8 | 135 |
| 5002-46 | Elapsed Time Clock | 2,575 | 3 | 54 |
| 5003-46 | Direct Control | 10,185 | 14 | 216 |
| 5019-46 | Elapsed Time Clock | 6,195 | 7 | 131 |
| 5040 | Selector Channel (2 channels) | 46,935 | 63 | 994 |
| 5041 | Selector Channel (3 channels) | 69,195 | 93 | 1,465 |
| 5042 | Selector Channel (4 channels) | 89,040 | 120 | 1,884 |
| 70/55 PROCESSORS AND MAIN STORAGE | | | | |
| 70/55-E | Processor (65K) | 425,250 | 718 | 8,997 |
| 70/55-F | Processor (131K) | 506,730 | 855 | 10,724 |
| 70/55-G | Processor (262K) | 700,245 | 1,183 | 14,820 |
| 70/55-H | Processor (524K) | 1,148,385 | 1,939 | 24,299 |
| 5004-55 | Memory Protect | 7,665 | 10 | 162 |
| 5002-55 | Elapsed Time Clock | 2,575 | 3 | 54 |
| 5003-55 | Direct Control | 12,755 | 17 | 270 |
| 5019-55 | Elapsed Time Clock | 6,195 | 7 | 131 |
| 5020 | Selector Channel (2 channels) | 22,945 | 31 | 487 |
| 5022 | Selector Channel (4 channels) | 40,740 | 54 | 864 |
| 5024 | Selector Channel (6 channels) | 58,590 | 79 | 1,240 |
| 70/60 PROCESSORS AND MAIN STORAGE | | | | |
| 70/60-F | Processor (131K) | 577,395 | 651 | 12,502 |
| 70/60-G | Processor (262K) | 769,860 | 868 | 16,658 |
| 70/60-H | Processor (393K) | 937,650 | 1,058 | 20,301 |
| 70/60-J | Processor (524K) | 1,085,700 | 1,224 | 23,507 |
| 70/60-K | Processor (655K) | 1,273,230 | 1,436 | 27,566 |
| 70/60-L | Processor (786K) | 1,421,280 | 1,603 | 30,771 |
| 70/60-M | Processor (917K) | 1,598,940 | 1,803 | 34,619 |
| 70/60-N | Processor (1,048K) | 1,756,990 | 1,971 | 37,824 |
| 5002-60 | Elapsed Time Clock | 2,575 | 3 | 54 |
| 5003-60 | Direct Control | 10,185 | 14 | 216 |
| 5019-60 | Elapsed Time Clock | 6,195 | 7 | 131 |
| 5057 | Selector Channel (2 channels) | 71,085 | 95 | 1,507 |
| 5058 | Selector Channel (4 channels) | 142,170 | 193 | 3,013 |
| 5059 | Memory Protect | 9,870 | 14 | 209 |
| 5026-60 | 1410-7010 Emulator | 54,705 | 71 | 1,158 |
| 5062 | Virtual Memory Feature | 148,050 | 167 | 3,211 |

* Rental prices do not include equipment maintenance.

UNIVAC Series 70

EQUIPMENT PRICES

| | | Purchase Price | Monthly Maint. | Rental (1-year lease)* |
|--|--|-------------------|-------------------|------------------------------|
| 70/61 PROCESSORS AND MAIN STORAGE | | | | |
| 70/61-G | Processor (262K) | \$ 917,910 | \$ 1,036 | \$ 19,873 |
| 70/61-H | Processor (393K) | 1,085,700 | 1,224 | 23,507 |
| 70/61-J | Processor (524K) | 1,233,750 | 1,392 | 26,712 |
| 70/61-K | Processor (655K) | 1,421,280 | 1,603 | 30,775 |
| 70/61-L | Processor (786K) | 1,569,330 | 1,770 | 33,980 |
| 70/61-M | Processor (917K) | 1,746,990 | 1,971 | 37,825 |
| 70/61-N | Processor (1,048K) | 1,895,040 | 2,137 | 41,030 |
| 5002-61 | Elapsed Time Clock | 2,575 | 3 | 56 |
| 5003-61 | Direct Control | 10,185 | 14 | 217 |
| 5019-61 | Elapsed Time Clock | 6,195 | 7 | 134 |
| 5057 | Selector Channel (2 channels) | 71,085 | 95 | 1,507 |
| 5058 | Selector Channel (4 channels) | 142,170 | 193 | 3,013 |
| 5059 | Memory Protect | 9,870 | 14 | 209 |
| CONSOLES | | | | |
| 70/97-10 | Console | 16,850 | 29 | 356 |
| 5051 | Keyboard Interlock | 495 | 1 | 10 |
| 70/97-20 | Console | 18,110 | 31 | 381 |
| 5060 | Run Time Recorder Interface | 263 | 0 | N/A |
| 5260 | Special Type Slug and Key | 53 | 0 | N/A |
| 70/216 | Input/Output Typewriter | 9,240 | 57 | 160 |
| 5259 | Form Supply Box | 53 | 0 | N/A |
| 5276-1 | Paper Tape Reader | 1,260 | 7 | 22 |
| 5276-2 | Paper Tape Reader | 1,525 | 10 | 25 |
| 5277-1 | Paper Tape Punch | 4,250 | 25 | 74 |
| 5277-2 | Printing Paper Tape Punch | 4,515 | 28 | 78 |
| MASS STORAGE | | | | |
| 70/560-005 | Virtual Memory Storage System (2.64M Bytes) | 105,000 | 424 | 2,226 |
| 70/560-008 | Virtual Memory Storage System (4.1M Bytes) | 166,150 | 646 | 3,223 |
| 70/560-016 | Virtual Memory Storage System (8.2M Bytes) | 301,950 | 1,223 | 5,819 |
| 70/564 | Disc Storage Unit | 26,785 | 76 | 596 |
| 70/567-8 | Drum Memory (4.13M Bytes) | 142,590 | 806 | 2,725 |
| 70/567-16 | Drum Memory (8.26M Bytes) | 285,180 | 1,213 | 5,452 |
| 70/568-11 | Mass Storage Unit (Mag. Cards) | 136,500 | 765 | 2,921 |
| 70/551 | Random Access Controller | 26,775 | 60 | 553 |
| 70/590-2 | Direct Access Storage System (2 Drives) | 95,340 | 219 | 2,061 |
| 70/590-3 | Direct Access Storage System (3 Drives) | 120,190 | 318 | 2,565 |
| 70/590-4 | Direct Access Storage System (4 Drives) | 115,040 | 417 | 3,068 |
| 70/590-5 | Direct Access Storage System (5 Drives) | 169,890 | 516 | 3,572 |
| 70/590-6 | Direct Access Storage System (6 Drives) | 194,740 | 616 | 4,075 |
| 70/590-7 | Direct Access Storage System (7 Drives) | 219,590 | 715 | 4,579 |
| 70/590-8 | Direct Access Storage System (8 Drives) | 244,440 | 814 | 5,082 |
| 70/590-9 | Direct Access Storage System (9 Drives) | 273,790 | 934 | 5,676 |
| 70/590-10 | Direct Access Storage System (10 Drives) | 298,640 | 1,033 | 6,179 |
| 70/590-11 | Direct Access Storage System (11 Drives) | 323,490 | 1,132 | 6,683 |
| 70/590-12 | Direct Access Storage System (12 Drives) | 348,340 | 1,232 | 7,186 |
| 70/590-13 | Direct Access Storage System (13 Drives) | 373,190 | 1,331 | 7,690 |
| 70/590-14 | Direct Access Storage System (14 Drives) | 398,040 | 1,431 | 8,193 |
| 70/590-15 | Direct Access Storage System (15 Drives) | 422,890 | 1,530 | 8,697 |
| 70/590-16 | Direct Access Storage System (16 Drives) | 447,740 | 1,629 | 9,200 |
| 5519 | Multichannel Switch | 5,770 | 15 | 141 |
| 5520 | Dual Access | 87,500 | 201 | 1,855 |
| 8519-002 | Direct Access Storage System (2 Drives) | 69,850 | 212 | 1,346 |
| 8519-003 | Direct Access Storage System (3 Drives) | 79,895 | 275 | 1,473 |
| 8519-004 | Direct Access Storage System (4 Drives) | 100,000 | 360 | 1,955 |
| 8519-005 | Direct Access Storage System (5 Drives) | 113,800 | 445 | 2,279 |
| 8519-006 | Direct Access Storage System (6 Drives) | 123,895 | 530 | 2,326 |
| 8519-007 | Direct Access Storage System (7 Drives) | 142,725 | 625 | 2,750 |
| 8519-008 | Direct Access Storage System (8 Drives) | 158,950 | 720 | 3,063 |
| 8440-00 | Disc Drive (1 Drive) | 29,856 | 153 | 622 |
| 5033-00 | 8440 Controller | 79,380 | 434 | 1,669 |
| F1470-00 | Dual Channel | 4,176 | 16 | 87 |
| F1482-00 | Dual Access (requires two 5033-00 Controllers) | 2,268 | 5 | 46 |

* Rental prices do not include equipment maintenance.

UNIVAC Series 70

EQUIPMENT PRICES

| | | Purchase Price | Monthly Maint. | Rental (1-year lease)* |
|--------------------------------|---|----------------|----------------|------------------------|
| MAGNETIC TAPE | | | | |
| 70/432-1 | Magnetic Tape Units (30KB) 800 BPI, 9 track, single channel | \$ 28,720 | \$ 153 | \$ 566 |
| 70/432-2 | Magnetic Tape Units (30KB) 800 BPI, 9 track, dual channel | 28,720 | 153 | 566 |
| 5465 | 7/9 Channel Tape Feature (For 70/432-1, -2) | 945 | 5 | 19 |
| 70/441-1 | Magnetic Tape Unit, 7-track, single channel | 35,965 | 190 | 705 |
| 70/441-2 | Magnetic Tape Unit, 7 track, dual channel | 35,965 | 190 | 705 |
| 70/442-1 | Magnetic Tape Units (60KB) 800 BPI, 9 track, single channel | 43,105 | 230 | 846 |
| 70/442-2 | Magnetic Tape Units (60KB) 800 bpi, 9 track, dual channel | 43,105 | 230 | 846 |
| 5464 | 7/9 Channel Tape Feature (For 70/442-1, -2) | 945 | 5 | 19 |
| 70/445-1 | Magnetic Tape Station (120KB) 800 BPI, 9 track, single channel | 37,065 | 199 | 731 |
| 70/445-2 | Magnetic Tape Station (120KB) 800 BPI, 9 track, dual channel | 37,065 | 199 | 731 |
| 5463 | Auto. Run to BT Marker (For 70/445-1, -2) | 470 | 2 | 8 |
| 70/451-1 | Magnetic Tape Unit (60KB) 1600 BPI, phase enc., single ch. (9 Track) | 37,695 | 199 | 720 |
| 70/451-2 | Magnetic Tape Unit (60KB) 1600 BPI, phase enc., dual ch. (9 Track) | 38,745 | 204 | 739 |
| 70/453-1 | Magnetic Tape Unit (120KB) 1600 BPI, phase enc., single ch. (9 Track) | 52,605 | 275 | 1,004 |
| 70/453-2 | Magnetic Tape Unit (120KB) 1600 BPI, phase enc., dual ch. (9 Track) | 53,550 | 281 | 1,022 |
| 70/463-108 | Tape Controller Single Channel 1x8 (7/9 tracks) | 43,260 | 98 | 895 |
| 70/463-116 | Tape Controller, Single Channel 1x16 (7/9 tracks) | 71,295 | 160 | 1,474 |
| 5414-1 | 381/382 Tape Mode | 785 | 2 | 16 |
| 5415-1 | Pack/Unpack Feature | 2,575 | 6 | 53 |
| 70/463-208 | Tape Controller, Dual Channel 2x8 | 57,330 | 129 | 1,187 |
| 70/463-216 | Tape Controller, Dual Channel 2x16 | 92,975 | 209 | 1,926 |
| 5414-2 | 381/382 Tape Mode | 1,525 | 3 | 31 |
| 5415-2 | Pack/Unpack Feature | 4,355 | 9 | 90 |
| 70/472-108 | Tape Controller, Single Channel 1x8 (9 track) | 35,650 | 81 | 738 |
| 70/472-116 | Tape Controller, Single Channel 1x16 (9 track) | 68,775 | 155 | 1,424 |
| 70/472-208 | Tape Controller, Dual Channel 2x8 (9 track) | 49,720 | 112 | 1,029 |
| 70/472-216 | Tape Controller, Dual Channel 2x16 (9 track) | 89,145 | 200 | 1,843 |
| 70/473-108 | Tape Controller, Single Channel 1x8 (7/9 track) | 38,220 | 86 | 789 |
| 70/473-116 | Tape Controller, Single Channel 1x16 (7/9 track) | 71,295 | 160 | 1,474 |
| 70/473-208 | Tape Controller, Dual Channel 2x16 (7/9 track) | 92,975 | 209 | 1,926 |
| 70/473-216 | Tape Controller, Dual Channel 2 x 16 (7/9 track) | 92,975 | 209 | 1,926 |
| 5402-1 | Pack/Unpack Feature for 70/473-108 or 116 | 2,575 | 6 | 53 |
| 5402-2 | Pack/Unpack Feature for 70/473-208 or 216 | 4,355 | 9 | 90 |
| 70/476-108 | Tape Controller, Single Channel 1x8 (9 track, 1600 BPI) | 40,845 | 92 | 845 |
| 70/476-116 | Tape Controller, Single Channel 1x16 (9 track, 1600 BPI) | 74,340 | 167 | 1,536 |
| 70/476-208 | Tape Controller, Dual Channel 2x8 (9 track, 1600 BPI) | 60,270 | 135 | 1,244 |
| 70/476-216 | Tape Controller, Dual Channel 2x16 (9 track, 1600 BPI) | 99,855 | 226 | 2,065 |
| 5431-1 | BiModal for 70/476-108, -116 | 12,915 | 29 | 266 |
| 5431-2 | BiModal for 70/476-208, -216 | 15,435 | 35 | 317 |
| 0862-04 | Uniservo 16 Tape Unit | 19,609 | 116 | 459 |
| F0937-01 | Dual Density (Bi-Modal) | 2,448 | 0 | 51 |
| F1319-00 | Dual Access (requires two 5034-00 controllers) | 2,448 | 10 | 51 |
| 0864-00 | Uniservo 20 Tape Unit | 27,696 | 132 | 577 |
| F1510-00 | Dual Access (requires two 5034-00 controllers) | 2,448 | 10 | 51 |
| 5034-00 | Uniservo 20 (and 16) Control Unit | 36,720 | 95 | 765 |
| F0826-99 | 9-Track NRZI (Bi-Modal) | 6,552 | 21 | 133 |
| CARD INPUT/OUTPUT UNITS | | | | |
| 70/232 | Card Reader (300 CPM) | 18,585 | 91 | 326 |
| 5340 | 600 CPM Feature | 2,415 | 14 | 42 |
| 5341-1 | Mark Read—Vertical | 7,350 | 37 | 130 |
| 5341-2 | Mark Read—Slant | 7,350 | 37 | 130 |
| 5204-2 | Column Binary | 1,525 | 10 | 28 |
| 70/234-10 | Card Punch (100 CPM) | 22,945 | 148 | 400 |
| 70/234-11 | Card Punch (100 CPM) Col. Binary | 28,825 | 183 | 498 |
| 5213 | Scored Card Feature | 525 | 3 | 8 |
| 70/236-10 | Card Punch (300 CPM) | 38,220 | 248 | 659 |
| 5215-1 | Scored Card Feature | 525 | 3 | 8 |
| 5261-1 | Programmed Stacker Select | 1,050 | 5 | 18 |
| 70/236-11 | Card Punch (300 CPM) Col. Binary | 44,100 | 284 | 763 |
| 5215-1 | Scored Card Feature | 525 | 3 | 8 |
| 5261-2 | Programmed Stacker Select | 1,050 | 5 | 18 |

* Rental prices do not include equipment maintenance.

UNIVAC Series 70

EQUIPMENT PRICES

| | | Purchase Price | Monthly Maint. | Rental (1-year lease)* |
|--|--|-------------------|-------------------|------------------------------|
| CARD INPUT/OUTPUT UNITS (Continued) | | | | |
| 70/237-10 | Card Reader (1435 CPM) | \$ 33,130 | \$ 200 | \$ 585 |
| 70/237-21 | Card Mark-Reader (Vertical) | 42,055 | 253 | 743 |
| 70/237-22 | Card Mark-Reader (Slant) | 42,055 | 253 | 743 |
| 5269 | Column 81 Inhibit (all 237's) | 53 | 0 | N/A |
| 5202 | 51 Column Card Feature (all 237's) | 525 | 3 | 8 |
| 5204-1 | Column Binary Feature (all 237's) | 1,525 | 10 | 28 |
| 5211-1 | End of File Feature (all 237's) | N/C | N/C | N/C |
| 5309 | Inhibit Leading Edge Check (all 237's) | 53 | 0 | N/A |
| PRINTERS | | | | |
| 70/242-10 | Printer, Medium Speed (625 LPM) | 45,835 | 250 | 601 |
| 70/242-20 | Printer, Medium Speed (625 LPM) | 61,110 | 334 | 879 |
| 70/242-30 | Printer, Medium Speed (Drum, 625 LPM) 132 Col. | 48,405 | 264 | 590 |
| 70/242-40 | Printer, Medium Speed (Drum, 625 LPM) 160 Col. | 63,685 | 347 | 869 |
| 70/243-10 | Printer, Hi-Speed (1250 LPM) | 50,925 | 275 | 927 |
| 70/243-20 | Printer, Hi-Speed (1250 LPM) | 66,200 | 357 | 1,205 |
| 70/243-30 | Printer, Hi-Speed (Drum, 1250 LPM) 132 Col. | 53,500 | 288 | 972 |
| 70/243-40 | Printer, Hi-Speed (Drum, 1250 LPM) 160 Col. | 68,775 | 370 | 1,250 |
| 70/243-51 | Printer, Hi-Speed (833 LPM) 132 Col. | 63,685 | 343 | 1,160 |
| 70/243-61 | Printer, Hi-Speed (833 LPM) 160 Col. | 78,960 | 424 | 1,436 |
| 5221 | Dual Speed Form Advance | 5,090 | 23 | 95 |
| 5333-1 | Form Stacker (for Modals 70/242-30, -40 & 70/243-30, -40, -50, -51, -61) | 1,525 | 5 | 28 |
| 70/246-050 | Printer (Train 450 LPM) | 74,600 | 466 | 487 |
| 70/246-100 | Printer (Train 750 LPM) | 76,100 | 498 | 879 |
| 70/246-200 | Printer (Train 1200 LPM) | 77,600 | 524 | 1,367 |
| 6746 | Print Train | 3,500 | Time & Materials | 132 |
| 70-248-11 | Bill Feed Printer | 88,985 | 549 | 1,481 |
| 5216 | Interchangeable Print Chain | 3,280 | Time & Materials | 84 |
| 70/249-11 | Bill Feed Printer Control | 52,765 | 119 | 1,091 |
| MISCELLANEOUS INPUT/OUTPUT UNITS | | | | |
| 70/221-10 | Paper Tape Reader/Punch (200/100 CPS) | 25,465 | 153 | 450 |
| 5219-10 | Advanced Sprocket 6-Level Read | 2,365 | 14 | 40 |
| 5256 | Long Block Indicator (All 221's) | 995 | 5 | 19 |
| 5292 | 4-N Terminate (All 221's) | 1,995 | 12 | 36 |
| 5296 | Read Kleinschmidt Format (All 221's) | 1,995 | 12 | 36 |
| 5297 | End of Tape (All 221's) | 500 | 3 | 8 |
| 5298 | Gapless Mode (All 221's) | 500 | 3 | 8 |
| 5299 | Punched Kleinschmidt Format (All 221's) | 1,735 | 10 | 31 |
| 70/221-11 | Paper Tape Reader/Punch (Read/Write EBCDIC) | 26,775 | 161 | 471 |
| 5219-11 | Advanced Sprocket 6-Level Read | 2,365 | 14 | 40 |
| 70/221-20 | Paper Tape Reader/Punch (Advanced Sprocket Punch) | 28,300 | 171 | 497 |
| 5219-10 | Advanced Sprocket 6-Level Read | 2,365 | 14 | 40 |
| 70/221-21 | Paper Tape Reader/Punch (Advanced Sprocket Punch EBCDIC) | 29,665 | 178 | 519 |
| 5219-11 | Advanced Sprocket 6-Level Read | 2,365 | 14 | 40 |
| 70/224-10 | Paper Tape Reader (1000 CPS) | 28,035 | 169 | 494 |
| 70/224-11 | Paper Tape Reader (1000 CPS EBCDIC) | 29,350 | 176 | 516 |
| 5264 | Long Block Indicator | 995 | 5 | 19 |
| 5273 | Supply Reel Reverse | 995 | 5 | 19 |
| 5293 | 4-N Terminate | 1,995 | 12 | 36 |
| 70/272-10 | MICR Sorter-Reader Controller for Burroughs B 103 or B 116 | 30,555 | 69 | 636 |
| DATA COMMUNICATIONS | | | | |
| 70/310-21 | Standard Interface Switch (one 1x2) | 4,410 | 10 | 90 |
| 70/310-22 | Standard Interface Switch (two 1x2) | 8,765 | 19 | 180 |
| 70/310-23 | Standard Interface Switch (three 1x2) | 13,125 | 30 | 270 |
| 70/310-24 | Standard Interface Switch (four 1x2) | 17,535 | 39 | 358 |
| 70/310-25 | Standard Interface Switch (five 1x2) | 21,895 | 49 | 450 |
| 70/310-26 | Standard Interface Switch (six 1x2) | 26,305 | 58 | 537 |
| 70/310-27 | Standard Interface Switch (seven 1x2) | 30,660 | 68 | 630 |
| 70/310-28 | Standard Interface Switch (eight 1x2) | 35,020 | 78 | 717 |
| 5305 | Cascaded Switch Connector | 210 | 0 | N/A |
| 70/325-2 | Telegraph Switch Unit | 1,310 | 3 | 25 |
| 70/326-2 | Data Set Switch Unit | 4,935 | 12 | 103 |
| 70/326-3 | Data Set Switch Unit | 4,935 | 12 | 103 |
| 5303 | Cable Set | 525 | 1 | 10 |
| 70/327-2 | Data Gathering Switch Unit | 5,435 | 15 | 110 |

*Rental prices do not include equipment maintenance.

UNIVAC Series 70

EQUIPMENT PRICES

| DATA COMMUNICATIONS (Continued) | | Purchase Price | Monthly Maint. | Rental (1-year lease)* |
|---------------------------------|--|-------------------|-------------------|------------------------------|
| 70/350-2 | Switch Controller (2 processors) | \$ 24,255 | \$ 54 | \$ 502 |
| 70/350-3 | Switch Controller (3 processors) | 29,350 | 63 | 605 |
| 70/350-4 | Switch Controller (4 processors) | 34,440 | 75 | 713 |
| 5304 | Extended Cable | 63 | 0 | N/A |
| 70/356 | Communication Line Switch Adapter | 3,885 | 8 | 79 |
| 70/510-11 | Voice Response Unit | 25,465 | 72 | 516 |
| 5514-11 | Voice Line Expansion | 7,925 | 22 | 160 |
| 70/510-21 | Voice Response Unit | 30,555 | 86 | 621 |
| 5514-21 | Voice Line Expansion | 10,185 | 29 | 206 |
| 70/510-26 | Voice Response Unit | 40,740 | 114 | 826 |
| 5514-26 | Voice Line Expansion | 13,545 | 38 | 273 |
| 70/627-10 | Data Exchange Control | 22,995 | 52 | 476 |
| 70/653-25 | Communication Control | 15,275 | 35 | 317 |
| 70/653-26 | Communication Control | 15,275 | 35 | 317 |
| 70/653-34 | Communication Control | 15,275 | 35 | 317 |
| 70/656 | Communication Control—Single Channel | 21,735 | 60 | 414 |
| 5628 | Auto Call Feature | 1,235 | 3 | 24 |
| 5630-1 | Line Adapter | N/C | N/C | N/C |
| 5630-2 | Line Adapter | N/C | N/C | N/C |
| 9141-00 | Communication Controller—Multi-Channel (16 lines) | 35,650 | 127 | 706 |
| 9141-01 | Communication Controller—Multi-Channel (32 lines) | 45,835 | 163 | 906 |
| 9141-02 | Communication Controller—Multi-Channel (48 lines) | 56,020 | 199 | 1,112 |
| 0973-00 | Standard Interface Adapter | 12,960 | 56 | 270 |
| 5617-1 | Telex Operation | 2,470 | 7 | 50 |
| 5618 | ANSII Block Check Character | 985 | 3 | 20 |
| 5620 | Timer Restart/Interval Selector | 735 | 2 | 16 |
| 5622 | Message Separation | 495 | 1 | 10 |
| 5623 | OW-Unshift and Transmit Ignore | 495 | 1 | 10 |
| 5624 | Time Reset | 735 | 2 | 16 |
| 5634 | DGS Operation | N/C | N/C | N/C |
| 5635 | Synchronous Call Duplex Operation | 985 | 3 | 20 |
| 70/710 | Telegraph Buffer | 1,365 | 4 | 26 |
| 70/712 | Telegraph Low Level Buffer | 1,945 | 5 | 38 |
| 70/715 | Parallel Buffer | 1,945 | 5 | 38 |
| 70/717 | Parallel Data Set Buffer | 4,935 | 15 | 100 |
| 5717 | Auto Call Feature | 995 | 3 | 20 |
| 70/720-11, 21, 22, & 23 | ADS Buffer | 2,156 | 6 | 43 |
| 5705 | Auto Call Feature | 995 | 3 | 20 |
| 70/721 | SDS Buffer | 2,155 | 6 | 43 |
| 5714-1 | Full Duplex Operation | 500 | 1 | 10 |
| 5714-2 | Full Duplex Operation | 500 | 1 | 10 |
| 70/722 | STR Buffer | 8,975 | 24 | 176 |
| 70/724 | EDGE Demodulator/Buffer | 2,575 | 7 | 52 |
| 70/725 | DGS Buffer (Metropolitan) | 5,435 | 15 | 110 |
| 70/740-11 | Data Terminal, 300 LPM, 80 Col. | 38,980 | 181 | 773 |
| 70/740-12 | Data Terminal, 600 LPM, 80 Col. | 48,825 | 209 | 969 |
| 70/740-21 | Data Terminal, 300 LPM, 132 Col. | 42,525 | 195 | 846 |
| 70/740-22 | Data Terminal, 600 LPM, 132 Col. | 52,290 | 222 | 1,041 |
| 5642 | Mark Read (ANSII/BINARY)—Vertical | 7,915 | 22 | 161 |
| 5643 | Mark Read (ANSII/BINARY)—Slanted | 7,915 | 22 | 161 |
| 70/741 | Card Reader, 300 CPM (for 70/740) | 9,450 | 43 | 188 |
| 5753 | Card Reader Adapter | 1,180 | 5 | 23 |
| 70/751-10 | Video Data Terminal, Std. Keyboard | 2,960 | 14 | 53 |
| 70/751-11 | Video Data Terminal, Key-punch Keyboard | 2,960 | 14 | 53 |
| 70/751-12 | Video Data Terminal, Upper and Lower Case Alphas | 3,255 | 15 | 59 |
| 70/751-12 | Video Data Terminal, Upper and Lower Case Alphas | 3,255 | 29 | 58 |
| 5770-2 | Connector Kit | 42 | 0 | N/A |
| 70/752 | Video Data Terminal | 6,720 | 45 | 123 |
| 5707 | Station Selection | 785 | 3 | 17 |
| 5710 | Data Format | 785 | 3 | 17 |
| 5711 | Printer Adapter | 1,050 | 4 | 22 |
| 70/755 | Video Data Switch | 5,195 | 19 | 124 |
| 70/756-11 | Video Data Generator (8 VDT's) | 10,855 | 45 | 200 |
| 70/756-21 | Video Data Generator (4 VDT's) | 8,885 | 39 | 161 |
| 70/756-31 | Video Data Generator (2 VDT's) | 7,895 | 34 | 145 |
| 5716 | Data Format | 395 | 2 | 6 |
| 70/759-11 | Video Data Controller; multiplexer connection only | 23,690 | 87 | 439 |
| 70/759-21 | Video Data Controller; communications connection | 15,790 | 56 | 295 |

* Rental prices do not include equipment maintenance.