NCR 8400, 8500 and 8600 Systems

MANAGEMENT SUMMARY

In a move echoed by most of the major computer vendors, NCR unveiled a completely revamped mid-range family of computers in its 8000 Series. The February 17, 1982 announcement of the V-8500 Group II systems underscores NCR's commitment to compete aggressively in the IBM 4300 Series marketplace. The seven new models extend the upper and lower performance limits of the previous V-8500M product line, and provide up to 66 percent better price/performance than the older systems, according to NCR. Prior to the V-8500 Group II announcement, NCR quietly repackaged its V-8455, the top of its 8400 family, into the V-8455 Group II, with improved performance and a full megabyte of memory, for only $39,890. NCR also slashed the price of a megabyte of memory from $22,300 to $14,100, a move that should make the new V-8500 Group II systems quite competitive.

The 8400 Series includes the I-8415, I-8435, and V-8455-II, which are designed primarily for interactive and batch processing. Both the IRX (Interactive Resource Executive) and VRX (Virtual Resource Executive) operating systems use virtual memory techniques. NCR's Century operating systems can also run on the three processors simply by changing the processor firmware. The 8400 Series can compete with such systems as the IBM System/38, Burroughs B-1900, and Hewlett-Packard HP3000-III (I-8415 and I-8435), as well as the IBM 4331-1 (V-8455). There are over 1,000 installations of the 8400 Series in the U.S.

The 8500 Series, originally introduced April 1976, is now the seven-model Group II family of systems, and includes the uniprocessor V-8535-II, V-8545-II, V-8555-II, and V-8565-II, and the dual processor V-8575-II, V-8585-II, ▷

NCR recently announced its new V-8500 Group II systems, which feature better price/performance than the previous V-8500M product line. The smaller 8400 Series and the large-scale V-8600 Series mainframes round out this diverse family of computers that can support batch, interactive, transaction, and distributed processing environments.

MODELS: I-8415, I-8435, V-8455-II, V-8535-II, V-8545-II, V-8555-II, V-8565-II, V-8575-II, V-8585-II, V-8595-II, V-8650, and V-8670.

CONFIGURATION: Depending on product line, one to four CPUs, 256K to 16,384K bytes of memory, and a wide assortment of I/O devices and available.

COMPETITION: Burroughs B 1900 through B 6900; Digital Equipment DECsystem-10 and -20; Hewlett-Packard HP 3000; Honeywell DPS 7 and DPS 8 Series; IBM System/38, 4300 and 303X Series, and 3083 Systems; Univac System 80, 1100/60 and 1100/80 Series.

PRICE: Purchase prices range from $38,575 (I-8415) to $1,675,000 (V-8670).

CHARACTERISTICS

MANUFACTURER: NCR Corporation, Dayton, Ohio 45479. Telephone (513) 445-5000.

CURRENT MODELS: I-8415, I-8435, V-8455-II, V-8535-II, V-8545-II, V-8555-II, V-8565-II, V-8575-II, V-8585-II, V-8595-II, V-8650, V-8670. ▶
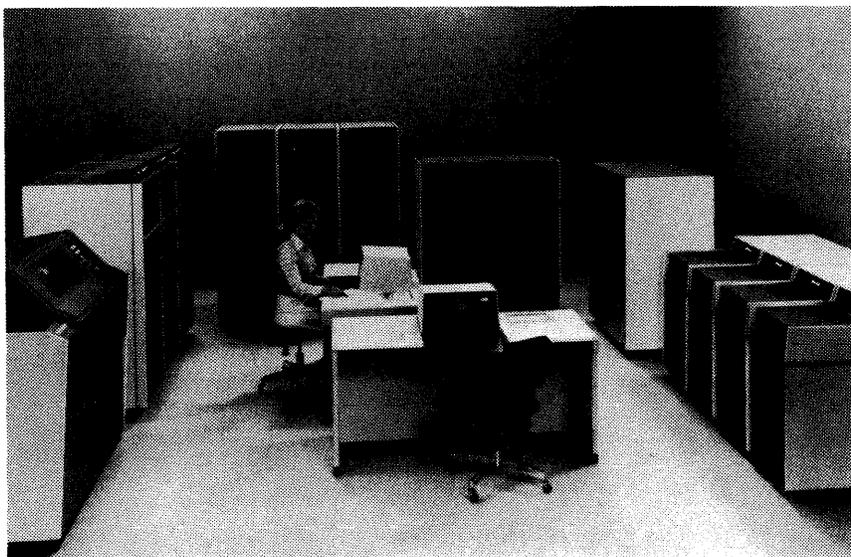
NCR's new V-8500 Group II Series includes seven models that can have from one to four CPUs, one to eight megabytes of memory, and a wide range of I/O devices. Performance is comparable to the IBM 4300 Series.

NCR 8400, 8500 and 8600 Systems

NCR 8400, 8500, AND 8600 SYSTEMS CHARACTERISTICS

	I-8415	I-8435	V-8455-II	V-8535-II	V-8545-II	V-8555-II
SYSTEM CHARACTERISTICS						
Date of introduction	March 1980	March 1980	4th Qtr. 1981	Feb. 1982	Feb. 1982	Feb. 1982
Number of main processors	1	1	1	1	1	1 to 4
Active Production	Yes	Yes	Yes	Yes	Yes	Yes
Relative performance level, approximate	NA	NA	0.48	0.53	0.75	1.00
System firmware	IS3	IS3	VS1, RS1	VS1, RS1	VS1, RS1	VS1, VS2, RS1
Operating systems	IRX	IRX	VRX, B1, B2, B3	VRX, B1, B2, B3	VRX, B1, B2, B3	VRX; VRX/MP, B1, B2, B3
Basic system rental, per month	$1,406	$1,787	$1,795	$2,930	$3,115	$4,095
MAIN PROCESSOR						
Cycle time, nanoseconds	112	112	112	112	84	56
Dynamic address translation hardware	No	No	Yes	Yes	Yes	Yes
Floating-point assist	No	No	Yes	Yes	Yes	Yes
VRX assist (instruction lookahead)	No	No	No	No	No	No
Instruction storage capacity, bytes	24K	24K	96K	24K	24K	24K
Upgradeable to	I-8435	—	—	V-8545-II	V-8555-II	V-8565-II
MAIN STORAGE (All MOS, error correcting)						
Memory circuitry	16K chip	16K chip	16K chip	16K, 64K chip	16K, 64K chip	16K, 64K chip
Cycle time, nanoseconds (write)	475	475	440	440	440	440
Minimum capacity, bytes	256K	256K	512K	1,024K	1,024K	1,024K
Maximum capacity, bytes	1,024K	1,024K	1,024K	1,024K	2,048K	4,096K
Increment size, bytes	256K	256K	256K	NA	1,024K	1,024K
Interleaving	None	None	None	None	None	2-way
I/O CONTROL						
Integrated disk control	Optional	Optional	Optional	Optional	Optional	Optional
Maximum disk subsystems per controller	1 string of 8 drives	1 string of 8 drives	3 strings of 8 drives	3 strings of 8 drives	3 strings of 8 drives	3 strings of 8 drives
Maximum no. of common trunks	2	2	4	4	6	6
Common trunk data rates, bytes/sec:						
Low-speed trunk	40KB	40KB	40KB	50KB	75KB	100KB
Medium-speed trunk	None	None	None	150KB	225KB	315KB
Very high-speed trunk	1150KB	1150KB	1150KB	1000KB	1200KB	1200KB
I/O Link Controllers	Yes	Yes	Yes	Yes	Yes	Yes
COMMUNICATIONS CONTROL						
Integrated comm. control, max. lines	20	20	20	20	20	20
External comm. control, max. lines	256	256	256	256	256	256

▷ and V-8595-II. All systems use the VRX virtual memory operating system which can also run programs written for Century systems without recompiling. The price/performance of these systems ranges through the IBM 4300 Series product line. The V-8555-II and V-8565-II uniprocessors can be connected into tightly-coupled MP (multiprocessor) configurations of from two to four processors. The V-8575-II, V-8585-II, and V-8595-II, which are already tightly-coupled dyadic systems, can be connected with another system of the same type to form a four-processor configuration. NCR's multiprocessor systems share a single copy of VRX/MP, the multiprocessor version of VRX. At the present time there are over 900 installations of 8500 systems in the U.S.

NCR's top-end processors, the V-8650 and V-8670, offer substantial performance increases over the largest V-85X5-II systems and can operate in the range of 3 to 5 MIPS (million instructions per second). The V-8650 is a uniprocessor and the V-8670 is a tightly-coupled dual- ▷

► **PRIOR MODELS:** I-8410, I-8430, V-8455, V-8555M, V-8565M, V-8575M, V-8585M.

DATE OF INTRODUCTION: See characteristics chart.

DATA FORMATS

BASIC UNIT: 8-bit byte. Each byte can represent 1 alphanumeric character, 1 or 2 BCD digits (in unpacked or packed format, respectively), or 8 binary bits. Four consecutive bytes form a "word."

FIXED-POINT OPERANDS: Can range from 1 to 256 bytes in length, in either decimal or binary mode. A "word binary" mode is available that takes particular advantage of the system's 4-byte adders; each 4-byte word is treated as a signed 31-bit integer.

FLOATING-POINT OPERANDS: Consist of a 7-bit exponent and a 24-bit fraction in the single-precision format and a 7-bit exponent and 56-bit fraction in the double-precision format.

INSTRUCTIONS: 4 or 7 bytes in length, specifying 1 or 2 memory addresses, respectively. ►

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NCR 8400, 8500, AND 8600 SYSTEMS CHARACTERISTICS

	V-8565-II	V-8575-II	V-8585-II	V-8595-II	V-8650	V-8670
SYSTEM CHARACTERISTICS						
Date of introduction	Feb. 1982	Feb. 1982	Feb. 1982	Feb. 1982	Nov. 1978	Nov. 1978
Number of main processors	1 to 4	2 or 4	2 or 4	2 or 4	1	2
Active Production	Yes	Yes	Yes	Yes	Yes	Yes
Relative performance level, approximate	1.25	1.65	2.08	2.48	5.00	12.50
System firmware	VS1, VS2, RS1	VS2	VS2	VS2	VS1	VS2
Operating systems	VRX, VRX/MP, B1, B2, B3	VRX/MP, B3	VRX/MP, B3	VRX/MP, B3	VRX B3	VRX/MP, B3
Basic system rental, per month	$6,913	$8,812	$12,265	$16,890	$43,580	$62,060
MAIN PROCESSOR						
Cycle time, nanoseconds	56	56	56	56	28	28
Dynamic address translation hardware	Yes	Yes	Yes	Yes	Yes	Yes
Floating-point assist	Yes	Yes	Yes	Yes	Yes	Yes
VRX assist (instruction lookahead)	Yes	No	Yes	Yes	Yes	Yes
Instruction storage capacity, bytes	32K	64K	64K	64K	96K	192K
Upgradeable to	—	V-8585-II	V-8595-II	—	V-8670	—
MAIN STORAGE (All MOS, error correcting)						
Memory circuitry	16K, 64K chip	16K, 64K chip	16K, 64K chip	16K, 64K chip	64K chip	64K chip
Cycle time, nanoseconds	440	440	440	440	380	380
Minimum capacity, bytes	2048K	2048K	2048K	4096K	4096K	4096K
Maximum capacity, bytes	6144K	6144K	6144K	8192K	8192K	16,384K
Increment size, bytes	1024K	1024K	1024K	2048K	2048K	2048K, 4096K
Interleaving	4-way	4-way	4-way	4-way	4-way	4-way
I/O CONTROL						
Integrated disk control	Optional	Optional	NA	NA	NA	NA
Maximum disk subsystems per controller	3 strings of 8 drives	3 strings of 8 drives	NA	NA	NA	NA
Maximum no. of trunks common	8	8	8	8	2; up to 32 channels	2; up to 32 channels
Common trunk data rates, bytes/sec:						
Low-speed trunk	100KB	100KB	100KB	100KB	50KB	50KB
Medium-speed trunk	315KB	315KB	315KB	315KB	None	None
Very high-speed trunk	1200KB	1200KB	1200KB	1200KB	1100KB	1100KB
I/O Link Controllers	Yes	Yes	Yes	Yes	Yes (CCP)	Yes (CCP)
COMMUNICATIONS CONTROL						
Integrated comm. control, max. lines	20	NA	NA	NA	NA	NA
External comm. control, max. lines	256	256	256	256	256	256

▷ processor system. NCR claims the V-8650 should be comparable to the IBM 3033S and the V-8670 is comparable to the new IBM 3083 in performance. Both systems use VRX exclusively. The V-8600 family was introduced in November, 1978, and initial deliveries occurred in the fourth quarter of 1981.

NCR's 8400, 8500, and 8600 systems are designed to operate in batch, transaction-oriented, interactive, remote job entry (RJE), and distributed processing environments. The VRX operating system supports multiprogramming with as many as 35 jobs operating concurrently.

PROCESSORS AND PERIPHERALS

The 8400, 8500, and 8600 Series processors are microcode based and make extensive use of emitter-coupled logic (ECL) circuitry. The system architectures in all three product families are based on a high-speed Internal Transfer Subsystem, an internal bus with speeds of up to ▷

▶ **MAIN STORAGE**

STORAGE TYPE: Metal oxide semiconductor (MOS). The 8400 and 8500 series currently use 16K memory chips, and the V-8600 is based on 64K chips. The new V-85X5-II models will use 64K chips later in 1982.

CAPACITY: The main memory capacity of each of the 8400, 8500, and 8600 systems is stated in the characteristics charts.

CYCLE TIME: See characteristics charts.

CHECKING: All data paths between the central processor and main storage are parity-checked by byte. When data is stored, an error-correcting code is substituted for the parity bits. When the data is retrieved, single-bit errors are detected and corrected automatically, and most multiple-bit errors are detected and signaled so that appropriate program action can be taken.

STORAGE PROTECTION: The segment table origin register guards against inadvertent overriding and/or ▶

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72 million bytes per second. Various processor and peripheral subsystems, such as the Memory Subsystem and Common Trunk Subsystem, are connected to the internal bus for improved system flexibility. Each processor's "personality," or operating mode, is controlled by three different types of firmware: Interactive, Century-emulation, and Virtual. Interactive (on "I" systems) firmware is used in on-line transactional or interactive processing, and is used on I-8400 Series systems only. Century emulation (on "N" systems) firmware permits batch processing, multiprogramming, on-line transaction processing, and is used on 8400 and 8500 systems. Virtual (on "V" systems) firmware uses virtual memory techniques that provide greater internal processing capabilities and better system resource management. The virtual firmware is available in the 8400, 8500, and 8600 systems. The V-8455-II, V-85X5-II, and V-8600 systems are designed specifically to use "V" firmware.

Various processor subsystems can be attached to the common Internal Transfer Subsystem. The Memory Subsystems use either 4K, 16K, or 64K MOS memory chips. Memory cycle times range from 380 to 440

PERIPHERAL AVAILABILITY FOR 8400, 8500, and 8600 SYSTEMS

	I-8415	I-8435	V-8455-II	V-8535-II	V-8545-II	V-8555-II	V-8565-II	V-8575-II	V-8585-II	V-8595-II	V-8650	V-8670
DISK STORAGE UNITS												
658			•	•	•	•	•	•	•	•	•	•
6530	•	•	•	•	•	•	•	•	•	•	•	•
6540	•	•	•	•	•	•	•	•	•	•	•	•
6550			•	•	•	•	•	•	•	•	•	•
6590	•	•	•	•	•	•	•	•	•	•	•	•
MAGNETIC TAPE UNITS												
633			•	•	•	•	•	•	•	•	•	•
634	•	•	•	•	•	•	•	•	•	•	•	•
635	•	•	•	•	•	•	•	•	•	•	•	•
636	•	•	•	•	•	•	•	•	•	•	•	•
6370			•	•	•	•	•	•	•	•	•	•
CARD EQUIPMENT												
684 Card Reader/Punch			•	•	•	•	•	•	•	•	•	•
6831 Card Reader	•	•	•	•	•	•	•	•	•	•	•	•
PRINTERS												
646	•	•	•	•	•	•	•	•	•	•	•	•
647	•	•	•	•	•	•	•	•	•	•	•	•
649	•	•	•	•	•	•	•	•	•	•	•	•
6420	•	•	•	•	•	•	•	•	•	•	•	•
MICR EQUIPMENT												
675	•	•	•	•	•	•	•	•	•	•	•	
6780			•	•	•	•	•	•	•	•	•	
PAPER TAPE												
660 Tape Reader			•	•	•	•	•	•	•	•	•	•
665 Tape Punch			•	•	•	•	•	•	•	•	•	•
COMMUNICATIONS												
621 Controller			•	•	•	•	•	•	•	•	•	•

unauthorized reading of data in specified blocks of storage. This register is standard in all V-8400, V-8500, and V-8600 systems.

CACHE MEMORY: The V-8600 systems have a cache memory for high-speed access to the most recently stored activities in memory. The V-8650 has a 32K-byte cache and the V-8670 uses a 128K-byte cache.

MEMORY INTERLEAVING: This feature is provided on all systems, and allows either two or four contiguous words to be read from or written to memory without accessing any memory module continuously for more than a single cycle. It also permits multiple simultaneous memory access from several subsystems. Four-way interleaving is provided in the V-8565-II, V-8575-II, V-8585-II, V-8565-II, and both V-8600 systems. The V-8555-II has two-way interleaving, and the V-8535-II and V-8545-II do not use interleaving.

CENTRAL PROCESSORS

The Central Processing Units for the 8400, 8500, and 8600 series systems are built around an Internal Transfer Subsystem, or high-speed bus, onto which major system components are connected. The processors make extensive use of emitter-coupled logic (ECL) circuitry.

A Processor Subsystem is connected to the Internal Transfer Subsystem. The Processor Subsystem operates under firmware control and performs the following functions in all systems: 1) interprets and executes instructions from software; 2) manages data transfer from main memory to peripheral devices; and 3) performs console functions as requested by the operator.

These additional CPU functions are provided by the Processor Subsystem (8400 series), Service Subsystem (8500), and the System Control Unit (8600): 1) firmware loading during start-of-day procedure; 2) peripheral subsystem message management; and 3) system testing diagnostics, and error logging.

Instructions are executed using a three-stage pipeline technique. The three stages are: 1) the fetch stage, which obtains the instruction; 2) the interpret stage, which assembles all necessary operands and decodes the instruction; and 3) the execute stage, which performs the specified operation. It takes three processor cycles to perform an instruction, and all three stages are active, continuously performing their respective functions on three separate instructions. This provides an effective execution rate of one instruction per processor cycle. Both V-8600 systems include a high-speed buffer software unit (32K in the V-8650 and 128K in the V-8670) for increased performance.

Both the 85X5-II and 8600 series offer multiple processor configurations. The V-8575-II, V-8585-II, V-8595-II, and V-8670 are dual-processor systems. Using the VRX/MP (multiprocessing) operating system, up to four processors can be configured on V-8555-II, V-8565-II, V-8575-II, V-8585-II, and V-8595-II systems. NCR's multiprocessing systems are based on a "tightly-coupled" principle, in which all processors 1) share access to all available main memory, 2) communicate with each other via data storage in memory and passing signals between each processor, and 3) operate equally under one copy of the operating system.

Connecting two or more systems into an MP configuration requires an MP kit which contains all the necessary

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▷ nanoseconds. The minimum memory size ranges from 256K bytes on the I-8415 and increases to 4096K on the V-8595-II and both V-8600 systems.

The maximum memory available ranges from 1024K bytes on the I-8415 to 16,384K on the V-8670. All memory subsystems have single-bit error correction and double-bit error detection. A high-speed cache memory is used in both V-8600 systems. I/O devices can be attached to the system via several peripheral subsystems: 1) the Common Trunk Subsystem, used on 8400 and 8500 systems (Trunk Channel Control Processor on V-8600), 2) the Integrated Disk Subsystem, used on the 8400 and 8500 systems, 3) the I/O Link Control Subsystem, used on 8400 and 8500 systems, and 4) the I/O Subsystem, used on the V-8600 systems. These systems can accommodate data transfer rates as high as two megabytes per second.

An optional Communications Subsystem is available on all models to connect remote terminals or satellite processors.

The Processor Subsystem (8400 Series), the Service Subsystem (8500 Series), and the System Control Unit (8600 Series) perform the following functions: 1) firmware loading during start-of-day procedures, 2) peripheral subsystem control, and 3) system testing and diagnostics.

The current 8400 Series consists of the I-8415, I-8435, and V-8455-II systems. The I-8415 can be field upgraded to the I-8435. The I-8415 and I-8435 have 256K bytes and the V-8455-II has one megabyte of memory standard. All three systems can be expanded to two megabytes. The processor cycle time in all 8400 systems is 112 nanoseconds.

The new V-8500 Group II systems replace the older V-8500M models and provide improved price/performance over their predecessors. Initial installations are scheduled for the fourth quarter of 1982. The seven-model product line includes the entry-level V-8535-II, a one-megabyte system that has about 75 percent of the older V-8555M's performance, and costs half as much. Next in line is the V-8545-II, also a one-megabyte system that has one-third more power than the V-8535-II. It can have up to two megabytes of memory. The V-8555-II has about 40 percent more performance than the V-8545-II, one megabyte of memory, and can be expanded up to four megabytes and four CPUs. The most powerful uniprocessor is the V-8565-II, which as 25 percent more throughput than the V-8555-II. This model features the same 56-nanosecond CPU as the larger dual-processor models, fourway memory interleaving for better performance, and a hardware-based Virtual Assist Unit that can boost virtual memory operations. The V-8565-II has two to six megabytes of memory, and can be expanded to four CPUs. Each of the smaller uniprocessors can be field upgraded to the V-8565-II. ▷

▶ hardware. The MP conversion requires an Interbus Cable between each processor, a 16KB Instruction Storage Unit to hold the larger VRX/MP (also known as VS2) firmware, and a two-sided floppy disk for each processor that contains the VRX/MP firmware. Exceptions to this rule are the V-8575-II, V-8585-II, and the V-8595-II, which are dual-processor systems operating under VRX/MP. The maximum four-processor configurations can be obtained by connecting two of the same model together via an Interbus Communications Adapter. No ISUs are needed.

INDEX REGISTERS: A separate set of 64 32-bit registers is maintained in reserved storage for each active program. The 64-word set associated with the program currently being executed by the processor is brought from memory and contained in a hardware register set.

INSTRUCTION REPERTOIRE: There are two basic system instruction sets: the 8500 Base Virtual Machine and the VRX Virtual Machine. The Base Virtual Machine uses the 71-instruction set found in the NCR Century 300 computer. The VRX Virtual Machine instruction set contains 95 instructions in the uniprocessor (VS1) version, and 103 instructions in the multiprocessor (VS2) version. The following table summarizes the instruction sets for both the Base Virtual Machine and the VRX Virtual Machine:

	Base Virtual Machine	VRX Virtual Machine
Fixed Point Binary	11	11
Decimal Arithmetic	9	9
Move Data	3	6
Logical	8	12
Transfer	13	24
Special	15	17
Input/Output	—	4
Floating Point	12	12

The additional instructions used in the multiprocessor VS2 set are for monitor and control functions within the larger system configuration.

A third virtual machine, the Cobol Virtual Machine, is a language processor that uses a portion of the VS firmware set to process object code generated by the VRX Cobol compiler.

VRX Fortran is available on V-85X5-II (with a hardware assist option) and V-8600 systems for processing ANSI Fortran 77 object code.

The VRX Virtual Machine permits programs currently running on the Base Virtual Machine and NCR Century processors to run on systems using the VRX operating system.

INSTRUCTION STORAGE UNIT (ISU): In all NCR 8400, 8500, and 8600 systems, most of the firmware that directs the system to perform the required functions (as a Century system, interactive processing system, or a virtual memory system) is stored in a high-speed memory called the Instruction Storage Unit. Capacity of the ISU ranges from 24K bytes in the I-8415 to 192K bytes in the V-8670.

TIME OF DAY CLOCK: Used by the software for such functions as providing time indication for operator messages and timing program runs by logging the starting and ending times of program execution.

PERFORMANCE CHARACTERISTICS

NCR's 84X5 and V-85X5-II processors offer higher performance and a lower cost than their 84X0 and V-85X5M predecessors. The I-8415 and I-8435 have more ▶

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▷ At the upper end of the performance scale are three dyadic, or dual-processor systems, the V-8575-II, V-8585-II, and V-8595-II. All models feature 56-nanosecond processor cycle times and from two to eight megabytes of four-way interleaved memory. The V-8575-II has about 20 percent less power than NCR's previous dyadic system, the V-8585M, and costs less than half as much. The V-8585-II has performance comparable to the system's namesake, the V-8585M, yet costs almost 40 percent less. Both the V-8575-II and V-8585-II have two to six megabytes of memory. The largest system is the V-8595-II, which has four to eight megabytes of memory, about 20 percent more power than the V-8585-II, and costs about 15 percent less than the V-8585M. The V-8575-II and V-8585-II can be field upgraded to the V-8595-II. The V-85X5-II uniprocessor models cannot be field upgraded to the dyadic systems since a swapout of CPUs is required.

The top-end 8600 Series has two models: the uniprocessor V-8650 and dual-processor V-8670. The V-8670, as in the other multiprocessor systems, has a tightly-coupled dual-processor configuration that uses a single copy of the VRX/MP operating system. Both the V-8650 and V-8670 have four megabytes of main memory, expandable to eight megabytes in the V-8650 and 16 megabytes in the V-8670. The V-8650 can be field upgraded to the V-8670.

The current 8400, 8500, and 8600 systems can use most of the peripheral devices that have been used on the more mature Century and Criterion systems. Users have a wide variety of peripherals to select from, including five different mass storage devices ranging from 10 megabytes up to 1.1 gigabytes, five tape drives with numerous configurations, a large assortment of low-, medium- and high-speed printers, and various unit record and MICR devices. The peripheral availability chart in this report provides greater detail on peripheral device applications.

Communications with remote terminals and remote hosts can be achieved via the Integrated Communications Subsystem (ICS) and the 621-103 Communications Multiplexer. The ICS provides up to 20 lines for on-line remote communications with terminals operating at from 50 to 9600 bps. The free-standing 621-103 Communications Multiplexer can accommodate a mix of asynchronous and synchronous lines up to 255 lines. Asynchronous lines can handle devices ranging up to 9600 bps, and synchronous lines can accommodate up to 56,000 bps speeds.

SOFTWARE AND SUPPORT

A choice of three basic operating systems is available for the 8400, 8500, and 8600 systems. The Interactive Resource Executive (IRX) is a virtual-memory system, used on 8400 Series processors only, which provides full interactive processing capabilities. Batch processing can also be supported. As many as 75 interactive users can communicate with the system.

To provide a migration path for existing NCR Century B1, B2, or B3 operating systems, certain 8400 and 8500 ▷

▶ power than the I-8410 and I-8430, and compete with the IBM System/38, Burroughs B-1900, and the Hewlett-Packard HP 3000-III. The V-8455-II has more power than the N- and V-8450 systems and is comparable in performance to the IBM 4331-1. The V-8535-II has 25 percent less power than the V-8555M, and the V-8545-II has one-third more than the V-8535-II. The V-8555-II has 40 percent more processing power than the V-8545-II, and is comparable to the IBM 4331-II. The V-8565-II has 25 percent more power than the V-8555-II, and compares with the Burroughs B 5930. The V-8575-II has about 20 percent less power than the V-8585M and is comparable to the IBM 4341-1. The V-8585-II has about the same power as the V-8585M, and about one-third more performance than the IBM 4341-1. The top-end V-8595-II has about 20 percent more power than the V-8585-II, and is comparable in performance to the IBM 4341 Model Group 11. According to NCR, dual-processor versions of the V-85X5-II series can provide up to twice the performance of comparable uniprocessor configurations.

The large-scale V-8650 offers more than twice the power of the V-8585-II and 10 percent more power than the IBM 3032. The dual-processor V-8670 is about five times faster than the V-8585-II and is comparable to the IBM 3033 in performance.

INPUT/OUTPUT CONTROL

Input/output control within the 8400 and 8500 systems is provided through three types of subsystems: Common Trunk I/O Subsystems, the I/O Link Controller (IOLC) used on all 84XX and 85XX systems, and the Integrated Disk Subsystem (IDS). The IDS is not used on the V-8575-II, V-8585-II, and V-8595-II.

I/O control on V-8600 systems is maintained by two basic subsystems: Channel Control Processors (CCP) which can control up to 32 peripheral channels, and an optional Trunk Channel Control Processor (TCCP), both of which interface a wide variety of peripherals.

The Common Trunk Subsystem and Trunk Channel Control Processor (TCCP) subsystems all use a combination of low-, medium-, and very high-speed trunks. Each trunk type is designed to handle peripherals with specific data transfer characteristics. Each trunk can attach up to eight I/O devices. Only low-speed and very high-speed trunks can be configured on 8400 and 8600 series processors. Low-, medium-, and very high-speed trunks can be configured on 8500 series processors.

Low-speed trunks provide for single-byte transfers to and from the CPU. The CPU performs the data transfers using reserved memory locations for control registers.

Medium-speed trunks have two major improvements over their low-speed counterparts. The control registers implemented in memory are contained in the trunk circuitry, and a 4-byte interface is used instead of the single-byte interface. The CPU performs the data transfers to and from main memory.

Very high-speed trunks are direct memory access devices that do not require any CPU activity. They include all the features of the medium-speed trunks and also have memory address generation circuitry and up to two stages of data buffering. The very high-speed trunks perform all functions necessary to transfer data to and from main memory.

The I/O Link Controller Subsystem is based on three elements: the I/O Link Controller, I/O Links, and the I/O Link Adapter. The I/O Link Controller (IOLC) can attach up to four peripheral subsystems through I/O links. Up to ▶

NCR 8400, 8500 and 8600 Systems

▷ Series models can function with any of these three operating systems, provided the Century-emulating RS1 or RS3 firmware is used. B-Series applications can be executed without the RS1 firmware if run under the VRX operating system. The Century operating systems can support single-user and multiprogrammed batch operations. Languages supported include Cobol 74, Fortran, RPG, Basic, and NEAT/3 assembler.

When using the Virtual Resource Executive (VRX), the user will effectively have 16 million bytes of storage available for each program, regardless of the real-memory capacity. VRX operates under the VS1 firmware in a uniprocessor system (VS3 in 8400 systems) and the VS2 firmware in a multiprocessor environment. The virtual-memory VRX can also run Century programs with minimal reconfigurations. The current version of VRX is Release 8.

As programs are executed under VRX, it uses special hardware called the Dynamic Address Translator to assign currently active portions of virtual storage to real memory. VRX supports various functions, such as batch, transaction processing, remote job entry (RJE), multiple RJE, direct program access, and on-line program development.

A primary feature of VRX is the data management system called the Criterion Access Method (CAM). CAM fully supports the input/output requirements of the Cobol-74 language and handles three different file organizations: sequential, relative, and indexed. For even greater database management requirements, NCR offers the popular TOTAL, from Cincom Systems, and TOTAL IQL, an interactive query language.

Three compilers are available with VRX: Cobol-74, Fortran 77, and NEAT/VS. The VRX Cobol-74 compiler is an implementation of the ANSI 1974-standard language; it produces object code for the Cobol virtual machine which runs under VRX. The NEAT/VS compiler is compatible with NCR's NEAT/3, a macro-oriented assembly language, and provides programming interfaces to VRX. The Fortran 77 compiler conforms to the ANSI Fortran 77 standards and requires an Extended Hardware Assist feature on all V-85X5-II Series processors.

Transaction processing and on-line program development support are key elements in NCR's product strategies. Leading the transaction processing movement is VRX TRAN-PRO, a general-purpose monitor that utilizes the speed and efficiency of VRX to its maximum benefit. Augmenting TRAN-PRO is VRX TRAN-QUEST, a comprehensive query language that operates either on-line with TRAN-PRO and TOTAL, or in a batch mode with TOTAL. NCR has three systems to facilitate the transition from batch to on-line operations, including VRX Telecomm/Development, which defines the network configuration, VRX TP-Monitor, which provides greater on-line efficiencies, and the EZ-KEY Data Entry System, for improved data entry operations. ▷

▶ four IOLCs can be configured in the V-8455-II and V-8535-II systems, up to six in the V-8545-II and V-8555-II, and up to eight in the V-8565-II, V-8575-II, V8585-II, and V-8595-II. The I/O Link is a coaxial cable that provides a two-megabyte-per-second bit-serial data path between the IOLC and the I/O Link Adapter (IOLA). The IOLA is a buffered interface that provides the timing necessary to connect the peripheral to the IOLC subsystem. Up to four I/O Link Adapters can be attached to an I/O Link Controller.

Channel Control Processors in the V-8600 I/O Subsystem interface directly to main memory via the Internal Transfer Subsystem. All I/O management functions are performed by the CCP with no involvement of the CPU required. Two CCPs are standard, and two are optional. Each CCP has eight channels. Up to 32 channels connect various peripheral subsystems to the CCP through the Dynamic Channel Exchange (DCX), a switching center that provides bit-serial data paths between the peripheral and CCP. Since all CCPs connect to the DCX, the loss of a CCP does not result in the loss of I/O devices. Automatic load leveling is also provided with this arrangement. The maximum data transfer rate over each channel is two megabytes per second. In those situations where an I/O device is not compatible with the CCP, an optional Trunk Channel Control Processor (TCCP) can be used. Up to two NCR common trunks (either low- or very high-speed) can be connected to the TCCP for these devices. The configurations available include either one low-speed or two low-speed, or one low-speed and one high-speed.

The Integrated Disk Subsystem, available on all systems except the V-8575-II, V-8585-II, V-8595-II, and the V-8600, is used primarily for attaching 658 and 6590 disk drives to the system. All 8400 and 8500 systems, depending on the model, can have up to two Integrated Disk Controllers. Each IDC controls one disk drive string with from one to eight spindles per string. The V-8600 connects various high-capacity disk systems via an I/O channel into a Channel Control Processor.

CONFIGURATION RULES: The number of I/O links that can be included with each type of system and the data rates for each type of interface are included in the characteristics charts in this report. On-line operations can be connected via the Integrated Communications Subsystem, or a common trunk. NCR's latest disk subsystems and other associated peripherals are interfaced through a fully-buffered Bit Serial I/O Link Controller. This interface maximizes I/O throughput, lowers I/O and central processor contention, and eliminates the need for common trunk interfaces.

The table on page "d" indicates the peripheral subsystems that are currently offered with each of the 8400, 8500, and 8600 systems.

MASS STORAGE

658 DISK SUBSYSTEM: Provides large-capacity random-access storage with a capacity of either 100 or 200 million bytes. The 658 disk subsystem can be interfaced to all NCR V-8400, 8500, and 8600 systems. The Bit Serial I/O Link Controller/Adapter combination is recommended by NCR. Each IOLC supports up four IOLAs, and each IOLA can handle from one to eight 658 drives. Other interfaces include the Integrated Disk Controller (IDC) and the 625-0301 free-standing controller. The 658 has a head movement time that ranges from 10 to 55 milliseconds and averages 20 to 30 milliseconds for random accesses. Average rotational delay is 8.33 milliseconds, and data transfer rate is 806,000 bytes per second.

6530 DISK SUBSYSTEM: A high-speed fixed/removable system with a 13.5 megabyte removable cartridge and from ▶

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▷ For communications users, VRX also offers a Network Description Language (NDL) to enable on-line configuration modification at execution time rather than at compilation time, thus providing more flexibility in a communications environment. Teletype-compatible devices, bisynchronous line disciplines, and existing Century on-line applications are supported.

Customer Operated Automatic Checkout (COACH) diagnostics, capable of isolating hardware problems to a faulty module, are also available to 8400/8500 users. COACH enables the user to provide advanced information to the NCR field engineer concerning the nature of the problem prior to his/her arrival at the site. A more comprehensive set of diagnostic programs is available to the NCR field engineer for in-depth fault isolation. This on-site diagnostic capability is further enhanced by the use of a remote system console that can, via telephone, connect NCR specialists to the customer's system for even greater levels of diagnosis and analysis.

NCR COMMUNICATIONS
NETWORK ARCHITECTURE

NCR's comprehensive communications network design, NCR/CNA, is composed of software and various services that define NCR's overall network strategy for the 1980s. NCR/CNA includes NCR/Data Link Control protocol, intra-network disciplines, access methods, and other telecommunications functions. The NCR/CNA approach permits each processor to function in an independent or distributed mode, which reduces the need for a centralized host to control the network.

The network protocol, NCR/Data Link Control (NCR/DLC), is a bit-oriented control protocol in accordance with ANSI's ADCCP and ISO's HDLC. NCR/DLC will support SDLC and the protocols of other vendors, such as BSC and TTY. For short-distance communications links, NCR/DLC includes a proprietary, modemless technique for high-speed (48,000 bps) transmission. A Virtual Circuit Interface, based on CCITT's X.25, will also be supported, enabling the network to provide communications links with public packet-switching networks.

CNA's processor access method, NCR/Telecommunications Access Method (NCR/TAM), will provide a standard, transparent telecommunications handler for application programs. The application program interface with NCR/TAM is the ANSI Cobol 74 Message Control System. The functions performed by NCR/TAM include system and link control queue management, resource scheduling, packet header processing, error recovery and reporting, and diagnostic support.

USER REACTION

Datapro received a whopping total of 176 NCR user responses in our 1982 survey of computer users. There were 88 responses from 8400 systems users with a total of 93 systems and 88 from 8500 systems users with a total of ▷

▶ 13.5 to 67.5 megabytes of formatted storage on fixed disks. The 6530-101 has a total of 27.0 megabytes, the 6530-0201 has 54 megabytes, and the 6530-0301 at maximum holds 81 megabytes of storage. The drives are interfaced via the 6539 I/O Link Adapter. Data is transferred at 1.2 megabytes per second. The average rotational delay is 8.33 milliseconds and the head movement time averages 30 milliseconds. The 6530 is designed for 8400, V-8500, and V-8600 systems.

6540 DISK SUBSYSTEM: A high-capacity fixed-disk system that provides up to 135 megabytes of formatted direct access storage on four fixed disks. The system uses Winchester movable-head technology. The 6540-0201 is a single-spindle unit with 135 megabytes and a four-spindle version, the 6540-0801, is available for a maximum of 540 megabytes. The drives are interfaced to 8400, V-8500, and V-8600 systems via the 6549 I/O Link Adapter. Data is transferred at 1.2 megabytes per second. The average rotational delay is 8.33 milliseconds and the head movement time averages 30 milliseconds or less.

6550 DISK SUBSYSTEM: A very high-capacity dual-spindle fixed disk drive that provides up to 1,092 megabytes of formatted storage. The system uses Winchester technology for head movement. As many as four 6550 drives can be connected to V-8500 and V-8600 systems via the 6559 I/O Link Adapter. The 6550 is supported under VRX Release 8 but not under any "N" mode firmware. Programs and files written for Century operating systems can be copied to the 6550 provided they can also run under VRX. Data is transferred at 1.2 megabytes per second. The average rotational delay is 8.33 milliseconds and the average head movement time is 25 milliseconds.

6590 DISK SUBSYSTEM: A dual-spindle system with a capacity ranging from 35 to 140 megabytes of direct access storage. Two different disk modules are available, both using Winchester technology: the 6591-0101 and 6591-0201, with 35 megabytes and 70 megabytes, respectively. The 6590 can be used in all 8400 and 8500 systems (except V-8575-II, V-8585-II, and V-8595-II) and connects via the Integrated Disk Controller subsystem. The 6590 connects to the V-8600 via the Channel Control Processor. The 6590 and 658 disk systems may be intermixed in the same system but not on the same string. Data is transferred at 885,000 bytes per second. The average rotational delay is 10.1 milliseconds and the average head movement time is 25 milliseconds.

INPUT/OUTPUT UNITS

633 MAGNETIC TAPE SYSTEM: Six models of 633 Series tape units are offered. Data transfer rates range from 10,000 to 240,000 bytes/sec. All use standard 1/2-inch tape, have vacuum-capstan drives, and use photocell sensing. Up to 8 tape units can be connected to a 624-type control unit. The various drives record on either a 7-track NRZI or 9-track PE/NRZI format. Packing densities on 7-track drives are 200, 556, or 800 bpi; and 800 and 1600 bpi on 9-track systems. Tape speeds are 50 ips on 7-track drives and 50, 90, and 150 ips on 9-track drives.

634 MAGNETIC TAPE SYSTEM: The NCR 634 Series tape units provide low-speed tape handling capabilities for 7- and 9-track magnetic tape. The 634 Series employs a "master/slave" operating technique in which each "master" unit contains a tape drive, the control electronics, and the trunk interface, and can control up to three additional "slave" units each containing a tape drive and associated read/write electronics. The following units are available:

634-117: 7 tracks; NRI; 200/556/800 bits/inch; 5,000/13,900/20,000 chars/second. The tape speed is 25 ips.

634-119: 9 tracks; NRZI, phase encoded, or dual mode (phase encoded and NRZI); 1600 bytes/inch (phase encoded ▶

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102 systems. The user population consisted of a wide variety of business types, with manufacturing, distribution, financial institutions, and municipal government represented most frequently. The primary applications were traditional financial and payroll/personnel operations, although many others were mentioned. The average installed time was two years for both the 8400 and 8500 systems. Purchases and rentals from NCR were about even at slightly under 40 percent, and third-party leases averaged about 23 percent. Just about everyone used Cobol as the primary programming language, with NCR's NEAT/3 a close second. The 8400 systems users preferred the NCR Century operating system over IRX by better than two to one, and VRX by almost four to one. The 8500 systems users preferred VRX over the Century operating systems by a substantial margin. Most users developed their applications programs in-house, with the purchase of NCR-developed programs almost as popular. The user responses for both the 8400 and 8500 systems are presented in the charts below.

8400 Systems	Excellent	Good	Fair	Poor	WA*
Ease of Operation	26	49	9	1	3.18
Reliability of mainframe	50	35	1	2	3.51
Reliability of peripherals	30	42	10	5	3.11
Responsiveness of maintenance service	42	35	7	4	3.31
Effectiveness of maintenance service	26	42	14	5	3.02
Technical Support					
Trouble-shooting	3	43	30	9	2.47
Education	5	42	25	12	2.48
Documentation	6	37	32	11	2.44
Operating Systems	20	53	12	3	3.02
Compilers and Assemblers	16	52	15	4	2.92
Applications Programs	5	37	28	5	2.56
Ease of Programming	21	45	15	5	2.95
Ease of Conversion	24	40	16	4	3.00
Overall Satisfaction	15	59	10	3	2.99

and NRZI); 1600 bytes/inch (phase encoded)/800 bps per inch (NRZI); 40,000/20,000 bytes/sec. The tape speed is 25 ips.

634-215/205: 9 tracks; phase encoded; 1600 bytes/inch; 80,000 bytes/sec. The tape speed is 50 ips.

634-219: 9 tracks; NRZI, phase encoded, or dual mode (phase encoded and NRZI); 1600 bytes/inch (phase encoded)/800 bytes/inch (NRZI); 80,000/40,000 bytes/sec. The tape speed is 50 ips.

635 MAGNETIC TAPE SYSTEM: The NCR 635 magnetic tape units are high-performance, 9-track tape drives that can read or write data with either the NRZI or phase encoded recording techniques. Up to eight Model 635 magnetic tape units can be connected to a 624-401 control unit. Features available with the Model 635 drives include automatic tape reel latching and automatic tape threading. Two models are available:

635-109: 9 tracks; 1600 bytes per inch (phase encoded)/800 bytes/inch (NRZI); 160,000/80,000 bytes/sec. The tape speed is 100 ips.

635-209: 9 tracks; 1600 bytes/inch (phase encoded)/800 bytes/inch (NRZI); 320,000/160,000 bytes/sec. The tape speed is 200 ips.

636 CASSETTE TAPE SUBSYSTEM: Consists of a controller and one or optionally two cassette handlers. Each cassette cartridge contains approximately 280 feet of tape with two parallel recording tracks, only one of which can be accessed at a time. The capacity of each track is 2040 80-character blocks or 984 256-character blocks. Recording density is 800 bits per inch in phase-encoded mode, tape speed is 7.5 inches per second, and data transfer rate is 750 characters per second.

7649 GENERAL PERIPHERAL CONTROLLER: Supports a 15-inches-per-second cassette drive, a diskette drive, and connects to the NCR common trunk interface.

6370 MAGNETIC TAPE SYSTEM: There are three high-performance models in the 6370 series, each of which uses either the 9-track 1600-bpi PE or 6250-bpi GCR recording format. Their characteristics are as follows:
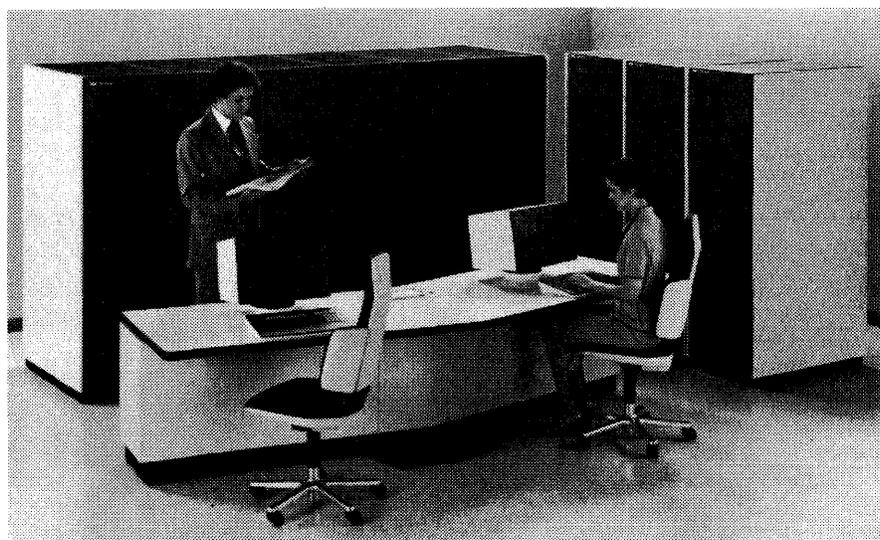
At the top of NCR's product line is the dual-processor V-8670, with 4 megabytes of memory, expandable to 16 megabytes. Processing speed is in the range of five MIPS (million instructions per second), making the V-8670 comparable to the IBM 3033. All NCR systems are air cooled.

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8500 Systems	Excellent	Good	Fair	Poor	WA*
Ease of Operation	43	39	4	1	3.43
Reliability of mainframe	47	36	4	1	3.47
Reliability of peripherals	29	50	7	1	3.23
Responsiveness of mainte-nance service	34	40	11	3	3.19
Effectiveness of mainte-nance service	25	45	16	2	3.06
Technical Support					
Trouble-shooting	10	44	23	9	2.64
Education	7	53	22	4	2.73
Documentation	5	48	27	7	2.59
Operating Systems	26	51	7	4	3.13
Compilers and Assemblers	18	58	11	1	3.06
Applications Programs	9	36	27	4	2.66
Ease of Programming	18	56	13	1	3.03
Ease of Conversion	34	37	9	5	3.18
Overall Satisfaction	21	56	10	1	3.10

*Weighted average for NCR 8400 and 8500 systems based on a scale of 4.0 for excellent.

We also asked the NCR users two final questions: "Did the system measure up to your expectations?" and, "Would you recommend it to another user?" Better than 80 percent of the 8400 users and 90 percent of the 8500 users felt their systems performed as they had expected. Less than 10 percent were unsatisfied with their computers. Almost 80 percent of the 8400 users and 85 percent of the 8500 users said they would recommend their systems to others. Again, less than 10 percent in both user groups answered "no" to this question. While statistics tell an important story, personal observations from NCR users can be even more beneficial. Accordingly, Datapro telephoned several NCR 8400 and 8500 users for their comments.

We first called on a clothing manufacturer in the southeast using an I-8415 for several different applications. Their previous system was an NCR 8250, and the conversion was "really smooth." The system runs under IRX, and currently has seven terminals on-line with an average response time of one to two seconds. They are going to isntall the next release of IRX when it becomes available, and are expecting a big boost in throughput. The hardware is now working very well after a bout with system errors. NCR literally worked around the clock and corrected the problems. Both hardware and software support are "great." The company's spokeswoman told us the 8415 "has really changed their business," affording them plenty of room for growth.

Moving north, we called on the DP director of a municipal government in the midwest who told us his V-8455 is a "terrific" machine. They experienced a "painless" upgrade from an older Century system, and had only four hours downtime during the conversion. The 8455 uses the Century B3 multiprogramming operating system with most applications still batch. The installation of VOSS-3 has helped to convert some of their jobs to interactive, but it's still a slow process, he told us. The big story is the substantial increase in peformance the 8455 provides. A full shift has been eliminated, and they are now performing a service bureau function to other ▷

6370-0401: 1600 (PE)/6250 (GCR); 75 ips; 120,000/468,750 characters/second.

6370-0601: 1600 (PE)/6250 (GCR); 125 ips; 200,000/781,250 characters/second.

6370-0801: 1600 (PE)/6250 (GCR); 200 ips; 320,000/1,250,000 characters/second.

Each drive is connected to V-8455-II, V-85X5-II, and V-8600 systems via a 6379 I/O Link Adapter. Each 6379 can have up to four drives connected. Drives with different speeds cannot be mixed on the same I/O Link Adapter. Automatic threading is standard.

684-101/301 CARD READ/PUNCH: Reads 80-column cards serially at speeds of up to 500 cpm and punches column-by-column at 100 to 460 cpm, depending on the number of columns punched in each card. The Model 684-301 operates as a card punch only and can be field-upgraded to a Model 684-101 card read/punch unit. Both Hollerith and binary code can be read and punched, either in one pass or in separate passes. Can operate as a card reader, card punch, or reader/punch for updating punched card files. Has a 1200-card input hopper and a 1300-card output stacker plus a card offset capability. Attaches to a position on a common trunk.

6831 SERIES CARD READER: Includes two tabletop-mounted units: the 600-cpm 6831-0201, which is available on all 8400 and 8500 systems, and the 1000-cpm 6831-0301. Both models read standard 80-column punched cards and translate each card column into one 8-bit ASCII character. Both units employ the shine-through reading technique and use light-emitting diodes and photo-transistors in the read station. Capacity of both input and output hoppers is 1000 cards.

660-101 PUNCHED TAPE READER: Reads 5-, 7-, or 8-channel tape at 1500 char/sec. Uses photoelectric read cells with either continuous or start/stop operation with a rewind rate of 150 inches/sec. Does not require a controller.

665-101 TAPE PUNCH: Punches 5-, 7-, or 8-channel tape at 200 char/sec. Operates in either continuous or start/stop modes.

646-201 TRAIN PRINTER: Prints at up to 1,200 lines per minute with 16, 20, 44, or 48 character sets and somewhat slower speeds with 52, 57, 64, or 96 character sets. Maximum speed in the burst mode is 2,500 lines per minute with a 16-character set. Has 132 print positions. Print spacing of 6 or 8 lines per inch is available. Has an integrated controller for attachment to a common trunk or IOLC.

647-201 TRAIN PRINTER: Prints at a peak speed of 2,000 lines per minute with a set of up to 48 characters, and at 3,500 lines per minute in the burst mode with a 16-character set. Can be equipped with 16, 20, 44, 46, 48, 52, 57, 64, or 96 character sets. Prints at 6 or 8 lines per inch in 132 print positions. Includes an integrated controller similar to the 646-201.

649-300 LINE PRINTER: A fully buffered 132-column drum printer with a maximum print speed of 300 lpm. The unit employs the standard 64-ASCII-character set. Data is transferred between the print buffer and the I/O control at 9100 bytes per second. The 649-300 printer uses single-part or multiple-part continuous forms that range from 4 to 20.5 inches in width and up to 22 inches in length.

6420 SERIES LINE PRINTERS: Include three band printers, the 300-lpm 6420-0101, the 600-lpm 6420-0201, and the 900-lpm 6420-0301. All versions are 132-position units and feature the 64-ASCII-character set. Models 6420-0101 ▶

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▷ communities in the area with the additional power. Uptime is usually 95 percent or better, and the only negative comments he made were problems with disk and tape drives, and NCR training programs. Service is "excellent," and they are going to add 658-type disks this year to support the increased on-line work.

Our first 8500 Series user was a manufacturing firm in the northeast using a V-8555M with VRX. Conversion from the previous V-8455 was "no problem at all—we just transferred the disk." There's an even mix of batch and interactive jobs at present and the DP manager told us he feels he has plenty of power to be virtually 100 percent on-line. "VRX goes with the 8555 very well," he told us, and the 17 CRTs on-line now generally get 1.0- to 1.5-second response times. He is "really sold" on the NCR products, especially since he has IBM in his past. Hardware support is "excellent," and software support "good, but it could be better." He felt VRX has "grown so fast" in the last few years that his NCR reps haven't always been able to keep up with it. Current plans include a second CPU and more CRTs. He has experienced no problems with his installation.

Since NCR's heritage is in the banking industry, our final call went to the DP director of a large northeastern savings and loan with a recently-installed four-processor V-8585 MP, the top of the line. The conversion from a V-8575M was very easy and the new processors will give the firm "plenty of power for new applications." All their operations are on-line, with 150 terminals all over the state, and the average response time is two seconds. They currently have Release 7 of VRX, and Release 8 is on the way. Previously they were using Century B3, and the director told us there is "no comparison" between B3 and VRX—the newer product runs circles around the older. Automated Teller Machines have been installed recently, and will pave the way for even more sophisticated products, he told us. The 8585 has had no problems at all, since they did extensive benchmarking before ordering the system. Hardware and software support are "excellent," and he felt the 8585 offered "very good" price/performance.□

▶ and -0201 offer compressed-pitch print as well as industry-standard 132-character lines on standard 8.5-inch paper. The 6420 Series printers all connect directly to common trunk or IOLC interfaces.

670-101 MICR SORTER/READER: Reads MICR-encoded documents of intermixed sizes, thicknesses, and paper weights at up to 600 documents per minute. Has 11 pockets capable of holding up to 225 items each. Also usable for offline sorting. Consists of a 622-401 controller and a 404-111 sorter.

671-101 MICR SORTER/READER: Reads MICR-encoded documents at up to 1200 per minute. Has 18 pockets. An endorser feature is available as an option. Also usable for off-line sorting. Includes a controller.

675-101 MICR SORTER/READER: Similar to the 670-101 in operation but reads documents at up to 750 6-inch documents per minute. The 675-101 can be used on-line and off-line. The controller is indexed.

6781-0101 DOCUMENT READER/SORTER: A 14-pocket unit that can operate at sorting speeds ranging from 800 to 1440 dpm, depending on the length of the processed items. Packets can be added in 10-packet increments for a total of 34 packets. Throughput for standard 6-inch documents is 1400 documents per minute. The 6781 sorts varying sizes of documents encoded in the E-13B font, and can be operated in either on-line or off-line mode.

COMMUNICATION CONTROL

INTEGRATED COMMUNICATIONS SUBSYSTEM: The Integrated Communications Subsystem provides up to 20 lines for on-line/real-time communications with remote devices using various transfer rates. The ICS links the computer system with remote terminals through either public or private communications networks. Integrated microprocessors (Communications Line Controllers), controlled by firmware, supervise the access, transmission, and output to and from the terminals in the system. A multiplexer or front-end processor can be added to the system to handle additional communications lines. The Integrated Communications Subsystem is available in all 8400 and 8500 systems except the V-8585-II and V-8595-II.

621-103 COMMUNICATIONS MULTIPLEXER: This system is capable of handling 15, 127, or 253 lines, using centralized character parity assembly and stripping, plus centralized block checking (CBC), cyclic redundancy checking (CRC), and function code control. A Hardware-Assisted Software Queue (HASQ) feature is also available to help identify the terminals. The 621-103 connects to the Common Trunk Subsystem. The 621-103 simultaneously handles both synchronous and asynchronous devices using various transmission codes and speeds. Asynchronous devices can operate at 16 speeds ranging from 45 to 2400 bits/sec, and synchronous devices at speeds ranging from 600 to 50,000 bits/sec.

692-600 ASYNCHRONOUS LINE ADAPTER: An interface device that connects the 621-103 Communications Multiplexer to one or more terminals. It can handle half- and full-duplex transmissions at speeds ranging from 45 to 4800 bits per second. It meets both EIA RS-232-C and CCITT V.24 data communications interface standards.

693-600 SYNCHRONOUS LINE ADAPTER: An interface device that connects the 621-103 Communications Multiplexer to a data set for synchronous data transmissions. It can handle half- and full-duplex modes at speeds ranging from 600 to 50,000 bits per second. It meets both EIA RS-232-C and CCITT V.24 data communications interface standards.

7900 VISUAL DISPLAY TERMINAL: The 7900 Model 1 Terminal is a microprocessor-based CRT that operates asynchronously and can communicate with all 8400, 8500, and 8600 systems. The CRT has a 12-inch diagonal display with 25 lines of 80 characters each. It uses a 7 x 7 dot matrix display and features five cursor controls, blinking, reverse video, and underlining. The keyboard can generate a full 128-characater ASCII set and includes a numeric pad. The 7900 can operate in either half- or full-duplex mode, and transmits at speeds ranging from 50 to 19,200 bits per second. The terminal has an EIA/20mA current loop interface and a serial interface for printers.

SOFTWARE

OPERATING SYSTEM: NCR offers three operating systems for the 8400 and 8500 Series computers: NCS, VRX, and IRX. The V-8600 systems use VRX only. Each of these control programs emphasizes one of the application areas (NCR Century Emulation, virtual memory systems, or interactive processing systems) for which the processors can be optimized. ▶

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▶ **NCR CENTURY SOFTWARE:** The NCS operating mode is a superset of the Century B1, B2, and B3 operating systems, and is compatible with Century software at the object-code level. Each B-series operating system consists of a Monitor, an Executive, and several other routines. The Monitor controls the sequencing, loading, and linking of programs. The Executive is a run-time supervisor that handles all I/O operations, error conditions, and program overlays.

Basic Executive (B1): All Century computers can use the basic B1 operating system. This system handles batch-mode processing of one program at a time. The B1 system consists of a Monitor, an I/O executive, and Disk Management, Log, and Display routines.

On-Line Operating Executive (B2): Usable on all Century systems with at least 32K bytes of main storage, this operating system divides main memory into two distinct areas which can be used for processing either two concurrent batch programs or one communications program plus one background batch program.

VIRTUAL RESOURCE EXECUTIVE: VRX is a group of software modules that utilize the VS1, VS2, or VS3 firmware to make up a flexible operating system with multiprocessing, virtual-machine, and virtual-storage capabilities, while remaining compatible with existing NCR Century programs. VRX supports multiple-processor systems and treats processing elements in the system as assignable resources. The current level of VRX is Release 8.

VRX uses virtual storage, allows supervisor routines to map main memory to disk, and allows executing programs to be relocated between main storage and secondary storage without directly involving the executing program itself. Using paging supervisor routines, VRX reads scheduled jobs from the page file on disk and writes changed pages back to disk as necessary. It attempts to optimize memory usage globally by allocating only enough real memory to a job to ensure efficient execution, releasing unused memory as soon as it becomes available.

In a virtual storage environment, a 16-million-byte virtual address space is available to each active job. Eight million bytes are used in common by the executive and certain software for all programs, and are referred to as the global software area. The remaining eight million bytes (local area) are used by the individual job for programs and data.

VRX monitors memory demands and performance for the entire job mix in order to detect excessive paging in or out (thrashing) and system underutilization. If it detects thrashing, the paging supervisor can reduce the number of active jobs; if it detects underutilization, it can activate new jobs and increase the system workload. Memory utilization statistics are recorded for every run and can be used to tune the system.

VRX multiprocessing (VRX/MP) enables the system to schedule and run multiple jobs at the same time by automatically allocating the peripherals, memory, and processor as needed. Each job may contain one or more related programs. Jobs are described to the system using a Job Control Language made up of Job Specification Language (JSL) statements and Monitor Control Language (MCL) statements. The Job Specification Language statements are used to define the hardware and media requirements of the job, while the Monitor Control Language statements identify the programs within each job and specify any run-time conditions for those programs. VRX permits users to assume as little or as much control over job processing as needed. Most scheduling, allocation, and processing decisions can be made by the software itself.

The VRX software, together with the virtual-storage firmware, enables the system to perform like two different machines using two different firmware instruction sets. The basic instruction set, called the Base VRX Instruction Set, makes the VRX system compatible with NCR Century systems and provides an interface for the virtual-storage software, while the optional VRX Cobol Instruction Set is designed to process VRX Cobol object code. A firmware routine automatically switches between the two firmware instruction sets as needed.

Virtual-storage firmware and software enable user programs, compilers, application software, and utility routines to run on the system without regard to the number of processors or the total amount of real memory. Only the active code of each program is in real memory during program processing.

The processor and memory space are assigned dynamically, and the operating software is also brought into memory only when needed and assigned space where available. There are no fixed processor assignments, no fixed partitions, and no fixed areas in real memory for software or program code. All inactive software and program code is stored in the Page File. Page sizes may be 1024 bytes, 2048 bytes, 4096 bytes, or 8192 bytes.

When a job is first introduced into the VRX system, the executive stores job specifications and any data cards for the job in a card spool file on disk and then validates the specifications. Once in the system, the job progresses through three distinct phases: scheduling, execution, and output. During the scheduling phase, a job can be in any of several states. Between acceptance and specification validation, it is in an unprocessed state. Following validation, if specifications indicate that execution should be delayed until some event such as operator action or completion of another job has occurred, the system will place the job temporarily in a hold state. Otherwise, the job enters the scheduling state, where it is placed in a scheduled job queue to await execution. The order in which jobs are placed in the queue is determined by the priority given in the specifications. As memory and peripherals become available, VRX software accesses the scheduled job queue and attempts to execute the highest-priority job. If sufficient memory and peripherals are not available to execute the highest-priority job, the software scans the remaining jobs on the queue to see if any of these can be executed with the available resources.

When a job passes to the execution phase, it competes with other jobs in the execution mix for processor and shared resource time. Up to 35 jobs may be in the execution mix at one time, with resource allocation being determined by execution priorities assigned in job specifications. During execution, control and user data are supplied on demand from the card input spool file. Print file output is also normally spooled on disk or, optionally, magnetic tape. When a job completes the execution phase, the executive releases all the peripherals and memory space that were used.

The job then enters the output phase, where it remains until its spooled print files have been printed. Job printing order is likewise determined by priorities assigned in the job specifications. At the end of the output phase, job accounting information is entered into the log and the job is removed from the system.

VRX provides two separate logs: a hardware log and a system log. The hardware log contains information valuable to the field engineer for system maintenance, while the system log contains operation and statistics messages that can be used for job accounting and performance evaluation. ▶

NCR 8400, 8500 and 8600 Systems

▶ VRX provides several levels of error recovery systems, each designed for specific applications. These facilities include a CAM (Criterion Access Method) file error recovery sytem, which uses CAM utilities to restore CAM files if an error occurs. There is also a batch recovery sytem, called Rescue/Restart, that enables a program to be continued from a previously defined rescue point instead of at the start.

VRX also provides for system recovery if an error condition results in the need to initialize the software again. A special Recovery Initialization system (REINIT) causes the software to save important system information such as spooled files before initialization so that currently active jobs can be started again.

The VRX System Peformance Measurement utility monitors the entire system's performance levels and produces printed reports to that effect in graphic or tabular format.

The Virtual Resource Executive incorporates facilities for handling NCR Century Series files, including sequential files, standard disk files, chained disk files, indexed sequential files, and NCR random filing system files. It uses a file management technique called the Criterion Access Method (CAM) that has been specifically designed for high performance under VRX with applications programmed in Cobol 74 and NEAT/VS. The CAM file structure minimizes reorganization and allows rapid insertion of records, eliminating many of the inefficiencies inherent in traditional random and indexed sequential accessing methods.

A high-level user programming language for file and record manipulation, file maintenance, data protection, and processing recovery is also provided. The access method has been designed to meet Cobol 74 requirements for sequential, indexed, and relative file processing. Since record and key lengths are variable and records with identical keys are permitted, CAM allows records to be designed in the most natural manner, and at the same time reduces external storage requirements.

The VRX Remote Job Entry subsystem (RJE) enables jobs to be input to the central computer system from remote locations by telephone communications lines; printer output is returned to the remote locations over the same lines. A remote terminal can also send messages to the central system or to any other terminal in the system.

VRX provides an On-line Program Development utility to generate source programs from as many as eight remote locations. The program may be compiled and run on the remote terminal. This utility also permits a user to create and run a catalogued job or disk control string from a remote location, to access spooled print files, and to communicate with executing VRX jobs.

The VRX Base System Package provides standard batch operating systems functions. Specfically, it can compile programs written in VRX Cobol-74, sort and merge various types of files, utilize NCR disk subsystems such as the 658, 6530, 6540, and 6550 with the capability of accessing greater than 64K disk sectors, perform general housekeeping functions, provide system performance data, analyze Cobol programs to maximize program efficiency, and provide improved disk storage management in a real-time environment.

The VRX Telecomm/Development Package permits the migration of a batch system to an on-line environment through user definition of the network configuration, user development of the on-line application, and direct user access to VRX print spool files and the VRX executive software.

To further enhance the VRX Telecomm/Development software, the VRX TP-Monitor Package provides transparency of the system to I/O devices, making it easier to change I/O units; improved job scheduling routines, and improved security measures.

Another tool to facilitate the change from batch to on-line is the EZ-KEY Data Entry System. Data enters the system through user-defined formats and is stored in the EZ-KEY data entry file. The system controls and validates the input data via batch totals, range checks, check digits, and arithmetic operations. Various utilities are provided to deal efficiently with batch data, and system performance statistics are available at the user's discretion.

VRX TRAN-PRO is a general purpose transaction processing monitor that supports on-line applications in a real-time environment. TRAN-PRO uses the VRX virtual memory to increase overall throughput and interfaces VRX tasking and dynamic storage allocation functions to decrease application program requirements. It operates in conjunction with the VRX Message Control System (MCS) to route the remote inputs into the TRAN-PRO system. VRX TRAN-PRO can be implemented in 8400, 8500, and 8600 systems.

Another element in the NCR on-line transaction processing environment is VRX TRAN-QUEST, a comprehensive query language. TRAN-QUEST has three modules: the Data Dictionary, which stores the contents and structure of the data bases; a Data Manager, which manipulates the data base for desired information; and the Query Processor, which provides both formatted and free-form inquiries. VRX TRAN-QUEST operates on one to two modes: on-line associated with VRX TRAN-PRO and VRX TOTAL, or in a batch environment with VRX TOTAL.

TOTAL: This popular data base management system, developed by Cincom Systems, Inc., is marketed and supported by NCR at an initial license fee of $31,350 per single-processor installation plus a monthly license fee of $1,122. TOTAL is described in detail in Report 70E-132-01.

NCR also offers the TOTAL IQL interactive query language, a non-procedural data retrieval language designed for use by non-programmers. The retrieval language permits users to direct inquiries to nearly any data file at any time. A data dictionary language allows the data base manager to limit specific user access to data at the field level by assigning passwords or access codes. TOTAL IQL is offered with TOTAL for an initial license fee of $15,675 plus a monthly license fee of $561.

INTERACTIVE RESOURCE EXECUTIVE: IRX is a virtual-memory operating system designed for use in interactive processing environments with up to 75 CRT workstations. User jobs are broken down into segments that range from 256 to 65,536 bytes in 256-byte increments. These job segments reside on disk until required and are classified as shareable data segments, private data segments, shareable code segments, and private code segments. The segments are also further classified as read-only, write-only, or execute-only to provide protection between various process segments.

Jobs and job steps are assigned for execution priorities according to three priority classifications: high-priority, low-priority interactive, or batch. Process selection is done on a time-slice basis that prevents batch jobs from excluding interactive jobs.

IRX supports three types of disk files: permanent files, spool files, and scratch files. Permanent files can be assigned generation numbers that range from 0 to 256. This dating ▶

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► technique allows users to maintain several versions of a file and to delete specific versions if desired. The IRX file management system supports three file organizations: sequential files, indexed files, and relative files. A dynamic mode of operation allows a file to be accessed both sequentially and/or randomly. Sequential files and index files may contain fixed or variable-length records, while relative files are limited to fixed-length records. IRX performance is also enhanced by overlapping disk accesses that allow seek functions to be initiated on several disk spindles simultaneously.

IRX features a two-level job control language that permits the use of a "privileged" job control command set as well as the normal command set. At system generation time, JCL commands can be deleted from the command set for additional security. Terminal privileges can also be set during run time from any privileged terminal by using the SET MASK command.

The IRX executive software is shareable so that only one copy is required for all interactive jobs.

COMPILERS AND ASSEMBLERS: VRX processes programs from several different compilers, such as NEAT/3, NEAT/VS, Century Cobol-68, Century Cobol-74, VRX Cobol, Fortran 66, VRX Fortran 77, and NCR RPG. Certain compilers are designed to generate object code for B-series operating systems: NEAT/3, Century Cobol-68, Century Cobol-74, Century Fortran, and NCR RPG. The remaining compilers (NEAT/VS, VRX Cobol, and VRX Fortran) are designed for the VRX virtual-storage operating system. B-series compilers generate object code which can be loaded and run by the VRX operating system. VRX compilers generate object modules which are then processed by the VRX Linkage Editor before loading and processing.

COBOL 74: Meets both ANSI and federal requirements for Cobol 74, providing the highest level of support for most modules and medium-level support for all other modules.

FORTRAN: Several levels of implementation of Fortran are supported, up to the full ANS level plus the following extensions: mixed-mode arithmetic, an unlimited number of dimensions in an array, random READ and WRITE statements, and extensions to the CALL statement. Basic Fortran (Fortran II), Intermediate Fortran (1130 compatible), Fortran IV, and Fortran E (Educational) are available on all systems. VRX Fortran 77 is available only on V-8500 and V-8600 systems.

ASSEMBLER: NEAT/3 is NCR's assembler language. Strong emphasis is placed upon the use of macro-instructions to facilitate coding. NEAT/3 Level 1 is a subset of NEAT/3 that provides an easy-to-learn programming language and fast compilation. NEAT/VS is an enhanced version of NEAT/3 that includes all the features of the original language plus extensions to exploit the virtual memory features of the VRX-based systems. Generally, the enhancements permit mixing of older Century programs with those written for execution under the newer operating systems. NEAT/VS can also process Century chained files, indexed-sequential files, or random files as well as the Criterion Access Method (CAM) files.

BASIC: A compiler for Basic, an algebraic language designed for time-sharing computers, can be used only on the NCR 8400 and 8500 computers. Programs are compiled as they are entered from remote teletypewriters and can be executed immediately. Diagnostic messages permit on-the-spot correction of many errors. An accounting routine facilitates billing by recording the amount of computing time used by each programmer at each terminal.

TELECOMMUNICATIONS

VRX provides telecommunications software that has been designed to simplify the application programmer's task by alleviating the concern for network configurations and communications protocols. The Message Control System is a high-level interface that allows on-line programs to transmit messages using logical source/destination names with no reference to terminal characteristics. It consists of five verbs—SEND, RECEIVE, ENABLE, DISABLE, and ACCEPT (message count)—that reference an MCS queue list. NDL statements specify terminals and communication links. These statements are used by the Network Definition Language Processor to create the tables necessary for on-line operation. The tables are subsequently combined with programs at load time by the Link Editor.

NCR's communications structure is called the NCR Communications Network Architecture (CNA). It is designed around the concept of logical addresses for each communicating location, without regard for local line configurations and system protocols. The network is essentially transparent to the user. Message flow is regulated by all nodes in the network, rather than a single host, resulting in better use of processing power throughout the network.

NCR/CNA uses NCR/DLC, SDLC, BSC, X.25, or TTY communications protocols. NCR/DLC is similar to ANSI/ADCCP and ISO/HDLC protocols, and will be compatible with IBM's SDLC. The NCR Telecommunications Access Method (NCR/TAM) software provides the gateway from the field terminal to the application program, and typically uses the Cobol Message Control System (MCS).

APPLICATION PROGRAMS: NCR offers "packaged" programs to handle key applications in manufacturing, food processing, wholesale distribution, retailing, schools, financial institutions, hospitals, and local government. Among the application programs available to users are:

Commercial Accounts Receivable
Retail Accounts Receivable
Accounts Payable
Payroll and Personnel Management
Medical Audit Statistics System (Mass)
Hospital Accounts Receivable
Hospital Clinical Analysis
Inpatient Accounting
Post-Discharge Accounts Receivable
Stewardship and Management Accounting
Student Scheduling and Grade Reporting
Student Test Analysis
Utility Billing
Department Store Sales Audit
General Reporting System
Project Network Analysis (PNA)
Basic Estimating Technique (BETS)
Fashion Reporting
Stable Stock Replenishment
CIF Bank System
Linear Programming
Law Enforcement Control System
Building Contractors System
Statistical Analysis
Personal Trust Accounting
Dedicated Commercial Bank Inquiry System
Local Government Administration System
Bill of Materials Processor
Manufacturing Inventory Control System
Medics
Computerized Loan and Savings System (CLASS) ►

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▶ Credit Management System
  Delinquent Accounts Receivable
  Purchase Order Management
  Laboratory Reporting System
  Pharmacy System (Hospital)
  Interactive Financial Management System
  Interactive Hospital Information System
  On-Line Order Processing/Inventory Control
  Bill of Material
  Materials Management
  Manufacturing Inventory Management
  Material Requirements Planning
  Routings
  Standard Costings
  Manufacturing Order Processing
  Work-in-Process
  Master Production Scheduling
  Capacity Requirements Planning
  Purchasing and Receiving

PRICING

ENTRY LEVEL I-8415 SYSTEM: Includes I-8415 CPU with 512K bytes of main memory, communications controller, five 796-101 CRT terminals, I/O link controller, CRT console, five communications lines, one 135-megabyte 6530-2401 dual fixed/removable disk drive, one 6420-3201 band printer (720 lines/minute), and IRX operating software and firmware. The purchase price is approximately $107,280, the annual maintenance cost is $6,931 and the monthly one-year cost is $3,870.

MID-RANGE V-8565-11 SYSTEM: Includes V-8565-11 uniprocessor with 2048K bytes of main memory, two I/O Link Controllers, CRT console terminal, a 1480-megabyte disk storage subsystem with two 200-megabyte 658 disk drives and eight 135-megabyte 6540 disk drives, a magnetic tape subsystem with four 635 9-track tape units, a 1200-lpm 646 line printer, a 6831 600 card/minute card reader, and an integrated communications controller with five lines. The purchase price is $515,166, the annual maintenance cost is $27,877, and the monthly one-year rental cost is $25,159.

HIGH PERFORMANCE V-8650 SYSTEM: Includes V-8650 uniprocessor with 6144K bytes of main memory, 32K bytes of cache memory, two Channel Control Processors, 16

I/O channels, two CRT consoles, one System Control Unit, one low-speed trunk and two Trunk Channel Control Processors, one card reader interface, four 6550 disk drives and four 200-megabyte 658 disk drives with a total of 5.2 gigabytes storage, four 9-track 6370 magnetic tape drives plus controller, two 2000-lpm 647 train printers, one 1000-cpm 6831 card reader, and a 621-103 communications multiplexer. The purchase price is $1,877,726, the annual maintenance cost is $116,387, and the monthly one-year rental cost is $69,403.

SOFTWARE: NCR continues its policy of unbundling software costs. In most cases there is a monthly licensing charge and for certain packages also an initial licensing fee. The monthly charge ranges up to slightly over $1,100 and initial fees range up to about $32,000.

The pricing policy for NCR applications software includes an initial license fee plus a monthly fee. The initial fee ranges from $540 for most programs to over $30,000. Payment of the initial fee provides for one year of use without additional monthly fees. Thereafter, the monthly license fees range from $10 to $700 a month.

SUPPORT: NCR systems support is billed to 8000 Series users at the rate of $86 per hour.

EDUCATION: All educational services are separately priced.

CONTRACT TERMS: The standard NCR rental contract permits unlimited use of the equipment for all processor models. There are no extra-use charges. The basic maintenance charge covers maintenance of the equipment for nine consecutive hours between 7 a.m. and 6 p.m. on Monday through Friday. Charges for maintenance coverage beyond this period are calculated by adding a percentage premium to the basic rates. The percentage increases for various coverage periods are as follows:

	9 hours	12 hours	16 hours	20 hours	24 hours
Monday-Friday	Base	8%	10%	18%	20%
Saturday	5%	N/A	7%	10%	10%
Sunday & Holiday	7%	N/A	9%	12%	12%

EQUIPMENT PRICES

	Purchase Price	Annual Maint.	One-Year Rental*
8415 PROCESSOR AND MAIN MEMORY			
I-8415 Interactive Processor System; includes a CRT console and 256K bytes of memory	$ 38,575	$ 1,513	$1,406
Additional Memory for I-8415:			
AK 5520-P123 256K to 512K bytes	5,565	294	191
AK 5520-P124 512K to 768K bytes	5,565	294	191
AK 5520-P125 768K to 1024K bytes	5,565	294	191
I/O CONTROL AND PROCESSOR OPTIONS FOR I-8415			
AK 5520-P171 8415 to 8435 system upgrade	14,900	140	449
AK 5520-P954 First group of 5 communications lines	3,180	168	130
AK 5520-P955 Second group of 5 communications lines	3,180	168	130
AK 5520-P956 Third group of 5 communications lines	3,180	168	130
AK 5520-P957 Fourth group of communications lines	3,180	168	130
AK 5520-P959 Additional ICS Light Display; order with AK 5520-P954	—	—	—
AK 5520-P903 Remote Audible Alarm	1,956	28	64
AK 5530-P142 I/O Link Control (maximum of 4)	3,710	224	142
AK 5530-P140 Low-speed trunk	3,562	159	133
AK 5530-P141 Very high-speed trunk	8,094	330	300

*Includes maintenance

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EQUIPMENT PRICES

		Purchase Price	Annual Maint.	One-Year Rental*
8435 PROCESSOR AND MAIN MEMORY				
I-8435	Interactive Processor System; includes a CRT console and 256K bytes of memory	50,000	1,652	1,787
Additional Memory for I-8435:				
AK 5520-P123	256K to 512K bytes	5,565	294	191
AK 5520-P124	512K to 768K bytes	5,565	294	191
AK 5520-P125	768K to 1024K bytes	5,565	294	191
I/O CONTROL AND PROCESSOR OPTIONS FOR I-8435				
AK 5520-P954	First group of 5 communications lines	3,180	168	130
AK 5520-P955	Second group of 5 communications lines	3,180	168	130
AK 5520-P956	Third group of 5 communications lines	3,180	168	130
AK 5520-P957	Fourth group of 5 communications lines	3,180	168	130
AK 5520-P959	Additional ICS Light Display; order with AK 5520-P954	—	—	—
AK 5520-P903	Remote Audible Alarm	1,956	28	64
AK 5530-P142	I/O Link Control (maximum of 4)	3,710	244	142
AK 5530-P140	Low-speed trunk	3,562	159	133
AK 5530-P140	Very high-speed trunk	8,094	330	300
8455 PROCESSOR AND MAIN MEMORY				
V-8455-II	Virtual Memory Procesor System; includes a CRT console and 1024K bytes of memory	39,890	1,912	1,795
Additional Memory for V-8455:				
AK 5520-P721	1024K to 1536K bytes	9,050	480	413
AK 5521-P722	1536K to 2048K bytes; requires AK 5521-P486	9,050	480	413
I/O CONTROL AND PROCESSOR OPTIONS FOR V-8455				
AK 5520-P954	First group of 5 communications lines	3,180	160	129
AK 5520-P955	Second group of 5 communications lines	3,180	160	129
AK 5520-P956	Third group of 5 communications lines	3,180	160	129
AK 5521-P957	Fourth group of 5 communications lines	3,180	160	129
AK 5521-P740	Low-speed trunk	3,562	147	132
AK 5521-P742	Very high-speed trunk	8,094	306	297
AK 5521-P959	Additional ICS Light Display; order with AK 5520-P954	—	—	—
AK 5521-P743	I/O Link Control	3,710	226	140
AK 5521-P745	IDC Control Module	20,700	1,465	572
AK 5521-P486	VRX Performance Assist; V-8455-II only	4,800	300	185
8535 PROCESSOR AND MAIN MEMORY				
V-8535-II	Virtual Memory Processor System; includes a CRT console, 1024K bytes of memory, a card reader interface, and I/O Link Control	59,370	2,628	2,930
8545 PROCESSOR AND MAIN MEMORY				
V-8545-II	Virtual Memory Processor System; includes a CRT console, 1024K bytes of memory, a card reader interface, and I/O Link Control	63,240	2,940	3,115
Additional Memory for V-8545-II:				
	1,024K-byte increment (up to 1)	14,100	1,036	831
8555 PROCESSOR AND MAIN MEMORY				
V-8555-II	Virtual Memory Processor System; includes a CRT console, 1024K bytes of memory, a card reader interface, and I/O Link Control	82,000	4,380	4,095
	Multiprocessor Conversion kit	37,500	1,885	1,339
Additional Memory for V-8555-II:				
	1,024K-byte increments (up to 3)	14,100	1,036	831
8565 PROCESSOR AND MAIN MEMORY				
V-8565-II	Virtual Memory Processor System; includes a CRT console, 2048K bytes of memory, a card reader interface, and Virtual Assist Unit	139,000	7,128	6,913
	Multiprocessor Conversion kit	37,500	1,885	1,339
Additional Memory for V-8565-II:				
	1,024K-byte increments (up to 4)	14,100	1,036	831

*Includes maintenance

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EQUIPMENT PRICES

		Purchase Price	Annual Maint.	One-Year Rental*
▶ 8575 PROCESSOR AND MAIN MEMORY				
V-8575-II	Virtual Memory Multiprocessor System; includes a CRT console, 2048K bytes of memory, and a card reader interface	178,250	8,592	8,812
	Multiprocessor Conversion kit	37,500	1,885	1,339
Additional Memory for V-8575-II:				
	1,024K-byte increments (up to 4)	14,100	1,036	831
8585 PROCESSOR AND MAIN MEMORY				
V-8585-II	Virtual Memory Multiprocessor System; includes a CRT console, 2048K bytes of memory, a card reader interface, and Virtual Assist Unit	248,000	12,012	12,265
	Multiprocessor Conversion kit	37,500	1,885	1,339
Additional Memory for V-8585-II:				
	1,024K-byte increments (up to 4)	14,100	1,036	831
8595 PROCESSOR AND MAIN MEMORY				
V-8595-II	Virtual Memory Multiprocessor System; includes a CRT console, 4096K bytes of main memory, card reader interface, and Virtual Assist Unit	341,000	16,600	16,890
	Multiprocessor Conversion kit	37,500	1,885	1,339
Additional Memory for V-8595-II:				
	2,048K-byte, increments (up to 2)	28,200	1,918	1,650
I/O CONTROL AND PROCESSOR OPTIONS FOR 8500 SERIES PROCESSORS				
I/O Control				
AK 56XO-PX40	Low-Speed Trunk	3,562	159	133
AK 56XO-PX41	Medium-Speed Trunk	5,380	230	200
AK 56XO-PX42	Very High-Speed Trunk	8,094	330	299
AK 56XO-PX43	I/O Link Control	3,710	244	142
Disk System Control				
AK 56XO-PX45	Integrated Disk Control (IDC) Module	20,700	1,582	582
IDC String Controllers (not on V-8575-II, V-8585-II, or V-8595-II)				
AK 56XO-PX46	IDC First String Control, for 6590 drives	500	—	13
AK 56XO-PX47	IDC First String Control, for 658 drives	5,500	—	150
AK 56XO-PX48	IDC Second String Control for 6590 drives	4,100	144	102
AK 56XO-PX49	IDC Second String Control, for 658 drives	4,100	144	102
AK 56XO-PX50	IDC Third String Control, for 6590 drives	4,100	144	102
AK 56XO-PX51	IDC Third String Control, for 658 drives	4,100	144	102
AK 56XO-PX55	IDC Dual Access Adapter	20,700	1,439	620
Communications Lines (not on V-8575-II, V-8585-II, or V-8595-II)				
AK 5600-P950 through P953	First through fourth 5-line Communications Line Controller (CLC); requires ICS light display	1,956	676	135
AK 5600-P954 through P957	First through fourth 5-line CLC/MLA (multi-line adapter); requires ICS light display	4,802	1,065	266
AK 5600-P959	ICS Light Display	—	—	—
AK 5600-P958, P960, and P961	MLA Upgrade for AK 5600-P950 through P953	2,846	389	131
Processor Performance Upgrades (Requires same memory configuration on both systems)				
V-8535-II to V-8545-II		3,870	312	185
V-8545-II to V-8555-II		18,760	1,440	980
V-8555-II to V-8565-II		57,000	2,748	2,818
V-8575-II to V-8585-II		69,750	3,420	3,453
V-8585-II to V-8595-II		93,000	4,588	4,625

*Includes maintenance

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EQUIPMENT PRICES

	Monthly License Fee
Firmware Options	
VRX Mode for V-8535-II	214
N Mode for V-8535-II	415
VRX Mode for V-8545-II	302
N Mode for V-8545-II	485
VRX Mode for V-8555-II	403
N Mode for V-8555-II	660
MP Option for V-8555-II	683
VRX Mode for V-8565-II	548
N Mode for V-8565-II	858
MP Option for V-8565-II	933
VRX Mode for V-8575-II	712
MP Option for V-8575-II	1,210
VRX Mode for V-8585-II	1,096
MP Option for V-8585-II	1,866
VRX Mode for V-8595-II	1,315
MP Option for V-8595-II	2,236

		Purchase Price	Annual Maint.	One-Year Rental*
8650 PROCESSOR AND MAIN MEMORY				
V-8650	Virtual Memory Uniprocessor System; includes 4096K bytes of main memory, 32K bytes cache memory, 2 Channel Control Processor (CCP), 16 I/O channels, dual CRT consoles, and one System Control Unit	1,120,000	71,172	43,580
Additional Memory for V-8650:				
AK 5710-P320	4096K to 6144K bytes	69,000	2,016	2,453
AK 5710-P321	6144K to 8192K bytes	69,000	2,016	2,453
8670 PROCESSOR AND MAIN MEMORY				
V-8670	Virtual Memory Dual Processor System; includes 4096K bytes of main memory, 128K cache memory, 2 Channel Processors (CCP), 16 I/O channels, dual CRT consoles, and one System Control Unit	1,675,000	74,708	62,060
Additional Memory for V-8670:				
AK 5710-P520	4096K to 6144K bytes	69,000	2,016	2,453
AK 5710-P521	6144K to 8192K bytes	69,000	2,016	2,453
AK 5710-P522	8192K to 12288K bytes	138,000	4,032	4,906
AK 5710-P523	12288K to 16384K bytes	138,000	4,032	4,906
I/O CONTROL AND PROCESSOR OPTIONS FOR V-8650 AND V-8670				
AK 5710-PX40	Additional CCP with 8 I/O channels	60,000	2,760	2,230
AK 5710-PX41	Trunk CCP with one Low-Speed Trunk	18,060	1,092	583
AK 5710-PX42	Low-Speed Trunk	3,360	132	123
AK 5710-PX43	Very High-Speed Trunk	7,635	276	277
AK 5710-P600	Card Reader Interface	1,150	60	35
AK 5710-P370	V-8650 to V-8670 System Upgrade	555,000	3,536	18,480
MASS STORAGE				
AU 0658-0201	Disk Drive; 100MB; requires 0625-0301 controller	19,610	1,382	784
AU 0658-0401	Disk Drive; 200MB; requires 0625-0301 controller	23,725	1,296	878
AU 0658-0002	Disk Drive Conversion; 100MB to 200MB capacity	2,000	—	323
BU 6589-0101	I/O Link Adapter	13,318	609	381
AA 0958-0002	Disk Pack for 0658-0201 or 0658-0401 drives	660	—	—
AU 6530-1201	Cartridge Disk Drive; 54MB	15,370	528	470
AK 6530-P401	Upgrade Kit; expands AU 6530-1201 to 81MB	4,558	238	150
AU 6530-1301	Cartridge Disk Drive; 81MB	16,960	581	518
AU 6530-2401	Cartridge Disk Subsystem; includes 54- and 81MB disk drives	22,976	1,307	779
AK 6530-P401	Upgrade Kit; upgrades AU 6530-2401-0090 to 162MB	4,558	238	150
AA 6531-0101	Disk Cartridge, 13.5MB	245	—	—

*Includes maintenance

NCR 8400, 8500 and 8600 Systems

EQUIPMENT PRICES

		Purchase Price	Annual Maint.	One-Year Rental*
► MASS STORAGE (Continued)				
BU 6549-0101	I/O Link Adapter for 6540	6,678	228	190
AU 6540-0201	Fixed Disk Drive; 135MB	16,695	959	589
AU 6540-0801	Fixed Disk Drive; 540MB, includes four 135MB units	53,530	2,657	1,845
BU 6559-0101	I/O Link Adapter for 6550	14,061	456	461
AU 6550-0101	Pack Disk Drive; 1092MB; 1st unit	50,032	2,203	1,697
AU 6550-0201	Pack Disk Drive, 1092MB; additional units	48,369	2,138	1,641
AU 6590-0101	Disk Drive; 2 spindles	18,290	1,211	731
AU 6590-0201	Disk Drive; 2 spindles	18,290	1,211	731
AU 6591-0101	35MB Data Module	900	—	64
AU 6591-0201	70MB Data Module	1,930	—	95
AU 6591-0301	Data Module for 6590-0201	1,930	—	95
AK 6590-P003	Rotational Position Sensing Kit	700	51	21

MAGNETIC TAPE

		Purchase Price	Annual Maint.	One-Year Rental*
AU 6370-0401	Magnetic Tape Unit; 75 ips, 9-track, PE/GCR, 120/470KB	25,900	1,361	748
BU 6379-0401	I/O Link Adapter for up to four 6370-0401 magnetic tape units	37,600	1,568	1,190
AU 6370-0601	Magnetic Tape Unit; 125 ips, 9-track, PE/GCR, 200/780KB	29,000	1,698	859
BU 6379-0601	I/O Link Adapter for up to four 6370-0601 magnetic tape units	37,600	1,568	1,190
AU 6370-0801	Magnetic Tape Unit; 200 ips, 9-track, PE/GCR, 320/1250KB	32,350	2,372	1,015
BU 6379-0801	I/O Link Adapter for up to four 6370-0801 magnetic tape units	40,290	1,844	1,242
AU 0633-0111	Single Magnetic Tape Unit; PE, 80KB, 9-track, 1600 bpi	7,340	1,579	397
AU 0633-0117	Single Magnetic Tape Unit; NRZI, 10/28/40KB, 7-track, 200/556/800 bpi	7,970	1,689	422
AU 0633-0119	Single Magnetic Tape Unit; NRZI, 40KB, 9-track, 800 bpi	8,900	1,689	459
BU 0624-0119	Controller for up to eight 633-0119 magnetic tape units	8,845	390	392
BU 0624-0179	Controller for up to eight 633-0119 and/or 633-0117 magnetic tape units with same speeds	9,000	390	364
AU 0633-0121	Dual Magnetic Tape Unit; PE, 80KB, 9-track, 1600 bpi	14,155	2,350	695
BU 0624-0111	Controller for up to eight 633-0111 and/or 633-0121 magnetic tape units	12,750	390	498
AU 0633-0211	Single Magnetic Tape Unit; PE, 144KB, 9-track, 1600 bpi (requires high-speed trunk)	12,810	1,579	582
BU 0624-0211	Controller for up to eight 633-0211 magnetic tape units	15,095	390	581
AU 0633-0311	Single Magnetic Tape Unit; PE, 240KB, 9-track, 1600 bpi (requires high-speed trunk)	14,375	1,579	635
BU 0624-0311	Controller for up to eight 633-0311 magnetic tape units	16,655	390	636
AU 0633-0837	Single Magnetic Tape Unit; 10/28/40KB, 9-track, 200/556/800 bpi	7,970	1,689	422
AU 0633-0839	Single Magnetic Tape Unit; NRZI, 40KB, 9-track, 800 bpi	8,900	1,689	459
BU 0624-0839	Controller for 633-0839	8,845	390	359
BU 0624-0879	Controller for 633-0837 and/or 633-0839	9,000	390	364
BU 0634-0117	Magnetic Tape Unit with Controller; 7-track, 25 ips, NRZI	26,670	2,133	780
AU 0634-0107	Magnetic Tape Unit; 25 ips, for use with 0634-0117	10,710	1,165	324
BU 0624-0401	Controller for up to eight 635-0109 and/or 635-0209 magnetic tape units	21,306	1,054	773
AU 0635-0109	Magnetic Tape Unit; 100 ips, 1600 bpi, 9-track, PE	17,066	1,926	735
AU 0635-0209	Magnetic Tape Unit; 200 ips, 1600 bpi, 9-track, PE	20,352	2,093	855
BU 0636-0301	Cassette Tape Handler	6,330	895	303
AK 0636-0001	Additional Cassette	1,265	163	56
BU 3250-1737	General Purpose Controller for 7649 Cassette Tape	7,035	641	274
AU 7642-1301	Diskette Drive	2,350	236	92
AU 7620-1203	Cassette Drive	1,575	72	54

PRINTERS

		Purchase Price	Annual Maint.	One-Year Rental*
BU 0646-0201	Train Printer; 1200 lpm, 132 positions, power stacker; includes controller	44,250	4,360	1,636
BU 0647-0201	Train Printer; 2000 lpm, 132 positions, power stacker; includes controller	73,829	7,757	2,630
AK 0646-P001	I/O Link Adapter for BU 0646-0201	2,258	156	101
AK 0647-P001	I/O Link Adapter for BU 0647-0201	2,258	198	101
AK 0960-0152	Print Train; 52 characters	3,950	—	114
AK 0960-0164	Print Train; 64 characters	3,950	—	114
AK 0960-0157	Print Train; 57 characters, OCR-A	3,950	—	114
AK 0960-0196	Print Train; 96 characters, UC/LC	3,950	—	114
BU 0649-0300	Printer; 300 lpm, 132 positions; includes controller	21,600	1,938	758
AK 0000-6491	6/8 Lines per Inch Option for 649-300 Printer	675	16	17
AU 6420-2101	Band Printer; 300 lpm, requires at least one print band	9,220	967	315
AU 6420-2201	Band Printer; 600 lpm, requires at least one print band	13,720	1,908	634
AU 6420-2301	Band Printer; 900 lpm, requires at least one print band; includes 6420-K024 quietized cabinet	30,000	3,307	1,143
RK 6420-K031	Criterion Interface; required for 6420-0101, 0201, and -0301 printers	4,000	700	247

*Includes maintenance

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NCR 8400, 8500 and 8600 Systems

EQUIPMENT PRICES

➤ **PRINTERS (Continued)**

		Purchase Price	Annual Maint.	One-Year Rental*
AK 6420-K010	Print Band; 64-character ASCII, 1403, 10 cpi	350	—	27
AK 6420-K019	Print Band; 96-character U/L case	350	—	27
AK 6420-K022	Print Band; 48-character ASCII, 1403, 10 cpi	350	—	27
AK 6420-K024	Quietized Cabinet	583	—	38
AU 6440-0102	Matrix Printer; 55 lpm, requires interface	2,365	571	179
RK 6440-K005	RS-232-C Interface (CCITT V.24)	1,185	74	35
AK 6440-K009	Elongated Character Set for 6440-0102 printer	25	—	3
AA 1001-A001	Pedestal for 6440-0101, -0102 printers	250	—	—
AU 6440-0202	Matrix Printer; 125 lpm	6,800	879	251
AU 6440-0302	Matrix Printer; 70 lpm	4,790	806	211
RK 6440-K030	Common Trunk Interface for 6440-0202, -0302 printers	515	67	23
AU 6440-0402	Matrix Printer; 50 lpm	4,115	519	175
RK 6440-P030	Common Trunk Interface for 6440-0402	575	67	23
RK 6440-K050	7x7 dot matrix standard with 6440-0202, -0302, and -0402 printers	—	—	—
SK 6440-K058	9x7 dot matrix for 6440-0202, -0302, and -0402 printers	105	—	4
AA 1001-A003	Pedestal for 6440-0202 and -0302 printers	250	—	—

PUNCHED CARD I/O UNITS

AU 0680-0201	Card Reader; 1200 cpm	32,500	2,793	845
AU 0684-0101	Card Read/Punch; 500/100-460 cpm	15,600	5,893	924
AU 0684-0301	Card Punch, 100-460 cpm	22,860	5,143	817
AU 0686-0102	Card Read/Punch; 800/83-294 cpm	16,800	4,960	873
AU 0686-0111	Card Read/Punch; 560/60-180 cpm	12,500	4,307	703
AU 0686-0201	Card Reader; 750 cpm	9,900	3,288	549
AU 0686-0302	Card Punch; 82-240 cpm	12,000	4,422	699
AU 0686-0311	Card Punch; 60-180 cpm	8,200	4,095	575
AU 0687-0301	Card Punch; 100 cpm	10,100	2,359	470
AU 6831-0201	Card Reader; 600 cpm	9,000	501	355
AU 6831-0301	Card Reader; 1000 cpm	12,300	1,200	511

PAPER TAPE I/O UNITS

AU 0660-0101	Paper Tape Reader, 1500 cps	11,600	1,042	400
AU 0665-0101	Paper Tape Punch, 200 cps	13,900	1,674	508

MICR I/O UNITS

AU 0670-0101	MICR Sorter; 600 dpm, 11 pockets; includes 622-401 controller	45,000	6,657	1,635
AU 0671-0101	MICR Sorter; 1200 dpm, 18 pockets; includes 622-401 controller	117,500	15,109	3,643
AF 0000-6711	Endorser Feature for 671-101 MICR sorter	12,000	1,298	435
AU 0675-0101	MICR Reader/Sorter; 750 dpm, 11 pockets	67,310	8,829	2,166
BU 6781-0101	MICR Document Reader/Sorter; up to 1,440 dpm, up to 34 pockets	128,700	11,668	3,714

COMMUNICATIONS

BU 0621-0103	On-Line Communications Multiplexer for up to 15 lines	8,480	714	249
AK 0691-0201	First Extension for 621-103 multiplexer; extends to 127 lines	—	—	—
AK 0691-0202	Second Extension for 621-103 multiplexer; extends capacity to 255 lines	—	—	—
AK 0621-F200	In-House Clock Driver for 0621-0103 multiplexer	2,120	236	85
AK 0621-F201	Synchronous Adapter Connection Cable Kit	475	29	15
AK 0621-F202	Wideband Interface	725	29	22
AK 0691-0101	Auxiliary Cage	7,950	130	135
AU 0690-0103	On-Line Auxiliary Bay	8,480	64	177
AU 0692-0600	Dual Asynchronous Adapter, one line disabled	1,500	151	84
AK 0692-0600	Dual Asynchronous Adapter, second line enabled	1,500	151	84
AU 0692-0638	438-3 Adapter	3,180	136	88
AU 0693-0600	Dual Synchronous Adapter, one line disabled	2,250	162	114
AK 0693-0600	Dual Synchronous Adapter, second line enabled	2,250	162	114
AU 0695-0600	On-Line Auto Dialer	1,695	158	55
AU 0698-0300	Integrated Asynchronous Modem	1,000	119	37
AU 0752-0200	Free-Standing External Modem	700	143	35

TERMINALS

BU 7900-1102	Model 7900 CRT; TTY compatible	2,000	324	102
AU 7900-2112	Model 7900 CRT; detachable keyboard; TTY compatible	2,170	324	108
AU 0260-8000	Thermal Printer; receive only	2,495	365	111
BU 7900-1303	Model 7900 CRT; asynchronous, pollable	3,500	395	173
AU 7900-1313	Model 7900 CRT; detachable keyboard; asynch., pollable	3,670	395	179
AU 0260-900	Thermal Printer; receive only	2,495	365	111

*Includes maintenance

NCR 8400, 8500 and 8600 Systems

SOFTWARE PRICES

	One-Time License Fee	Monthly License Fee
► **RS1 Basic System Software**		
VOSS Master	$0	$0
B3 Operating System	0	0
NEAT/3	0	198
Cobol 68	0	198
Cobol 74	0	150
Basic Fortran Compiler	0	12
Intermediate Fortran Compiler	0	24
Full Fortran Compiler	0	48
Educational Fortran Compiler	0	12
RPG Compiler	0	44
Object Module Assembly Program (OMAP)	0	12
SORT/MERGE	0	66
Student Cobol	3,170	66
RS1 On-Line System Software		
Time-Sharing	0	242
Remote Batch Entry (RBE)	0	48
B2 Prepass Compiler	0	44
Queue Executive Interface (QX1)	0	12
Basic I (Dedicated)	1,200	68
Basic I (Dual)	1,200	68
Basic I I/O Writer	1,200	68
Basic M	2,315	48
RS1 Data Management System Software		
Index Sequential Filing System	0	19
Random Filing System (RFS)	0	19
NCR Total	31,350	1,122
Total IQL	15,675	561
VS1 Basic System Software		
VRX Operating System	0	0
VRX Cobol 74 Compiler	0	132
VRX COBUG	0	12
VRX Fortran 77 Compiler	0	100
NRX NEAT/VS Compiler	0	158
VRX SORT/MERGE	0	121
VRX TRAN-PRO	25,475	550
VRX TRAN-QUEST	13,000	325
VS1 On-Line System Software		
Terminal Communications Processor	0	60
Network Definition Language Processor	0	36
On-Line Program Development	0	61
Remote Job Entry	0	72
VRX Telecommunications	0	22
EZ-KEY Data Entry System	1,500	42
VS1 Data Management System Software		
CAM/VRX Utilities	0	12
VRX File Conversion Utility	0	48
Management Sciences Application Software		
Statistics	886	19
Linear Programming	594	12
Project Network Analysis	4,092	85
Vehicle Scheduling	594	12
Feed Information System (FIS)	10,797	333
General Application Software		
General Payroll	648	13
Payroll/Cost, Labor Scheduling	648	13
Accounts Receivable—Commercial	966	20
Accounts Receivable—Consumer	966	20
Accounts Receivable—Tape	966	20
Accounts Payable	966	20
General Ledger with Reporting Subsystem	648	13
Accounting System Interface	648	13 ►

NCR 8400, 8500 and 8600 Systems

SOFTWARE PRICES

	One-Time License Fee	Monthly License Fee
► **Manufacturing Application Software**		
Inventory Material Control (IMC)	1,585	33
Inventory Material Requirements (IMR)	805	17
Bill of Materials	1,585	33
Manufacturing Systems Inquiry	805	17
Production Scheduling	805	17
Inventory Requirements Planning	1,190	25
Work in Progress	10,900	273
Order Processing	10,000	250
Wholesale Application Software		
Emphasis	805	17
Order Billing Technique II (ORBIT II)	1,585	33
Order Billing Technique III (ORBIT III)	1,585	33
SPIRIT V (not on 8600 series)	13,068	289
SPIRIT—Sales Analysis	1,182	—
Medical Application Software		
Post Discharge Accounts Receivable	1,550	45
In-Patient Records	1,150	30
Medical Audit Statistics	1,150	30
Criterion Loan and Savings System (CLASS)		
General Ledger	2,000	70
Savings	23,000	825
Loans	16,000	570
Education Application Software		
Stewardship & Management Accounting	1,580	45
SCHOLARS II	13,750	393
Student Test Analysis	640	18
School Bus Scheduling System	2,926	84
Government Application Software		
Law Enforcement—Traffic	1,080	23
Law Enforcement—Uniform Crime Reports	0	0
Law Enforcement—Case Assignment	2,250	75
Law Enforcement—Police Information	2,250	75
Law Enforcement—Operations Management	2,250	75
Food Distribution Application Software		
Order Billing Technique I (ORBIT I)	1,435	34
Department Store Application Software		
Retail Sales Audit	855	20
Fashion Reporting	2,520	60
Pre-Edit Processing	1,620	40
Staple Stock Replenishment	2,020	50
MEDICS Application Software		
MEDICS A-10	33,000	800
MEDICS ADT	11,000	275
IRX—System Software		
IRX—Operating System	5,445	121
IRX—Utilities	1,485	33
IRX—Cobol 74 Compiler	4,950	110
IRX—Basic	3,345	84■