NCR 8400, 8500 and 8600 Systems

MANAGEMENT SUMMARY

NCR's 8000 Series of medium- to large-scale mainframes provides the user with a diversified product line with many systems and options from which to choose. The philosophy of "Migration Path Engineering" provides that programs, files, and most peripheral equipment now in use on NCR systems can be moved directly to a newer one with minimal conversion effort. This makes it especially attractive for NCR Century system users to upgrade to the 8000 Series.

The 8400 Series, with the I-8415, I-8435, and V-8455, is 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 approximately 1,150 installations of the 8400 Series in the U.S.

The 8500 Series, which was introduced in April 1976, now is made up of four models, the V-8555M, V-8565M, V8575M, and the V-8585M. The V-8555M, V-8565M, and V-8575M are uniprocessors, and the V-8585M is a tightly-coupled dual-processor system. All systems use the VRX virtual memory operating system which can run programs written for Century systems without recompiling. The performance of these systems ranges from the IBM 4331-1 to the 4341-2. The V-8555M, V-8565M, and V-8575M uniprocessors can be connected into tightly-coupled MP (multiprocessor) configurations of from two to four processors. The V-8585M, which is already a tightly-coupled dual-processor system, can be connected with another V-8585M to form a four-processor configuration. NCR's multiprocessor systems share a single copy of the operating system. The V-8585M uses ▷

NCR's 8400, 8500, and 8600 Series offer a wide range of computing power and a choice of three basic operating systems for maximum flexibility. The product line is comparable in performance to the IBM System/ 38 and progresses up to the 3033. The systems function equally well in batch, interactive, transaction-oriented, and distributed processing environments.

CHARACTERISTICS

MANUFACTURER: NCR Corporation, Dayton, Ohio 45479. Telephone (513) 449-2000.

CURRENT MODELS: I-8415, I-8435, V-8455, V-8555M, V-8565M, V-8575M, V-8585M, V-8650, V-8670.

PRIOR MODELS: I-8410, I-8430, N-8450, V-8450, N-8550, V-8550, N-8560, V-8560, N-8570, V-8570, V-8580, V-8590.

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. ▶
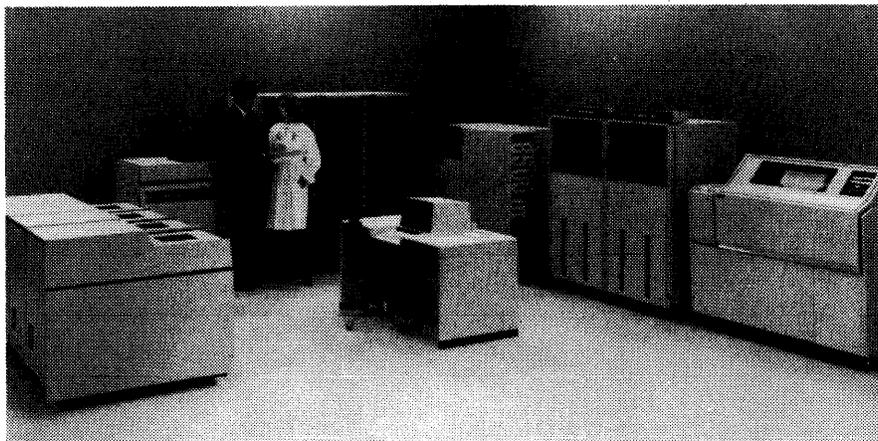
The NCR V-8555M has 512K bytes of main storage, is expandable to a full 2 megabytes of memory, and has slightly less power than the IBM 4331-2. A wide range of peripherals is available.

NCR 8400, 8500 and 8600 Systems

NCR 8400, 8500, AND 8600 SYSTEMS CHARACTERISTICS

	I-8410	I-8415	I-8430	I-8435	N-8450
SYSTEM CHARACTERISTICS					
Date of introduction	Nov. 1978	March 1980	Sept. 1977	March 1980	April 1977
Number of main processors	1	1	1	1	1
Active Production	No	Yes	No	Yes	No
Primary application	Interactive processing	Interactive processing	Interactive processing	Interactive processing	Century emulation
Relative performance level, approximate	0.7	NA	1.0	NA	1.4
System firmware	IS3	IS3	IS3	IS3	RS3
Operating systems	IRX	IRX	IRX	IRX	B1, B2, B3
Basic system rental, per month	$2,120	$1,432	$3,028	$1,565	$2,475
MAIN PROCESSOR					
Cycle time, nanoseconds	112	112	112	112	112
Dynamic address translation hardware	No	No	No	No	No
Floating-point assist	No	No	No	No	No
VRX assist (instruction lookahead)	No	No	No	No	No
Instruction storage capacity, bytes	24K	24K	52K	24K	42K
Upgradeable to	I-8430	I-8435	—	—	V-8450
MAIN STORAGE (All MOS, error correcting)					
Memory circuitry	16K chip	16K chip	4K chip	16K chip	4K chip
Cycle time, nanoseconds	475	475	475	475	475
Minimum capacity, bytes	256K	256K	256K	256K	256K
Maximum capacity, bytes	1024K	1024K	1024K	1024K	1024K
Increment size, bytes	256K	256K	64K, 256K	256K	64K, 128K, 256K
Interleaving	None	None	None	None	None
I/O CONTROL					
Integrated disk control	Optional	Optional	Optional	Optional	Optional
Maximum disk subsystems per controller	1 string of 8 drives	1 string of 8 drives	1 string of 8 drives	1 string of 8 drives	1 string of 8 drives
Maximum no. of trunks common	2	2	3	2	4
Common trunk data rates, bytes/sec:					
Low-speed trunk	40KB	40KB	40KB	40KB	40KB
Medium-speed trunk	None	None	None	None	None
Very high-speed trunk	1150KB	1150KB	1080KB	1150KB	1080KB
I/O Link Controllers	No	Yes	No	Yes	No
COMMUNICATIONS CONTROL					
Integrated comm. control, max. lines	20	20	13	20	20
External comm. control, max. lines	256	256	None	256	256

the multiprocessor version of the VRX operating system, VRX/MP, exclusively. The other systems use VRX/MP only when in a multiprocessor configuration.

Processing power in each system can be increased by more than two times using multiple processors. At the present there are over 900 8500 Series systems installed in the U.S.

NCR's top-end processors, the V-8650 and V-8670, offer large performance increases over the V-8585M and operate in the range of 3 MIPS (million instructions per second) to 5 MIPS. The V-8650 is a uniprocessor and the V-8670 is a tightly-coupled dual-processor system. NCR claims the V-8650 should be comparable to the IBM 3032 and the V-8670 is comparable to the IBM 3033 in performance. Both systems use VRX exclusively. The V-8600 family was introduced in November, 1978, and initial deliveries are targeted for 2nd quarter 1981.

Within the 8000 Series product line the 84X5 and V-85X5M systems are generally more powerful and less expensive than their 84X0 and 85X0 predecessors. They use emitter-coupled logic (ECL) circuits extensively, and have 16K memory chips with cycle times ranging from 370 to 440 nanoseconds.

MAIN STORAGE

STORAGE TYPE: Metal oxide semiconductor (MOS). The 8400 and 8500 series currently use 16K memory chips, and the V-8600 is to be based on 64K chips.

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 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.

NCR 8400, 8500 and 8600 Systems

NCR 8400, 8500, AND 8600 SYSTEMS CHARACTERISTICS

	V-8450	V-8455	N-8550	V-8550	V-8555M	N-8560
SYSTEM CHARACTERISTICS						
Date of introduction	April 1977	March 1979	April 1976	April 1976	March 1979	April 1977
Number of main processors	1	1	1	1	1	1
Active Production	No	Yes	No	No	Yes	No
Primary application	Virtual memory	Virtual memory	Century emulation	Virtual memory	Virtual memory	Century emulation
Relative performance level, approximate	1.4	NA	1.5	1.5	2.0	2.4
System firmware	VS3	VS1, RS1	RS1	VS1; RS1	VS1, RS1	RS1
Operating systems	VRX	VRX, B1, B2, B3	B1, B2, B3	VRX; B1, B2, B3	VRX; B1, B2, B3	B1, B2, B3
Basic system rental, per month	$3,225	$1,835	$3,782	$4,532	$3,223	$5,112
MAIN PROCESSOR						
Cycle time, nanoseconds	112	112	112	112	84	84
Dynamic address translation hardware	Yes	Yes	No	Yes	Yes	No
Floating-point assist	No	Yes	Yes	Yes	Yes	Yes
VRX assist (instruction lookahead)	No	No	Nc	No	No	No
Instruction storage capacity, bytes	96K	96K	8K	24K	24K	10K
Upgradeable to	—	—	V-8550, N-8560	V-8560, V-8570	V-8565M	V-8560, N-8570
MAIN STORAGE (All MOS, error correcting)						
Memory circuitry	4K chip	16K chip	4K chip	4K chip	16K chip	4K chip
Cycle time, nanoseconds	475	440	475	475	440	475
Minimum capacity, bytes	512K	512K	256K	512K	512K	256K
Maximum capacity, bytes	1024K	1024K	1024K	2048K	2048K	1536K
Increment size, bytes	64, 128K, 256K	256K	64K, 128K, 256K	64K, 128K, 256K	512K, 1024K	64K, 128K, 256K
Interleaving	None	No	2-way above 512K bytes	2-way	None	2-way above 512K bytes
I/O CONTROL						
Integrated disk control	Optional	Optional	Optional	Optional	Optional	Optional
Maximum disk subsystems per controller	1 string of 8 drives	3 strings of 8 drives	1 string of 8 drives	1 string of 8 drives	3 strings of 8 drives	2 strings of 8 drives
Maximum no. of trunks common	4	4	4	4	6	5
Common trunk data rates, bytes/sec:						
Low-speed trunk	40KB	40KB	50KB	50KB	75KB	75KB
Medium-speed trunk	None	None	150KB	150KB	225KB	225KB
Very high-speed trunk	1080KB	1150KB	1080KB	1080KB	1150KB	1060KB
I/O Link Controllers	Yes	Yes	No	Yes	Yes	No
COMMUNICATIONS CONTROL						
Integrated comm. control, max. lines	20	20	20	20	20	20
External comm. control, max. lines	256	256	256	256	256	256

▷ 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 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) ▷

▶ 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-8575M, V-8580, V-8585M, V-8590, and both V-8600 systems. The V-8565M has two-way interleaving, and the V-8555M does 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 ▶

NCR 8400, 8500 and 8600 Systems

NCR 8400, 8500, AND 8600 SYSTEMS CHARACTERISTICS

	V-8560	V-8565M	N-8570	V-8570	V-8575M	V-8580
SYSTEM CHARACTERISTICS						
Date of introduction	April 1977	March 1979	April 1976	April 1976	March 1979	Nov. 1977
Number of main processors	1	1	1	1	1	1
Active Production	No	Yes	No	No	Yes	No
Primary application	Virtual memory	Virtual memory	Century emulation	Virtual memory	Virtual memory	Virtual memory
Relative performance level, approximate	2.4	3.5	3.4	3.5	4.3	4.6
System firmware	VS1; RS1	VS1, RS1	RS1	VS1; RS1	VS1, RS1	VS1; RS1
Operating systems	VRX; B1, B2, B3	VRX, B1, B2, B3	B1, B2, B3	VRX; B1, B2, B3	VRX; B1, B2, B3	VRX; B1, B2, B3
Basic system rental, per month	$5,852	$5,033	$7,470	$7,542	$8,450	$12,652
MAIN PROCESSOR						
Cycle time, nanoseconds	84	56	56	56	56	56
Dynamic address translation hardware	Yes	Yes	No	Yes	Yes	Yes
Floating-point assist	Yes	Yes	Yes	Yes	Yes	Yes
VRX assist (instruction lookahead)	No	No	No	No	Yes	Yes
Instruction storage capacity, bytes	24K	24K	10K	24K	32K	32K
Upgradeable to	V-8570	V-8575M	V-8570	V-8580	V-8585M	—
MAIN STORAGE (All MOS, error correcting)						
Memory circuitry	4K chip	16K chip	4K chip	4K chip	16K chip	16K chip
Cycle time, nanoseconds	475	440	475	475	440	475
Minimum capacity, bytes	512K	1024K	512K	512K	2048K	1024K
Maximum capacity, bytes	3072K	3072K	2048K	4096K	4096K	4096K
Increment size, bytes	64K, 128K, 256K	1024K	128K, 256K	128K, 256K	1024K	1024K
Interleaving	2-way	2-way	2-way	2-way	4-way	4-way
I/O CONTROL						
Integrated disk control	Optional	Optional	Optional	Optional	Optional	Optional
Maximum disk subsystems per controller	2 strings of 8 drives	3 strings 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 trunks common	5	6	6	6	8	8
Common trunk data rates, bytes/sec:						
Low-speed trunk	75KB	100KB	100KB	100KB	100KB	100KB
Medium-speed trunk	225KB	315KB	315KB	315KB	315KB	315KB
Very high-speed trunk	1060KB	1150KB	1150KB	1150KB	1150KB	1150KB
I/O Link Controllers	Yes	Yes	No	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

▷ firmware permits batch processing, multiprogramming, on-line transaction processing, and is used on 8400 and 8500 systems. Virtual (on "V" systems) firmware uses virtual operating resources that provide greater internal processing capabilities and better system resource management. The virtual firmware is available in the 8400, 8500, and 8600 systems. The latest series of systems, the V-8455 and V-85X5M, 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 nanoseconds. The minimum memory size ranges from 256K bytes on the I-8415 and increases to 4096K on 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 ▷

▶ 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 the 85X5 and 8600 series offer multiple processor configurations. The V-8585M and V-8670 are dual-processor systems. Using the VRX/MP (multiprocessing) operating system, up to four processors may be configured on V-8555M, V-8565M, V-8575M, and V-8585M 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 "M" systems into an MP configuration requires an MP kit which contains all the ▶

NCR 8400, 8500 and 8600 Systems

NCR 8400, 8500, AND 8600 SYSTEMS CHARACTERISTICS

	V-8585M	V-8590	V-8650	V-8670
SYSTEM CHARACTERISTICS				
Date of introduction	March 1979	Nov. 1977	Nov. 1978	Nov. 1978
Number of main processors	2	2	1	2
Active Production	Yes	No	Yes	Yes
Primary application	Virtual memory	Virtual memory	Virtual memory	Virtual memory
Relative performance level, approximate	7.6	7.5	15.0	38.0
System firmware	VS2	VS2	VS1	VS2
Operating systems	VRX/MP B3	VRX/MP B3	VRX B3	VRX/MP B3
Basic system rental, per month	$14,130	$20,902	$46,100	$62,900
MAIN PROCESSOR				
Cycle time, nanoseconds	56	56	N/A	N/A
Dynamic address translation hardware	Yes	Yes	Yes	Yes
Floating-point assist	Yes	Yes	Yes	Yes
VRX assist (instruction lookahead)	Yes	Yes	Yes	Yes
Instruction storage capacity, bytes	32K	128K	96K	192K
Upgradeable to	V-8585MP	—	V-8670	—
MAIN STORAGE (All MOS, error correcting)				
Memory circuitry	16K chip	16K chip	64K chip	64K chip
Cycle time, nanoseconds	440	475	380	380
Minimum capacity, bytes	2048K	2048K	4096K	4096K
Maximum capacity, bytes	6144K	6144K	8192K	16,384K
Increment size, bytes	1024K, 2048K	1024K	2048K	2048K, 4096K
Interleaving	4-way	4-way	4-way	4-way
I/O CONTROL				
Integrated disk control	NA	NA	NA	NA
Maximum disk subsystems per controller	3 strings of 8 drives	3 strings of 8 drives	3 strings of 8 drives	3 strings of 8 drives
Maximum no. of trunks common	8	8	2	2
Common trunk data rates, bytes/sec:				
Low-speed trunk	100KB	100KB	100KB	100KB
Medium-speed trunk	315KB	315KB	None	None
Very high-speed trunk	1150KB	1150KB	1150KB	1150KB
I/O Link Controllers	Yes	Yes	Yes (CCP)	Yes (CCP)
COMMUNICATIONS CONTROL				
Integrated comm. control, max. lines	NA	NA	NA	NA
External comm. control, max. lines	256	256	256	256

▷ 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 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 has 512K bytes of memory standard. All three ▷

► necessary 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. Companies with high uptime requirements may elect an optional MP Backup Kit. This package provides a second interbus connection, which can be used in the event of a primary connector failure. An exception to this rule is the V-8585M, which is a dual-processor system operating under VRX/MP. The maximum four-processor configuration is obtained by connecting two V-8585Ms 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: ►

NCR 8400, 8500 and 8600 Systems

▷ systems can be expanded to 1024K bytes. The processor cycle time in all 8400 systems is 112 nanoseconds.

The 8500 systems, formerly known as NCR's Criterion family, presently consists of four systems: the V-8555M, V-8565M, V-8575M, and V-8585M. The first three systems are uniprocessors, and the V-8585M is a tightly-coupled dual-processor model. The processor cycle time for all systems is 56 nanoseconds, except for the V-8555M, which is 84 nanoseconds.

The V-8555M has 512K bytes of memory, expandable to 2048K; the V-8565M has 1024K bytes standard, expandable to 3072K bytes; the V-8575 has 2048K bytes standard, expandable to 4096K bytes, and the V-8585M has 2048K bytes standard, expandable to 6144K bytes.

Each system can be increased to as many as four tightly-coupled processors. The V-8555M can be field upgraded to the V-8565M, and the V-8565M to the V-8575M.

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. The processor cycle time ▷

	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 (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 ▶

PERIPHERAL AVAILABILITY FOR 8400, 8500, and 8600 SYSTEMS

	I-8410	I-8415	I-8430	I-8435	V-8450	V-8455	N-8550	V-8550	V-8555M	N-8560	V-8560	V-8565M	N-8570	V-8570	V-8575M	V-8580	V-8585M	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																			
640					●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
646		●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
647		●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
649		●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
6420	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
MICR EQUIPMENT																			
670							●			●			●						
671							●			●			●						
675	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		
6780					●	●	●	●	●	●	●	●	●	●	●	●	●		
PAPER TAPE																			
660 Tape Reader					●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
665 Tape Punch					●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
COMMUNICATIONS																			
621 Controller					●	●	●	●	●	●	●	●	●	●	●	●	●	●	●

NCR 8400, 8500 and 8600 Systems

▷ on 8600 processors is not available. Both the V-8650 and V-8670 have 4096K bytes of main memory, expandable to 8192K bytes in the V-8650 and to 16,384K bytes in the V-8670. The V-8650 can be field upgraded to the V-8670.

All current models in the 8400 and 8500 Series have increased performance at substantially reduced prices over their predecessors.

The 8400, 8500, and 8600 systems can use most of the peripheral devices that have been used on Century 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, five high-speed printers generating as high as 2,000 lines per minute, and various record and MICR devices. The chart on the opposite page 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 accomodate 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 may communicate with the system.

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

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. ▷

▶ 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.

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 85X5 series processors offer higher performance and a lower price than their 84X0 and 85X0 predecessors. The I-8415 and I-8435 have more 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 has more power than the N- and V-8450 systems and is about 10 percent less powerful than the IBM 4331-1. The V-8555M has 30 percent more processing power than the V-8550, about 75 percent more power than the IBM 4331-1, and slightly less power than the IBM 4331-2. The V-8565M has 45 percent more power than the V-8560, and is comparable to the recently announced Burroughs B-5930 processor. The V-8575M has 24 percent more performance than the V-8570 and slightly less power than the IBM 4341-1. The dual-processor V-8585M has 65 percent more power than the V-8580, about 35 percent more power than the IBM 4341-1, and slightly less power than the 4341-2.

According to NCR, dual-processor versions of the V-85X5 series systems (except the V-8585M) provide up to twice the performance of a comparable uniprocessor configuration.

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

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. ▶

NCR 8400, 8500 and 8600 Systems

▷ 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.

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. The FORTRAN 77 compiler requires an Extended Hardware Assist feature on all V-85X5 Series processros.

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 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 1980's. NCR/CNA includes NCR/Data Link Control protocol, intra-network disciplines, acccess 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 ▷

▶ 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 four IOLC's can be configured in the V-8455 system, up to six in the V-8555, V-8565, and V-8585, and up to eight in the V-8575. 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-8600 and V-8585M, is used primarily for attaching 658 and 6590 disk drives to the system. All 8400 and 8500 systems, depending on the model, can have from one to three 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 new interface maximizes I/O throughput, lowers I/O and central processor contention, and eliminates the need for common trunk interfaces.

The table on page "f" 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 new Bit Serial I/O Link Controller/Adapter combination is recommended by NCR. Each IOLC supports up four IOLAs, and each IOLA can ▶

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▷ 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 the application programs. The application program interface with NCR/TAM is the ANSI COBOL 74 Message Control System. The functions performed by NCR/TAM inlcude system and link control queue management, resource scheduling, packet header processing, error recovery and reporting, and diagnostic support.

USER REACTION

Datapro received a total of 84 NCR user responses in our 1980 survey of computer users. There were 45 responses from 8400 systems users and 38 from 8500 systems users. The individual systems breakdowns are as follows:

8400

8410	8
8430	9
8450	11
8455	15
Unspecified	2

8500

|	
8550	13
8555	5
8560	3
8565	7

▷

▶ 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 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 7 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-8585M and MP systems) and connects via the Integrated Disk Controller ▶
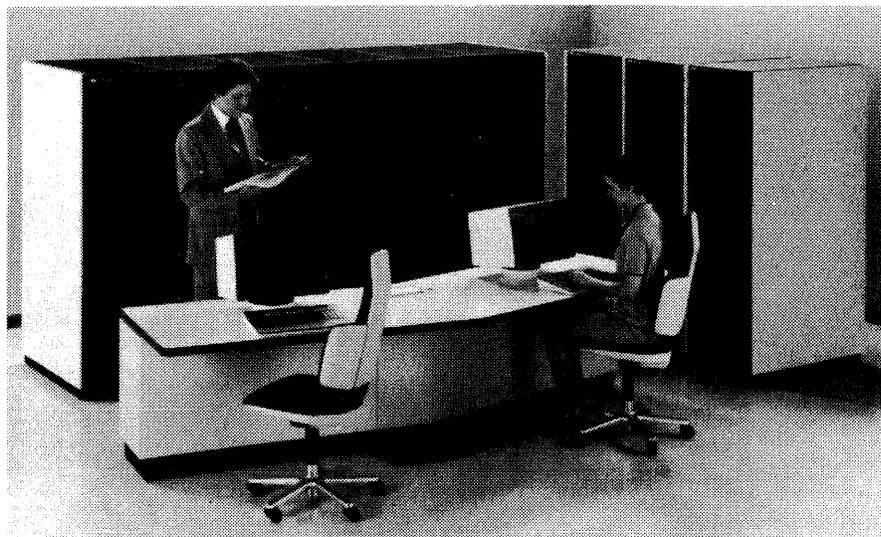
At the top of NCR's product line is the dual-processor V-8670, with 4 megabytes of memory, expandable to 16 megabytes. Processing speed is in the range of five MIPS (million instructions per second), making the V-8670 comparable to the IBM 3033. All NCR systems are air cooled.

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8500 (Continued)

8570	6
8575	2
8580	1
Unspecified	1

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 18 months for the 8400 systems and 2½ years for 8500 systems, and ranged from one month to about four years. The majority of users purchased their systems, with rentals and leases about even. 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 almost two to one, and VRX by almost three to one. The 8500 systems users were evenly divided between the Century operating system and VRX. Most users developed their applications programs in-house, with the purchase of outside programs almost as popular. The combined user responses for both the 8400 and 8500 systems are presented in the chart below.

	Excellent	Good	Fair	Poor	WA*
Ease of Operation	37	38	6	1	3.4
Reliability of mainframe	41	35	6	1	3.4
Reliability of peripherals	23	44	16	0	3.1
Responsiveness of maintenance service	33	30	16	5	3.1
Effectiveness of maintenance service	23	38	16	7	2.9
Technical Support					
Troubleshooting	9	30	27	18	2.4
Education	8	50	21	5	2.7
Documentation	6	32	33	12	2.4
Operating Systems	27	43	11	3	3.1
Compilers and Assemblers	24	43	13	3	3.1
Applications Programs	8	38	18	7	2.7
Ease of Programming	29	40	9	4	3.1
Ease of Conversion	35	34	10	2	3.3
Overall Satisfaction	24	49	6	3	3.1

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

Datapro contacted four 8500 and three 8400 systems users for their comments. The first user, a midwestern municipal government, has been successfully using a V-8560 processor with the VRX operating system. With only an occasional software problem, they are quite pleased with the V-8560, and are increasing their transaction processing activities in 1981.

A manufacturer in the northeast uses an N-8550 for his financial, payroll, and manufacturing activities. The DP manager told us that the B-3 operating system is "cumbersome," and he is considering VRX for the future. While he is generally pleased with the system, he is planning to increase his processing power in the near ▷

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 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 new 15 inches per second cassette drive, a diskette drive, and connects to the NCR common trunk interface. ▶

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▷ future, and will consider NCR as well as competitive systems.

A large New England hospital upgraded from a Century 50 to a V-8555M, and found the new system much faster and easier to work with. The DP manager told us he is presently using VRX Release 6, and plans to install Release 7 when it becomes available. He is changing from a predominantly batch operation to an interactive one, and will use an interactive executive compatible under VRX. He said he had some initial compiler bugs and added the quality control on some of his equipment was a bit off. Minor problems notwithstanding, he is very happy with the V-8555M and recommends it to others.

The fourth 8500 user we interviewed was a southeastern financial institute with a V-8575 and a recently installed dual-processor V-8585. He operates with about 40 branch locations, and runs primarily an on-line real time operation. He is using VRX Release 6 on both processors, and has acquired a lot of experience with the operating system. He was somewhat disappointed with NCR, in that he felt NCR kept the details of its operating systems "a big secret." The problems were ironed out, and he is now quite satisfied with VRX and his operation in general. He also commented that NCR's documentation is much improved.

The first 8400 system user we contacted was a large southwestern manufacturer who upgraded from an NCR 8250 to his present I-8430. The DP manager told us he uses both the interactive firmware and the NCR Century firmware for different operations. He runs interactive jobs during the day and Century mode at night for more batch-oriented jobs. He is using the high capacity 6530 disk drives, and is very pleased, especially since he was one of the first users.

A publishing firm in the far west installed a V-8455 but found they needed more power. They subsequently installed a V-8555M and are presently very satisfied with the system and VRX.

Returning to the northeast, our last interview was with a distributor who uses his N-8450 for the usual financial/payroll/distribution applications. He is quite pleased with the B-3 operating system and currently is not considering VRX because of its additional cost.□

▶ **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:

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, V-85X5, 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 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.

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▶ **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. Pockets can be added in 10-pocket increments for a total of 34 pockets. 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-8585M.

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 (BCC), 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-characacter 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.

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.

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 Reassignment feature that permits the operator to reassign peripherals among partitions without interrupting operation of the system; 5) software overlay pooling; 6) operator-initiated dynamic allocation of memory between two partitions, 7) card input spooling, 8) common disk backup for software overlays to facilitate recovery from a read error; 9) dynamic assignment of partition priorities; and 10) operator-controlled job scheduling.

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 7.

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NCR 8400, 8500 and 8600 Systems

► 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.

Under VRX, a processor, when available, accesses and sets into execution the next task to be performed. The processor executes the task until the job suspends, freeing that processor to execute the next task.

Jobs are scheduled automatically by the software, depending on their assigned priorities and the peripheral and memory availability. All jobs may have the same priority, or specific jobs may be assigned higher or lower priorities when they are input to the system. The operator can change the job priority at run time if necessary.

Peripherals are also assigned automatically by the software according to the general type associated with a symbolic unit designator. Specific peripherals can be assigned to a job when a special hardware option is needed. Disk units and disk files can be shared concurrently by multiple jobs.

In order to provide compatibility with the real-storage (B-Series) operating systems, VRX provides each job with a simulated system disk, which is actually an area in virtual memory for each job to store the program overlays and dynamic information normally contained in the work storage area of the current system disk.

Print files are normally written to disk or magnetic tape and printed at a later time, either automatically by the software or under control of an off-line print program. Each print spool file is identified by a report header which contains the job name, the job number, and the name of the file. Job control statements and data can also be stored on disk, either all at at one time or in small batches for later use by a specific job. VRX also permits job control strings, made up of Job Specification Language statements and Monitor Control Language statements, to be stored in disk files for use at a later time. This technique, which is normally used only for jobs that must be run repeatedly, eliminates the need to load the statements through the card reader each time the same job is to be run.

VRX runs programs compiled for use under the B2 operating system in the NEAT/VS or VRX COBOL languages. A Network Descriptor Language (NDL) enables users to specify the communications configuration needed at run time instead of at compile time, eliminating the need for source-code modification and additional compile time.

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 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.

VRX provides several level of error recovery systems, each designed for specific applications. These facilities include a CAM file error recovery sytem, which uses CAM utilities to restore CAM files if an error occurs. There is also a batch reacovery 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.

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.

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 ►

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▶ 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.

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 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.

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 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.

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 langauage 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 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, NEATVS, 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 (NEATVS, 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. ▶

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▶ 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. NEATVS 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 enhancement permit mixing of older Century programs with those written for execution under the newer operating systems. NEATVS 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 freeing him from 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/DLA, 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)
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 $104,120, the annual maintenance cost is $6,832 and the monthly one-year cost is $3,758.

MID-RANGE V-8565M SYSTEM: Includes V-8565M 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 $469,065, the annual maintenance cost is $25,128, and the monthly one-year rental cost is $16,924. ▶

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► **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 Procesors, 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 $2,546,050, the annual maintenance cost is $126,272, and the monthly one-year rental cost is $71,604.

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 uses at the rate of $57 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*

8410 PROCESSOR AND MAIN MEMORY

I-8410 Interactive Processor System; includes a CRT console, I/O link controller for 6530 Disk Drives and printer attachment, and 5 communications lines with ICS light display.

		Purchase Price	Annual Maint.	One-Year Rental*
	Processor with 256K bytes of memory and:			
AU-8410-0001	81 megabytes of disk storage	$65,000	$3,050	$2,120
AU 8410-0002	135 megabytes of disk storage	70,100	3,490	2,305
AU 8410-0003	162 megabytes of disk storage	72,600	3,710	2,397
AU 8410-0004	216 megabytes of disk storage	77,650	4,150	2,582
AU 8410-0005	242 megabytes of disk storage	80,150	4,370	2,674
AU 8410-0006	297 megabytes of disk storage	85,225	4,810	2,859
AU 8410-0007	324 megabytes of disk storage	87,725	5,030	2,951
	Processor with 512K bytes of memory and:			
AU 8410-0011	81 megabytes of disk storage	74,500	3,395	2,420
AU 8410-0012	135 megabytes of disk storage	79,600	3,838	2,605
AU 8410-0013	162 megabytes of disk storage	82,100	4,058	2,697
AU 8410-0014	216 megabytes of disk storage	87,150	4,498	2,882
AU 8410-0015	242 megabytes of disk storage	89,650	4,718	2,974
AU 8410-0016	297 megabytes of disk storage	94,725	5,158	3,159
AU 8410-0017	324 megabytes of disk storage	97,225	5,378	3,251
	Processor with 768K bytes of memory and:			
AU 8410-0021	81 megabytes of disk storage	84,000	3,746	2,720
AU 8410-0022	135 megabytes of disk storage	89,100	4,186	2,905
AU 8410-0023	162 megabytes of disk storage	91,600	4,406	2,997
AU 8410-0024	216 megabytes of disk storage	96,650	4,846	3,182
AU 8410-0025	242 megabytes of disk storage	99,150	5,066	3,274
AU 8410-0026	297 megabytes of disk storage	104,225	5,506	3,459
AU 8410-0027	324 megabytes of disk storage	106,725	5,726	3,551
	Processor with 1024K bytes of memory and:			
AU 8410-0031	81 megabytes of disk storage	93,500	4,094	3,020
AU 8410-0032	135 megabytes of disk storage	98,600	4,534	3,205
AU 8410-0033	162 megabytes of disk storage	101,100	4,754	3,297
AU 8410-0034	216 megabytes of disk storage	106,150	5,194	3,482
AU 8410-0035	242 megabytes of disk storage	108,650	5,414	3,574
AU 8410-0036	297 megabytes of disk storage	113,725	5,854	3,759
AU 8410-0037	324 megabytes of disk storage	116,225	6,074	3,851

Additional Memory for I-8410:

		Purchase Price	Annual Maint.	One-Year Rental*
AK 5520-P120	256K to 512K bytes	11,500	336	300
AK 5520-P121	512K to 768K bytes	11,500	336	300
AK 5520-P122	768K to 1024K bytes	11,500	336	300 ►

*Includes maintenance

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EQUIPMENT PRICES

		Purchase Price	Annual Maint.	One-Year Rental*
▶ I/O CONTROL AND PROCESSOR OPTIONS FOR I-8410				
AK 5520-P955	Second group of 5 communications lines	3,000	144	120
AK 5520-P956	Third group of 5 communications lines	3,000	144	120
AK 5520-P957	Fourth group of 5 communications lines	3,000	144	120
AK 5520-P959	Additional ICS Light Display; order with AK 5520-P956	—	—	—
AK 5520-P903	Remote Audible Alarm	1,845	24	60
AK 5520-P198	N-Mode Feature	12,000	240	300
AK 5520-P170	8410 to 8430 system upgrade	28,200	1,210	908
AK 5530-P140	Low-Speed Trunk	3,360	132	123
AK 5530-P141	Very High-Speed Trunk	7,635	276	277
8415 PROCESSOR AND MAIN MEMORY				
I-8415 Interactive Processor System; includes a CRT console and 256K bytes of memory		38,575	1,320	1,390
Additional Memory for I-8415:				
AK 5520-P123	256K to 512K bytes	5,250	252	176
AK 5520-P124	512K to 768K bytes	5,250	252	176
AK 5520-P125	768K to 1024K bytes	5,250	252	176
I/O CONTROL AND PROCESSOR OPTIONS FOR I-8415				
AK 5520-P171	8415 to 8435 system upgrade	14,900	120	447
AK 5520-P954	First group of 5 communications lines	3,000	144	120
AK 5520-P955	Second group of 5 communications lines	3,000	144	120
AK 5520-P956	Third group of 5 communications lines	3,000	144	120
AK 5520-P957	Fourth group of communications lines	3,000	144	120
AK 5520-P959	Additional ICS Light Display; order with AK 5520-P954	—	—	—
AK 5520-P903	Remote Audible Alarm	1,845	24	60
AK 5530-P142	I/O Link Control (maximum of 4)	3,500	204	130
AK 5530-P140	Low-speed trunk	3,360	132	123
AK 5530-P141	Very high-speed trunk	7,635	276	277
8430 PROCESSOR AND MAIN MEMORY				
I-8430	Interactive Processor System; includes 256K bytes of main memory, CRT console terminal/ keyboard, I/O link controller for 6530 Disk Drives and printer attachment, 5 communications lines with ICS light display; operating software included in package			
	Processor with 256K bytes of memory and:			
AU 8430-0001	81 megabytes of disk storage	93,190	4,260	3,028
AU 8430-0002	135 megabytes of disk storage	98,280	4,692	3,213
AU 8430-0003	162 megabytes of disk storage	100,780	4,920	3,305
AU 8430-0004	216 megabytes of disk storage	105,860	5,352	3,490
AU 8430-0005	243 megabytes of disk storage	108,360	5,580	3,582
AU 8430-0006	297 megabytes of disk storage	113,440	6,012	3,767
AU 8430-0007	324 megabytes of disk storage	115,940	6,240	3,859
	Processor with 512K bytes of memory and:			
AU 8430-0011	81 megabytes of disk storage	102,690	4,596	3,328
AU 8430-0012	135 megabytes of disk storage	107,780	5,040	3,513
AU 8430-0013	162 megabytes of disk storage	110,280	5,268	3,605
AU 8430-0014	216 megabytes of disk storage	115,360	5,700	3,790
AU 8430-0015	243 megabytes of disk storage	117,860	5,928	3,882
AU 8430-0016	297 megabytes of disk storage	122,940	6,360	4,067
AU 8430-0017	324 megabytes of disk storage	125,440	6,588	4,159
	Processor with 768K bytes of memory and:			
AU 8430-0021	81 megabytes of disk storage	112,190	4,956	3,628
AU 8430-0022	135 megabytes of disk storage	117,280	5,388	3,813
AU 8430-0023	162 megabytes of disk storage	119,780	5,616	3,905
AU 8430-0024	216 megabytes of disk storage	124,860	6,048	4,090
AU 8430-0025	243 megabytes of disk storage	127,360	6,276	4,182
AU 8430-0026	297 megabytes of disk storage	132,440	6,708	4,367
AU 8430-0027	324 megabytes of disk storage	134,940	6,936	4,459
	Processor with 1024K bytes of memory and:			
AU 8430-0031	81 megabytes of disk storage	121,690	5,304	3,928
AU 8430-0032	135 megabytes of disk storage	126,780	5,736	4,113
AU 8430-0033	162 megabytes of disk storage	129,280	5,964	4,205
AU 8430-0034	216 megabytes of disk storage	134,360	6,396	4,390
AU 8430-0035	243 megabytes of disk storage	136,860	6,624	4,482
AU 8430-0036	297 megabytes of disk storage	141,940	7,056	4,667
AU 8430-0037	324 megabytes of disk storage	144,440	7,284	4,759
Additional Memory for I-8430:				
AK 5630-P323	256K to 320K bytes	3,780	156	120
AK 5630-P324	320K to 384K bytes	3,780	156	120
AK 5630-P325	384K to 448K bytes	3,780	156	120
AK 5630-P326	448K to 512K bytes	3,780	156	120
AK 5630-P327	256K to 512K bytes	11,500	336	300
AK 5630-P328	512K to 768K bytes	11,500	336	300
AK 5630-P329	768K to 1024K bytes	11,500	336	300 ▶

*Includes maintenance

NCR 8400, 8500 and 8600 Systems

EQUIPMENT PRICES

		Purchase Price	Annual Maint.	One-Year Rental*
▶ I/O CONTROL AND PROCESSOR OPTIONS FOR I-8430				
AK 5520-P955	Second group of 5 communications lines	3,000	144	120
AK 5520-P956	Third group of 5 communications lines	3,000	144	120
AK 5520-P957	Fourth group of 5 communications lines	3,000	144	120
AK 5520-P959	Additional ICS Light Display; order with AK 5520-P956	—	—	—
AK 5520-P903	Remote Audible Alarm	1,845	24	60
AK 5520-P198	N-Mode Feature	12,000	240	300
AK 5530-P140	Low-Speed Trunk	3,360	132	123
AK 5530-P141	Very High-Speed Trunk	7,635	276	277
AK 5630-P349	Integrated Disk Control (IDC) for 8430 systems	8,700	960	300
AK 5630-P346	IDC Attachment for 6590 disks	500	—	13
AK 5630-P347	IDC 8-Spindle Expansion; prerequisite for all 658 disk drives or for use of more than 4 spindles	6,000	360	160

8435 PROCESSOR AND MAIN MEMORY

I-8435 Interactive Processor System; includes a CRT console and 256K bytes of memory		50,000	1,440	1,770

Additional Memory for I-8435:

AK 5520-P123	256K to 512K bytes	5,250	252	176
AK 5520-P124	512K to 768K bytes	5,250	252	176
AK 5520-P125	768K to 1024K bytes	5,250	252	176

I/O CONTROL AND PROCESSOR OPTIONS FOR I-8435

AK 5520-P954	First group of 5 communications lines	3,000	144	120
AK 5520-P955	Second group of 5 communications lines	3,000	144	120
AK 5520-P956	Third group of 5 communications lines	3,000	144	120
AK 5520-P957	Fourth group of 5 communications lines	3,000	144	120
AK 5520-P959	Additional ICS Light Display; order with AK 5520-P954	—	—	—
AK 5520-P903	Remote Audible Alarm	1,845	24	60
AK 5530-P142	I/O Link Control (maximum of 4)	3,500	204	130
AK 5530-P140	Low-speed trunk	3,360	132	123
AK 5530-P140	Very high-speed trunk	7,635	276	277

8450 PROCESSOR AND MAIN MEMORY

N-8450	NCR Century Processor System; includes 256K bytes of main memory, CRT console terminal/keyboard, and one low-speed trunk; operating software included	72,600	5,076	2,475
V-8450	Virtual Memory Processor System; 512K bytes of main memory, 48K bytes of control memory, CRT console terminal/keyboard, and one low-speed trunk; operating software included	95,630	6,096	3,225

Additional Memory for 8450 Processors:

AK 5630-P521	128K to 192K bytes	3,780	156	120
AK 5630-P522	192K to 256K bytes	3,780	156	120
AK 5630-P523	256K to 320K bytes	3,780	156	120
AK 5630-P524	320K to 384K bytes	3,780	156	120
AK 5630-P525	384K to 448K bytes	3,780	156	120
AK 5630-P526	448K to 512K bytes	3,780	156	120
AK 5630-P527	512K to 640K bytes	7,560	312	240
AK 5630-P528	640K to 768K bytes	7,560	312	240
AK 5630-P529	768K to 896K bytes	7,560	312	240
AK 5630-P530	896K to 1024K bytes	7,560	312	240
AK 5630-P331	256K to 512K bytes	11,500	336	300
AK 5630-P533	512K to 768K bytes	11,500	336	300
AK 5630-P534	768K to 1024K bytes	11,500	336	300

I/O CONTROL AND PROCESSOR OPTIONS FOR 8450 PROCESSORS

AK 5630-P370	N-8450 to V-8450 upgrade	2,500	180	115
AK 5630-P954	First group of 5 communications lines	4,530	888	236
AK 5630-P955	Second group of 5 communications lines	4,530	888	236
AK 5630-P956	Third group of 5 communications lines	4,530	888	236
AK 5630-P957	Fourth group of 5 communications lines	4,530	888	236
AK 5630-P540	Low-speed trunk	3,360	132	123
AK 5630-P541	Additional very high-speed trunk	7,635	276	277
AK 5630-P545	Integrated Disk Control Module	14,700	960	400
AK 5630-P546	IDC Attachment for 6590 Disk System	500	—	13
AK 5630-P547	IDC 8-Spindle Expansion Module	6,000	360	160

8455 PROCESSOR AND MAIN MEMORY

V-8455	Virtual Memory Processor System; includes a CRT console and 512K bytes of memory	51,000	1,912	1,835

Additional Memory for V-8455:

AK 5520-P720	512K to 1024K bytes	10,500	432	385

I/O CONTROL AND PROCESSOR OPTIONS FOR V-8455

AK 5520-P954	First group of 5 communications lines	3,000	144	120
AK 5520-P955	Second group of 5 communications lines	3,000	144	120
AK 5520-P956	Third group of 5 communications lines	3,000	144	120 ▶

*Includes maintenance

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EQUIPMENT PRICES

		Purchase Price	Annual Maint.	One-Year Rental*
I/O CONTROL AND PROCESSOR OPTIONS FOR V-8455 (Continued)				
AK 5520-P957	Fourth group of 5 communications lines	3,000	144	120
AK 5520-P740	Low-speed trunk	3,360	132	123
AK 5520-P742	Very high-speed trunk	7,635	276	277
AK 5520-P959	Additional ICS Light Display; order with AK 5520-P954	—	—	—
AK 5520-P743	I/O Link Control	3,500	204	130
AK 5520-P745	IDC Control Module	20,700	1,320	560
8550 PROCESSOR AND MAIN MEMORY				
N-8550	NCR Century Processor System; includes 256K bytes of main memory, 8K bytes of control memory, one low-speed and one very high-speed trunk, and card reader or paper tape reader interface; operating software included in package	114,500	5,900	3,782
V-8550	Virtual Memory Processor System; includes 512K bytes of main memory, one low-speed and one very high-speed trunk, and card reader or punched paper tape reader interface; operating software included in package	137,500	6,920	4,532
Additional Memory for N-8550:				
AK 5600-P322	256K to 320K bytes	3,780	156	120
AK 5600-P323	320K to 384K bytes	3,780	156	120
AK 5600-P324	384K to 448K bytes	3,780	156	120
AK 5600-P325	448K to 512K bytes	3,780	156	120
AK 5600-P331	256K to 512K bytes	11,500	336	300
Additional Memory for N-8550 and V-8550:				
AK 5600-P326	512K to 640K bytes	7,560	312	240
AK 5600-P327	640K to 768K bytes	7,560	312	240
AK 5600-P328	768K to 896K bytes	7,560	312	240
AK 5600-P329	896K to 1024K bytes	7,560	312	240
Additional Memory for V-8550:				
AK 5600-P332	512K to 768K bytes	11,500	336	300
AK 5600-P333	768K to 1024K bytes	11,500	336	300
AK 5600-P334	512K to 1024K bytes	10,500	432	385
AK 5600-P336	1024K to 1536K bytes	10,500	432	385
AK 5600-P337	1536K to 2048K bytes	10,500	432	385
8555 PROCESSOR AND MAIN MEMORY				
V-8555M	Virtual Memory Processor System; includes a CRT console, 512K bytes of memory, and a card reader interface	90,700	2,677	3,223
AK 5600-P775	Multiprocessor Conversion kit	64,400	1,572	2,252
AK 5600-P776	Multiprocessor Back-up kit; use with AK 5600-P775	12,980	312	451
Additional Memory for V-8555M:				
AK 5600-P720	512K to 1024K bytes	10,500	432	385
AK 5600-P721	1024K to 1536K bytes	10,500	432	385
AK 5600-P722	1536K to 2048K bytes	10,500	432	385
AK 5600-P723	1024K to 2048K bytes	21,000	864	770
8560 PROCESSOR AND MAIN MEMORY				
N-8560	NCR Century Processor System; includes 256K bytes of main memory, one low-speed, one medium-speed, and one very high-speed trunk, and card reader or punched paper tape reader interface; operating software included in package	157,725	6,440	5,112
V-8650	Virtual Memory Processor System; includes 512K bytes of main memory, one low-speed, one medium-speed, and one very high-speed trunk, and card reader or punched paper tape reader interface; operating software included in package	180,725	7,460	5,852
Additional Memory for N-8560:				
AK 5600-P522	256K to 320K bytes	3,780	156	120
AK 5600-P523	320K to 384K bytes	3,780	156	120
AK 5600-P524	384K to 448K bytes	3,780	156	120
AK 5600-P525	448K to 512K bytes	3,780	156	120
AK 5600-P533	256K to 512K bytes	11,500	336	300
Additional Memory for N-8560 and V-8560:				
AK 5600-P526	512K to 640K bytes	7,560	312	240
AK 5600-P527	640K to 768K bytes	7,560	312	240
AK 5600-P528	768K to 896K bytes	7,560	312	240
AK 5600-P529	896K to 1024K bytes	7,560	312	240
AK 5600-P530	1024K to 1280K bytes	11,500	336	300
AK 5600-P531	1280K to 1536K bytes	11,500	336	300

*Includes maintenance

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EQUIPMENT PRICES

		Purchase Price	Annual Maint.	One-Year Rental*
8560 PROCESSOR AND MAIN MEMORY (Continued)				
Additional Memory for V-8560:				
AK 5600-P534	512K to 768K bytes	11,500	336	300
AK 5600-P537	768K to 1024K bytes	11,500	336	300
AK 5600-P538	1024K to 1280K bytes	11,500	336	300
AK 5600-P539	1280K to 1536K bytes	11,500	336	300
AK 5600-P578	512K to 1024K bytes	10,500	432	385
AK 5600-P579	1024K to 2048K bytes	21,000	864	770
AK 5600-P580	2048K to 3072K bytes	21,000	864	770
8565 PROCESSOR AND MAIN MEMORY				
V-8565M	Virtual Memory Processor System; includes a CRT console, 1024K bytes of memory, and a card reader interface	142,800	3,929	5,033
AK 5600-P775	Multiprocessor Conversion kit	64,400	1,572	2,252
AK 5600-P776	Multiprocessor Back-up kit; use with AK 5600-P775	12,980	312	451
Additional Memory for V-8565-M:				
AK 5600-P723	1024K to 2048K bytes	21,000	864	770
AK 5600-P724	2048K to 3072K bytes	21,000	864	770
8570 PROCESSOR AND MAIN MEMORY				
N-8570	NCR Century Processor System; includes 512K bytes of main memory, one low-speed, one medium-speed, and one very high-speed trunk; operating software included in package	233,465	8,480	7,470
V-8570	Virtual Memory Processor System; includes 512K bytes of main memory, one low-speed, one medium-speed, and one very high-speed trunk; operating software included in package	235,965	9,500	7,542
Additional Memory for N-8570 and V-8570:				
AK 5600-P422	512K to 640K bytes	7,560	312	240
AK 5600-P423	640K to 768K bytes	7,560	312	240
AK 5600-P424	768K to 896K bytes	7,560	312	240
AK 5600-P425	896K to 1024K bytes	7,560	312	240
AK 5600-P426	1024K to 1280K bytes	11,500	336	300
AK 5600-P427	1280K to 1536K bytes	11,500	336	300
AK 5600-P428	1536K to 1792K bytes	11,500	336	300
AK 5600-P429	1792K to 2048K bytes	11,500	336	300
Additional Memory for V-8570:				
AK 5600-P475	512K to 1024K bytes	10,500	432	385
AK 5600-P476	1024K to 2048K bytes	21,000	864	770
AK 5600-P477	2048K to 3072K bytes	21,000	864	770
AK 5600-P478	3072K to 4096K bytes	21,000	864	770
8575 PROCESSOR AND MAIN MEMORY				
V-8575M	Virtual Memory Processor System; includes a CRT console, 2048K bytes of memory, and a card reader interface	237,800	7,179	8,450
AK 5600-P775	Multiprocessor Conversion kit	64,400	1,572	2,252
AK 5600-P776	Multiprocessor Back-up kit; use with AK 5600-P775	12,980	312	451
Additional Memory for V-8575-M:				
AK 5600-P724	2048K to 3072K bytes	21,000	864	770
AK 5600-P725	3072K to 4096K bytes	21,000	864	770
8580 PROCESSOR AND MAIN MEMORY				
V-8585M	Virtual Memory Processor System; includes 1024K bytes of main memory, 32K bytes of control memory, low-speed, medium-speed, and high-speed trunks, and card reader interface; operating software included in package	393,670	16,856	12,652
Additional Memory for V-8580:				
AK 5600-P621	1024K to 2048K bytes	46,000	1,344	1,200
AK 5600-P622	2048K to 3072K bytes	46,000	1,344	1,200
AK 5600-P623	3072K to 4096K bytes	46,000	1,344	1,200
8585 PROCESSOR AND MAIN MEMORY				
V-8585M	Virtual Memory Multiprocessor System; includes a CRT console, 2048K bytes of memory, and a card reader interface	398,000	12,015	14,130
AK 5640-P775	Multiprocessor Conversion kit	64,400	1,572	2,252
AK 5640-P776	Multiprocessor Back-up kit; use with AK 5640-P775	12,980	312	451
Additional Memory for V-8585M:				
AK 5640-P724	2048K to 3072K bytes	21,000	864	770
AK 5640-P725	3072K to 4096K bytes	21,000	864	770
AK 5640-P726	4096K to 6144K bytes	42,000	1,728	1,540

*Includes maintenance

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EQUIPMENT PRICES

		Purchase Price	Annual Maint.	One-Year Rental*
8590 PROCESSOR AND MAIN MEMORY				
V-8590	Virtual Memory Multiprocessor System; includes two processors, 2048K bytes of main memory, 128K bytes of control memory, CRT console terminal, card reader interface; operating software included in package	593,980	34,484	20,902
Additional Memory for V-8590:				
AK 5640-P421	2048K to 3072K bytes	43,000	1,344	1,200
AK 5640-P422	3072K to 4096K bytes	43,000	1,344	1,200
AK 5640-P423	4096K to 5120K bytes	43,000	1,344	1,200
AK 5640-P424	5120K to 6144K bytes	43,000	1,344	1,200
I/O CONTROL AND PROCESSOR OPTIONS FOR 8500 SERIES PROCESSORS				
I/O Control				
AK 56X0-PX40	Low-Speed Trunk	3,360	132	123
AK 56X0-PX41	Medium-Speed Trunk; not available on 8560, 8570, and 8580 processors	5,075	192	185
AK 5600-PX41	Very High-Speed Trunk for 8560, 8570, 8580 processors only	7,635	276	277
AK 56X0-PX42	Very High-Speed Trunk	7,635	276	277
AK 56X0-PX43	I/O Link Control	3,500	204	130
AK 5640-P443	I/O Link Control for 8590	68,040	1,212	1,670
Disk System Control				
AK 56X0-PX45	Integrated Disk Control (IDC) Module for 8550 and 8560	14,700	960	400
AK 5600-P645	IDC for 8580	49,000	1,800	1,340
AK 5640-P445	IDC for 8590	71,450	2,100	1,755
AK 56X0-PX45	IDC for all other 8500 Series	20,700	1,320	560
IDC String Controller for 8550 and 8560				
AK 5600-PX47	IDC Expansion to 8 spindles; prerequisite for all 658 disk drives or use of more than 4 spindles in 6590 subsystems	6,000	360	160
AK 5600-PX48	IDC First String Control for 658 drives	5,500	—	150
AK 5600-PX49	IDC Second String Control, for 6590 drives	4,100	120	100
AK 5600-PX50	IDC Second String Control, for 658 drives	4,100	120	100
IDC String Controllers (not on 8550, 8560, and 8585)				
AK 56X0-PX46	IDC First String Control, for 6590 drives	500	—	13
AK 5640-P446	IDC First String Control on 8590	11,845	264	295
AK 56X0-PX47	IDC First String Control, for 658 drives	5,500	—	150
AK 5640-P447	IDC First String Control on 8590	11,845	264	295
AK 56X0-PX48	IDC Second String Control, for 6590 drives	4,100	120	100
AK 5640-P448	IDC Second String Control for 8590	11,845	264	295
AK 56X0-PX49	IDC Second String Control, for 658 drives	4,100	120	100
AK 5640-P449	IDC Second String Control for 8590	11,845	264	295
AK 56X0-PX50	IDC Third String Control, for 6590 drives	4,100	120	100
AK 5640-P450	IDC Third String Control for 8590	11,845	264	295
AK 56X0-PX51	IDC Third String Control, for 658 drives	4,100	120	100
AK 5640-P451	IDC Third String Control for 8590	11,845	264	295
AK 56X0-PX55	IDC Dual Access Adapter	20,700	1,200	600
AK 5600-P655	IDC Dual Access Adapter for 8580	49,000	1,800	1,340
AK 5640-P455	IDC Dual Access Adapter for 8590	68,040	2,100	1,670
Communications Lines (not on 8585 and 8590)				
AK 5600-P950 through P953	First through fourth 5-line Communications Line Controller (CLC); requires ICS light display	1,845	564	118
AK 5600-P954 through P957	First through fourth 5-line CLC/MLA (multi-line adapter); requires ICS light display	4,530	888	236
AK 5600-P959	ICS Light Display	—	—	—
AK 5600-P958, P960, and P961	MLA Upgrade for AK 5600-P950 through P953	2,685	324	118
Console Options				
RK 5600-P902	Additional Console channel	840	36	24
RK 5640-P902	Additional Console Channel (for 8590)	840	36	24
AU 5851-0101	CRT/Keyboard for Dual Console (8550 only; standard with all other systems)	1,040	60	31
AU 7200-0605	CRT for Dual Console (8550 only; standard with all other systems)	5,600	319	145
RK 5601-P103	Console Top with 260 Thermal Printer	3,985	252	123
Additional Options				
AK 5600-PX7X	Upgrade from N-Series to V-Series processor (8550, 8560, and 8570 models)	2,500	180	115
AK 5600-PX01	Fast Floating Point Assist (not on 8580, 8585-M, or 8590)	5,290	132	185
AK 5600-P903	Remote Audible Alarm	1,845	24	60

*Includes maintenance

NCR 8400, 8500 and 8600 Systems

EQUIPMENT PRICES

		Purchase Price	Annual Maint.	One-Year Rental*
I/O CONTROL AND PROCESSOR OPTIONS FOR 8500 SERIES PROCESSORS (Continued)				
Processor Performance Upgrades				
AK 5600-P310	N-8550 to N-8560	13,000	648	325
AK 5600-P312	V-8550 to V-8560	13,000	648	325
AK 5600-P510	N-8560 to N-8570	21,000	900	525
AK 5600-P512	V-8560 to V-8570	21,000	900	525
AK 5600-P510	V-8570 to V-8580	36,000	1,800	800
	V-8555M to V-8565M	52,100	1,128	1,800
	V-8565M to V-8575M	95,000	2,928	3,390

		Purchase Price	Annual Maint.	One-Year Rental*	Monthly License Fee
Firmware Options					
RW 8211-0111	VRX Mode for V-8555M	—	—	—	380
SW 8211-0311	N Mode for V-8555M	—	—	—	457
SW 8211-0211	MP Option for V-8555M	—	—	—	644
SW 8211-0212	VRX/MP Mode for V-8555M; 3 processors	—	—	—	952
SW 8211-0213	VRX/MP Mode for V-8555M; 4 processors	—	—	—	1,138
RW 8211-0121	VRX Mode for V-8565M	—	—	—	517
SW 8211-0321	N Mode for V-8565M	—	—	—	622
SW 8211-0221	MP Option for V-8565M	—	—	—	880
SW 8211-0222	VRX/MP Mode for V-8565M; 3 processors	—	—	—	1,293
SW 8211-0223	VRX/MP Mode for V-8565M; 4 processors	—	—	—	1,551
RW 8211-0131	VRX Mode for V-8575M	—	—	—	671
SW 8211-0331	N Mode for V-8575M	—	—	—	809
SW 8211-0231	MP Option for V-8575M	—	—	—	1,144
SW 8211-0232	VRX/MP Mode for V-8575M; 3 processors	—	—	—	1,678
SW 8211-0233	VRX/MP Mode for V-8575M; 4 processors	—	—	—	2,013
RW 8211-0141	VRX Mode for V-8585M	—	—	—	1,034
SW 8211-0241	MP Option for V-8585M	—	—	—	1,760

		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	1,776,500	81,840	46,100
Additional Memory for V-8650:				
AK 5710-P320	4096K to 6144K bytes	98,400	2,016	3,350
AK 5710-P321	6144K to 8192K bytes	98,400	2,016	3,350
8670 PROCESSOR AND MAIN MEMORY				
V-8670	Virtual Memory Dual Processor System; includes 4096K bytes of main memory, 128K cache memory, 2 Channel Control Processors (CCP), 16 I/O channels, dual CRT consoles, and one System Control Unit	2,555,000	96,000	62,900
Additional Memory for V-8670:				
AK 5710-P520	4096K to 6144K bytes	98,400	2,016	3,350
AK 5710-P521	6144K to 8192K bytes	98,400	2,016	3,350
AK 5710-P522	8192K to 12288K bytes	196,800	4,032	6,700
AK 5710-P523	12288K to 16384K bytes	196,800	4,032	6,700
I/O CONTROL AND PROCESSOR OPTIONS FOR V-8650 AND V-8670				
AK 5710-PX40	Additional CCP with 8 I/O channels	210,000	2,760	5,010
AK 5710-PX41	Trunk CCP with one Low-Speed Trunk	18,060	1,092	583
AK 5710-PX42	Low-Speed Trunk	3,360	132	118
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	778,500	14,160	16,800
MASS STORAGE				
AU 0658-0201	Disk Drive; 100MB; requires 0625-0301 controller	18,500	1,208	725
AU 0658-0401	Disk Drive; 200MB; requires 0625-0301 controller	21,850	1,200	800
AU 0658-0002	Disk Drive Conversion; 100MB to 200MB capacity	2,000	—	305
AK 0625-0301	Disk Control for up to 16 658-0201 or 658-0401 drives	21,800	3,564	1,008
AK 0625-0301	Drive Expansion Feature for 0625-0301 disk control	2,250	180	59
AA 0958-0002	Disk Pack for 0658-0201 or 0658-0401 drives	660	—	—
AU 6530-1201	Cartridge Disk Drive; 54MB	14,500	480	440

*Includes maintenance

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EQUIPMENT PRICES

MASS STORAGE (Continued)

		Purchase Price	Annual Maint.	One-Year Rental*
AK 6530-P401	Upgrade Kit; expands AU 6530-1201 to 81MB	4,300	216	140
AU 6530-1301	Cartridge Disk Drive; 81MB	16,000	528	485
AU 6530-2401	Cartridge Disk Subsystem; includes 54- and 81MB disk drives	21,675	1,188	725
AK 6530-P401	Upgrade Kit; upgrades AU 6530-2401-0090 to 162MB	4,300	216	140
AA 6531-0101	Disk Cartridge, 13.5MB	245	—	—
BU 6549-0101	I/O Link Adapter for 6540	6,300	226	180
AU 6540-0201	Fixed Disk Drive; 135MB	15,750	888	550
AU 6540-0801	Fixed Disk Drive; 540MB, includes four 135MB units	50,500	2,460	1,725
BU 6559-0101	I/O Link Adapter for 6550	13,265	456	435
AU-6550-0101	Pack Disk Drive; 1092MB; 1st unit	47,200	2,040	1,588
AU-6550-0201	Pack Disk Drive, 1092 MB; additional units	45,630	1,980	1,536
AU 6590-0101	Disk Drive; 2 spindles	27,200	1,081	900
AU 6590-0201	Disk Drive; 2 spindles	27,200	1,081	900
AU 6591-0101	35MB Data Module	900	—	60
AU 6591-0201	70MB Data Module	1,930	—	90
AU 6591-0301	Data Module for 6590-0201	1,930	—	90
AK 6590-P003	Rotational Position Sensing Kit	700	51	20

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	1,260	685
BU 6379-0401	I/O Link Adapter for up to four 6370-0401 magnetic tape units	37,600	1,452	965
AU 6370-0601	Magnetic Tape Unit; 125 ips, 9-track, PE/GCR, 200/780KB	29,000	1,572	785
BU 6379-0601	I/O Link Adapter for up to four 6370-0601 magnetic tape units	37,600	1,452	965
AU 6370-0801	Magnetic Tape Unit; 200 ips, 9-track, PE/GCR, 320/1250KB	32,350	2,196	925
BU 6379-0801	I/O Link Adapter for up to four 6370-0801 magnetic tape units	40,290	1,800	1,100
AU 0633-0111	Single Magnetic Tape Unit; PE, 80KB, 9-track, 1600 bpi	7,340	1,327	353
AU 0633-0117	Single Magnetic Tape Unit; NRZI, 10/28/40KB, 7-track, 200/556/800 bpi	7,970	1,419	375
AU 0633-0119	Single Magnetic Tape Unit; NRZI, 40KB, 9-track, 800 bpi	8,900	1,419	410
BU 0624-0119	Controller for up to eight 633-0119 magnetic tape units	8,845	358	366
BU 0624-0179	Controller for up to eight 633-0119 and/or 633-0117 magnetic tape units with same speeds	9,000	358	340
AU 0633-0121	Dual Magnetic Tape Unit; PE, 80KB, 9-track, 1600 bpi	14,155	1,975	624
BU 0624-0111	Controller for up to eight 633-0111 and/or 633-0121 magnetic tape units	12,750	358	466
AU 0633-0211	Single Magnetic Tape Unit; PE, 144KB, 9-track, 1600 bpi (requires high-speed trunk)	12,810	1,327	528
BU 0624-0211	Controller for up to eight 633-0211 magnetic tape units	15,095	358	545
AU 0633-0311	Single Magnetic Tape Unit; PE, 240KB, 9-track, 1600 bpi (requires high-speed trunk)	14,375	1,327	578
BU 0624-0311	Controller for up to eight 633-0311 magnetic tape units	16,655	358	597
AU 0633-0837	Single Magnetic Tape Unit; 10/28/40KB, 9-track, 200/556/800 bpi	7,970	1,419	375
AU 0633-0839	Single Magnetic Tape Unit; NRZI, 40KB, 9-track, 800 bpi	8,900	1,419	410
BU 0624-0839	Controller for 633-0839	8,845	358	335
BU 0624-0879	Controller for 633-0837 and/or 633-0839	9,000	358	340
BU 0634-0117	Magnetic Tape Unit with Controller; 7-track, 25 ips, NRZI	26,670	1,812	710
AU 0634-0107	Magnetic Tape Unit; 25 ips, for use with 0634-0117	10,710	1,008	279
BU 0636-0301	Cassette Tape Handler	6,330	792	276
AK 0636-0001	Additional Cassette	1,265	144	51

PRINTERS

		Purchase Price	Annual Maint.	One-Year Rental*
BU 0646-0201	Train Printer; 1200 lpm, 132 positions, power stacker; includes controller	44,250	4,037	1,517
BU 0647-0201	Train Printer; 2000 lpm, 132 positions, power stacker; includes controller	69,650	6,589	2,427
AK 0646-P001	I/O Link Adapter for BU 0646-0201	2,110	144	85
AK 0647-P001	I/O Link Adapter for BU 0647-0201	2,130	168	100
AK 0960-0152	Print Train; 52 characters	3,150	—	107
AK 0960-0164	Print Train; 64 characters	3,150	—	107
AK 0960-0157	Print Train; 57 characters, OCR-A	3,150	—	107
AK 0960-0196	Print Train; 96 characters, UC/LC	3,150	—	107
BU 0649-0300	Printer; 300 lpm, 132 positions; includes controller	21,600	1,685	694
AK 0000-6491	6/8 Lines per Inch Option for 649-300 Printer	675	14	16
AU 6420-0101	Band Printer; 300 lpm, requires at least one print band	13,000	1,320	425
AU 6420-0201	Band Printer; 600 lpm, requires at least one print band	18,900	2,400	695
AU 6420-0301	Band Printer; 900 lpm, requires at least one print band; includes 6420-K024 quietized cabinet	26,500	3,000	965
RK 6420-K031	Criterion Interface; required for 6420-0101, 0201, and -0301 printers	4,000	600	225
AK 6420-K010	Print Band; 64-character ASCII, 1403, 10 cpi	330	—	25
AK 6420-K019	Print Band; 96-character U/L case	330	—	25
AK 6420-K022	Print Band; 48-character ASCII, 1403, 10 cpi	330	—	25
AK 6420-K024	Quietized Cabinet	550	—	35
AU 6440-0101	Matrix Printer with Interface; 55 lpm, connected to common trunk	2,995	468	150
AU 6440-0102	Matrix Printer; 55 lpm, requires interface	2,295	468	155
RK 6440-K005	RS-232 Interface (CCITT V.24)	1,150	60	30
SK 6440-K003	Character Buffer; 796-101 serial interface	1,000	19	70
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	6,600	720	215
AU 6440-0302	Matrix Printer; 70 lpm	4,650	660	180
RK 6440-K030	Common Trunk Interface for 6440-0202, -0302 printers	500	60	20

*Includes maintenance

NCR 8400, 8500 and 8600 Systems

EQUIPMENT PRICES

		Purchase Price	Annual Maint.	One-Year Rental*
PRINTERS (Continued)				
AU 6440-0402	Matrix Printer; 50 lpm	3,995	468	155
RK 6440-P030	Common Trunk Interface for 6440-0402	500	60	20
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	2,347	760
AU 0684-0101	Card Read/Punch; 500/100-460 cpm	15,600	4,952	793
AU 0684-0301	Card Punch, 100-460 cpm	22,860	4,322	702
AU 0686-0102	Card Read/Punch; 800/83-294 cpm	16,800	4,168	757
AU 0686-0111	Card Read/Punch; 560/60-180 cpm	12,500	3,619	606
AU 0686-0201	Card Reader; 750 cpm	9,900	2,763	473
AU 0686-0302	Card Punch; 82-240 cpm	12,000	3,716	600
AU 0686-0311	Card Punch; 60-180 cpm	8,200	3,441	487
AU 0687-0301	Card Punch; 100 cpm	10,100	1,982	412
AU 6831-0201	Card Reader; 600 cpm	9,000	447	330
AU 6831-0301	Card Reader; 1000 cpm	12,300	1,071	471
PAPER TAPE I/O UNITS				
AU 0660-0101	Paper Tape Reader, 1500 cps	11,600	876	363
AU 0665-0101	Paper Tape Punch, 200 cps	13,900	1,407	457
MICR I/O UNITS				
AU 0670-0101	MICR Sorter; 600 dpm, 11 pockets; includes 622-401 controller	45,000	5,455	1,327
AU 0671-0101	MICR Sorter; 1200 dpm, 18 pockets; includes 622-401 controller	117,500	11,336	2,870
AF 0000-6711	Endorser Feature for 671-101 MICR sorter	12,000	974	353
AU 0675-0101	MICR Reader/Sorter; 750 dpm, 11 pockets	63,500	7,500	1,780
BU 6781-0101	MICR Document Reader/Sorter; up to 1,440 dpm, up to 34 pockets	128,700	9,464	2,810
COMMUNICATIONS				
BU 0621-0103	On-Line Communications Multiplexer for up to 15 lines	8,000	654	230
AK 0691-0201	First Extension for 621-103 multiplexer; extends capacity 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	2,000	216	78
AK 0621-F201	Synchronous Adapter Connection Cable Kit	450	27	14
AK 0621-F202	Wideband Interface	685	27	21
AK 0691-0101	Auxiliary Cage	7,500	130	127
AU 0690-0103	On-Line Auxiliary Bay	8,000	58	166
AU 0692-0600	Dual Asynchronous Adapter, one line disabled	1,500	142	83
AK 0692-0600	Dual Asynchronous Adapter, second line enabled	1,500	142	83
AU 0692-0638	438-3 Adapter	3,000	128	82
AU 0693-0600	Dual Synchronous Adapter, one line disabled	2,250	146	113
AK 0693-0600	Dual Synchronous Adapter, second line enabled	2,250	146	113
AU 0695-0600	On-Line Auto Dialer	1,600	158	52
AU 0698-0300	Integrated Asynchronous Modem	1,000	102	35
AU 0752-0200	Free-Standing External Modem	700	135	34

*Includes maintenance

SOFTWARE PRICES

	Initial 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
Basic FORTRAN Compiler	0	11
Intermediate FORTRAN Compiler	0	22
Full FORTRAN Compiler	0	44
Educational FORTRAN Compiler	0	11
RPG Compiler	0	44
Object Module Assembly Program (OMAP)	0	11
SORT/MERGE	0	66
Student COBOL	3,170	66

NCR 8400, 8500 and 8600 Systems

SOFTWARE PRICES

	Initial License Fee	Monthly License Fee
RS1 On-Line System Software		
Time-Sharing	0	220
Remote Batch Entry (RBE)	0	44
B2 Prepass Compiler	0	40
Queue Executive Interface (QX1)	0	11
BASIC I (Dedicated)	1,090	62
BASIC I (Dual)	1,090	62
BASIC I I/O Writer	1,090	62
BASIC M	1,650	44
RS1 Data Management System Software		
Index Sequential Filing System	0	17
Random Filing System (RFS)	0	17
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	11
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	55
Network Definition Language Processor	0	33
On-Line Program Development	0	61
Remote Job Entry	0	66
VRX Telecommunications	0	20
VS1 Data Management System Software		
CAM/VRX Utilities	0	11
VRX File Conversion Utility	0	44
Management Sciences Application Software		
Statistics	805	17
Linear Programming	540	11
Project Network Analysis	3,720	77
Vehicle Scheduling	540	11
Feed Information System (FIS)	9,815	303
General Application Software		
General Payroll	540	11
Payroll/Cost, Labor Scheduling	540	11
Accounts Receivable—Commercial	805	17
Accounts Receivable—Consumer	805	17
Accounts Receivable—Tape	805	17
Accounts Payable	805	17
General Ledger with Reporting Subsystem	540	11
Accounting System Interface	540	11
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)	11,880	210
SPIRIT—Sales Analysis	1,075	—
Medical Application Software		
Post Discharge Accounts Receivable	1,190	25
In-Patient Records	805	17
Medical Audit Statistics	540	11

NCR 8400, 8500 and 8600 Systems

SOFTWARE PRICES

	Initial License Fee	Monthly License Fee
Criterion Loan and Savings System (CLASS)		
General Ledger	1,000	30
Savings	20,000	540
Loans	15,000	405
Education Application Software		
Stewardship & Management Accounting	1,190	25
SCHOLARS II	10,340	330
Student Test Analysis	480	10
School Bus Scheduling System	2,200	72
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)	1,355	29
Department Store Application Software		
Retail Sales Audit	805	17
Fashion Reporting	2,375	50
Pre-Edit Processing	1,530	32
Staple Stock Replenishment	1,905	40
MEDICS Application Software		
MEDICS A-10	33,000	690
MEDICS ADT	11,000	230
IRX—System Software		
IRX—Operating System	4,950	110
IRX—Utilities	1,350	30
IRX—COBOL 74 Compiler	4,500	100■