NCR V-8800 System

MANAGEMENT SUMMARY

UPDATE: *NCR Corporation has discontinued the production of the V-8500 and V-8600 Systems, which were first introduced in 1983. The top-of-the-line V-8800 System, announced in 1986, is replacing the two older systems. NCR has reduced the purchase price of the V-8800 System by 38 percent and has added several new storage and input/output peripherals.*

The V-8800 System, like its predecessors the V-8500 and V-8600 Systems, is designed to operate in batch, on-line transaction, remote job entry (RJE), and distributed processing environments. The V-8800 System can provide up to 50 percent more power than a comparable V-8600 System. This power is achieved through the additional NEAT Assist Unit (NAU) hardware component in the V-8800, which speeds up the execution of NEAT virtual commands. Because of this hardware feature, the V-8600 cannot be field upgraded to a V-8800 System. The V-8800 is, however, completely program compatible with V-8500 and V-8600 Systems and object code compatible with the NCR 9800 Systems, protecting the user's substantial software investment. Utilizing the system-to-system hardware adapter, the V-8800 can also act like an application processor in a 9800 System configuration.

The V-8800 System features a 32-entry Dynamic Address Translator (DAT), double the size of the V-8500 DAT, and the DAT Assist Unit (DAU), which performs virtual/real and real/virtual address translation. Arithmetic functions that were performed by microcode in the V-8500 are now performed by the Arithmetic Assist Unit (AAU), significantly speeding up Fortran program execution.

The V-8800 System uses fault tolerance with automatic recovery to achieve high system availability. Fault- ▷

The V-8800 is NCR's high-end system. It features redundant processing capabilities, provided by the NCR incremental architecture. This hardware/software combination allows loose or combination loose/tight coupling within a configuration. The V-8800 System is designed for batch, transaction, and distributed processing environments.

MODELS: V-8835, V-8845, V-8855, V-8865, V-8875, V-8885, and V-8895.
CONFIGURATION: The V-8800 models have from one to eight central processors; 4 to 32 megabytes of memory, upgradable in 4-megabyte increments to a maximum of 64 megabytes; and 16 to 128 input/output channels.
COMPETITION: Honeywell Bull DPS 8000; IBM 4381 Series; NAS/VL Series; and Unisys A 10, A 12, and 2200/400.
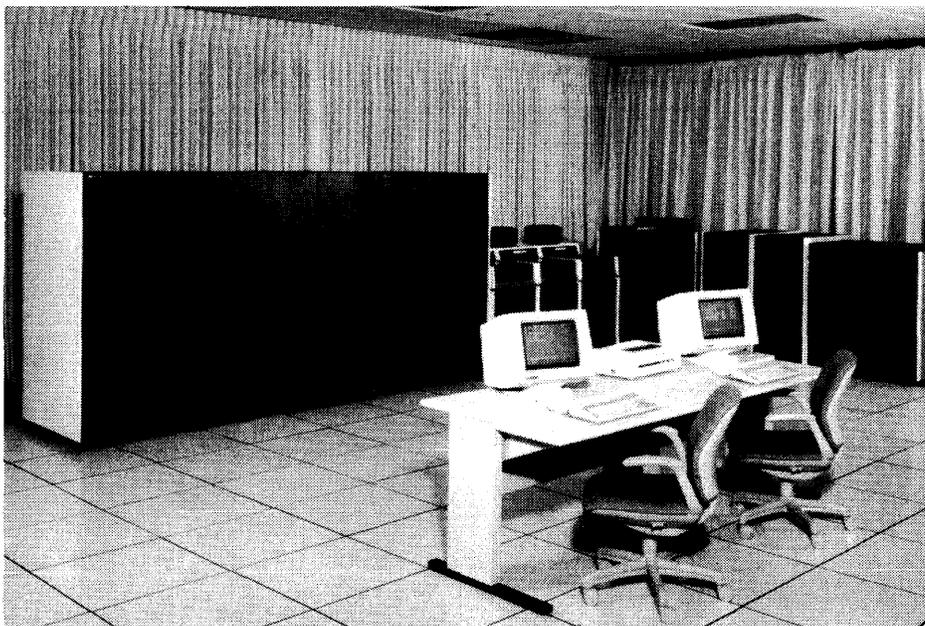**PRICE:** Purchase prices range from $295,000 for the V-8835 to $2,199,000 for the V-8895.

CHARACTERISTICS

MANUFACTURER: NCR Corporation, 1700 South Patterson Boulevard, Dayton, Ohio 45479. Telephone (513) 445-5000. In Canada: NCR Canada Limited, 117 Eglington Avenue East, Toronto, Ontario M4P 1J1.

MODELS:

NCR V-8835, V-8845, V-8855, V-8865, V-8875, V-8885, ▶
V-8895.

NCR's V-8800 System comprises seven models, with one to eight central processors. Memory capacity ranges from 4 to 32 megabytes, upgradable in 4-megabyte increments to a maximum of 64 megabytes.

NCR V-8800 System

TABLE 1. SYSTEM COMPARISON

MODEL	V-8835	V-8845	V-8855	V-8865
SYSTEM CHARACTERISTICS				
Date announced	Sept. 86	Sept. 86	Sept. 86	Sept. 86
Date first delivered	Aug. 86	Aug. 86	Aug. 86	Aug. 86
Field upgradable to	V-8845	V-8855	V-8865	V-8875
Relative performance	4.5	8.55	8.82	12.3
Number of processors	1	2	2	3
Cycle time, nanoseconds	38	38	38	38
Word size, bits	32	32	32	32
Operating system	VRX	VRX	VRX	VRX
MAIN MEMORY				
Type	64K-bit MOS	64K-bit MOS	64K-bit MOS	64K-bit MOS
Minimum capacity, bytes	4M	8M	8M	12M
Maximum capacity, bytes	16M	16M	32M	32M
Increment size, bytes	4M	4M	4M	4M
Cycle time, nanoseconds	336	336	336	336
BUFFER STORAGE				
Minimum capacity, bytes	32K	128K	64K	160K
Maximum capacity, bytes	32K	64K	128K	160K
Increment size	Not applicable	Not applicable	Not applicable	Not applicable
INPUT/OUTPUT CONTROL				
Number of channels:				
Byte multiplexer	Not available	Not available	Not available	Not available
Block multiplexer	Not available	Not available	Not available	Not available
Word	Not available	Not available	Not available	Not available
Other	16 to 32	16 to 32	16 to 64	16 to 64

▷ tolerant system characteristics include redundancy, fault detection, fault isolation, reconfiguration, and repair. Systems with these characteristics can achieve higher reliability and minimize the effects and costs of computer system failures.

COMPETITIVE POSITION

NCR is a successful computer manufacturer with a broad product line, with particular strength in retail point-of-sale terminals and systems, self-service financial terminals, and general-purpose computers. After experiencing a substantial increase in earnings and revenues in 1987, the company announced that net income grew 20 percent to $74,133,000 in the first quarter of 1988, up from $61,524,000 reported for the same period in 1987. International marketing groups, paced by European and Pacific regions, showed the strongest revenue advance, supported by continued gains in the United States.

NCR specializes in small banking systems. The firm is also well established in other financial areas and local government, which is a profitable, but competitive, market segment. The biggest challenger in the local government, banking, and financial environment is Unisys with its Line of Business (L.O.B.) marketing strategy. Software programs especially designed for the financial sector and local government are available for the Unisys A 10 and A 12. IBM's 4381 systems have the biggest installed base, mostly in commercial and manufacturing environments. Even though the NAS AS/VL Series is in the same performance range as the V-8800, it is primarily a plug-compatible system for the IBM 4381, targeted towards remote-site computing or users migrating from older IBM operating systems to MVS. Similar to NCR, Honeywell Bull's DPS 8000 is aimed at fault-tolerant and on-line transaction processing applications in the general business sector. ▷

▶ DATA FORMATS

BASIC UNIT: Eight-bit byte. Each byte can represent one alphanumeric character, one or two BCD digits (in unpacked or packed format, respectively), or eight binary bits. Four consecutive bytes form a 32-bit 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: Four or eight bytes in length, specifying one or two memory addresses, respectively.

INTERNAL CODE: Eight-bit EBCDIC is standard.

MAIN MEMORY

The memory subsystem consists of the interface, timing, and control logic, permitting it to function independent of other subsystems. When multiple memory subsystems are present on the same system, the memory interleaving feature is used. Data in main memory is interleaved with up to four contiguous words located in separate modules. Interleaving allows two or four 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.

STORAGE TYPE: 64K-bit RAM Metal Oxide Semiconductor (MOS).

CAPACITY: See Table 1 for capacities of individual models. ▶

NCR V-8800 System

TABLE 1. SYSTEM COMPARISON (Continued)

MODEL	V-8875	V-8885	V-8895
SYSTEM CHARACTERISTICS			
Date announced	Sept. 86	Sept. 86	Sept. 86
Date first delivered	Aug. 86	Aug. 86	Aug. 86
Field upgradable to	V-8885	V-8895	Not applicable
Relative performance	16.14	24.26	32.28
Number of processors	4	6	8
Cycle time, nanoseconds	38	38	38
Word size, bits	32	32	32
Operating system	VRX	VRX	VRX
MAIN MEMORY			
Type	64K MOS	64K MOS	64K MOS
Minimum capacity, bytes	16M	24M	32M
Maximum capacity, bytes	32M	48M	64M
Increment size, bytes	4M	4M	4M
Cycle time, nanoseconds	336	336	336
BUFFER STORAGE			
Minimum capacity, bytes	256K	384K	512K
Maximum capacity, bytes	256K	384K	512K
Increment size	Not applicable	Not applicable	Not applicable
INPUT/OUTPUT CONTROL			
Number of channels:			
Byte multiplexer	Not available	Not available	Not available
Block multiplexer	Not available	Not available	Not available
Word	Not available	Not available	Not available
Other	16 to 64	32 to 96	32 to 128

▷ **ADVANTAGES AND RESTRICTIONS**

The V-8800 System is mainly a replacement system for the older V-8500 and V-8600 Systems. Even though the V-8800 overlaps the 9800 System at the high end, it provides a better migration path and lower cost solution for V-8500 and V-8600 users than the 9800 Systems. While the 9800 Systems have improved price/performance characteristics compared to the V-8800, the latter is the better choice for users with large on-line networks. These are usually insurance companies, banks, or other financial institutions that require a fast batch update on an on-line file after the on-line day has ended and before the next has begun. The V-8800 is also the preferred choice of users with programs that have post wait schemes such as the NCR Customer Information File (CIF) system for banks. These programs require the output of other programs before they can begin. For applications of this type, a large, powerful processor is more effective than a number of small processors.

How long until the new system is effective and the total cost are usually the most important considerations. The V-8800's capability to run existing programs, especially large, single-threaded programs migrated from the V-8500 and V-8600 Systems without modification, makes it the most time- and cost-effective choice.

According to John Scorsone, vice president of the Business Systems Division, NCR will continue to sell the V-8800 for the next several years and will continue to make enhancements to the systems software.

USER REACTION

The 1987 Datapro survey of general-purpose mainframes users yielded responses from 65 NCR V-8500, V-8600, ▷

▶ **CYCLE TIME:** See Table 1.

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; double-bit errors are detected and signaled so that appropriate program action can be taken.

RESERVED STORAGE: A separate set of sixty-four 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.

CENTRAL PROCESSOR

The Central Processing Unit (CPU) makes extensive use of Emitter-Coupled Logic (ECL) circuitry. It is a microprogrammed, register-to-register unit built around an Internal Transfer Subsystem, a high-speed bus with a data transfer rate of 70 megabytes. All major system components are connected to this bus. 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.

Additional CPU functions provided by the System Control Unit (SCU) include firmware loading during start-of-day procedure, peripheral subsystem message management, and system testing diagnostics and error logging.

The SCU is the central control point of the V-8800 System. A microprogrammed control processor controls two independent console displays for operator communications and system diagnostics, two 1-megabyte flexible disk drives for firmware loading and error logging, an optional console printer, and channels for additional CRT/keyboard units that can operate as remote system consoles. From either of ▶

NCR V-8800 System

and V-8800 users. Of those surveyed, 71 percent purchased and 17 percent leased the systems directly from NCR, and 12 percent leased the hardware from a third-party vendor. More than 50 percent upgraded from smaller NCR systems, indicating strong vendor loyalty. The sites surveyed represented a variety of industries; banking/finance/securities and government clearly dominated. Sixteen systems were installed in the financial sector, fourteen in local government, eleven in retail/wholesale businesses, seven in manufacturing, and five in educational facilities. Other industries mentioned were service bureaus with four systems; health care/medical with three systems; construction, utilities, distribution, actuarial services, and software development with one system each. As would be expected, most machines (94 percent) were installed as organizational systems.

As usual, principal applications areas were accounting/billing and payroll/personnel (52 percent each); banking-check processing/loan/savings and order processing/inventory (29 percent each); purchasing (28 percent); sales/distribution (23 percent); and education/scheduling/administration (15 percent). Other applications such as manufacturing, health care/medical, and insurance were cited less frequently.

Cobol was the most popular programming language, followed by NCR's own NEAT/3. The preferred data base management system was TOTAL; users rated it good to excellent for overall satisfaction and ease of installation and use.

Out of 65 respondents, 62 percent had a disaster recovery plan in place. Only 28 percent of the users had implemented an information center. When asked about future acquisitions, more than 50 percent of the users said they planned to expand their current hardware and communications facilities.

The users were asked to rate their V-8500, V-8600, and V-8800 Systems in 14 categories. Their ratings are summarized in the table below.

	Excellent	Good	Fair	Poor	WA*
Ease of operation	17	39	9	0	3.13
Reliability of mainframe	37	23	4	1	3.48
Reliability of peripherals	26	35	2	2	3.38
Maintenance service:					
Responsiveness	23	32	8	1	3.30
Effectiveness	19	28	15	3	3.06
Technical support:					
Troubleshooting	11	36	16	2	2.86
Education	15	31	14	3	2.92
Documentation	5	37	16	6	2.64
Manufacturers software:					
Operating system	20	38	5	1	3.20
Compiler & assemblers	16	41	7	1	3.11
Application programs	5	30	17	11	2.46
Ease of programming	9	41	14	1	2.89
Ease of conversion	21	29	11	2	3.10
Overall satisfaction	18	40	6	1	3.15

*Weighted Average on a scale of 4.0 for Excellent.

the system consoles or a remote console, both primitive-level diagnostics (which test the basic hardware functions and capabilities) and virtual-level diagnostics (which test the virtual-machine functions and capabilities) can be run on system elements while normal operations continue. The primary controlling unit for the SCU is the Control Processor (CP).

Most of the firmware that directs the system to perform the required functions is stored in a high-speed memory called the Instruction Storage Unit (ISU). Capacity of the ISU ranges from 128K bytes on the V-8835 to 1014K bytes on the V-8895.

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. A high-speed cache buffer, ranging from 32K to 512K bytes, also increases performance.

The V-8800 System offers multiple processor configurations. The "base models" include the uniprocessor V-8835 and the dyadic processor V-8845. The other V-8855, V-8865, V-8875, V-8885, and V-8895 models are made up of multiple configurations of the base models and are termed the "Processor Complex" models. The V-8855 consists of two V-8835 processors; the V-8865 consists of one V-8835 uniprocessor and one V-8845 dyadic processor; the V-8875 consists of two 8845 dyadic processors; the V-8885 consists of three 8845 dyadic processors; and the V-8895 consists of four 8845 dyadic processors. The dyadic processor 8845 is a tightly coupled system, and the 8855 is loosely coupled; however, when a complex processor system includes both an 8835 and an 8845 system, a unique combination of both tight and loose coupling results.

SPECIAL FEATURES: The NEAT Assist Unit (NAU) speeds up the execution of the most commonly used NEAT virtual commands. NEAT is NCR's proprietary programming language. To perform the calculations of virtual/real and real/virtual address translation, the processor uses a hardware component called the Dynamic Address Translation Assist Unit (DAU).

PHYSICAL SPECIFICATIONS: The V-8800 System requires a computer room temperature range of 64.4 to 78.8 degrees Fahrenheit with a relative humidity range of 40 to 50 percent for optimum operation. The processor power supplies require 400 cycle 3-phase power and a voltage of 220 to 240 V AC.

CONFIGURATION RULES

The V-8800 System comprises seven models: one uniprocessor, one dyadic, and five multiprocessor models. The uniprocessor Model V-8835 consists of one central processor, 4 megabytes of main memory, 32K bytes of cache memory, two channel control processors with 16 I/O channels, two CRT consoles, and one system control unit with one control processor. The dyadic Model V-8845 consists of two tightly coupled processors, 8 megabytes of shared main memory, 128K bytes of cache memory, two channel control processors with 16 I/O channels, two CRT consoles, and a control unit with one control processor. The

NCR V-8800 System

▷ Users were asked two final questions: "Did the system measure up to your expectations?" and "Would you recommend it to another user?" More than 92 percent of the respondents felt their systems performed as they had expected, less than 2 percent were not satisfied with their computers, and the rest were undecided. Approximately 82 percent of the users said they would recommend their systems to others, while 11 percent answered "no" to this question. ☐

▶ five multiprocessor Models V-8855, V-8865, V-8875, V-8885, and V-8895 have from two to eight central processors, 8 to 32 megabytes of main memory, 64K to 512K bytes of cache memory, four to six channel control processors with 16 to 32 I/O channels, two CRT consoles, and a system control unit with one control processor.

INPUT/OUTPUT CONTROL

I/O control on the V-8800 System is maintained by two basic subsystems: Channel Control Processors (CCPs) control up to 32 peripheral channels, and an optional Trunk Channel Control Processor (TCCP) interfaces with a wide variety of peripherals.

The CCPs in the I/O Subsystem interface directly to main memory through the Internal Transfer Subsystem. All I/O management functions are performed by the CCPs without any involvement of the CPU. Two CCPs are standard, and four more are optional. On the V-8835 and V-8845 models, 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 CCPs. Since all CCPs connect to the DCX, the loss of a CCP does not result in the loss of I/O devices. This arrangement also provides automatic load leveling. The maximum data transfer rate over each channel is 2 megabytes per second. In those situations where an I/O device is not compatible with the CCP, an optional TCCP can be used. Up to two common trunks can be connected to the TCCP for these devices. The configurations available include either one low speed, two low speed, or one low speed and one high speed.

The TCCP's 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. Very high speed trunks are direct memory access devices that do not require any CPU activity. The trunk circuitry contains all the control registers implemented in memory, plus 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 using a four-byte interface.

The Dynamic Channel Director (DCD) is a solidstate electronic switch and is used on the V-8800 "Processor Complex" models in place of the DCX. The DCD offers additional I/O capabilities that provide the intersystem communications required for loose coupling. The basic 4-by-16 DCD module connects any of four CCPs to any of 15 channels and one System-to-System Adapter (SSA). DCDs are available in four sizes: 4 by 16, 8 by 32, 12 by 48, and 16 by 64. Additional DCDs can be connected to provide high availability and/or additional I/O ports. The SSA is a bit-serial link device that allows multiple hosts to indirectly communicate with each other.

The Dynamic Channel Director, Channel Control Processor, and System-to-System Adapter are part of the combination hardware/software incremental architecture that provides multiprocessing capabilities. Users have the option of loose coupling or a combination of loose and tight coupling in the configuration. Each loosely coupled host processor executes its own copy of the VRX operating system. In the event of a hardware, software, or firmware failure, duplicate copies of the critical applications can be automatically activated to continue processing at the exact point of failure, thus ensuring data integrity and high system availability. The failure can then be isolated and repaired while processing continues.

MASS STORAGE

For information on mass storage devices for the V-8800 System, refer to Table 2.

INPUT/OUTPUT UNITS

Refer to Table 3 for information on tape units and printers.

TERMINALS

Terminals used with the V-8800 System are listed in Table 4.

COMMUNICATIONS

Communications hardware for the V-8800 System includes synchronous, asynchronous, and bit-oriented Data Link Control (DLC) adapters, multiplexers, integrated and free-standing modems, and communications processors that can be configured to handle any on-line, realtime network requirements. Front-end communications processors are also available to handle all network control functions so that telecommunications are transparent to host processors and application programs.

The use of the *621 Communications Multiplexer* on V-8800 Processor Complex models requires a TCCP that includes a low-speed common trunk, with another low-speed or high-speed trunk available as an option. A *Multiplexer Channel Control Processor (MCCP)* may be required to increase the low-speed trunk bandwidth to 40K bytes to accommodate medium-to-high speed 621 Multiplexer activity. The MCCP should only be added if really necessary, because it occupies one CCP position and can restrict growth in the I/O subsystem.

The *721 Communications Processor* serves as a front-end processor, a remote communications concentrator, a message-switching system, or a unit performing combinations of these functions for up to 62 full-duplex or 95 half-duplex lines.

The *5620 Communications Processor* is designed for local or remote network configurations requiring up to 32 duplex communications lines.

The *3650 Communications Processor* is designed for network configurations at local or remote locations requiring up to 128 duplex communications lines.

SOFTWARE

OPERATING SYSTEM: NCR offers a virtual operating system for the V-8800 System. The *Virtual Resource Executive (VRX)* is a group of software modules that utilize the VS8 firmware to make up a flexible operating system with multiprocessing, virtual-machine, and virtual-storage capabilities. VRX supports multiple-processor systems and ▶

NCR V-8800 System

TABLE 2. MASS STORAGE

MODEL	6543-7404	6099-5113	6099-5213	6099-5413
Cabinets per subsystem	1 or 4	1	1	1
Disk packs/HDAs per cabinet	2 to 4	1	2	4
Capacity	415.2MB	415.MB	830.4MB	1.6GB
Tracks/segments per drive unit	711	Not specified	Not specified	Not specified
Average seek time, msec.	20	20	20	20
Average access time, msec.	28.3	28.3	28.3	28.3
Average rotational delay, msec.	8.3	8.3	8.3	8.3
Data transfer rate	1.2MB	1.8MB	1.8MB	1.8MB
Controller model	6099	Included	Included	Included
Comments	Can be stacked 2 high	Can be stacked 2 high	Can be stacked 2 high	Can be stacked 2 high

▶ treats processing elements in the system as assignable resources. The current level of VRX is Release 12, which includes incremental architecture capabilities.

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

In a virtual storage environment, a 16M-byte virtual address space is available to each active job. Eight million bytes, used in common by the executive and certain software for all programs, are referred to as the global software area. The remaining 8 million bytes (local area) are used by the individual job for programs and data.

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

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

The VRX software, together with the virtual-storage firmware, enables the system to perform like two different machines using two different firmware instruction sets. The basic instruction set, called the Base VRX Instruction Set, provides an interface for the virtual-storage software, while the 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 peripherals and memory 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 can be 1024, 2048, 4096, or 8192 bytes.

When a job is first introduced into the VRX system via on-line terminals, the executive stores job specifications and any data parameters for the job in a 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. Resource allocation is 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 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. ▶

NCR V-8800 System

TABLE 3. INPUT/OUTPUT UNITS

Magnetic Tape Units	Number of Tracks	Recording Density, Bits/Inch	Encoding	Tape Speed, Inches/Sec.	Transfer Rate, Bytes/Sec.
6376-0201	9	1600/6250	PE/GCR	200	320K to 1250K
6376-0202	9	1600/6250	PE/GCR	200	320K to 1250K
6373-0101	9	1600/6250	PE/GCR	25/75	40K to 469K
6373-0102	9	1600/6250	PE/GCR	25/75	40K to 469K
6325-0101	9	800/1600	NRZI/PE	45	36K to 72K

Printers	Printing Speed	Print Positions	Horizontal Spacing, Chars./Inch	Vertical Spacing, Lines/Inch	Form Size, Inches
6471-0201	2,000 lpm	132	10	6 or 8	Industry std.
6430-0101	360 lpm	132	10	6 or 8	Industry std.
6430-0201	720 lpm	132	10	6 or 8	Industry std.
6470-0102	1,500 lpm	132	10	6 or 8	Industry std.
6480-0101	103 ppm	—	to 20	to 24	Industry std.
6411	120 cps	80	10	6 or 8	8½ x 11
6455	33 cps	—	10	6 or 8	8½ x 11

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 levels of error recovery systems, each designed for specific applications. These facilities include a *Criterion Access Method (CAM)* file error recovery system, which uses CAM utilities to restore CAM files if an error occurs. A batch recovery system, called *Rescue/ Restart*, continues a program from a previously defined rescue point rather than from 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 (REINIT)* system causes the software to save important system information such as spooled files before initialization so that currently active jobs can be started again.

The *Inter Host Management Facility's (IHMF's)* Inter Host Communication (IHC) mode is responsible for the communications between base processors in loosely coupled configurations. The two components constituting the IHMF are a task that receives messages from other hosts through the SSA and routes those messages to the appropriate task within the host and a set of "user-callable" routines for output to other hosts. The IHMF provides host-to-host communications for VRX and applications. It is a necessary element to detect failure and to activate automatic recovery.

The *InstantReady* mode uses two hosts for critical on-line applications. One host handles all on-line activity with the required files opened, while the second host has the same on-line applications (InstantReady) loaded and the same files opened, but in a suspended state waiting for transaction input. When a failure in the first host is detected, the InstantReady job is automatically activated by VRX and, with automatic switchovers, assumes the entire transaction load.

Interhost *File Sharing* is designed to facilitate the InstantReady concept in incremental processing without precluding the ability to run in a shared work load mode. A file can be shared by more than one host if it resides on an interhost shared disk and declared open for interhost sharing by its users. B-Series input or I/O files and CAM sequential and relative input or I/O files can be shared under InstantReady.

The VRX incorporates facilities for handling sequential, indexed sequential, and NCR random files. It also uses *CAM*, a file management technique 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.

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.

VRX *Remote Job Entry (RJE) subsystem* 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.

The VRX Base System Package provides standard batch operating system functions. Specifically, it can compile programs written in VRX Cobol-74, sort and merge various types of files, utilize NCR disk subsystems such as the 6543 with the capability of accessing greater than 64K-byte disk sectors, perform general housekeeping functions, provide system performance data, analyze Cobol programs to maximize program efficiency, and provide improved disk storage management in a realtime environment.

PROGRAMMING LANGUAGES: The high-level languages supported by the V-8800 System are Basic, Cobol 74, Cobol 68, Fortran IV, Fortran E, NEAT/3, NEAT/VS, and NCR RPG.

DATA BASE MANAGEMENT: The *NCR-Total* data base management system is a licensed software product running under the VRX operating system. It is available in two versions. *Total Basic* is single threaded with a copy of Total bound to each active task. *Total Central* is multi-threaded and is located in its own job region. The structured *Data Base Definition Language* provides for the initial generation of a Total data base description module and all subsequent modifications. The *Data Management Language* interfaces to the operating system and the application program for all communications with the Total data base. File Sharing under Total Basic uses file locks when

NCR V-8800 System

➤ an update to a data set is to occur. Total Central uses a combination of File Sharing options and a record-locking facility to protect files to be updated.

DATA MANAGEMENT: The *NCR-DMS* data management system for the VRX environment includes several software tools that provide resource control, system documentation, applications development aids, and end-user information access.

The *DMS/Directory* is an integrated dictionary/directory that simplifies documentation and control of data bases, files, records, data elements, software, hardware, and networks. *DMS/Data Entry* is an on-line, source-data entry system for batch processing, allowing batches of data to be entered at the originating point of the transaction. The system controls and validates the input data via batch totals, range checks, check digits, and arithmetic operations. Various utilities are provided to deal efficiently with batch data, and system performance statistics are available at the user's discretion. *DMS/Tran-Pro* is a general-purpose transaction processing monitor that supports on-line applications in a realtime environment. *Tran-Pro* uses the VRX virtual memory to increase overall throughput and interfaces VRX tasking and dynamic storage allocation functions to decrease applications program requirements. It is designed for users with large network and data base requirements. The *DMS-Query* interactive query language is a nonprocedural data retrieval language designed for use by nonprogrammers. The retrieval language permits users to direct inquiries to nearly any data file at any time. A data dictionary language allows the data base manager to limit specific user access to data at the field level by assigning passwords or access codes. The *DMS/Reporter* is an off-line report writer for batch generation of large reports with extensive data manipulation and sorting.

DATA COMMUNICATIONS: VRX provides communications software designed to simplify the application programmer's task. Users need not worry about network configurations and communications protocols. The *Message Control System (MCS)* 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. The *Network Description Language (NDL)* defines a communications network and the queue arrangement to be used by an on-line program. The *Network Description Language Processor (NDLP)* reads NDL statements, processes them, and creates the tables necessary for on-line operation. The tables are subsequently combined with programs at load time by the Link Editor.

The VRX IVS Telecomm/Development Package permits the migration of a batch system to an on-line environment. Users can define the network configuration, develop the on-line application, and access VRX print spool files and the VRX executive software.

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 Telecommunications software provides NCR/DLC, SDLC, BSC, X.25, TTY, and ISO asynchronous 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; it typically uses the Cobol Message Control System (MCS).

PROGRAM DEVELOPMENT: *VRX-IVS* includes facilities for on-line, interactive program development, testing, and debugging. Programmers at remote locations can create, modify, and run source programs through interactive terminals. This includes text editing, file library maintenance, and program execution. Source programs are entered directly into the system and can pass through the test and debug cycles without interfering with regular system operation.

UTILITIES: The *System Performance Utility* monitors the entire system's performance levels and produces data-related copy, print, and sort and interactive file-related copy, print, compare, backup, and delete. It also performs system maintenance and program debug, CAM file handling, time-ordered index CAM file handling, and program development.

OTHER SOFTWARE: NCR offers software packages to handle key applications in manufacturing, retailing, schools, financial institutions, hospitals, and public safety.

PRICING AND SUPPORT

POLICY: NCR continues its policy of unbundling software costs. In most cases, there is a monthly licensing charge and, for certain packages, a onetime licensing fee also. The monthly charge ranges up to slightly over $1,000; onetime fees range up to about $36,000. Specific software prices were not provided by the vendor.

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 8 a.m. and 5 p.m. Monday through Friday. Charges for maintenance coverage beyond this period are calculated by adding a percentage premium to the basic maintenance 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%	6%	7%	10%	10%
Sunday & Holiday	7%	8%	9%	12%	12%

SUPPORT: NCR has a Software Maintenance plan with a toll-free telephone number to call for assistance. If the problem cannot be resolved over the telephone, on-site fault isolation activity and software updates are supplied at the current hourly rate.

EDUCATION: All educational services are separately priced.

TYPICAL CONFIGURATION: The following configurations illustrate a single-processor V-8835 System and an eight-processor V-8895 System. The quoted prices include all necessary hardware components, but no software. ➤

NCR V-8800 System

TABLE 4. TERMINALS

MODEL	4920	4940	4902
DISPLAY PARAMETERS			
Max. chars./screen	2,000, 3,300	2,000	2,000, 3,300
Screen size (lines x chars.)	25 x 80/132	25 x 80/132	25 x 80
Symbol formation	7 x 12 dot matrix	7 x 12 dot matrix	5 x 9 dot matrix
Character phosphor	Green, amber, white	Green, amber, white	Color
Total colors/no. simult. displayed	Not applicable	Not applicable	8
KEYBOARD PARAMETERS			
Style	Typewriter, numeric pad	Typewriter, numeric pad	Typewriter, numeric pad
Character/code set	128 ASCII	128 ASCII	128 ASCII
Detachable	Standard	Standard	Standard
Program function keys	12/24	16/32	8/16
OTHER FEATURES			
Buffer capacity	Not available	Not available	Not available
Tilt/swivel	Standard	Standard	Tilt
Graphics capability	25 symbols	Not available	11 symbols
TERMINAL INTERFACE	RS-232-C	RS-232-C	RS-232-C

Model V-8835

One V-8835 uniprocessor, 4 megabytes of main memory, 32K bytes of cache memory, 2 Channel Control Processors, 16 I/O channels, 2 CRT consoles, 1 System Control Unit, and 1 System Control Processor	$295,000
2 6543 disk drives (415.2MB)	44,260
4 6376 magnetic tape units (200 ips)	119,080
2 6470 band printers (1,500 lpm)	17,000
20 4920 terminals	19,900
TOTAL PURCHASE PRICE:	**$495,240**

Model V-8895:

Four V-8845 dyadic processors with 32M bytes of memory, 512K bytes of cache memory, 8 Channel Control Processors, 1 System-to-System Adapter, an 8x32 Dynamic Channel Director, and 2 CRT consoles	$2,199,000
4 6543 disk drives (415.2MB)	80,095
4 6376 magnetic tape units (200 ips)	119,080
3 6470 band printers (1,500 lpm)	106,650
40 7910 terminals	39,800
TOTAL PURCHASE PRICE:	**$2,544,625**

EQUIPMENT PRICES

		Purchase Price ($)	Annual Maint. ($)	One-Year Rental* ($)
V-8835 PROCESSOR AND MAIN MEMORY				
V-8835	Virtual Memory Uniprocessor System; includes 4 megabytes of main memory, 32K bytes of cache memory, 2 Channel Control Processors with 16 I/O channels, dual CRT consoles, one System Control Unit with one Control Processor, and DCX or DCD interface	295,000	20,625	**16,720
AU 8835-8845	V-8835-V-8845 Upgrade	235,000	1,875	**10,190
Additional Memory for V-8835				
AK 5710-P520	4M to 8M bytes	64,800	4,032	3,220
V-8845 PROCESSOR AND MAIN MEMORY				
V-8845	Virtual Memory Dual Processor System; includes 8 megabytes of main memory, 128K bytes of cache memory, 2 Channel Control Processors with 16 I/O channels, dual CRT consoles, one System Control Unit with two Control Processors, and a DCX/DCD interface	530,000	26,530	**27,520
Additional Memory for V-8845 through V-8895				
AK 5710-P522	8M to 12M bytes	64,800	4,032	3,220
AK 5710-P523	12M to 16M bytes	64,800	4,032	3,220
V-8855 PROCESSOR AND MAIN MEMORY				
V-8855	System includes two V-8835 Virtual Memory Uniprocessor Systems (see V-8835 above for description), a 4x16 Dynamic Channel Director, and a System-to-System Adapter	633,000	33,750	**34,160

*Includes maintenance.
**Three-year rental only.
NC—No charge.
NA—Not applicable.

NCR V-8800 System

		Purchase Price ($)	Annual Maint. ($)	One-Year Rental* ($)

V-8865 PROCESSOR AND MAIN MEMORY

| V-8865 | System includes one V-8835 Uniprocessor and one V-8845 Dual-Processor (see V-8835 and V-8845 above for descriptions), a 4x16 Dynamic Channel Director, and a System-to-System Adapter | 870,000 | 42,845 | **45,290 |

V-8875 PROCESSOR AND MAIN MEMORY

| V-8875 | System includes two V-8845 Dual-Processor Systems (see V-8845 above for description), a 4x16 Dynamic Channel Director, and a System-to-System Adapter | 1,106,000 | 48,565 | **56,100 |

V-8885 PROCESSOR AND MAIN MEMORY

| V-8885 | System includes three V-8845 Dual-Processor Systems (see V-8845 above for description), an 8x32 Dynamic Channel Director, and a System-to-System Adapter | 1,668,000 | 72,845 | **84,430 |

V-8895 PROCESSOR AND MAIN MEMORY

| V-8895 | System includes four V-8845 Dual-Processor Systems (see V-8845 above for description), an 8x32 Dynamic Channel Director, and a System-to-System Adapter | 2,199,000 | 97,130 | **111,790 |

I/O CONTROL OPTIONS

AK 5710-P537	Channel Control Processor with DCX interface for 8 I/O channels	9,000	635	454
AK 5710-P538	Channel Control Processor with DCD interface	9,000	635	454
AK 5710-P539	Channel Control Processor Upgrade; DCX to DCD	2,225	152	110
AK 5710-P541	Trunk Channel Control Processor and one Low-Speed Trunk	18,060	1,092	583
AK 5710-P542	Low-Speed Trunk	3,360	132	123
AK 5710-P543	Very High Speed Trunk	7,635	276	277
AK 5710-P584	Multiplexer Channel Control Processor	6,775	600	450
AK 5710-P045	Control Processor Upgrade	4,850	161	230
AK 5720-P050	Expanded High-Speed Link	2,225	75	105
AU 6032-0707	Auxiliary Cabinet for System-to-System Adapter	1,500	NA	55
AC 1401-C128	Cable; BSL 50 ft.	130	NA	NA
AC 1401-C128	Cable; BSL 100 ft.	140	NA	NA

		Monthly License Fee ($)
	Firmware Options	
	V-8835 Firmware	700
	V-8845 Firmware	900
	V-8855 Firmware	1,400
	V-8865 Firmware	1,600
	V-8875 Firmware	1,800
	V-8885 Firmware	2,700
	V-8895 Firmware	3,600

		Purchase Price ($)	Annual Maint. ($)	One-Year Rental* ($)
MASS STORAGE				
AU 6099-5113	Disk Subsystem; 415.2 megabytes	29,035	1,296	1,390
AU 6099-5213	Disk Subsystem; 830.4 megabytes	44,260	1,788	2,105
AU 6099-5413	Disk Subsystem; 1.6 gigabytes	80,095	3,276	3,810
AU 6543-7404	Disk Drive; 415.2 megabytes	19,000	660	865
AK 6099-K014	Kit; 6099/6543 stacking	350	NA	NA
AU 6540-0201	Fixed Disk Drive; 135MB	10,800	959	589

*Includes maintenance.
**Three-year rental only.
NC—No charge.
NA—Not applicable.

NCR V-8800 System

		Purchase Price ($)	Annual Maint. ($)	One-Year Rental* ($)
MAGNETIC TAPE				
AU 6373-0101	Magnetic Tape Unit; 25/75 ips, 9 track, PE/GCR, 40/469KB, primary unit	25,990	2,988	1,350
AU 6373-0102	Magnetic Tape Unit; 25/75 ips, 9 track, PE/GCR, 40/469KB, secondary unit	17,745	2,280	945
AU 6376-0201	Magnetic Tape Unit; 200 ips, 9 track, PE/GCR, 320/1250KB, primary unit	49,510	5,050	2,505
AU 6376-0202	Magnetic Tape Unit; 200 ips, 9 track, PE/GCR, 320/1250KB, secondary unit	23,190	2,950	1,230
AK 6376-K201	Dual Controller Upgrade kit	32,500	1,500	1,465
BU 6325-0101	Magnetic Tape Unit with Controller; 9 track, 45 ips, 80KB	14,400	958	792
PRINTERS				
BU 6471-0201	Band Printer; 2,000 lpm, 64-character band, controller	39,500	4,800	2,482
AK 6471-K004	Hour Meter	230	NA	10
AK 6471-K005	Static Eliminator	820	NA	35
AK6471-K006	Audio Alarm	230	NA	10
AK 6471-K401	Print Band; 48 characters	500	NA	NA
AK 6471-K601	Print Band; 64 characters	500	NA	NA
AK 6471-K608	Print Band; 64 characters and OCR-A	500	NA	NA
AK 6471-K901	Print Band; 96 characters	500	NA	NA
AU 6470-0102-7198	Band Printer; 1,500 lpm, 64-character band, controller and cables	35,550	3,000	1,736
AK 6470-K004	Hour Meter	230	NA	NA
AK 6470-K401	Print Band 48 characters	500	NA	NA
AK 6470-K601	Print Band 64 characters	500	NA	NA
AK 6470-K603	Print Band 64 characters and OCR-B	500	NA	NA
AK 6470-K608	Print Band 64 characters and OCR-A	500	NA	NA
AK 6470-K901	Print Band 96 characters	500	NA	NA
BU 6430-0101-0232	Band Printer; 360 lpm, and interface for 64-character band	8,750	977	449
AK 6430-K010	Print Band; 64 characters	350	NA	27
AK 6430-K020	Print Band; 64 characters, CP, 15 cpi	350	NA	27
AK 6430-K002	Print Band; 48 characters	350	NA	27
AK 6430-K019	Print Band; 96 characters	350	NA	27
BU 6430-0201-7100	Band Printer; 720 lpm, interface for 64-character band, RS-232 interface	13,995	1,500	725
AU 6430-0202-7190	Band Printer; 72 lpm, system printer	13,995	1,500	725
BU 6480-0101-0682	Laser Printer; includes Photoconductor Drum, software driver, utilities, and two character sets	210,430	6,720	9,500
D002-03XX	Various Software for 6480-0101: 64 and 96 character sets, 10, 12, 15, and 20 pitch, Gothic, US, Italics, and OCR-A	NC	NC	NC
D002-05XX	Various Software for 6480-0101: graphic element 64-character set, 10, 12, 15, and 20 pitch	NC	NC	NC
MICR I/O UNITS				
AU 6770-1101	MICR Reader/Sorter; 1,400 dpm; 14 pockets	114,700	13,705	3,454
AU 6755-0101	MICR Reader/Sorter; 750 dpm, 11 pockets	58,850	7,800	2,250
BU 6781-0101	MICR Document Reader/Sorter; up to 1,400 dpm, up to 34 pockets	128,700	13,109	3,834
COMMUNICATIONS				
BU 0621-0101	On-Line Communications Multiplexer for up to 15 lines	12,720	858	254
AK 0621-F200	In-House Clock Driver for 0621-0103 multiplexer	2,120	248	86
AK 0621-F201	Synchronous Adapter Connection Cable Kit	475	30	15
AK 0621-F202	Wideband Interface	725	30	22
AK 0691-0101	Auxiliary Cage	7,950	138	136
AU 0690-0103	On-Line Auxiliary Bay	8,480	68	177
AU 0692-0600	Dual Asynchronous Adapter	3,000	245	122
AU 0693-0600	Dual Synchronous Adapter	4,500	275	173
AU 0694-0800	C.C. DLC Adapter	2,275	191	93
AU 0695-0600	On-Line Auto Dialer	995	175	57
TERMINALS				
AU 4902	Color Video Display Terminal; half/full duplex, asynchronous	1,595	120	NA
AU 4920	Video Display Terminal; half/full duplex, asynchronous	995	108	NA
AU 4940	Video Display Terminal; half/full duplex, asynchronous	595	96	NA

Includes maintenance.
**Three-year rental only.*
NC—No charge.
NA—Not applicable.∎