# NCR 8400 and 8500 Systems

## MANAGEMENT SUMMARY

When NCR announced the first two models of its now-extensive 8000 Series of computers in April 1976, the event was received calmly by the computer industry. After all, a few weeks before the announcement, William S. Anderson, NCR's chairman, had mentioned a new series of computers that would replace the company's earlier Century Series, which dated back to 1968. Thus, when the Criterion 8550 and 8570 models were introduced as two upward-compatible computers that spanned the performance range of the Century 200, 201, and 251 and extended beyond that of the Century 300, few persons outside of NCR perceived the sweeping changes that were in progress.

The Criterion 8550 was specifically designed to compete against the IBM 370/115 and 370/125, the Univac 90/30, the larger members of the Burroughs B 1800 family, and the Honeywell Level 62 and 64 systems. The Criterion 8570 is designed as competition for the IBM 370/138 and 370/145, the Honeywell Level 64 and low-end Level 66 systems, and the Burroughs B 3800 and B 4800 systems. These two models, the Criterion 8550 and 8570, constituted the entire 800 Series until one year later, when the full scope of the new NCR computer family was revealed.

In April 1977, NCR announced several new 8000 Series computers, including the 8350, 8450, and 8560 systems. But, more significantly, the company revealed a plan that would capitalize on its large existing customer base of financial institutions, retailers, manufacturers, distributors, wholesalers, transportation firms, hospitals, schools, and both local and state governments. The strategy was to offer this customer base a full range of computers, data terminals, and communications equipment, and the primary element in the NCR systems design was hardware and software compatibility that would ▷

**The NCR 8400 and 8500 Series computer systems provide a growth path from the earlier NCR Century Series and also provide vehicles for NCR's new virtual-memory operating system. Each model of the 8400 and 8500 Series is optimized for interactive processing, NCR Century emulation, or virtual-memory operation by a specific microcode set. At the time of this writing, over 320 8400 and 8500 systems have been installed.**

## CHARACTERISTICS

**MANUFACTURER: NCR Corporation, 1700 South Patterson Boulevard, Dayton, Ohio 45479. Telephone (513) 449-2000.**

**MODELS: I-8430, I-8450, N-8450, V-8450, N-8550, V-8550, N-8560, V-8560, N-8570, V-8570, V-8580, and V-8590.**

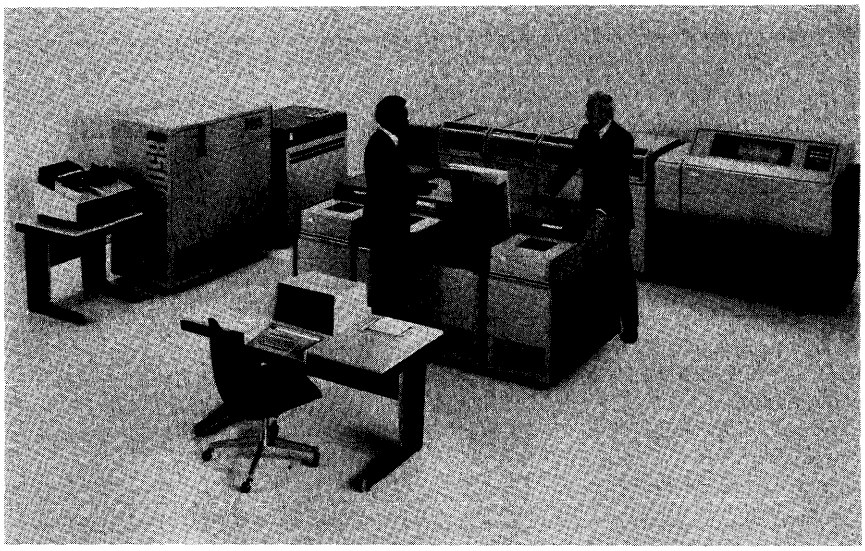
### DATA FORMATS

**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 8 bytes in length, specifying 1 or 2 memory addresses, respectively.** ◀



*The NCR 8560 represents an intermediate growth step between the 112-nanosecond 8550 processor and the 56-nanosecond 8570 processor. The 84-nanosecond 8560 processor is also midway between the 8550 and 8570 in terms of maximum memory capacity (1536K bytes) and I/O trunk configurability.*

# NCR 8400 and 8500 Systems

## CHARACTERISTICS OF THE NCR 8400 AND 8500 SYSTEMS

| | I-8430 | N-8450 | I-8450 | V-8450 | N-8550 | V-8550 |
|---|---|---|---|---|---|---|
| SYSTEM CHARACTERISTICS | | | | | | |
| Date of introduction | Sept. 1977 | April 1977 | Fall 1978 | April 1977 | April 1976 | April 1976 |
| Processor configuration | 1 main processor | 1 main processor | 1 main processor | 1 main processor | 1 main processor and 1 service processor | 1 main processor and 1 service processor |
| Primary application | Interactive processing | Century emulation | Interactive processing | Virtual memory | Century emulation | Virtual memory |
| Relative performance level, approximate | 1.0 | 1.4 | 1.3 | 1.4 | 1.5 | 1.5 |
| System firmware | IS3 | RS3 | IS3 | VS3 | RS1 | VS1; RS1 |
| Operating systems | IRX | B1, B2, B3 | IRX | VRX | B1, B2, B3 | VRX; B1, B2, B3 |
| Basic system rental, per month | $2,050 | $2,425 | NA | $4,025 | $2,900 | $4,700 |
| MAIN PROCESSOR | | | | | | |
| Cycle time, nanoseconds | 112 | 112 | 112 | 112 | 112 | 112 |
| Dynamic address translation hardware | No | No | No | Yes | No | Yes |
| Floating-point assist | No | No | No | No | Yes | Yes |
| VRX assist (instruction lookahead) | No | No | No | No | No | No |
| Upgradeable to | — | V-8450 | V-8450 | — | V-8550, N-8560 | V-8560, V-8570 |
| MAIN STORAGE | | | | | | |
| Type | MOS | MOS | MOS | MOS | MOS | MOS |
| Memory circuitry | 4K chip | 4K chip | 4K chip | 4K chip | 4K chip | 4K chip |
| Cycle time, nanoseconds | 475 | 475 | 475 | 475 | 475 | 475 |
| Minimum capacity, bytes | 128K | 128K | — | 384K | 128K | 384K |
| Maximum capacity, bytes | 384K | 1024K | 1024K | 1024K | 1024K | 1024K |
| Increment size, bytes | 64K | 64K, 128K | 64K, 128K | 64K, 128K | 64K, 128K | 64K, 128K |
| Bytes fetched per cycle | 4 | 4 | 4 | 4 | 4 | 4 |
| Interleaving | None | None | None | None | 2-way above 512K bytes | 2-way above 512K bytes |
| Error correction | Yes | Yes | Yes | Yes | Yes | Yes |
| CONTROL STORAGE | | | | | | |
| Type | Bipolar | Bipolar | Bipolar | Bipolar | Bipolar | Bipolar |
| Cycle time, nanoseconds | 112 | 112 | 112 | 112 | 112 | 112 |
| Word size, bits | 16 | 16 | 16 | 16 | 16 | 16 |
| Capacity, bytes | 52K | 42K | 52K | 48K | 8K | 24K |
| Additional firmware in main memory | No | No | No | No | Yes | Yes |
| I/O CONTROL | | | | | | |
| Integrated disk control | Optional | Optional | Optional | Optional | Optional | Optional |
| Maximum subsystem 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 | 1 string of 8 drives |
| No. of trunks standard | 1 | 1 | 1 | 1 | 2 | 2 |
| No. of trunks optional | 2 | 3 | 3 | 3 | 2 | 2 |
| Common trunk data rates, bytes/sec: | | | | | | |
| Low-speed trunk | 40 KBS | 50 KBS | 50 KBS | 50 KBS | 50 KBS | 50 KBS |
| Medium-speed trunk | None | None | None | None | 150 KBS | 150 KBS |
| Very high-speed trunk | 1080 KBS | 1080 KBS | 1080 KBS | 1080 KBS | 1080 KBS | 1080 KBS |
| Aggregate data rate | 2100 KBS | 3200 KBS | 3200 KBS | 3200 KBS | 3200 KBS | 3200 KBS |
| Input/Output Subsystems (IOSS) | No | No | No | No | No | No |
| I/O Link Controllers per IOSS | — | — | — | — | — | — |
| Link adapters per link controller | — | — | — | — | — | — |
| High-performance peripherals available | No | No | No | No | No | No |
| COMMUNICATIONS CONTROL | | | | | | |
| Integrated comm. control, max. lines | 13 | 20 | 20 | 20 | 20 | 20 |
| External comm. control, max. lines | None | 256 | None | 256 | 256 | 256 |

enable the smallest entry-level user to move progressively upward to more powerful systems that could be either centralized or distributed.

The scheme called for systems that can be used for batch processing, for interactive processing, and as virtual-memory systems. Hence, the 8000 Series computers, with one exception, are "soft" or "virtual" machines that can be optimized through the use of high-speed firmware, or microcode, for each of the three application areas. The exception is the 8300 series of packaged systems, which are actually enhanced and repackaged Century computers

**INTERNAL CODE: ASCII.**

### MAIN STORAGE

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

**CAPACITY: The main memory capacity of each of the 8400 and 8500 systems is stated in the characteristics charts on the second and third pages of this report.**

**CYCLE TIME: The memory cycle time for all 8400 and 8500 systems is 475 nanoseconds. However, the 2-way interleaving employed in the 8550 through 8570 systems and the 4-way interleaving employed in the 8580 and 8590 systems produces an *effective cycle time* that is substantially less.**

# NCR 8400 and 8500 Systems

## CHARACTERISTICS OF THE NCR 8400 AND 8500 SYSTEMS (Continued)

| | N-8560 | V-8560 | N-8570 | V-8570 | V-8580 | V-8590 |
|---|---|---|---|---|---|---|
| SYSTEM CHARACTERISTICS | | | | | | |
| Date of introduction | April 1977 | April 1977 | April 1976 | April 1976 | Nov. 1977 | Nov. 1977 |
| Processor configuration | 1 main processor and 1 service processor | 1 main processor and 1 service processor | 1 main processor and 1 service processor | 1 main processor and 1 service processor | 1 main processor and 1 service processor | 2 main processors and 1 service processor |
| Primary application | Century emulation | Virtual memory | Century emulation | Virtual memory | Virtual memory | Virtual memory |
| Relative performance level, approximate | 2.4 | 2.4 | 3.4 | 3.5 | 4.6 | 7.5 |
| System firmware | RS1 | VS1; RS1 | RS1 | VS1; RS1 | VS1; RS1 | VS2; RS1 |
| Operating systems | 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 | $5,030 | $6,330 | $6,900 | $7,900 | $12,650 | $20,900 |
| MAIN PROCESSOR | | | | | | |
| Cycle time, nanoseconds | 84 | 84 | 56 | 56 | 56 | 56 |
| Dynamic address translation hardware | No | Yes | No | Yes | Yes | Yes |
| Floating-point assist | Yes | Yes | Yes | Yes | Yes | Yes |
| VRX assist (instruction lookahead) | No | No | No | No | Yes | Yes |
| Upgradeable to | V-8560, N-8570 | V-8570 | V-8570 | V-8580 | — | — |
| MAIN STORAGE | | | | | | |
| Type | MOS | MOS | MOS | MOS | MOS | MOS |
| Memory circuitry | 4K chip | 4K chip | 4K chip | 4K chip | 16K chip | 16K chip |
| Cycle time, nanoseconds | 475 | 475 | 475 | 475 | 475 | 475 |
| Minimum capacity, bytes | 192K | 384K | 256K | 384K | 1024K | 2048K |
| Maximum capacity, bytes | 1536K | 1536K | 2048K | 2048K | 4096K | 6144K |
| Increment size, bytes | 64K, 128K, 256K | 64K, 128K, 256K | 128K, 256K | 128K, 256K | 1024K | 1024K |
| Bytes fetched per cycle | 4 | 4 | 4 | 4 | 4 | 4 |
| Interleaving | 2-way | 2-way | 2-way | 2-way | 4-way | 4-way |
| Error correction | Yes | Yes | Yes | Yes | Yes | Yes |
| CONTROL STORAGE | | | | | | |
| Type | Bipolar | Bipolar | Bipolar | Bipolar | Bipolar | Bipolar |
| Cycle time, nanoseconds | 84 | 84 | 56 | 56 | 56 | 56 |
| Word size, bits | 16 | 16 | 16 | 16 | 16 | 16 |
| Capacity, bytes | 10K | 24K | 10K | 24K | 32K | 64K per main processor |
| Additional firmware in main memory | Yes | Yes | Yes | Yes | Yes | Yes |
| I/O CONTROL | | | | | | |
| Integrated disk control | Optional | Optional | Optional | Optional | Optional | Optional(1or2) |
| Maximum subsystem per controller | 2 strings of 8 drives | 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 |
| No. of trunks standard | 3 | 3 | 3 | 3 | 3 | 0 |
| No. of trunks optional | 2 | 2 | 3 | 3 | 5 | 7 |
| Common trunk data rates, bytes/sec: | | | | | | |
| Low-speed trunk | 75 KBS | 75 KBS | 100 KBS | 100 KBS | 100 KBS | 100 KBS |
| Medium-speed trunk | 225 KBS | 225 KBS | 315 KBS | 315 KBS | 315 KBS | 315 KBS |
| Very high-speed trunk | 1060 KBS | 1060 KBS | 1150 KBS | 1150 KBS | 1150 KBS | 1150 KBS |
| Aggregate data rate | 3300 KBS | 3300 KBS | 4500 KBS | 4500 KBS | 6500 KBS | 12,000 KBS |
| Input/Output Subsystem (IOSS) | No | No | No | No | No | Yes |
| I/O Link Controllers per IOSS | — | — | — | — | — | 6 |
| Link adapters per link controller | — | — | — | — | — | 4 |
| High-performance peripherals available | No | No | No | No | No | Yes |
| COMMUNICATIONS CONTROL | | | | | | |
| Integrated comm. control, max. lines | 20 | 20 | 20 | 20 | 20 | No |
| External comm. control, max. lines | 256 | 256 | 256 | 256 | 256 | 256 |

(See the New Product Announcement in Report 70C-656-01).

Theoretically, each of the NCR 8400 and 8500 systems can have three "flavors" or operating modes: "N", "I", or "V". The "N" systems (N-8450, N-8550, N-8560, and N-8570) are Century emulators. They can execute the NCR B1, B2, or B3 operating systems which provide batch processing, multiprogramming, or on-line transaction processing. These systems execute the Century 300 instruction set and can accept directly both object programs and files written

**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: Provided by multiple base address and limit registers. For each active program, one base address register (BAR) and one limit address register (LAR) define the lower and upper address limits of main storage that can be accessed.**

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for use on any of the smaller Century systems. The "I" systems are for use in an on-line transaction processing or conversational processing environment in which there is frequent interaction between the machine and the operator. "V" systems provide virtual resource systems that are free from the constraints of physical memory size and also provide the additional benefits of scheduling, operational ease, and system resource management.

In September 1977, the I-8430 system was introduced, and in November 1977, the V-8580 and V-8590 systems were announced. The V-8590 marked another "first" for the 8000 Series: a dual-processor system that is the most powerful ever offered by NCR. An I-8450 system was also mentioned at the April 1977 announcement but not formally released at that time.

All of the 8400 and 8500 computers are designed as multimode machines. By reloading the control storage with the appropriate firmware load, these systems can be altered for different modes as usage needs dictate. NCR calls this concept "Migration Path Engineering." It permits users to migrate upward in terms of system performance without restraining them to a specific operating philosophy.

## SYSTEM ARCHITECTURE

In designing the 8400 and 8500 Series computers, NCR's approach was to marry the latest technologies in hardware, firmware, and software. Rather than striving for technical innovation, the company's design engineers set out to develop a unified architecture embodying many of the latest techniques that have been proven and have matured in other systems. As a result, these systems are the first to combine all of the following state-of-the-art features in a single system:

- Extensive use of ECL circuitry.
- MOS memory with error correction on 4K or 16K chips that can be expanded to 6 million bytes within the same mainframe.
- A fast "pipeline" processor that cycles at speeds up to 56 nanoseconds.
- Multiple virtual storage, which provides up to 16 million bytes of virtual memory per program.
- A dedicated service processor to manage operating control and act as the diagnostic control center.
- Direct memory access by high-speed peripherals.
- Three levels of diagnostics, which automatically check components and isolate functions. A remote diagnostic capability can link NCR diagnosticians to a user's system.
- On-line program development to simplify application programming.

## CENTRAL PROCESSORS

**The 8500 Central Processing Unit consists of the internal transfer bus (ITB), the main processor, and the service processor. The Model 8590 includes two main processors.**

**The main processor is designed for fast interpretation and execution of object programs by firmware. The firmware is executed out of a high-speed control store, which operates at the same cycle time as the main processor: 112 nanoseconds for the Model 8550; 84 nanoseconds for the Model 8560; or 56 nanoseconds for Models 8570, 8580, and 8590. Through the use of a "pipeline," firmware instructions are executed at the effective speed of one instruction per processor cycle. The pipeline consists of three phases of instruction processing: fetch, interpretation, and execution. Each phase requires one processor cycle, but the pipeline is designed so that three firmware instructions are processed in parallel, one in each phase.**

**The service processor operates in parallel with the main processor, and is concerned primarily with input/output control and diagnostics. It controls and drives the card reader, flexible disk, console CRT, and any hard-copy console devices. It also performs the firmware load function, in which firmware is read from the flexible disk and distributed to each firmware-driven subsystem, and controls the integrated communications option.**

**The service processor has primary responsibility for error control and system diagnostics, including a start-of-day diagnostic which is run as part of the initial firmware load process. If a malfunction occurs in the system, the service processor provides the tools for detection and isolation of the problem.**

**Model 8450 consists of one 112-nanosecond processor that is equivalent in performance level to the service processor employed in the 8500 models. The Model 8430 incorporates a similar processor with lower performance than the unit used in the Model 8450.**

**The internal transfer bus is the focal point of the system architecture. The ITB is a very high-speed data path (36 million or 72 million bytes per second, depending on the model) that serves as the medium for intercommunication among all the subsystems, including the main processor, the service processor, the memory subsystem, the common trunk subsystem, and the integrated disk controller.**

**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. The registers are normally accessed relative to the contents of the BAR. By convention, all but 27 of the registers are reserved for system software use.**

**INDIRECT ADDRESSING: Up to five levels of indirect addressing can be used, and indirect addressing can be combined with indexing.**

**INSTRUCTION REPERTOIRE: The instruction set of the "N-mode" systems is that of the NCR Century 300 system. There are 71 instructions available, all standard. The class breakdown and number of instructions within each class are as follows:**

**Decimal Arithmetic: 10 instructions for adding, subtracting, multiplying, dividing, and comparing signed, packed BCD fields; for adding and subtracting unsigned, unpacked BCD fields; and for packing and unpacking BCD fields.**

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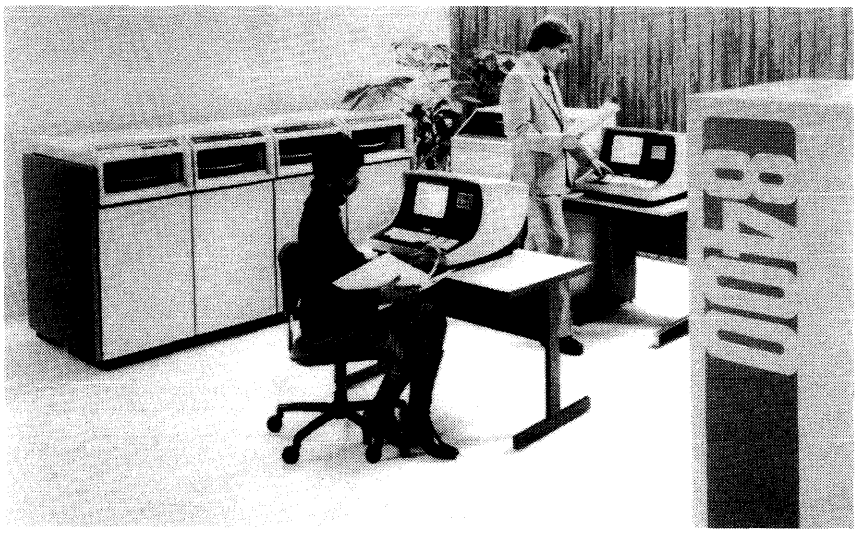

*The NCR I-8430 is a medium-scale computer system designed for use in an interactive processing environment. This system is a lower-performance, entry-level version of the I-8450, which will be NCR's largest interactive processing system. The I-8430 can control up to 13 low-speed communications lines.*

- An additional miniprocessor that serves as an intelligent disk interface, plus multiple microprocessors for low-cost communications interfacing.

The hardware architecture is based upon a highly flexible internal transfer bus (ITB) of the type found in many current minicomputer systems. The ITB is a very high-speed (36 million or 72 million bytes per second, depending on the model) data path across which all subsystems communicate with one another, including the main processor, the service processor, the memory subsystems, the common trunk subsystems, and the integrated disk controller. The main advantage of the bus architecture is its flexibility. New hardware can be designed in the form of a subsystem that fits on the bus, interfacing through a local bus adapter (LBA); thus, architectural extensions such as multiple processors, new I/O subsystems, and new integrated controllers are possible.

Although it is possible to have three versions of each computer, NCR states that interactive-mode ("I") systems will only be offered in the 8400 computers, at least for some time. The rationale behind this limitation is that the 8500 computers provide more performance than is currently warranted in systems of this type.

The 8400 and 8500 systems now include 12 models: I-8430, N-8450, I-8450, V-8450, N-8550, V-8550, N-8560, V-8560, N-8570, V-8570, V-8580, and V-8590. These 12 models, however, represent only 7 hardware systems; the I, N, and V versions of a particular system differ only in firmware.

In order to briefly describe these seven hardware systems and to establish their relationships to one another, it is most convenient to start near the middle, with the 8550 system. The 8550 computer actually consists of two processors: a 112-nanosecond main processor that executes instructions, and a lower-performance service processor that controls low-speed input/output subsystems. The 8450 computer consists of only one 112-nanosecond processor that is equivalent in performance level to the

**Fixed-Point Binary: 10 instructions for adding, subtracting, multiplying, dividing, and shifting word-oriented (4-byte) binary operands; for adding, subtracting, and comparing variable-length binary fields; and for performing binary-to-decimal and decimal-to-binary conversions.**

**Floating-Point: 12 instructions for adding, subtracting, multiplying, dividing, and comparing floating-point operands in both short (1-word) and long (2-word) formats.**

**Data Movement: 3 instructions for internal data transfer operations.**

**Logical: 8 instructions for editing, scanning, code translation, and Boolean operations.**

**Transfer: 13 instructions for testing, branching, and counting.**

**Special: 15 instructions for various hardware functions such as input/output, loading base and limit address registers, repeating an instruction, setting up trace/monitor conditions, handling interrupts, etc.**

**The 8400 and 8500 systems also feature a firmware COBOL accelerator feature that interpretively converts each COBOL statement into a 32-bit machine-executable metalanguage instruction.**

**INSTRUCTION TIMINGS: The 8400 and 8500 systems include memory interleaving and other performance-enhancing mechanisms that cause traditional instruction execution times to be an inaccurate performance indicator. Instead, the relative performance levels have been included in the characteristics charts on the second and third pages of this report.**

**INSTRUCTION STORAGE UNIT: In the 8400 and 8500 systems, most of the firmware that directs the system to perform the required functions (i.e., to function as an NCR Century system, an interactive processing-oriented system, or a virtual memory system) is stored in a high-speed memory called the Instruction Storage Unit (ISU). The characteristics of this control storage are contained in the "Control Storage" section of the system characteristics charts on the second and third pages of this report.**

**In the 8500 systems, the firmware is not totally contained in the control store. NCR breaks the firmware set into three classes according to frequency of use, and only the first two classes (most frequently used instructions) are stored in the ISU.**

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service processor used in the 8550 systems. The I-8430 system also uses this processor, with the IS3 interactive firmware set.

Going upward from the 8550, the 8560 and 8570 processors use the same main processor/service processor arrangement, but with faster processors—84 nanoseconds for the 8560 processor and 56 nanoseconds for the 8570 processor. The 8580 is nearly identical to the 8570, having the same 56-nanosecond processor, but has been enhanced through the addition of an instruction look-ahead feature that prefetches the next four instructions. The 8590 system is a three-processor configuration consisting of a service processor and two 56-nanosecond main processors, each similar to that of the 8570, in a tightly coupled system.

The 8590 also incorporates a new high-performance input/output subsystem that is twice as fast as its common trunk counterpart. The Input/Output Subsystem (IOSS) includes controllers that can transfer data between the CPU and itself at 2 million bytes per second. Up to six of these high-speed controls can be in simultaneous operation, providing an I/O bandwidth of 12 million bytes per second.

The relative performance levels of the various 8400 and 8500 Series systems are shown in the charts on the second and third pages of this report.

Until loaded with firmware, these systems are "faceless" computers. Only after being firmware-loaded from a floppy disk does the hardware acquire a specific set of attributes. Where the firmware interfaces directly with software, it takes the form of what NCR calls a "virtual machine," defined simply as a machine, implemented in firmware, which executes software. A particular virtual machine may be designed to execute existing programs in the same manner as an existing machine, as in the case of the real-storage RS1 or RS3 firmware, which duplicates an NCR Century computer and runs the existing B1, B2, and B3 operating system software; or it may take the form of a new machine designed to match the needs of new software or to reflect the attributes of a specific programming language. In the latter case, firmware enables the virtual machine to be designed to execute instructions much more like those of the source language than was previously feasible with hard-wired logic. Virtual machine commands may correspond nearly one-for-one with the verbs of the higher-level language, as is the case with the COBOL virtual machine. The result should be greatly improved performance for COBOL programs.

The virtual-storage (VS1 or VS3) firmware includes the COBOL virtual machine as well as a virtual machine designed to match the needs of the Virtual Resource Executive (VRX) operating system software. These two virtual machines—COBOL and VRX—reside together in the firmware control store and are executed concurrently as required by the software, thus providing multiple virtual machine operation. The switching between virtual machines is performed by a firmware routine, and does not

The additional microcode occupies between 20K and 30K bytes, depending on the model, and is located in the upper end of main memory (highest-numbered addresses). The processor that forms the basis for the 8400 systems does not have circuitry that enables it to access higher memory. Hence, all microcode for these systems must be resident within the ISU.

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. The time of day clock is accessed by addressing main memory location (hex) 108. The 32-bit contents of the word at this location are incremented every millisecond. The contents are decoded by software to arrive at the actual time of day.

INTERVAL TIMER: Provides the operating system with the ability to interrupt a program after the specified number of milliseconds. Thus, in a multiprogramming environment, the interval timer prevents any program from using more of the main processor time than specified. By doing this, the timer also detects and prevents program loops.

## 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 new Input/Output Subsystem (IOSS) employed exclusively within the V-8590 system, and integrated control subsystems, which include the integrated disk control and the integrated communications control.

The common trunk I/O control subsystem was originally introduced with the NCR Century computer systems (Report 70C-656-01) and has been retained within all 8000 Series computers, permitting all NCR Century peripherals to be employed in the newer systems. Three types of common trunks are offered—low-speed, medium-speed, and very high-speed—and each is designed to accommodate peripherals with specific data transfer characteristics. The common trunk subsystem permits the initiation of any I/O operation through the execution of the INOUT instruction, terminates these operations in a common sequence, and produces standard termination status codes for storage in memory.

Each common trunk can attach up to eight I/O devices. The INOUT instruction references two memory locations: one is a peripheral address field (PAF) that identifies the trunk, position, and unit number of the peripheral to be selected and the function to be performed; and the other is used to store the terminal status code. The PAF is two to six bytes long, depending on the peripheral. Only one of the eight peripheral subsystems can transfer data at a time.

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

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

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

The Input/Output Subsystem (IOSS) is available only on the V-8590 system. The elements of the subsystem are the I/O link control that interfaces the internal transfer bus, I/O links, and I/O link adapters. The I/O link control (IOLC) can attach up to four peripheral subsystems through I/O links. The data transfer rate of the IOLC between itself and the internal transfer bus is 2 megabytes per second, twice that of

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require any control store loading process or program awareness while the switching is occurring.

Several subsystems on the ITB are firmware-driven, including the main processor, the service processor, the integrated communications module, and the integrated disk controller. Each of these subsystems has firmware loaded into its writeable control store as part of the start-of-day procedure, under control of the service processor.

The main processor is designed for fast interpretation and execution of object programs by firmware. The firmware executes out of a high-speed control store that has the same cycle time as the main processor. Through the use of a pipeline, firmware instructions are executed effectively at the speed of one instruction per processor cycle.

The service processor operates in parallel with the main processor, and is concerned primarily with input/output control and diagnostics (including a start-of-day diagnostic which is run as part of the initial firmware loading process) and with control of the integrated communications subsystem. Should a malfunction occur in the system, the service processor provides the tools for isolation and detection of the problem.

The 8400 and 8500 systems can use most of the peripheral devices that were available with the Century systems. In addition to these, four new peripherals—a 600-card/minute card reader, a 173-characters/second matrix printer, a 1000-characters/second paper tape reader, and a Winchester-style disk unit that uses removable 35- or 70-megabyte data modules—were introduced in April 1976. Two high-performance peripherals, a 540-megabyte disk drive and a 1,250-KBS GCR magnetic tape unit, were introduced for use exclusively with the high-speed input/output subsystem of the 8590.

The NCR 8450 is a 112-nanosecond microprogrammed computer available in the N, V, or I version. The N-8450 requires a minimum of 128K bytes of 475-nanosecond MOS error-correcting memory, while the V-8450 requires at least 384K bytes. Aside from that, control storage capacity is the major difference among the three versions: 42K bytes for the N-8450, 48K bytes for the V-8450, and 52K for the I-8450. The V-8450 is the smallest virtual-memory system that will be offered. These models include one low-speed trunk, capable of attaching up to eight peripherals. Memory may be expanded to 1024K bytes.

The I-8430 is a lower-performance, entry-level model that has the same configurability as the 8450 systems. A basic I-8430 system includes a 112-nanosecond CPU, 128K bytes of 475-nanosecond error-correcting MOS memory, and one 40-KBS low-speed I/O trunk allowing attachment of up to eight peripherals. Memory is expandable in 64K-byte increments up to 384K bytes, and the I/O subsystem can be expanded through the addition of two I/O trunks—one low-speed and one very high-speed trunk or two very high-speed trunks. The maximum data transfer rate of the very high-speed trunk is 1,080 kilobytes per second.

**the very high-speed trunks. The I/O links are ordinary coaxial cables the connect the link control to I/O link adapters mounted at the peripheral devices. The I/O link control is effectively a parallel-to-serial converter and 4-line multiplexer. Data is passed bit-serially over the I/O links between the link control and the link adapters. The link adapters are buffered interfaces that reside at the device ends of the I/O links. Each link adapter matches the characteristics of the device it services and can attach up to eight devices. The V-8590 can have up to six I/O link controls, providing a maximum aggregate data transfer rate of 12 megabytes per second.**

**The integrated peripheral controllers are dedicated devices, disk or communications, that occupy the space required for a common trunk.**

**CONFIGURATION RULES: The number of I/O trunks that can be included with each type of system and the data rates for each type of trunk are included in the characteristics charts on the second and third pages of this report. The medium-speed trunk is not available on 8400 systems. All 8400 and 8500 systems are limited to two low-speed trunks, and the 8500 systems can have one medium-speed trunk. In the V-8590 system, the inclusion of I/O link controls or integrated disk controls reduces the number of trunks that can be included with that system.**

**The following table indicates the peripheral subsystems that are currently offered with each of the 8400 and 8500 systems. It must be noted, however, that the nonavailability of certain peripherals with specific systems may represent marketing restrictions rather than technical restrictions. Marketing restrictions are generally relaxed as a product line matures.**

## PERIPHERAL AVAILABILITY FOR 8400 AND 8500 SYSTEMS

| | | I-8430 | I-8450 | N-8450 | V-8450 | N-8550 | V-8550 | N-8560 | V-8560 | N-8570 | V-8570 | V-8580 | V-8590 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DISK STORAGE UNITS | | | | | | | | | | | | | |
| 655 | | | | ● | ● | ● | ● | ● | ● | ● | | | |
| 656 | | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | | |
| 657 | | | | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| 658 | | | | ● | ● | ● | ● | ● | ● | | | | |
| 6590 | | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| 6540 | | | | | | | | | | | | | ● |
| MAGNETIC TAPE UNITS | | | | | | | | | | | | | |
| 633 | | | | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| 634 | | | | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| 635 | | | | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| 6370 | | | | | | | | | | | | | ● |
| 636 | Cassette Unit | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| CARD EQUIPMENT | | | | | | | | | | | | | |
| 680 | Card reader | | | ● | ● | ● | ● | ● | ● | ● | ● | | |
| 684 | Card reader/punch | | | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| 686 | Card reader/punch | | | ● | ● | ● | ● | ● | ● | ● | | | |
| 687 | Card punch | | | ● | ● | ● | ● | ● | ● | ● | | | |
| 6831 | Card reader | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| PRINTERS | | | | | | | | | | | | | |
| 640 | | | | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| 646 | | | | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| 647 | | | | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| 649 | | | | ● | ● | ● | ● | ● | ● | ● | ● | | |
| 6440 | | | | ● | ● | ● | ● | ● | ● | ● | | | |
| 6420 | | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| MICR EQUIPMENT | | | | | | | | | | | | | |
| 670 | | | | ● | | ● | | ● | | ● | | | |
| 671 | | | | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| 675 | | | | ● | | ● | | ● | | ● | | | |
| 6770 | | | | ● | | ● | | ● | | ● | | | |
| MISCELLANEOUS | | | | | | | | | | | | | |
| 660 | Paper Tape Reader | | | ● | ● | ● | ● | ● | ● | ● | ● | ● | |
| 665 | Paper Tape Punch | | | ● | ● | ● | ● | ● | ● | ● | ● | ● | |
| 6640 | Paper Tape Reader | | | | | ● | ● | ● | ● | ● | ● | | |
| 420 | OCR | | | ● | ● | ● | ● | ● | ● | ● | ● | | |
| 621 | Communications Control | | | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |

# NCR 8400 and 8500 Systems

Like the 8450 systems, the I-8430 features an integrated disk controller and an integrated data communications controller, but with slightly differing specifications. The I-8430 disk controller supports up to eight of the new 67-megabyte 6590-0102 disk drives, while the 8450 disk controller can attach either the 67-megabyte 6590-type disk drives or the 200-megabyte 658-type drives. The I-8430 can also utilize the 9.96-megabyte 656-type disk drives through the optional very high-speed trunks. The I-8430 integrated communications subsystem supports up to 13 9600-bps CRT terminals, whereas the 8450 version supports up to 20 terminals. Both models are expandable in five-line groups.

The I-8430 is a virtual-memory machine designed to serve up to 13 users executing independent interactive programs. In addition, each user terminal can initiate one or more separate programs that execute concurrently.

The I-8430 and the I-8450 also feature a new operating system, the Interactive Resource Executive (IRX), and microcode enhancements that aid both the IRX operating system and the COBOL 74 compiler. IRX, in conjunction with the microcode accelerators, provides the capability for direct processing through the CPU and permits the instantaneous updating of all active files.

A 112-nanosecond CPU is standard with the 8550 systems. They start with 128K bytes of 475-nanosecond error-correcting memory (384K minimum for the V-8550 virtual system) and include either 8K bytes (N-8550) or 24K bytes (V-8550) of control storage. Like the 8450, the 8550 basic system includes one 50-KBS low-speed and one 1,080-KBS very high-speed trunk; but unlike the smaller system, the 8550 can also employ one 150-KBS medium-speed trunk.

The 8560 systems are built around an 84-nanosecond processor with 10K bytes of control storage for the N-8560 and 24K bytes for the V-8560. Minimum memory for the N-8560 is 192K bytes, while the V-8560 starts at 384K bytes. Maximum memory is 1536K bytes. Both versions have one low-speed, one medium-speed, and one very high-speed trunk in the basic system.

Based on a 56-nanosecond processor, the N-8570 and the V-8570 include 256K bytes and 384K bytes, respectively, of 475-nanosecond MOS memory and one each of the low-speed, medium-speed, and very high-speed trunks. 10K bytes of control storage are contained in the N-8570, and 24K in the V-8570. The 8570 integrated disk controller can support three 8-drive strings in either single- or dual-controller configurations.

The V-8580 CPU is an enhanced version of the V-8570 CPU that includes a faster processing unit with an instruction look-ahead feature for greater performance. The base V-8580 includes a 56-nanosecond CPU with 1024K bytes of error-correcting MOS memory, 32K bytes of control memory, one 100-KBS low-speed common trunk, one 315-KBS medium-speed common trunk, one

## MASS STORAGE

**655 SERIES DUAL-SPINDLE DISK UNIT: Has two independent spindles, and each spindle is capable of driving a removable disk pack. The 3-disk NCR 955-1 disk pack stores up to 4,194,304 bytes (or 8,388,608 packed decimal digits) in 512-byte sectors, with 8 sectors per track. Each spindle has a comb-like access mechanism with 12 read/write heads servicing each of the 6 recording surfaces. Up to 262,144 bytes per pack can be read without head movement (524,288 bytes per dual-spindle unit).**

**Types 655-151 and 655-152 have an average head movement time of 131 milliseconds, while Types 655-101 and 655-102 have an average head movement time of 44.7 milliseconds. All four dual-spindle models have an average rotational delay of 20.8 milliseconds and a data transfer rate of 108,000 bytes/second. All four models are for "integrated" attachment and do not require controllers.**

**The 655-201 Dual-Spindle Disk Unit is similar to the 655-101 or 655-102 except that it is a "free-standing" unit that is used with the 625-101 Disk Controller. Up to four 655-201 units (or up to eight spindles) can be attached to each controller. The same 955-1 disk pack is used with the 655-201 unit.**

**656-401 DISK SUBSYSTEM: Each 656-401 disk unit accommodates two recording disks: one optional fixed disk and one removable 956-1 disk pack. Each disk (fixed and removable) has a data storage capacity of 4.98 million bytes, providing a total data capacity of 9.96 million bytes per disk unit. The 656-401 disk unit uses the "master/satellite" technique of operation; that is, a master unit (one containing the disk controller) may control itself and one satellite (a 656-401 unit not containing a controller). Both versions are housed in identical low-profile cabinets.**

**Each disk pack used with the 656-401 disk unit contains 406 cylinders, with a total of 812 tracks. A track is divided into 12 sectors of equal length (9744 sectors per recording disk), with each sector containing one address area and one data area, separated by a gap. The address areas and separation gaps contain the information used by the disk unit to locate specific data areas on a track. The data areas are 512 bytes in length, and each disk pack has a capacity of 4,988,928 data bytes.**

**The 656-401 Disk Subsystem has a head movement time ranging from 10 to 70 milliseconds and averaging 35 milliseconds. Average rotational delay is 12.5 milliseconds, and data transfer rate is 312,500 bytes per second.**

**657-101/102 DISK SUBSYSTEM: Provides medium-capacity random-access storage in removable 11-high disk packs. Each NCR 957-1 disk pack stores up to 29.8 million bytes of data in standard-density format or up to 47.7 million bytes in "dual-density" format. The 957-1 pack is physically compatible with the IBM 2316 pack, although the recording formats differ. Each spindle holds one disk pack and has a comb-like access mechanism with one read/write head serving each of the 20 recording surfaces. Average head movement time is 60 milliseconds and average rotational delay is 12.5 milliseconds. Capacity and data transfer rate depend upon which of two controllers is used:**

- **The 625-201 Disk Controller records data at a density of 2200 bpi. Maximum data capacity is 7459 bytes per track, 149,180 bytes per cylinder, and 29.8 million bytes per 11-disk pack. Data transfer rate is 315,000 bytes/second. The 625-201 can control up to eight 657-type spindles for a total on-line capacity of 238.4 million bytes.**
- **The 625-202 Dual-Density Disk Controller can record data at either 2200 or 3500 bpi, under programmed control. Maximum data capacity at the higher density is**

# NCR 8400 and 8500 Systems

1,149-KBS very high-speed common trunk, console display/keyboard, and the VS1 microcode. Main memory is expandable to 4096K bytes in 1024K-byte increments. Up to five additional common trunks and an integrated disk controller can be added to the I/O subsystem. A 20-line integrated communications controller can also be added to the V-8580.

At the high end, the basic V-8590 system includes two 56-nanosecond main processors, 2048K bytes of error-correcting MOS memory, 128K bytes of control memory, console display/keyboard, and the VS2 microcode. No I/O link controls or common trunks are included in the base configuration. Memory is expandable to 6144K bytes in the same 1024K-byte increments as the V-8580 uses. The I/O subsystem can include several combinations of low-speed, medium-speed, or very high-speed common trunks and I/O link controls.

All of the NCR 8400 and 8500 systems require either a paper tape reader or a card reader to complete a minimal operational configuration.

## SOFTWARE

Using real-storage firmware, the "N" models of the 8400 and 8500 systems function as Century systems that run existing B-series software and user programs. With virtual-storage firmware, they operate under control of the VRX operating system and function as virtual storage systems.

The B-series software offered with the 8400 and 8500 systems is the most current release. The B1, B2, and B3 operating systems are available to 8400 and 8500 users, together with a full set of Century B-series compilers, utilities, and application programs. Current NCR Century applications can be transferred directly to 8400 and 8500 systems without recoding, recompiling, or restructuring files.

Under the Virtual Resource Executive (VRX), the user will effectively have 16 million bytes of storage available to each program, whether his actual hardware configuration includes 384K bytes or 6 million bytes of main memory. As programs are executed, VRX, operating in conjunction with special hardware called a dynamic address translator, assigns to real memory those portions of virtual storage that are currently active. NCR claims that its implementation of virtual storage in VRX is equivalent to IBM's OS/MVS.

A primary feature of VRX is a new 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.

Two new compilers are provided with VRX: COBOL 74 and NEAT/VS. The VRX COBOL 74 compiler is primarily a high-level implementation of the ANSI 1974 standard language; it produces object code for the COBOL virtual machine (CVM) which runs under VRX.

**11,944 bytes per track, 238,880 bytes per cylinder, and 47.7 million bytes per pack. Data transfer rate is 500,000 bytes/second. The 625-202 can control up to eight 657-type spindles for a total on-line capacity of 381.6 million bytes.**

**658 DISK SUBSYSTEM: Provides large-capacity random-access storage in interchangeable 10-high disk packs. The 658-201 drive has a capacity of 100 million bytes, while the 658-401 drive has a capacity of 200 million bytes. The 658-201 can be field-upgraded to a capacity of 200 million bytes per disk drive. Both drives use the NCR 958-2 Disk Pack, which has 19 tracks in each of 404 data cylinders plus 7 spares, and a basic capacity of up to 100 million bytes per disk pack. In the 200-million-byte recording mode, each 958-2 Disk Pack contains 808 cylinders plus 15 spares for a capacity of up to 200 million bytes. The double disk pack capacity is achieved through use of the NCR 0658-0002 Feature, which is required on each disk drive in the subsystem.**

**The 658 disk units can be connected to 8400/8500 systems via the integrated disk controller. The 8400 and 8550 IDC's can control a maximum of 8 spindles, the 8560 IDC can control up to 16 spindles in up to 2 strings of 1 to 8 spindles each, and the 8570, 8580, and 8590 IDC's can control up to 24 drives in up to 3 strings of 1 to 8 spindles each. Alternatively, up to eight 658-201 Disk Units in either 100-million-byte or 200-million-byte format can be attached to a 625-301 control unit. Attachment of additional disk drives, up to a maximum of 16 drives per control unit, requires the optional NCR 0625-0002 Drive Expansion Feature.**

**The 658 Disk Subsystem has a head movement time that ranges from 10 to 55 milliseconds and averages 30 for random accesses. Average rotational delay is 8.4 milliseconds, and data transfer rate is 806,000 bytes per second. Rotational Position Sensing and Command Retry are standard features. Error correction circuitry in the control unit permits detection and correction of errors in 11-bit bursts of data or address information. The Model 625-301 control unit contains a magnetic tape cassette handler for loading the control program, loading and reading on-line and off-line diagnostic programs, and recording statistical usage/error logging data. In addition, the control unit utilizes interchangeable address plugs to facilitate servicing of individual disk drives.**

**6590-0101 DATA MODULE DISK UNIT: A "Winchester" style unit similar to the IBM 3340, the 6590 disk unit contains two spindles that accommodate one 6591 data module each. The 6591 features head-in-pack technology with a storage capacity of either 35 or 70 million bytes. Both modules have two logical tracks per physical track and six physical tracks per logical cylinder. The 35-million-byte module has 348 logical cylinders, while the 70-million-byte module has 696 logical cylinders. Each module has a logical track capacity of 8,368 bytes and a logical cylinder capacity of 100,416 bytes.**

**Average rotational delay for the 6590 disk unit is 10.1 milliseconds, average seek time 25.0 milliseconds, average access time 35.1 milliseconds, and data transfer rate is 885,000 bytes per second. An optional 6590 RPS kit provides Rotational Position Sensing for the 6590 disk drives. One kit per dual-spindle 6590 unit is required.**

**The 6590 disk drives connect to the integrated disk controller and can be intermixed with 658 disk drives. The configuration rules for the 6590 disk drives are the same as those for the 658 drives. The 658 and 6590 drives cannot be intermixed on the same string.**

**6540 DATA STORAGE SUBSYSTEM: One of two high-speed peripherals released for use on the high-performance I/O subsystem (IOSS) that is available only with the V-8590 system, the 6540-0801 is a four-spindle disk storage unit that employs non-removable media and the high-density "Winchester" recording technique. Each of the four spindles has a**

# NCR 8400 and 8500 Systems

The NEAT/VS compiler is compatible with NCR's NEAT/3, a macro-oriented assembly language, and provides programming interfaces to the new software features available under VRX.

The VRX operating system also features an on-line program development capability for entry and modification of source programs, and a new Link Editor to assist in writing modular programs. The Link Editor binds together program modules written in either COBOL 74 or NEAT/VS prior to program execution.

VRX includes new telecommunications software that supports two new programming interfaces for development of on-line systems: a Message Control System (MCS) interface and a Low-Level Interface (LLI). MCS is compatible with the COBOL 74 language, and provides a terminal-insensitive interface to the application programmer. LLI is a more basic interface that gives the programmer more control over his telecommunications devices.

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 discipline, 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 DISTRIBUTED NETWORK ARCHITECTURE

In August 1977, NCR announced the basic elements of its network architecture, which is called, appropriately, NCR Distributed Network Architecture (NCR/DNA). The announcement defined DNA's link protocol, intra-network disciplines, access methods, and other telecommunications functions.

NCR/DNA will be used as the design guide for all new NCR telecommunications products and will be implemented in stages over several years. As its name implies, the NCR/DNA network approach permits each processor to function in an independent or distributed mode. Such an approach avoids the need to have a centralized or master processor controlling the network.

The network protocol, NCR/Data Link Control (NCR/DLC), is a bit-oriented control protocol in accordance

**formatted storage capacity of 135 megabytes, yielding a subsystem total of 540 megabytes. The 6540-0801 unit is connected to the 8590 system through the 6548-0101 I/O link adapter (IOLA). A second four-spindle unit can also be attached to the IOLA to create a 1080-megabyte maximum subsystem (eight spindles). Average head-positioning time for the 6540 disk drives is 30 milliseconds, and average rotational delay is 8.3 milliseconds (3600 rpm). The data transfer rate is 1.2 megabytes per second.**

## INPUT/OUTPUT UNITS

**633 MAGNETIC TAPE HANDLERS: Six models of 633 Series tape units are offered. Data transfer rates range from 10,000 to 240,000 bytes/sec. All use standard ½-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 following models are available:**

**633-111: 9 tracks; phase-encoded; 1600 bytes/inch; 80,000 bytes/sec. Forward tape speed 50 ips, rewind speed 150 ips. Requires 624-111 controller.**

**633-117: 7 tracks; NRZI; 200, 556, or 800 char/inch; 10,000, 27,800, or 40,000 char/sec. Forward tape speed 50 ips; rewind speed 150 ips. Requires 624-179 controller.**

**633-119: 9 tracks; NRZI; 800 bytes/inch; 40,000 char/sec. Forward tape speed 50 ips; rewind speed 150 ips. Requires 624-119 or 624-179 controller.**

**633-121: Dual-drive unit with same characteristics as 633-111.**

**633-211: 9 tracks; phase-encoded; 1600 bytes/inch; 144,000 bytes/sec. Forward tape speed 90 ips; rewind speed 240 ips. Requires 624-211 controller.**

**633-311: 9 tracks; phase-encoded, 1600 bytes/inch; 240,000 bytes/sec. Forward tape speed 150 ips; rewind speed 380 ips. Requires 624-311 controller.**

**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. Three master units and three slave units are available; 9-track master tape units that have the dual-mode option permit NRZI and phase-encoded tape units to be intermixed in one master/slave combination. The following "master" units and their associated "slave" units are available:**

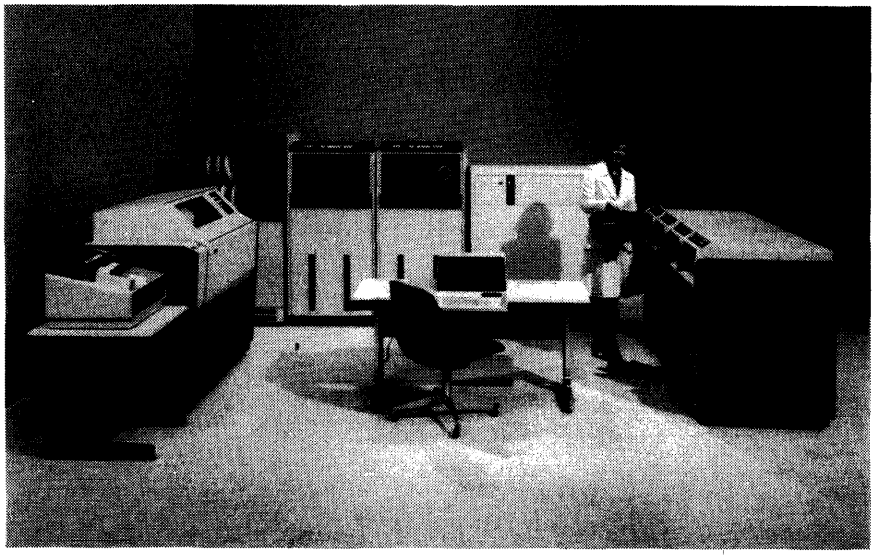
**634-117 Master Unit: 7 tracks; NRZI; 200/556/800 bits/inch; 5,000/13,900/20,000 char/second. Forward tape speed is 25 ips; rewind speed is 160 ips. The 634-107 magnetic tape unit is the associated slave unit for use with the 634-117; it has the same characteristics as the master unit.**

**634-119 Master Unit: 9 tracks; NRZI, phase encoded, or dual mode (phase encoded and NRZI); 1600 bytes/inch (phase encoded)/800 bytes per inch (NRZI); 40,000/20,000 bytes/sec. Forward tape speed is 25 ips; rewind speed is 160 ips. The associated slave unit is the 634-109 magnetic tape unit.**

**634-219 Master Unit: 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. Forward tape speed is 50 ips; rewind speed is 160 ips. The associated slave unit for the 634-219 is the 634-209 magnetic tape unit.**

**635 MAGNETIC TAPE SYSTEM: The NCR 635 magnetic tape units are high-performance, 9-track tape drives that can**

# NCR 8400 and 8500 Systems



*The NCR 8570 was one of the first two 8000 Series systems introduced in April 1976. Originally offered as an NCR Century emulator, this system is now also available in a virtual-memory model designated the V-8570. The configuration shown here includes four 70-megabyte Model 6590 Disk Drives that feature "Winchester-style" data modules similar to IBM's 3348 data modules.*

with ANSI's ADCCP and ISO's HDLC. NCR/DLC will support SDLC and the protocols of other vendors that are compatible with ADCCP/HDLC. 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.

DNA'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 include system and link control, queue management, resource scheduling, packet header processing, error recovery and reporting, and diagnostic support.

The DNA software within each terminal and processor that performs the routing function is called the NCR Data Transporting Network (NCR/DTN). Operating as a store-and-forward packet-switching system, NCR/DTN provides physical addressing of transmissions based on the application-supplied logical addresses. Tables in each node processor provide the physical address for each logical address. In this manner, physical elements can be altered without affecting the application programs. The table also provides for alternate routings when system elements in the normal routing path fail. While NCR/DTN operates under NCR/DLC protocol internally, a facility to "exit" for accommodation of other protocols is a feature of this software.

Other features of NCR/DNA include in-service diagnostics, dynamic network reconfiguration, and support for current NCR link protocols.

**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. Controllers equipped with the 0624-0001 dual-model feature can be used to control 7-track NCR 634-107 magnetic tape units recorded with the NRZI recording technique as well as the 635 magnetic tape units. 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. Forward tape speed is 100 ips; rewind speed is 480 ips.**

**635-209: 9 tracks; 1600 bytes/inch (phase encoded)/800 bytes/inch (NRZI); 320,000/160,000 bytes/sec. Forward tape speed is 200 ips; rewind speed is 640 ips.**

**6370 SERIES MAGNETIC TAPE SUBSYSTEM: This is a high-performance peripheral subsystem that is offered only with the V-8590 system. It attaches to the new I/O Subsystem (IOSS). The series consists of three models, the 75-ips 6370-0401, the 125-ips 6370-0601, and the 200-ips 6370-0801. The units connect to the IOSS through the 6379 I/O link adapters (IOLA's). Up to four 6370 magnetic tape drives can be attached to one 6379 IOLA. Each of the three 6379 models requires a particular version of the 6379 IOLA, which precludes intermixing models in the same subsystem. All three models are 9-track and record data at either 1600 bpi using the phase-encoding (PE) technique or 6250 bpi using group-coded recording (GCR). Unlike the 634 and 635 Series magnetic tape units, the 6370 cannot handle tapes recorded in the 800-bpi NRZI format.**

**In the 6250-bpi GCR recording mode, the 6370 units employ an improved error correction technique that permits correction of errors that occur in any single track or simultaneously in any two tracks. Errors in all nine tracks of a single data block can be corrected if they occur on no more than two tracks at a time. The units also automatically insert resynchronization bursts into long data blocks. Automatic threading is optional on all three models, and the 6370-0801 includes an automatic latching hub.**

**636-301 CASSETTE HANDLER: 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**

# NCR 8400 and 8500 Systems

## USER REACTION

Datapro received responses from seven users of the NCR 8500 Series systems during the 1977 survey of general-purpose computer users. In addition, we contacted and interviewed two more users to obtain their impressions of these systems. The group of nine users was collectively leasing 10 systems consisting of seven N-8550's, one N-8560, and two V-8570's. The user population consisted of eight small-to-medium-scale businesses and one municipal government organization. The business population included six retail operations and two wholesale operations. The average installed life of the 10 systems was slightly over 12 months.

Memory included in the systems varied between a 192K-byte minimum system and 768K bytes, averaging about 428K bytes per system. Seven of the 10 systems had 384K bytes or more. Disk storage capacity ranged from 200 megabytes to 2400 megabytes, and the average was about 850 megabytes. Only three of the nine users indicated the presence of interactive terminals on their systems: an 8550 system with 10 terminals, an 8570 system with 51 terminals, and an 8560 system with 73 terminals.

All but one of the nine respondents were using their 8500 systems as NCR Century emulators under the B1 (one user) or B3 (seven users) operating system. The ninth user had an 8570 system operating under NCR's new VRX virtual-memory operating system.

All of the systems were being used for conventional business data processing. In addition, two users indicated data communications usage and two others indicated usage in data base management systems. Nearly all of the users listed in-house personnel as the chief source of their applications programs, while only one-third indicated usage of any of NCR's extensive applications software.

None of the 11 systems had been purchased. Ten of the systems were being leased from NCR, while one had been obtained on a third-party lease.

The user responses from both the mail survey and the telephone interviews are tabulated below. The composite weighted average ratings for all non-IBM computer systems rated in our 1977 annual survey are also shown for comparative purposes.

| | Excellent | Good | Fair | Poor | WA* (NCR 8500) | WA** (Non-IBM Systems) |
|---|---|---|---|---|---|---|
| Ease of operation | 4 | 5 | 0 | 0 | 3.4 | 3.4 |
| Reliability of mainframe | 6 | 3 | 0 | 0 | 3.7 | 3.3 |
| Reliability of peripherals | 4 | 4 | 1 | 0 | 3.3 | 2.7 |
| Responsiveness of maintenance service | 5 | 3 | 1 | 0 | 3.4 | 3.0 |
| Effectiveness of maintenance service | 3 | 4 | 2 | 0 | 3.1 | 2.8 |
| Technical support | 2 | 6 | 0 | 0 | 3.3 | 2.4 |
| Operating systems | 1 | 8 | 0 | 0 | 3.1 | 3.3 |
| Compilers and assemblers | 2 | 7 | 0 | 0 | 3.2 | 3.2 |
| Applications programs | 2 | 5 | 1 | 0 | 3.1 | 2.7 |
| Ease of programming | 5 | 3 | 0 | 0 | 3.6 | 3.3 |
| Ease of conversion | 6 | 1 | 2 | 0 | 3.1 | 3.0 |
| Overall satisfaction | 4 | 5 | 0 | 0 | 3.4 | 3.1 |

*Weighted Averages for the NCR 8500 systems on a scale of 4.0 for Excellent.

**Weighted Averages for all non-IBM computer systems rated in the 1977 annual user survey.

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.

680-201 CARD READER: Reads 80-column cards serially at 1200 cards per minute. Has one input hopper and one output stacker with capacities of 4,000 cards each. A reject stacker with a capacity of 240 cards is also provided. Does not require a controller.

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.

686-102 CARD READ/PUNCH: Reads 80-column cards serially at up to 800 cpm and punches column-by-column at 83 to 294 cpm, depending on the number of columns punched. Has a single card feed path, a 1500-card input hopper, and two 1800-card programmable output stackers plus a 100-card reject stacker. Does not require a controller.

686-111 CARD READ/PUNCH: Reads 80-column cards serially at up to 560 cpm and punches column-by-column at 60 to 180 cpm, depending on the number of columns punched. Has a 1500-card input hopper and two 1800-card programmable output stackers plus a 100-card reject stacker. Does not require a controller.

686-111 CARD READ/PUNCH: Reads 80-column cards serially at up to 560 cpm and punches column-by-column at 60 to 180 cpm, depending on the number of columns punched. Has a 1500-card input hopper and two 1800-card programmable output stackers plus a 100-card reject stacker. Does not require a controller.

686-201 CARD READER: Reads 80-column cards serially at up to 750 cpm. Has a 1500-card input hopper and two 1800-card programmable output stackers plus a 100-card reject stacker. Does not require a controller.

6831 SERIES CARD READERS: Include two tabletop-mounted units: the 600-cpm 6831-0201, which is available on all 8400 and 8500 systems, and the 1000-cpm 6831-0301, which is offered only with the V-8580 and V-8590 systems. Both models read standard 80-column punched cards and translate each card column into one 8-bit ASCII character. The 6831 card readers are attached to the integrated card reader interface that is included with each 8400/8500 system. Both units employ the shine-through reading technique and use light-emitting diodes and photo-transistors in the read station. The card feed mechanism uses air pressure to riffle the first one-half inch of cards in the input hopper and the last one-half inch of cards in the output hopper to maintain separation and reduce the effects of static electricity. Capacity of both input and output hoppers is 1000 cards.

686-302 CARD PUNCH: Punches 80-column cards at 83 to 294 cpm, depending on the number of columns punched. Does not require a controller.

686-311 CARD PUNCH: Punches 80-column cards at 60 to 180 cpm, depending on the number of columns punched. Does not require a controller.

687-301 CARD PUNCH: Punches 80-column cards at 100 cpm. Has an 800-card input hopper and an 800-card output stacker. Requires a 622-701 controller.

# NCR 8400 and 8500 Systems

In 11 of the 12 survey categories, the NCR 8500 computers received ratings that were equal to or higher than the composite average ratings given to all non-IBM computers in the annual Datapro user survey. The only category that was rated below the composite average rating was that of Operating Systems, where the NCR systems were rated two-tenths of a point below the impressively high collective rating of 3.3 that was given to the non-IBM operating systems. In 9 of the remaining 11 categories—Reliability of Mainframe, Reliability of Peripherals, Responsiveness of Maintenance Service, Effectiveness of Maintenance Service, Technical Support, Applications Programs, Ease of Programming, Ease of Conversion, and Overall Satisfaction—the NCR sysetms were rated above the average ratings for all the non-IBM computers.

The differences between the ratings given the 8500 systems and the composite ratings were impressively large in several categories. In Reliability of Peripherals, the difference was six-tenths of a point. And in the category of Technical Support, which often draws relatively low ratings from non-IBM computer users, the difference was nine-tenths of a point in NCR's favor. NCR also showed an advantage of four-tenths of a point in the categories of Reliability of Mainframe and Responsiveness of Maintenance Service.

The lone VRX user we contacted was especially enthusiastic about the system and confirmed many of NCR's claims regarding the speed of the virtual COBOL machine. This user also noted that the On-Line Program Development facility for virtual machines was very good.

The only negative aspects of the survey were the "fair" ratings given by two users to the categories of Effectiveness of Maintenance Service and Ease of Conversion. Both of these users were among the first few to have NCR 8500 systems installed, and both noted that early start-up problems had prompted these lower ratings.

The bottom-line indicator of Overall Satisfaction was rated three-tenths of a point higher than the composite average for this category, confirming a rather high degree of user satisfaction with these new systems.□

**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.**

**6640 PAPER TAPE READER: A table-top-mounted unit that can read 5-, 7-, or 8-level tapes at up to 1000 cps. The data rate is reduced substantially, however, if small groups of characters are read. The unit uses the shine-through reading technique and employs a quartz-iodine lamp and 10 photocells. Eight of the photocells read the punched data, one reads the sprocket hole associated with the character being read, and one reads the sprocket hole of the next data character to clock the data to the CPU. Two other photocells detect the presence of paper tape and broken tape.**

**626-101 PRINTER CONTROLLER: Connects any of the following free-standing printers through a common trunk attachment: 640-102, -200, -210, or -300.**

**640-200 PRINTER: Has 132 print positions and 64 printable characters, with 160 print positions and a 52-character print set optionally available. Peak speed is 1,500 lpm. Optional 52-character set enables all-numeric printing at 3,000 lpm. Continuous-Form Tab Set Handling is available. Requires the 626-101 controller.**

**640-210 PRINTER: Same as the 640-200, except has 160 print positions.**

**640-300 PRINTER: Usable in the same manner as the 640-200. Has 132 print positions and up to 128 printable characters (double alpha). Peak speed is 1,200 lpm. Requires the 626-101 controller for attachment to a common trunk.**

**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.**

**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.**

**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. Each line requires two complete drum revolutions. During the first revolution, odd-numbered columns are printed. The paper is then shifted by one column and the even-numbered columns are printed. Standard vertical spacing is 6 lines per inch, and an 8-lines-per-inch option is available. Vertical format control is provided by a 12-channel punched paper tape.**

**6420 SERIES LINE PRINTERS: Include three models, 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 are compressed-pitch units that print 132-character lines on standard 8.5-inch paper, while the 6420-0301 model uses 14-inch paper. The 6420 Series printers all connect directly to common trunk cables and require no additional interfacing.**

**420-1/420-2 OPTICAL CHARACTER READERS: Both models read journal tapes imprinted with NCR Optical Font (NOF) characters at 52 lines per second. From 1 to 32 characters can be read from each line, and the units recognize 10 stylized numeric digits and 6 special symbols. Differences between the 420-1 and 420-2 include the following:**

| | 420-1 | 420-2 |
|---|---|---|
| Journal roll length | 100 feet (max.) | 130 feet (max.) |
| Transport speed | 6.5 ips | 13 ips |
| Read speed | 26 lines/sec (max.) 832 cps | 52 lines/sec (max.) 1664 cps |
| Rescan time | 160 msec/line | 40 msec/line |
| Manual entry required | entire line | unreadable characters |

**The 420 readers are connected to the common trunk through the 622-301 OCR control unit.**

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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 off-line sorting. Consists of a 622-401 controller and a 404-111 sorter.

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

6770-1101 MICR READER/SORTER: A 14-pocket unit that can operate at sorting speeds ranging from 820 to 1440 dpm, depending on the length of the processed items. Throughput for standard 6-inch documents is 1200 documents per minute. The 6770 sorts varying sizes of documents encoded in the E-13B font. The wide range of sizes enables the unit to sort checks, card stock, and postal money orders, as well as other documents 2.5 to 4.25 inches wide, 4.85 to 8.75 inches long, and 0.003 to 0.009 inch thick. Each pocket is capable of holding 450 items. Pocket indicators signal programmed halts, full pockets, and other operating conditions. An item counter is provided to display the total number of documents sorted by each pass to provide a daily count of all processed items.

The 6770 can also operate off-line, reading any one of six defined fields and sorting on a selected digit position within the field. In addition, a zero kill feature distributes documents with zeros in and to the left of the selected digit position to a designated pocket. Also in the off-line mode, the 6770 has an out-sort/edit feature which allows the selection of two independent groups of five digits in any one of six defined fields. The field selected for out-sort/edit need not be the same as the field selected for the off-line sort. The 6770 can be configured with an optional endorser feature that prints a full endorsement of data and name on the reverse side of each document. The operator can turn the endorser on or off as required.

## 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, 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.

621-103 COMMUNICATIONS MULTIPLEXER: Capable of handling 16 or 256 lines, using ROM transmission/control character tables, centralized character parity assembly and stripping, plus centralized BCC, 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. A "bucket" operation capability is also available to permit the transmission of records of indeterminate length through a hardware technique of using dual buffers. 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 ADAPTER: Handles up to 16 transmission speeds ranging from 45 to 2400 bits/second, and permits attachment of popular NCR devices such as the 270 Financial Terminal, 260 General-Purpose Terminal, and 499 Accounting Computer, as well as other non-NCR devices.

693-600 SYNCHRONOUS ADAPTER: Supports speeds from 600 to 50,000 bits/second for popular IBM binary synchronous (BSC) terminal devices or processor-to-processor communications. Operates under the B2 Software Executive and the BSC application package in IBM 2780 mode. A flexible, multitask communications capability is supported.

796 VISUAL DISPLAY TERMINALS: The 796-101, -201, and -301 were announced in February 1974. Each includes an 8-by-10-inch CRT display with a capacity of 1920 characters in 24 lines of 80 characters each, a typewriter keyboard, a 10-key numeric pad, and an optional NCR 260 Non-Impact Printer for hard-copy output. The basic 796-101 display is teletypewriter-compatible and transmits in asynchronous mode, one character at a time, at a speed of 110 bits per second. The 796-201 Block/Conversational Terminal can transmit in the conversational (one character at a time), message, or page operational mode and has a maximum data transfer rate of 2400 bits per second. The 796-201 can also be equipped with an optional 11,520-element graphics matrix for preparation of charts and graphs and an integrated acoustic coupler for communication through a telephone handset. The 796-301 Pollable CRT Terminal operates in either page or message mode at transmission speeds of up to 9600 bits per second. The 796-401 Block/Conversational CRT Terminal was announced in November 1975 and features a selection switch for operation at 110, 300, 1200, 2400, or 9600 bits per second; the conversational, page, and message operational modes are supported, and the graphics and printer options are available.

## SOFTWARE

OPERATING SYSTEM: NCR offers three operating systems for the 8400 and 8500 Series computers: NCS, VRX, and IRX. 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. The following paragraphs describe the B-series operating systems used on the Century computers; the NCS operating system can effectively function in any of the Century modes.

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.

The Monitor is called into main memory at the start of each day and at the end of each program. It controls the sequencing, linking, and loading of programs. It can run a series of programs as directed by a control string entered via punched cards, punched tape, or the console keyboard. The Monitor provides calendar and date-controlled protection of files and calendar-controlled scheduling and modification of programs. The I/O Executive is divided into a memory-resident portion and a disk-resident portion. The memory-resident portion occupies about 4000 bytes of main memory and handles all I/O operations, error conditions, program overlays, and subroutine calls. The disk-resident routines are called into main memory when needed to deal with less frequent situations such as open and closing of files, retries of I/O operations that failed, etc.

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The Disk Management routines are used primarily to ensure that the system disks always contain accurate, up-to-date versions of the NCR software. The Log routines maintain a system disk log of status information such as hardware malfunctions and incorrect operating procedures. The Display routines provide communication links between the operator and either the programmer or the operating system.

*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. A Dynamic Storage allocation feature allows memory for servicing terminals to be allocated as a central pool. The Resident Sector Management feature allows the operating system to map program and software overlays into unassigned areas of memory.

The Queue Executive Interface (QXI), released for the B2 dual-program executive in August 1975, includes on-line communications drivers for handling teletypewriter-compatible terminals and the NCR 796-301 Visual Display Terminals. A specialized Financial/Retail On-Line Communications Driver is also available for handling communications networks configured with the specialized NCR banking and retail terminals.

The B2 system's resident portion occupies about 11K to 15K bytes of main storage.

*Multiprogramming Executive (B3):* This Century operating system divides main memory into two or more partitions of at least 16K bytes each. Each partition has its own set of 63 index registers and, in the original B3 release, its own disk unit and its own job stream so that its operations were largely independent of other partitions.

Principal extensions added to the B3 operating system after its initial release include resource-sharing features such as: 1) the use of a single system disk unit, shared by all active programs, rather than a separate disk unit for each partition; 2) the capability for programs running in different partitions to access a shared disk unit; 3) a Common Program Library Disk that permits programs in several partitions to store programs, utility routines, and user routines on a single disk unit; and 4) a Peripheral Reassignment feature that permits the operator to reassign peripherals among partitions without interrupting operation of the system.

An extended version of B3 released in July 1974 included the following major extensions: 1) the use of a common disk unit for the Common Program Library and the Common System Disk; 2) software overlay pooling; and 3) operator-initiated dynamic allocation of memory between two partitions. Further enhancements added to the B3 system in August 1975 included card input spooling, common disk backup for software overlays to facilitate recovery from a read error, dynamic assignment of partition priorities, and operator-controlled job scheduling. The latest release of the B3 operating system also provides facilities for automatic propagation of utility routines from a master disk pack. One or more user partitions in a B3 system can contain an on-line program running under the B2 executive.

VIRTUAL RESOURCE EXECUTIVE: VRX is a group of software modules that utilize the VS1 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 VRX multiprocessing enables the system to schedule and run multiple jobs at the same time by automatically allocating the peripherals, memory, and processor as needed. Each job may contain one or more related programs. Jobs are described to the system using a Job Control Language made up of Job Specification Language (JSL) statements and Monitor Control Language (MCL) statements. The Job Specification Language statements are used to define the hardware and media requirements of the job, while the Monitor Control Language statements identify the programs within each job and specify any run-time conditions for those programs. VRX permits users to assume as little or as much control over job processing as needed. Most scheduling, allocation, and processing decisions can be made by the software itself.

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

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

The processor and memory space are assigned dynamically, and the operating software is also brought into memory only when needed and assigned space where available. There are no fixed processor assignments, no fixed partitions, and no fixed areas in real memory for software or program code. All inactive software and program code is stored in the Page File. Page sizes may be 512 bytes, 1024 bytes, 2048 bytes, or 4096 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 awaiting the services of a processor.

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.

VRX provides for a maximum of 10 Common Program Library (CPL) disks, which can be used to contain user programs, disk control strings, and cataloged jobs. The first five CPL disks are system disks, and the next five are user CPL disks. CPL disks are defined at the start of the processing day, while user CPL disks can be defined when a job is input to the system. A maximum of three additional program library disks can be assigned to a job at run time; these disks are specified by using Monitor Control Language statements to assign numbers. When a program is requested at run time, the software searches the program library disks first, the user CPL disks second, and the system CPL disks last.

The VRX software automatically polls all disk and punched card peripherals in the system at specific intervals to determine whether the status of those peripherals has changed

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since the last check. If the status has changed from inoperative (or not ready) to ready since the last check and the device is either a system device or a disk unit needed by an active job, the system performs a read operation. If the device is a system card reader, all data that is read is stored on disk as a card spool file. If the device is a system disk or a disk unit needed by an active job, the software checks the volume header and a peripheral assignment table to determine whether a pack change is acceptable; if a change is not acceptable, a message is displayed, requesting the operator to put the original pack back on the specified unit.

File specification parameters that are normally defined during program compilation can be specified or changed at run time by inputting a special FILE Monitor Control Language statement. This control statement is required by VRX COBOL programs to complete file descriptions because file specification worksheets are not permitted by COBOL standards; however, it can also be used by VRX COBOL and NEAT/VS programs to change file specifications such as file protection information, peripheral types, and reference names at run time.

Disk files may optionally be recorded in a system file catalog to enable the software to automatically locate such files by file name. This eliminates the need to specify the volume identification, unit identification, and other identifiers at run time. Some file types are recorded in the file catalog automatically; others must be entered and updated by special File Catalog utility routines.

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 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. Job Detail Reports are printed automatically at the completion of each job, providing a sequential record of activities and messages related to that job. This report also provides statistics messages that can be used for job-related accounting and performance evaluation. Further details can be provided by the Log Reporter utility routine to access the log and print specific message types.

VRX provides several levels of error recovery systems, each designed for specific applications. These facilities include a CAM file error recovery system, which uses CAM utilities to restore CAM files if an error occurs. There is also a batch recovery system, called Rescue/Restart, that enables a program to be continued from a previously defined rescue point instead of at the start. The VRX Telecommunications Program Recovery system enables users to reduce data loss and continue operation if an error occurs in an on-line program. To maintain compatibility with the B2 real-storage on-line system, VRX permits the continued use of own-code intervention for B2 on-line programs.

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.

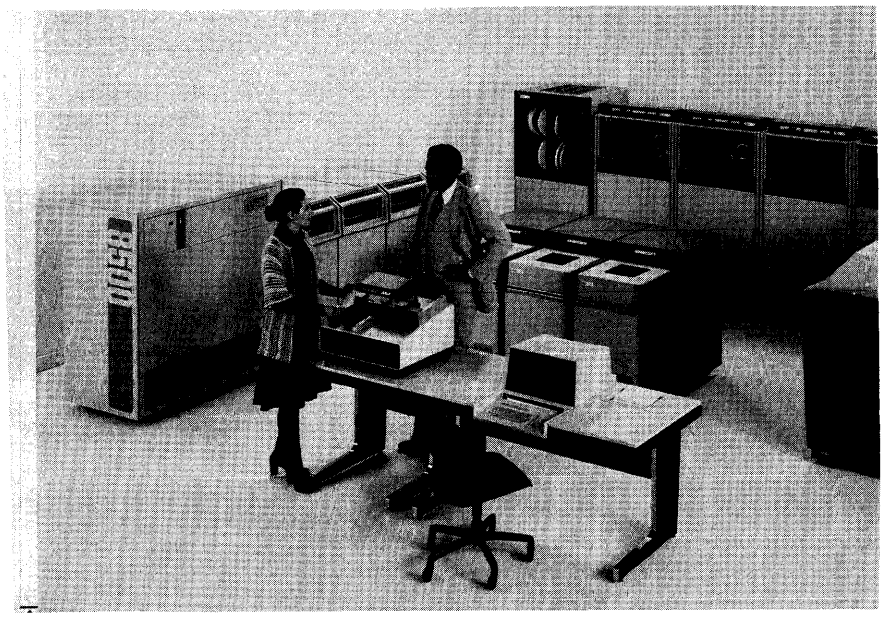
When a job passes to the execution phase, it competes with other jobs in the execution mix for processor and shared resource time. Up to 35 jobs may be in the execution mix at one time, with resource allocation being determined by execution priorities assigned in job specifications. During execution, 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 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 also offers a new file management technique called the Criterion Access Method (CAM) that has been specifically designed for high performance under VRX with applications programmed in COBOL 74 and NEAT/VS.

The CAM file structure minimizes reorganization and allows rapid insertion of records, eliminating many of the in-

# NCR 8400 and 8500 Systems



*The NCR V-8580 is the largest of the single-processor 8500 systems. The 8580 is available for use as an NCR Century emulator with the RS1 firmware and as a virtual-memory system with the VS1 firmware. The system shown includes a mixed disk storage subsystem that consists of four 6590 fixed-media disk drives and three 658 removable-media disk drives.*

efficiencies inherent in traditional random and indexed sequential accessing methods. Indexes are integrated into the file to avoid time-consuming hardware seeking between index and data block reading. Each index block is in the same disk cylinder as the group of data blocks to which it refers. Files have no overflow area in the conventional sense. Instead, overflow is handled by software in the following three-step process. During the creation, empty blocks are set aside in each cylinder, and empty cylinders are set aside within each file. When the system detects that overflow is about to occur in a block during record insertion, it examines the two adjacent blocks. If it finds one with a low record density, some records are transferred to it from the full block and the index is updated. The insertion can then be made without overflow. If both adjacent blocks have a high density, the contents of the block reaching overflow are split, with half being written to an empty block in the same cylinder and half remaining in the original block. The index is updated, and the insertion is performed without overflow. If no more empty blocks remain in the cylinder, half the cylinder contents are copied to an empty cylinder and the indexes in both cylinders are updated. This technique eliminates overflow and therefore reduces the frequency with which files must be reorganized.

CAM employs a block chaining method for logical data block sequencing. This allows the software to access data sequentially without using the index after the first access, even though the logical block sequence is not the hardware block sequence. Thus, a sequential file can be accessed on a direct-access device at the maximum possible speed.

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 also 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.

INTERACTIVE RESOURCE EXECUTIVE: IRX is a virtual-memory operating system designed for use in interactive processing environments with up to 24 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-

# NCR 8400 and 8500 Systems

## STORAGE REQUIREMENTS OF NCR 8000 SERIES SOFTWARE

| | Main Memory | | Disk Storage | |
|---|---|---|---|---|
| | Minimum | Typical | Minimum | Typical |
| RS1 Basic System Software: | | | | |
| VOSS Master | 16KB | 64KB | 3.7MB | 3.7MB |
| B3 Operating System | 24KB | 45KB | 7.7MB | 10.2MB |
| NEAT/3 Compiler | 16KB | 32KB | 3.7MB | 4.2MB |
| COBOL 68 Compiler | 16KB | 64KB | 1.7MB | 2.1MB |
| Basic FORTRAN Compiler | 16KB | 16KB | 2.6MB | 2.6MB |
| Intermediate FORTRAN Compiler | 32KB | 32KB | 2.5MG | 2.5MB |
| Full FORTRAN Compiler | 32KB | 32KB | 2.5MB | 2.5MB |
| Educational FORTRAN Compiler | 32KB | 32KB | 1.1MB | 1.1MB |
| RPG Compiler | 16KB | 32KB | 1.8MB (1) | 1.8MB (1) |
| Object Module Assembly Program (OMAP) | 32KB | 64KB | 0.2MB | 1.2MB |
| Sort/Merge | 16KB | 32KB | 0.8MB | (2) |
| COBOL S | 32KB | 32KB | 3.3MB | 3.3MB |
| NCS COBOL 74 Compiler | 32KB | 64KB | 1.4MB (1) | 2.3MB (1) |
| RS1 On-line System Software: | | | | |
| Time-Sharing | 64KB | 128KB | 3.8MB | 16MB |
| Remote Batch Entry (RBE) | 16KB | 32KB | 1.1MB | 1.1MB |
| B2 Prepass Compiler | 32KB | 32KB | 2.8MB (3) | 2.8MB (3) |
| Queue Executive Interface (WX1) | 18KB | 32KB | 0.1MB (4) | 0.1MB (4) |
| BASIC I (Dedicated) | 16KB | 16KB | 4.8MB | 9.4MB |
| BASIC I (Dual) | 16KB | 16KB | 4.7MB | 9.3MB |
| BASIC I I/O Writer | 16KB | 16KB | 4.7MB | 9.3MB |
| BASIC M | 32KB | 32KB | 4.8MB | 9.4MB |
| Management Access To Records (MATR I) | 16KB | 16KB | 0.1MB | 0.2MB |
| Management Access To Records (MATR II) | 48KB | 48KB | 0.6MB | 1.6MB |
| RS1 Data Management System Software: | | | | |
| Index Sequential Filing System | 32KB | 64KB | 0.4MB | 10.4MB |
| Random Filing System (RFS) | 64KB | 128KB | 0.4MB | 5.3MB |
| NCR TOTAL (Read-only version) | 8KB to 15KB | 30KB to 40KB | 0.1MB | 0.25MB |
| TOTAL IQL | 30KB | 40KB | 70KB | 0.13MB |
| VS1 Basic System Software: | | | | |
| VRX Operating System | 140KB | 200KB | 21.3MB | 31.8MB |
| VRX COBOL 74 Compiler | 40KB | 180KB | 0.9MB | 0.9MB |
| VRX COBUG | — | — | 0.1MB | 0.1MB |
| VRX NEAT/VS Compiler | 16KB | 100KB | 4.7MB (1) | 6.8MB (1) |
| VRX SORT/MERGE | 16KB | 100KB | 4MB | 4MB |
| VS1 On-Line System Software: | | | | |
| Terminal Communications Processor | 32KB | 100KB | 7.6MB (1) | 9.7MB (1) |
| Network Definition Language Processor | 64KB | 96KB | 0.5MB | 0.5MB |
| On-Line Program Development | 100KB | 180KB | 0.3MB | 6.2MB |
| VS1 Data Management System Software: | | | | |
| CAM/VRX Utilities | 16KB | 64KB | 2MB | 2MB |
| Management Sciences Application Software: | | | | |
| Statistics | 32KB | 64KB | 0.9MB (4) | 0.9MB (4) |
| Linear Programming | 16KB | 32KB | 3.6MB (4) | 3.6MB (4) |
| Project Network Analysis | 16KB | 32KB | 0.1MB (4) | 0.1MB (4) |
| Coordinate Geometry | 32KB | 32KB | 0.3MB (4) | 0.3MB (4) |
| Vehicle Scheduling | 16KB | 32KB | 0.7MB | 0.7MB |
| Feed Information System | 32KB | 32KB | 3.1MB | 5.6MB |
| NCR MAGEN | 64KB | 64KB | — | — |
| General Application Software: | | | | |
| General Payroll | 16KB | 16KB | 1.5MB | 3.9MB |
| General Payroll (Tape Master File) | 16KB | 16KB | 2.2MB | 4.9MB |
| Payroll Cost, Labor Scheduling | 16KB | 16KB | 1.7MB | 5.5MB |
| Accounts Receivable—Commercial | 16KB | 16KB | 5.7MB | 15.6MB |
| Accounts Receivable—Consumer (10-cycle Master File) | 16KB | 16KB | 41.7MB | 125.4MB |
| Accounts Receivable—Tape | 32KB | 32KB | 1.8MB | 3.9MB |
| Accounts Payable | 16KB | 16KB | 2.7MB | 6.4MB |
| General Ledger with Reporting Subsystem | 16KB | 16KB | 1.4MB | 2.5MB |
| General Reporting System | 16KB | 16KB | 3MB | 7.3MB |
| Accounting System Interface | 32KB | 32KB | 1.7MB | 4.1MB |
| NCR NEATFLOW | 16KB | 16KB | 1MB | 2.6MB |
| DOCUMAT Stage I | 16KB | 16KB | 2.6MB | 6MB |
| DOCUMAT Stage II | 16KB | 16KB | 2.6MB | 6MB |
| DOCUFLOW Stage I | 32KB | 32KB | 3.6MB | 8.6MB |
| DOCUFLOW Stage II | 32KB | 32KB | 3.6MB | 8.6MB |
| Commercial Bank Application Software: | | | | |
| CIF Series "A" (All Modules) | 32KB | 32KB | 6.7MB | 12MB |
| CIF Series "B" (All Modules; includes Demand Deposit Accounting) | 64KB | 96KB | 22.7MB | 63.6MB |
| General Ledger | 32KB | 32KB | 0.5MB | 0.5MB |
| Financial On-Line Central Information System | 96KB | 96KB | 11.2MB | 41.3MB |
| Personal Trust Accounting | 32KB | 32KB | 18.5MB | 36.9MB |
| CIF Series "C" (All Modules) | 96KB | 128KB | 28MB | 190MB |
| Community Bank Interactive On-line System (CBIS) | 80KB | 96KB | 0.6MB | 16MB |

(1) Includes common work files.
(2) Three times input file size.
(3) Plus object program.
(4) Plus user files.

# NCR 8400 and 8500 Systems

## STORAGE REQUIREMENTS OF NCR 8000 SERIES SOFTWARE (Continued)

| | Main Memory | | Disk Storage | |
|---|---|---|---|---|
| | Minimum | Typical | Minimum | Typical |
| Savings & Loan Application Software: | | | | |
| CLASS System (All; includes Savings) | 64KB | 128KB | 19.4MB | 98.7MB |
| General Ledger | 32KB | 32KB | 0.5MB | 0.5MB |
| Manufacturing Application Software: | | | | |
| Interactive Manufacturing Control System (IMC) | 48KB | 64KB | 9.7MB | 10.2MB |
| IMR | 48KB | 64KB | 20.4MB | 20.4MB |
| Bill of Materials | 32KB | 64KB | 23MB | 23MB |
| Manufacturing Systems Inquiry | 32KB | 64KB | 20.4MB | 20.4MB |
| Production Scheduling | 16KB | 32KB | 5.1MB | 5.1MB |
| Inventory Requirements Planning | 16KB | 32KB | 5.1MB | 5.1MB |
| Wholesale Application Software: | | | | |
| EMPHASIS | 32KB | 32KB | 5.1MB | 5.1MB |
| Order Billing Technique II (ORBIT II) | 16KB | 32KB | 5.1MB | 5.1MB |
| Order Billing Technique III (ORBIT III) | 16KB | 32KB | 5.1MB | 5.1MB |
| SPIRIT | 32KB | 32KB | 5.1MB | 5.1MB |
| Accounts Receivable and Inventory | 16KB | 16KB | 5MB | 10MB |
| Beverage Distribution System | 16KB | 32KB | 5MB | 10MB |
| Farm Cooperation Grain Elevator System (F.I.S.) | 32KB | 32KB | 3.1MB | 5.6MB |
| Medical Application Software: | | | | |
| Post-Discharge Accounts Receivable | 16KB | 16KB | 24.6MB | 28.7MB |
| In-Patient Records | 16KB | 16KB | 17.9MB | 17.9MB |
| Medical Audit Statistics | 16KB | 32KB | 12.3MB | 20.5MB |
| CIMS—In-Patient Records | 64KB | 64KB | 30MB | 40MB |
| CIMS—Post-Discharge Accounts Receivable | 64KB | 64KB | 60MB | 70MB |
| CIMS—Out-Patient Billing | 64KB | 64KB | 20MB | 25MB |
| CIMS—Medical Audit Statistics | 64KB | 64KB | 30MB | 40MB |
| CIMS—Medicare Billing and Log | 64KB | 64KB | 38MB | 45MB |
| Hospital In/Out Patient Accounts Receivable (IHIS) | 64KB | 96KB | 5.6MB | 18MB |
| Education Application Software: | | | | |
| Stewardship and Management Accounting | 16KB | 32KB | 6.1MB | 6.1MB |
| Student Test Analysis | 16KB | 16KB | — | — |
| SCHOLARS | 32KB | 32KB | 30MB | 70MB |
| School Bus Scheduling System | 16KB | 32KB | 1MB | 1MB |
| Student Scheduling Grade Reporting | 16KB | 16KB | 20MB | 64MB |
| School Payroll (General Payroll) | 16KB | 16KB | 1.5MB | 3.9MB |
| School Appropriation Accounting | 56KB | 80KB | 5.2MB | 7.2MB |
| Government Application Software: | | | | |
| Utility Billing | 16KB | 32KB | 4.1MB | 7.2MB |
| Law Enforcement—Traffic | 16KB | 16KB | 7.2MB | 7.2MB |
| Law Enforcement—UCR | 16KB | 32KB | 2.9MB | 7.2MB |
| Law Enforcement—Accidents | 16KB | 32KB | 1.4MB | 7.2MB |
| Law Enforcement—Case Assignment | 16KB | 32KB | 3.9MB | 7.2MB |
| Law Enforcement—Police Information | 16KB | 32KB | 4.6MB | 7.2MB |
| Law Enforcement—Operations Management | 16KB | 32KB | 4.5MB | 7.2MB |
| Local Government—Payroll (General Payroll) | 16KB | 16KB | 1.5MB | 3.9MB |
| Local Government—Utility Billing | 16KB | 32KB | 4.1MB | 7.2MB |
| Local Government—Appropriation Accounting | 56KB | 80KB | 5.1MB | 7.2MB |
| Food Distribution Application Software: | | | | |
| Order Billing Technique I (ORBIT I) | 16KB | 16KB | 2MB | 4.1MB |
| Department Store Application Software: | | | | |
| Retail Sales Audit | 32KB | 32KB | 104MB | 104MB |
| Fashion Reporting | 32KB | 32KB | 6.2MB | 6.2MB |
| Pre-Edit Processing | 64KB | 64KB | 52MB | 52MB |
| Common Trunk Interface (725) (On-Line Retail) | 64KB | 64KB | 52MB | 52MB |
| Retail Cycle Billing (CAR) | 16KB | 32KB | 54.5MB | 54.5MB |
| IRX Basic System Software: | | | | |
| 8400 IRX | 64K | — | 2.5MB (5) | — |
| 8400 Utilities | 128K | — | — | — |
| MEDICS (A21) | 256KB | 256KB | 28.1MB | 32.3MB |
| Century Simulation—System Software: | | | | |
| Century 101 Simulator | 32KB (6) | 32KB (6) | 0.3MB | 0.3MB |
| Type V-S Library Pack #1 | 16KB | — | 3.1MB | — |
| Type V-S Library Pack #2 | 16KB | — | 3.1MB | — |
| NCS COBOL 74 Compiler | 32KB | 64KB | 1.4MB (1) | 2.3MB (1) |
| IRX System Software: | | | | |
| Remote Batch Communication (Stand-Alone) | 37KB | 37KB | 0.3MB | 0.3MB |
| IMOS I Operating System and Utilities | 33KB | 34KB | 0.3MB | 0.3MB |
| IMOS I COBOL 74 Compiler | 13KB (7) | 13KB (7) | (8) | (8) |
| IRX Operating System | 40KB | 43KB | 0.5MB | 0.5MB |
| IRX Utilities | (10) | 13KB (9) | (10) | 0.3MB (9) |
| IRX COBOL 74 Compiler | 13KB (9) | 13KB (9) | (10) | (10) |
| IRX Remote Batch Communication (RBS) | 10KB (9) | 10KB (9) | (10) | 0.1MB (9) |
| Hotel and Food Service Application Software: | | | | |
| RECIPE (3 Modules) | 64KB | 64KB | 2.5MB | 2.5MB |
| INN-TACT | 16KB | 16KB | 1.1MB | 5.2MB |

(1) Includes common work files.
(5) Includes 8400 Utilities.
(6) Plus simulated Century memory.
(7) Plus IMOS requirements.
(8) Included with IMOS.
(9) Plus IRX requirements.
(10) Included with IRX.

# NCR 8400 and 8500 Systems

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.

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. The 8400 and 8500 Series virtual machine firmware permits the COBOL 74 compiler to interpretively generate machine-executable 32-bit commands. Each COBOL statement produces one object-level instruction that is executed immediately by the system hardware.

FORTRAN: The 8400 and 8500 systems support several levels of implementation of FORTRAN, 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.

FORTRAN E: The FORTRAN E compiler incorporates the features of full FORTRAN, described above, with the exception of random I/O. The compiler is designed for use in educational environments and features fast compilation, immediate execution of programs, and comprehensive error statements. Execution speeds of FORTRAN E programs are slower than those produced by the Full FORTRAN compiler, however, and there are no facilities for saving FORTRAN E object programs.

BASIC: A compiler for BASIC, an algebraic language designed for time-sharing computers, can be used 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.

ASSEMBLER: NEAT/3 is NCR's assembler language. Strong emphasis is placed upon the use of macro-instructions to facilitate coding. The disk-oriented NEAT/3 Compiler is usable on all NCR Century and 8400/8500 systems.

NEAT/3 Level 1 is a subset of NEAT/3 that provides an easy-to-learn programming language and fast compilation.

NEAT/VS is an enhanced version of NEAT/3 that includes all the features of the original language plus extensions to exploit the virtual memory features of the VRX-based systems. Generally, the enhancements permit mixing of older Century programs with those written for execution under the newer operating systems. NEAT/VS can also process Century chained files, indexed-sequential files, or random files as well as the newer Criterion Access Method (CAM) files.

RPG: An RPG compiler is available for use on the 8400 and 8500 systems.

TOTAL: This popular data base management system, developed by Cincom Systems, Inc., is marketed and supported by Cincom for NCR computers at an initial license fee of $28,500 per single-processor installation plus a monthly license fee of $1,144. There is also a maintenance charge of $1,500 after the first year. TOTAL is described in detail in Report 70E-132-01.

NCR also offers the TOTAL IQL interactive query language, a non-procedural data retrieval language designed for use by non-programmers. The retrieval language permits users to direct inquiries to nearly any data file at any time. A data dictionary language allows the data base manager to limit specific user access to data at the field level by assigning passwords or access codes. TOTAL IQL is offered with TOTAL for an initial license fee of $14,250 plus a monthly license fee of $572. The annual support charge for IQL is $750.

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:

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
Order Entry
Stewardship and Management Accounting
Student Scheduling and Grade Reporting
Student Test Analysis
Requirements Planning
Production Scheduling
Emphasis
Utility Billing
Department Store Sales Audit
General Reporting System
Project Network Analysis (PNA)
Basic Estimating Technique (BETS)
Fashion Reporting
Stable Stock Replenishment
CIF-DDA 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

## PRICING

ENTRY-LEVEL I-8430 SYSTEM: Includes I-8430 CPU with 128K bytes of main memory, one low-speed trunk, one very high-speed trunk, and integrated disk controller;

# NCR 8400 and 8500 Systems

CRT console terminal; one 67-megabyte 6590 dual disk drive; one 60-cpm card reader; five communications lines; and IRX operating software. Monthly rental charge is $4,285 on a one-year lease, and purchase price is $136,125.

TYPICAL V-8450 SYSTEM: Includes V-8450 CPU with 768K bytes of main memory, one low-speed trunk, one very high-speed trunk, and integrated disk controller; CRT console terminal; a 402-megabyte disk storage subsystem consisting of six 67-megabyte 6590 dual disk drives; a magnetic tape subsystem consisting of two 80-KBS 9-track 634 magnetic tape units; a 1200-lpm 646 line printer; a 600-cpm 6831 card reader; and 10 communications lines. Monthly rental charge is $16,155 on a one-year lease, and purchase price is $587,680.

LARGE-SCALE N-8570 SYSTEM: Includes N-8570 CPU with 1.5 million bytes of main memory, one low-speed trunk, one medium-speed trunk, two very high-speed trunks, and integrated disk controller; CRT console terminal; one 600-cpm card reader; one 173-cps console printer, a 2400-megabyte disk storage subsystem consisting of three 4-drive strings of 200-megabyte 658 disk pack drives; a magnetic tape subsystem consisting of six 160-KBS 9-track 635 magnetic tape units; two 1200-lpm 646 line printers; a 1000-cpm 6831 card reader; a 100-to-460-cpm 684-301 card punch; and a 621-103 communications multiplexer with adapters for 128 communications lines. This system is priced at $30,237 per month on a one-year lease or $1,370,280 for purchase.

HIGH-PERFORMANCE V-8590 SYSTEM: Includes V-8590 CPU with 4 million bytes of main memory, card reader interface, one low-speed trunk, two very high-speed trunks, and one I/O link control; CRT console terminal; one 1000-cpm card reader; one 173-cps console printer; a 1600-megabyte disk subsystem consisting of eight 200-megabyte 658 disk drives; a magnetic tape subsystem consisting of four 1250-KBS 6370 magnetic tape units; a 1500-lpm 640 line printer; and a 621-103 communications multiplexer with adapters for 128 communications lines. Monthly rental charge is $55,563 on a one-year lease, and purchase price is $1,737,540.

SOFTWARE: In May 1976, NCR announced an "unbundled" pricing policy for its software. The new policy applies to new NCR Century and 8000 Series users. There was no change in pricing for current Century users of software installed or on order prior to May 1, 1976. Century users were allowed to move to other Century systems and continue to use software that was installed or on order prior to May 1 with no change in pricing. Century customers who moved to 8000 Series systems were allowed to carry the Century application packages forward at no charge, provided they were in use prior to May 1.

The pricing policy for NCR applications software includes an initial license fee plus a monthly fee. The initial fee ranges from $250 for most programs to over $3,000 for a totally integrated system of financial application modules. Payment of the initial fee provides for one year of use without additional monthly fees. Thereafter, the monthly license fees range from $5 to $135 a month. Systems software is subject to monthly license fees only, ranging from $5 to $150 a month. The policy, over a period of time, will result in a fully unbundled pricing policy.

SUPPORT: NCR systems support is billed to 8000 Series users at the rate of $47 per hour or $320 per day.

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 | 16 hours | 20 hours | 24 hours |
|---|---|---|---|---|
| Monday-Friday | Base | 10% | 18% | 20% |
| Saturday | 5% | 7% | 10% | 10% |
| Sunday and holidays | 7% | 9% | 12% | 12% |

NCR offers a 10 percent discount on all 8400 and 8500 systems and peripherals to users willing to sign a five-year lease agreement. A graduated purchase option credit accrues toward subsequent purchase of the systems.■

## EQUIPMENT PRICES

| | | Purchase Price | Monthly Maint. | Rental* (1-year lease) |
|---|---|---|---|---|
| **8430 PROCESSOR AND MAIN MEMORY** | | | | |
| I-8430 | Interactive Processor System; includes 128K bytes of main memory, CRT console terminal/keyboard, and one low-speed trunk; operating software included in package | $71,500 | $400 | $2,050 |
| Memory for I-8430 | | | | |
| 5630-P321 | 128K to 192K bytes of memory | 9,500 | 32 | 300 |
| 5630-P322 | 192K to 256K bytes of memory | 9,500 | 32 | 300 |
| 5630-P323 | 256K to 320K bytes of memory | 9,500 | 32 | 300 |
| 5630-P324 | 320K to 384K bytes of memory | 9,500 | 32 | 300 |

*Rental prices include maintenance.

# NCR 8400 and 8500 Systems

## EQUIPMENT PRICES

| | | Purchase Price | Monthly Maint. | Rental* (1-year lease) |
|---|---|---|---|---|
| **8450 PROCESSOR AND MAIN MEMORY** | | | | |
| I-8450 | Interactive Processor System; includes 128K bytes of main memory, 48K bytes of control memory, CRT console terminal/keyboard, and one low-speed trunk; operating software included in package | NA | NA | NA |
| N-8450 | NCR Century Processor System; includes 128K bytes of main memory, CRT console terminal/keyboard, and one low-speed trunk; operating software included in package | 88,950 | 400 | 2,425 |
| Memory for I-8450 and N-8450 | | | | |
| 5630-P521 | 128K to 192K bytes of memory | 9,500 | 32 | 300 |
| 5630-P522 | 192K to 256K bytes of memory | 9,500 | 32 | 300 |
| 5630-P523 | 256K to 320K bytes of memory | 9,500 | 32 | 300 |
| 5630-P524 | 320K to 384K bytes of memory | 9,500 | 32 | 300 |
| V-8450 | Virtual Memory Processor System; 384K bytes of main memory, 48K bytes of control memory, CRT console terminal/keyboard, and one low-speed trunk; operating software included in package | 140,300 | 586 | 4,025 |
| Memory for N-8450 and V-8450 | | | | |
| 5630-P525 | 384K to 448K bytes of memory | 9,500 | 32 | 300 |
| 5630-P526 | 448K to 512K bytes of memory | 9,500 | 32 | 300 |
| 5630-P527 | 512K to 640K bytes of memory | 19,000 | 64 | 600 |
| 5630-P528 | 640K to 768K bytes of memory | 19,000 | 64 | 600 |
| 5630-P529 | 768K to 896K bytes of memory | 19,000 | 64 | 600 |
| 5630-P530 | 896K to 1024K bytes of memory | 19,000 | 64 | 600 |
| **8550 PROCESSOR AND MAIN MEMORY** | | | | |
| N-8550 | NCR Century Processor System; includes 128K 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 | 107,400 | 458 | 2,900 |
| V-8550 | Virtual Memory Processor System; includes 384K bytes of main memory, 24K bytes of control memory, one low-speed and one very high-speed trunk, and card reader or punched paper tape reader interface; operating software included in package | 156,500 | 644 | 4,700 |
| Memory for N-8550 | | | | |
| 5600-P320 | 128K to 192K bytes of memory | 9,500 | 32 | 300 |
| 5600-P321 | 192K to 256K bytes of memory | 9,500 | 32 | 300 |
| 5600-P322 | 256K to 320K bytes of memory | 9,500 | 32 | 300 |
| 5600-P323 | 320K to 384K bytes of memory | 9,500 | 32 | 300 |
| Memory for N-8550 and V-8550 | | | | |
| 5600-P324 | 384K to 448K bytes of memory | 9,500 | 32 | 300 |
| 5600-P325 | 448K to 512K bytes of memory | 9,500 | 32 | 300 |
| **8560 PROCESSOR AND MAIN MEMORY** | | | | |
| N-8560 | NCR Century Processor System; includes 192K bytes of main memory, 24K bytes of control 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 | 195,200 | 787 | 5,030 |
| V-8560 | Virtual Memory Processor System; includes 384K bytes of main memory, 24K bytes of control 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 | 237,050 | 993 | 6,330 |
| Memory for N-8560 | | | | |
| 5600-P521 | 192K to 256K bytes of memory | 9,500 | 32 | 300 |
| 5600-P522 | 256K to 320K bytes of memory | 9,500 | 32 | 300 |
| 5600-P523 | 320K to 384K bytes of memory | 9,500 | 32 | 300 |
| Memory for N-8560 and V-8560 | | | | |
| 5600-P524 | 384K to 448K bytes of memory | 9,500 | 32 | 300 |
| 5600-P524 | 448K to 512K bytes of memory | 9,500 | 32 | 300 |
| 5600-P526 | 512K to 640K bytes of memory | 19,000 | 64 | 600 |
| 5600-P527 | 640K to 768K bytes of memory | 19,000 | 64 | 600 |
| 5600-P528 | 768K to 896K bytes of memory | 19,000 | 64 | 600 |
| 5600-P529 | 896K to 1024K bytes of memory | 19,000 | 64 | 600 |
| 5600-P530 | 1024K to 1280K bytes of memory | 38,000 | 128 | 1,200 |
| 5600-P531 | 1280K to 1536K bytes of memory | 38,000 | 128 | 1,200 |

*Rental prices include maintenance.

# NCR 8400 and 8500 Systems

## EQUIPMENT PRICES

| | | Purchase Price | Monthly Maint. | Rental* (1-year lease) |
|---|---|---|---|---|
| **8570 PROCESSOR AND MAIN MEMORY** | | | | |
| N-8570 | NCR Century Processor System; includes 256K bytes of main memory, 10K bytes of control memory, one low-speed, one medium-speed, and one very high-speed trunk; operating software included in package | 282,600 | 873 | 6,900 |
| V-8570 | Virtual Memory Processor System; includes 384K bytes of main memory, 24K bytes of control memory, one low-speed, one medium-speed, and one very high-speed trunk; operating software included in package | 314,950 | 1,047 | 7,900 |
| Memory for N-8570 | | | | |
| 5600-P420 | 256K to 384K bytes of memory | 19,000 | 64 | 600 |
| Memory for N-8570 and V-8570 | | | | |
| 5600-P421 | 384K to 512K bytes of memory | 19,000 | 64 | 600 |
| 5600-P422 | 512K to 640K bytes of memory | 19,000 | 64 | 600 |
| 5600-P423 | 640K to 768K bytes of memory | 19,000 | 64 | 600 |
| 5600-P424 | 768K to 896K bytes of memory | 19,000 | 64 | 600 |
| 5600-P425 | 896K to 1024K bytes of memory | 19,000 | 64 | 600 |
| 5600-P426 | 1024K to 1280K bytes of memory | 38,000 | 128 | 1,200 |
| 5600-P427 | 1280K to 1536K bytes of memory | 38,000 | 128 | 1,200 |
| 5600-P428 | 1536K to 1792K bytes of memory | 38,000 | 128 | 1,200 |
| 5600-P429 | 1792K to 2048K bytes of memory | 38,000 | 128 | 1,200 |
| **8580 PROCESSOR AND MAIN MEMORY** | | | | |
| V-8580 | 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 | 517,400 | 1,403 | 12,650 |
| Memory for V-8580 | | | | |
| 5600-P621 | 1024K to 2048K bytes of memory | 110,000 | 512 | 3,670 |
| 5600-P622 | 2048K to 3072K bytes of memory | 110,000 | 512 | 3,670 |
| 5600-P623 | 3072K to 4096K bytes of memory | 110,000 | 512 | 3,670 |
| **8590 PROCESSOR AND MAIN MEMORY** | | | | |
| V-8590 | Virtual Memory Multiprocessor System; includes 2048K bytes of main memory, 128K bytes of control memory, CRT console terminal, card reader interface; operating software included in package | 720,000 | 2,872 | 20,900 |
| Memory for V-8590 | | | | |
| 5640-P421 | 2048K to 3072K bytes of memory | 110,000 | 330 | 3,670 |
| 5640-P422 | 3072K to 4096K bytes of memory | 110,000 | 330 | 3,670 |
| 5640-P423 | 4096K to 5120K bytes of memory | 110,000 | 330 | 3,670 |
| 5640-P424 | 5120K to 6144K bytes of memory | 110,000 | 330 | 3,670 |
| **I/O CONTROL AND PROCESSOR OPTIONS** | | | | |
| I/O Control for I-8430 and 8450 Systems | | | | |
| 5630-PX40 | Additional Low-Speed Trunk; maximum of two | 4,150 | 10 | 100 |
| 5630-PX41 | Additional Very High-Speed Trunk; maximum of two | 9,300 | 22 | 225 |
| 5630-P349 | Integrated Disk Control (IDC) for 8430 systems | 8,700 | 80 | 300 |
| 5630-P545 | IDC for 8450 systems; requires one 5630-P546 or 5630-P548 control | 14,700 | 80 | 400 |
| 5630-PX46 | IDC Attachment for 6590 disks | 1,500 | — | 40 |
| 5630-PX47 | IDC 8-Spindle Expansion; prerequisite for all 658 disk drives or for use of more than 4 spindles | 6,000 | 30 | 160 |
| 5630-P546 | IDC, First String Control, for 6590 drives | 1,500 | — | 40 |
| 5630-P548 | IDC, First String Control, for 658 drives; requires 5630-P547 expansion | 5,500 | — | 150 |
| I/O Control for 8500 Series Processors | | | | |
| 56X0-PX40 | Low-Speed trunk for all 8500 systems; maximum of two | 4,150 | 10 | 100 |
| 5600-P341 | Medium-Speed Trunk for 8550 systems | 6,300 | 15 | 150 |
| 5640-P441 | Medium-Speed Trunk for 8590 systems; maximum of one | 6,300 | 15 | 150 |
| 5600-P342 | Very High-Speed Trunk for 8550 systems | 9,300 | 22 | 225 |
| 5600-P541 | Very High-Speed Trunk for 8560 systems | 9,300 | 22 | 225 |
| 5600-P441 | Very High-Speed Trunk for 8570 systems | 9,300 | 22 | 225 |
| 5600-P641 | Very High-Speed Trunk for 8580 systems | 9,300 | 22 | 226 |
| 5640-P442 | Very High-Speed Trunk for 8590 systems | 9,300 | 22 | 225 |

*Rental prices include maintenance.

# NCR 8400 and 8500 Systems

## EQUIPMENT PRICES

| | | Purchase Price | Monthly Maint. | Rental* (1-year lease) |
|---|---|---|---|---|
| **I/O CONTROL AND PROCESSOR OPTIONS (Continued)** | | | | |
| 5600-P345 | Integrated Disk Control (IDC) Module for 8550; maximum of 24 spindles | 14,700 | 80 | 400 |
| 5600-P346 | IDC 6590 Attachment | 1,500 | — | 40 |
| 5600-P347 | IDC Expansion to 8 Spindles; prerequisite for all 658 disk drives or use of more than 4 spindles in 6590 subsystems | 6,000 | 30 | 160 |
| 5600-P348 | IDC 658 Attachment; requires 5600-P347 expansion | 5,500 | — | 150 |
| 5600-P545 | Integrated Disk Control (IDC) Module for 8560; maximum of 16 spindles | 14,700 | 80 | 400 |
| 5600-P546 | IDC 6590 Attachment | 1,500 | — | 40 |
| 5600-P547 | IDC Expansion to 8 Spindles; prerequisite for all 658 disk drives or for use of more than 4 spindles in 6590 subsystems | 6,000 | 30 | 160 |
| 5600-P548 | IDC, First String Control, for 658 drives; requires 5600-P547 expansion | 5,500 | — | 150 |
| 5600-P549 | IDC, Second String Control, for 6590 drives | 4,100 | 10 | 100 |
| 5600-P550 | IDC, Second String Control, for 658 drives | 4,100 | 10 | 100 |
| 5600-P445 | Integrated Disk Control (IDC) Module for 8570; maximum of 24 spindles | 20,700 | 110 | 560 |
| 5600-P446 | IDC, First String Control, for 6590 drives | 1,500 | — | 40 |
| 5600-P447 | IDC, First String Control, for 658 drives | 5,500 | — | 150 |
| 5600-P448 | Additional String Controls; maximum of two | 4,100 | 10 | 100 |
| 5600-P455 | IDC Dual Access Adapter; permits concurrent access to second drive string | 20,700 | 100 | 600 |
| 5600-P456 | 658 Attachment; required if 658 disks are attached to dual IDC's | 1,100 | 2 | 25 |
| 5600-P645 | Integrated Disk Control (IDC) Module for 8580; maximum of 24 spindles | 49,000 | 150 | 1,340 |
| 5600-P646 | IDC, First String Control, for 6590 drives | 1,500 | — | 40 |
| 5600-P647 | IDC, First String Control, for 658 drives | 5,500 | — | 150 |
| 5600-P648 | Additional String Controls; maximum of two | 4,100 | 10 | 100 |
| 5600-P655 | IDC Dual Access Adapter; permits concurrent access to second drive string | 49,000 | 150 | 1,340 |
| 5600-P656 | 658 Attachment; required if 658 disks are attached to dual IDC's | 1,100 | 2 | 25 |
| 5640-P446 | Integrated Disk Control (IDC) Module for 8590; maximum 24 spindles per control | 71,450 | 2,100 | 1,755 |
| 5640-P446 | Additional String Controls; maximum of three strings per control | 11,845 | 22 | 295 |
| 5640-P455 | IDC Dual Access Adapter | 68,040 | 175 | 1,670 |
| 5640-P443 | I/O Link Control for 8590 | 68,040 | 101 | 1,670 |
| Communications for I-8430 and 8450 | | | | |
| 5630-P954 | Communication Line Controller (CLC) and Multiple Line Adapter (CLC/MLA) Combination; requires 5630-P959 light display; maximum of 2 | 6,000 | 70 | 200 |
| 5630-P959 | ICS Light Display | — | — | — |
| 5630-P950 | CLC; requires 5630-P959 Light Display; maximum of 4 (for 8450 systems only) | 2,500 | 45 | 100 |
| 5630-P956 | Third Group of 5 Low-Speed Lines (for 8430 and 8450) | 6,000 | — | 200 |
| 5630-P957 | Fourth Group of 5 Low-Speed Lines (for 8430 and 8450) | 6,000 | 70 | 200 |
| Communications for 8550, 8560, 8570, and 8580 | | | | |
| 5600-P950 | Medium-Speed Communication Line; maximum of 4 | 2,500 | 45 | 100 |
| 5600-P954 | Five Low-Speed Communication Lines; maximum of 20 lines | 6,000 | 70 | 200 |
| 5600-P959 | ICS Light Display | — | — | — |
| 5600-P958 | MLA Upgrade | 3,500 | 25 | 100 |
| Console Options | | | | |
| 0796-0101 | Additional CRT for dual console (for V-8450); requires 5630-902 console channel | 2,000 | 25 | 90 |
| 5630-P902 | Additional Console Channel (for 8450) | 1,500 | 3 | 35 |
| 5600-P902 | Additional Console Channel (for 8550, 8560, and 8570) | 800 | 3 | 20 |
| 5640-P902 | Additional Console Channel (for 8590) | 800 | 3 | 20 |
| 5851-0001/ 0101 | CRT/Keyboard for Dual Console; dual system requires console table, plain console top, CRT, and stand (all 8500 systems) | 950 | 5 | 25 |
| 7200-0605 | Console Display Unit | 5,600 | 22 | 140 |
| 5630-P910 | Thermal Printer, hard-copy device | 3,000 | 15 | 85 |
| 5601-P103 | Console Top with 260 Thermal Printer | 3,700 | 20 | 100 |
| Additional Options | | | | |
| 5600-P301 | Fast Floating Point Assist (for 8550, 8560, and 8570) | 6,400 | 10 | 150 |
| 5600-P302 | Additional Power Supply (for 8550 and 8560) | 9,200 | 20 | 240 |
| 5630-P903 | Remote Audible Alarm (for I-8430 and 8450) | 2,200 | 24 | 50 |
| 5600-P903 | Remote Audible Alarm (for 8500 systems) | 2,200 | 24 | 50 |
| 5630-P370 | N-8450 to V-8450 Upgrade | 13,350 | 58 | — |
| 5600-P370 | N-8550 to N-8570 Upgrade; requires additional power supply, medium-speed trunk, and at least 256K memory | 108,660 | 59 | — |
| 5600-P372 | V-8550 to V-8570 Upgrade | 142,950 | 368 | — |
| 5600-P373 | V-8550 to V-8560 Upgrade | 74,250 | 334 | — |
| 5600-P398 | N-8550 to V-8550 Upgrade | 13,350 | 58 | 400 |

*Rental prices include maintenance.

# NCR 8400 and 8500 Systems

## EQUIPMENT PRICES

| | | Purchase Price | Monthly Maint. | Rental* (1-year lease) |
|---|---|---|---|---|
| **I/O CONTROL AND PROCESSOR OPTIONS (Continued)** | | | | |
| 5600-P570 | N-8560 to V-8560 Upgrade | 13,350 | 110 | — |
| 5600-P571 | N-8560 to N-8570 Upgrade | 68,700 | 34 | — |
| 5600-P573 | V-8560 to V-8570 Upgrade | 68,700 | 34 | — |
| 5600-P471 | N-8570 to V-8570 Upgrade | 13,350 | 110 | 400 |
| 5600-P472 | V-8570 to V-8580 Upgrade; includes 1024K bytes of 8580 memory | 316,050 | 638 | 8,070 |
| **MASS STORAGE** | | | | |
| 0655-0201 | Disk Drive; 8.4MB | 26,500 | 179 | 685 |
| 0625-0101 | Controller for 0655-0201 disk drives | 14,000 | 21 | 313 |
| 0955-0001 | Disk Pack for 655-type disk drives; 8.4MB | 160 | — | — |
| 0656-0102 | Disk Drive; 4.9MB | 13,020 | 84 | 356 |
| 0000-6561 | Controller for up to two 656 disk drives; additional controller required for third, fifth, and seventh drives | 6,750 | 35 | 173 |
| 0956-0001 | Disk Pack for 656 disk drives; 4.9MB | 120 | — | — |
| 0657-0101 | Disk Drive; 30/48MB, one spindle | 26,450 | 120 | 613 |
| 0657-0102 | Dual-Spindle Disk Unit; 60MB or 96MB; 96MB capacity requires 625-0202 controller; 60MB capacity requires 625-0201 or 625-0202 controller | | | |
| | First Disk Drive | 41,400 | 133 | 944 |
| | Second Disk Drive | 32,200 | 133 | 744 |
| | Additional Disk Drive | 27,600 | 133 | 644 |
| 0625-0201 | Low-Density Controller for 30MB 675-0101 disk drives; 315KBS data rate | 40,250 | 612 | 887 |
| 0625-0202 | High-Density Controller for 657-101 disk drives; 500KBS data rate | 49,450 | 1,068 | 1,097 |
| 0625-0201 | High-Density Option; required to attach 48MB disk drive to 625-0201 low-density controller | 9,200 | 456 | 210 |
| 0957-0102 | Disk Pack for 657-type disk drives; 30/48MB | 235 | — | — |
| 0658-0201 | Disk Drive; 100MB; requires 0625-0301 controller | 24,000 | 127 | 630 |
| 0658-0401 | Disk Drive, 200MB; requires 0625-0301 controller | 30,500 | 152 | 835 |
| 0658-0002 | Disk Drive Conversion; 100MB to 200MB capacity | 14,200 | 50 | 305 |
| 0625-0301 | Disk Control for up to 16 658-0201 or 658-0401 drives | 38,200 | 246 | 946 |
| 0625-0301 | Drive Expansion Feature for 0625-0301 disk control | 2,250 | 12 | 56 |
| 6589-0101 | I/O Link Adapter for up to eight 658-0201 or 658-0401 disk drives (8590 only) | 11,280 | 45 | 280 |
| 0958-0002 | Disk Pack for 0658-0201 or 0658-0401 drives | 860 | — | — |
| 6590-0101 | Disk Drive; 2 spindles | 37,500 | 85 | 900 |
| 6590-0201 | Disk Drive; 2 spindles | 23,500 | 85 | 900 |
| 6591-0101 | 35MB Data Module | 1,500 | — | 70 |
| 6591-0201 | 70MB Data Module | 2,000 | — | 85 |
| 6591-0301 | Data Module for 6590-0201 | 1,500 | — | 70 |
| 6590-P003 | Rotational Position Sensing Kit | 700 | 4 | 20 |
| 6540-0801 | Disk Drive Unit; 540MB, includes four 135MB units (for 8590 only) | 50,500 | 205 | 1,335 |
| 6549-0101 | I/O Link Adapter for up to two 6540-0801 quad-drive units | 9,500 | 45 | 275 |
| **MAGNETIC TAPE** | | | | |
| 6370-0401 | Magnetic Tape Unit; 75 ips, 9-track, PE/GCR, 120/470KB | 24,100 | 100 | 640 |
| 6379-0401 | I/O Link Adapter for up to four 6370-0401 magnetic tpe units | 30,250 | 115 | 785 |
| 6370-0601 | Magnetic Tape Unit; 125 ips, 9-track, PE/GCR, 200/780KB | 27,000 | 125 | 730 |
| 6379-0601 | I/O Link Adapter for up to four 6370-0601 magnetic tape units | 30,250 | 115 | 785 |
| 6370-0801 | Magnetic Tape Unit; 200 ips, 9-track, PE/GCR, 320/1250KB | 36,000 | 240 | 1,160 |
| 6379-0801 | I/O Link Adapter for up to four 6370-0801 magnetic tape units | 31,500 | 150 | 815 |
| 0633-0111 | Single Magnetic Tape Unit; PE, 80KB, 9-track, 1600 bpi | 12,600 | 86 | 328 |
| 0633-0117 | Single Magnetic Tape Unit; NRZI, 10/28/40KB, 7-track, 200/556/800 bpi | 13,650 | 92 | 348 |
| 0633-0119 | Single Magnetic Tape Unit; NRZI, 40KB, 9-track, 800 bpi | 14,700 | 92 | 383 |
| 0624-0119 | Controller for up to eight 633-0119 magnetic tape units | 12,600 | 29 | 318 |
| 0624-0179 | Controller for up to eight 633-0119 and/or 633-0117 magnetic tape units with same speeds | 13,020 | 29 | 323 |
| 0633-0121 | Dual Magnetic Tape Unit; PE, 80KB, 9-track, 1600 bpi | 24,750 | 128 | 587 |
| 0624-0111 | Controller for up to eight 633-0111 and/or 633-0121 magnetic tape units | 18,060 | 29 | 443 |
| 0633-0211 | Single Magnetic Tape Unit; PE, 144KB, 9-track, 1600 bpi (requires high-speed trunk) | 21,375 | 86 | 503 |
| 0624-0211 | Controller for up to eight 633-0211 magnetic tape units | 21,000 | 29 | 518 |
| 0633-0311 | Single Magnetic Tape Unit; PE, 240KB, 9-track, 1600 bpi (requires high-speed trunk) | 22,050 | 86 | 553 |
| 0624-0311 | Controller for up to eight 633-0311 magnetic tape units | 23,100 | 29 | 568 |
| 0633-0837 | Single Magnetic Tape Unit; 10/28/40KB, 9-track, 200/556/800 bpi | 7,970 | 92 | 348 |
| 0633-0839 | Single Magnetic Tape Unit; NRZI, 40KB, 9-track, 800 bpi | 8,900 | 92 | 383 |
| 0624-0839 | Controller for 633-0839 | 8,845 | 29 | 318 |
| 0624-0879 | Controller for 633-0837 and/or 633-0839 | 9,000 | 29 | 323 |
| 634-0117 | Magnetic Tape Unit with Controller; 7-track, 25 ips, NRZI | 26,670 | 151 | 676 |
| 634-0107 | Magnetic Tape Unit; 25 ips, for use with 0634-0117 | 10,710 | 84 | 279 |
| 0636-0301 | Cassette Tape Handler | 9,000 | 66 | 240 |
| 0636-0001 | Dual Cassette Transport Feature | 2,000 | 12 | 51 |

*Rental prices include maintenance.

# NCR 8400 and 8500 Systems

## EQUIPMENT PRICES

| | | Purchase Price | Monthly Maint. | Rental* (1-year lease) |
|---|---|---|---|---|
| **PRINTERS** | | | | |
| 6420-0101 | Band Printer; 300 lpm, requires at least one print band | 14,500 | 110 | 425 |
| 6420-0201 | Band Printer; 600 lpm, requires at least one print band | 23,500 | 200 | 695 |
| 6420-0301 | Band Printer; 900 lpm, requires at least one print band; includes 6420-K024 quietized cabinet | 33,000 | 250 | 965 |
| 6420-K031 | Criterion Interface; required for 6420-0101, 0201, and -0301 printers | 4,000 | 50 | 225 |
| 6420-K010 | Print Band; 64-character ASCII, 1403, 10 cpi | 630 | — | 25 |
| 6420-K019 | Print Band; 96-character U/L case | 630 | — | 25 |
| 6420-K022 | Print Band; 48-character ASCII, 1403, 10 cpi | 630 | — | 25 |
| 6420-K024 | Quietized Cabinet | 550 | — | 35 |
| 6440-0101 | Matrix Printer With Interface; 55 lpm, connected to common trunk | 4,495 | 39 | 150 |
| 6440-0102 | Matrix Printer; 55 lpm, requires interface | 2,575 | 39 | 95 |
| 6440-K005 | RS-232 Interface (CCITT V.24) | 2,125 | 15 | 70 |
| 6440-K003 | Character Buffer; 796-101 serial interface | 2,125 | 19 | 70 |
| 6440-K009 | Elongated Character Set for 6440-0102 printer | 25 | — | 3 |
| 1001-A001 | Pedestal for 6440-0101, -0102 printers | 250 | — | — |
| 6440-0202 | Matrix Printer; 125 lpm | 8,150 | 65 | 270 |
| 6440-0302 | Matrix Printer; 70 lpm | 5,250 | 55 | 180 |
| 6440-K030 | Common Trunk Interface for 6440-0202, -0302 printers | 1,350 | 4 | 50 |
| 6440-0402 | Matrix Printer; 50 lpm | 3,995 | 39 | 155 |
| 6440-P030 | Common Trunk Interface for 6440-0402 | 500 | 10 | 20 |
| 6440-K050 | 7x7 dot matrix for 6440-0202, -0302, and -0402 printers | 105 | — | — |
| 6440-K058 | 9x7 dot matrix for 6440-0202, -0302, and -0402 printers | 105 | — | — |
| 1001-A003 | Pedestal for 6440-0202 and -0302 printers | 275 | — | — |
| 0640-0102 | Printer; 450/900 lpm, 132 positions; requires 626-101 controller | 26,000 | 90 | 642 |
| 0640-0200 | Printer; 1500/3000 lpm, 132 positions; requires 626-101 controller for Common Trunk attachment | 47,500 | 163 | 1,321 |
| 0640-0210 | Printer; 1500/3000 lpm, 160 positions; requires 626-101 controller for Common Trunk attachment | 51,750 | 163 | 1,421 |
| 0640-0300 | Printer; 1200 lpm, 132 positions; requires 626-101 controller | 37,450 | 127 | 1,042 |
| 0626-0101 | Printer Control Unit for common trunk attachment of 640-102, 640-200, 640-205, 640-210, 640-215, or 640-300 printers | 14,000 | 37 | 335 |
| 6401 | 6/8 Lines per inch for 640-102 printer | 1,000 | 0 | 25 |
| 6402 | Continuous Form Tab Set Handling Feature for 640-200 printer | 300 | 2 | 10 |
| 0646-0201/ 961-0201 | Train Printer and Control; 1200 lpm, 132 positions; requires print train | 44,250 | 378 | 1,343 |
| 0647-0201/ 961-0201 | Train Printer and Controller; 200 lpm, 132 positions; requires print train | 69,650 | 518 | 1,833 |
| 0960-0152 | Print Train; 52 characters | 2,950 | Time & mat'l. | 100 |
| 0960-0164 | Print Train; 64 characters | 2,950 | Time & mat'l. | 100 |
| 0960-0157 | Print Train; 57 characters, OCR-A | 2,950 | Time & mat'l. | 100 |
| 0960-0196 | Print Train; 96 characters | 2,950 | Time & mat'l. | 100 |
| 0649-0300 | Printer; 300 lpm, 132 positions; includes controller | 24,150 | 112 | 640 |
| 0649-0001 | 6/8 Lines per Inch Option for 649-300 Printer | 675 | 1 | 15 |
| **PUNCHED CARD I/O UNITS** | | | | |
| 0680-0201 | Card Reader; 1200 cpm | 32,500 | 174 | 739 |
| 0684-0101 | Card Read/Punch; 500/100-460 cpm | 25,830 | 304 | 688 |
| 0684-0301 | Card Punch, 100-460 cpm | 22,860 | 268 | 609 |
| 0686-0102 | Card Read/Punch; 800/83-294 cpm | 24,000 | 258 | 668 |
| 0686-0111 | Card Read/Punch; 560/60-180 cpm | 20,500 | 224 | 529 |
| 0686-0201 | Card Reader; 750 cpm | 14,750 | 171 | 413 |
| 0686-0302 | Card Punch; 82-240 cpm | 20,500 | 230 | 520 |
| 0686-0311 | Card Punch; 60-180 cpm | 14,750 | 213 | 413 |
| 0687-0301 | Card Punch; 100 cpm | 15,500 | 135 | 382 |
| 6831-0201 | Card Reader; 600 cpm | 11,500 | 32 | 277 |
| 6831-0301 | Card Reader; 1000 cpm (for 8580 and 8590) | 13,800 | 75 | 375 |
| 5630-P600 | Card Reader Interface (for 8430 only) | 1,150 | 5 | 30 |
| **PAPER TAPE I/O UNITS** | | | | |
| 0660-0101 | Paper Tape Reader, 1500 cps | 14,750 | 51 | 336 |
| 0665-0101 | Paper Tape Punch, 200 cps | 18,000 | 79 | 419 |

*Rental prices include maintenance.

# NCR 8400 and 8500 Systems

## EQUIPMENT PRICES

| | | Purchase Price | Monthly Maint. | Rental* (1-year lease) |
|---|---|---|---|---|
| **MICR I/O UNITS** | | | | |
| 0670-0101 | MICR Sorter; 600 dpm, 11 pockets; includes 622-401 controller | 45,000 | 369 | 1,242 |
| 0671-0101 | MICR Sorter; 1200 dpm, 18 pockets; includes 622-401 controller | 117,500 | 734 | 2,659 |
| 6711 | Endorser Feature for 671-101 MICR sorter | 12,000 | 63 | 335 |
| 0675-0101 | MICR Reader/Sorter | 58,000 | 459 | 1,344 |
| 0622-0401 | MICR Sorter Control Unit | 15,100 | 14 | 221 |
| **COMMUNICATIONS** | | | | |
| 0621-0103 | On-Line Communication Multiplexer for up to 15 lines | 8,000 | 49 | 224 |
| 0691-0201 | First Extension for 621-103 multiplexer; extends capacity to 127 lines | | | |
| 0691-0202 | Second Extension for 621-103 multiplexer; extends capacity to 255 lines | | | |
| 0621-F200 | In-House Clock Driver for 0621-0103 multiplexer | 2,000 | 17 | 76 |
| 0621-F201 | Synchronous Adapter Connection Cable Kit | 450 | 2 | 14 |
| 0621-F202 | Wideband Interface | 685 | 2 | 21 |
| 0691-0101 | Auxiliary Cage | 7,500 | 10 | 126 |
| 0690-0103 | On-Line Auxiliary Bay | 8,000 | 4 | 165 |
| 0692-0600 | Dual Asynchronous Adapter, one line disabled | 1,500 | 10 | 81 |
| 0692-0600 | Dual Asynchronous Adapter | 3,000 | 20 | 162 |
| 0692-0638 | 438-3 Adapter | 3,000 | 9 | 80 |
| 0693-0600 | Dual Synchronous Adapter, one line disabled | 4,500 | 10 | 111 |
| 0693-0600 | Dual Synchronous Adapter | 9,000 | 10 | 222 |
| 0695-0600 | On-Line Auto Dialer | 1,600 | 12 | 51 |
| 0698-0300 | Integrated Asynchronous Modem | 1,000 | 8 | 33 |
| 0752-0200 | Free-Standing External Modem | 700 | 10 | 32 |

*Rental prices include 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 | 90 |
| COBOL 68 | 0 | 90 |
| Basic FORTRAN Compiler | 0 | 20 |
| Intermediate FORTRAN Compiler | 0 | 40 |
| Full FORTRAN Compiler | 0 | 75 |
| Educational FORTRAN Compiler | 0 | 20 |
| RPG Compiler | 0 | 40 |
| Object Module Assembly Program (OMAP) | 0 | 10 |
| SORT/MERGE | 0 | 20 |
| Student COBOL | 3,500 | 40 |
| **RS1 On-Line System Software** | | |
| Time-Sharing | 0 | 150 |
| Remote Batch Entry (RBE) | 0 | 20 |
| B2 Prepass Compiler | 0 | 40 |
| Queue Executive Interface (QX1) | 0 | 10 |
| BASIC I (Dedicated) | 990 | 56 |
| BASIC I (Dual) | 990 | 56 |
| BASIC I I/O Writer | 990 | 56 |
| BASIC M | 1,500 | 40 |
| Management Access To Records (MATR II) | 1,500 | 40 |
| **RS1 Data Management System Software** | | |
| Index Sequential Filing System | 0 | 15 |
| Random Filing System (RFS) | 0 | 15 |
| NCR TOTAL | 28,500 | 1,144 |
| TOTAL IQL | 14,250 | 572 |

# NCR 8400 and 8500 Systems

## SOFTWARE PRICES

| | Initial License Fee | Monthly License Fee |
|---|---|---|
| **VS1 Basic System Software** | | |
| VRX Operating System | 0 | 0 |
| VRX COBOL 74 Compiler | 0 | 90 |
| VRX COBUG | 0 | 10 |
| VRX NEAT/VS COMPILER | 0 | 50 |
| VRX SORT/MERGE | 0 | 40 |
| **VS1 On-Line System Software** | | |
| Terminal Communications Processor | 0 | 60 |
| Network Definition Language Processor | 0 | 25 |
| On-Line Program Development | 0 | 50 |
| VRX Network Definition Language | 0 | 25 |
| **VS1 Data Management System Software** | | |
| CAM/VRX Utilities | 0 | 10 |
| **Management Sciences Application Software** | | |
| Statistics | 250 | 10 |
| Linear Programming | 250 | 5 |
| Project Network Analysis | 500 | 60 |
| Coordinate Geometry | 250 | 10 |
| Vehicle Scheduling | 250 | 5 |
| Feed Information System (FIS) | 7,500 | 225 |
| NCR MAGEN | | |
| **General Application Software** | | |
| General Payroll | 250 | 5 |
| Payroll/Cost, Labor Scheduling | 250 | 5 |
| Accounts Receivable—Commercial | 250 | 10 |
| Accounts Receivable—Consumer | 250 | 10 |
| Accounts Receivable—Tape | 250 | 10 |
| Accounts Payable | 250 | 10 |
| General Ledger | 250 | 5 |
| General Reporting System | 250 | 5 |
| Accounting System Interface | 250 | 5 |
| **Commercial Bank Application Software** | | |
| CIF—Series "A" | 250 | 10 |
| CIF—Series "B" | 3,250 | 135 |
| CIF—Series "B" General Ledger | 250 | 10 |
| Financial On-Line Central Info System | 4,000 | 100 |
| Personal Trust Accounting | 12,500 | — |
| **Manufacturing Application Software** | | |
| Inventory Material Control (IMC) | 480 | 20 |
| Inventory Material Requirements (IMR) | 280 | 10 |
| Bill of Materials | 480 | 20 |
| Manufacturing Systems Inquiry | 250 | 10 |
| Production Scheduling | 280 | 10 |
| Inventory Requirements Planning | 360 | 15 |
| **Wholesale Application Software** | | |
| Emphasis | 250 | 10 |
| Order Billing Technique II (ORBIT II) | 480 | 20 |
| Order Billing Technique III (ORBIT III) | 480 | 20 |
| SPIRIT | 530 | 25 |
| **Medical Application Software** | | |
| Post Discharge Accounts Receivable | 360 | 15 |
| In-Patient Records | 250 | 10 |
| Medical Audit Statistics | 250 | 5 |

# NCR 8400 and 8500 Systems

## SOFTWARE PRICES

| | Initial License Fee | Monthly License Fee |
|---|---|---|
| **Criterion Loan and Savings System (CLASS)** | | |
| All Modules | 2,800 | 110 |
| General Ledger | 250 | 10 |
| Savings | 1,320 | 55 |
| Loans | 480 | 20 |
| Alpha Locater | 250 | 10 |
| Statement Savings | 250 | 10 |
| Loans in Progress | 250 | 5 |
| **Education Application Software** | | |
| Stewardship & Management Accounting | 360 | 15 |
| SCHOLARS: | 12,500 | 80 |
| Student Test Analysis | | |
| School Bus Scheduling System | | |
| Student Scheduling/Grade Reporting | | |
| School Payroll (General Payroll) | | |
| School Appropriation Accounting | | |
| **Government Application Software** | | |
| Law Enforcement — Traffic | 0 | 0 |
| 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 |
| Local Government — Utility Billing | 360 | 15 |
| **Food Distribution Application Software** | | |
| Order Billing Technique I (ORBIT I) | 750 | 10 |
| **Department Store Application Software** | | |
| Retail Sales Audit | 250 | 10 |
| Fashion Reporting | 720 | 30 |
| Pre-Edit Processing | 430 | 20 |
| Staple Stock Replenishment | 530 | 25 |
| Common Trunk Interface (725) (On-Line Retail) | 250 | 5 |
| **MEDICS Application Software** | | |
| MEDICS A-10 | 60,000 | 630 (5 yrs.) |
| MEDICS ATD | 24,500 | 240 |
| MEDICS (A20) | 60,000 | 630 (5 yrs.) |
| **Century Simulation—System Software** | | |
| Century 101 Simulator | | |
| Type V-S Library Pack #1 | — | 5 |
| Type V-S Library Pack #2 | — | 5 |
| NCS COBOL 74 Compiler | — | 90 |
| **IRX—System Software** | | |
| IRX—Operating System | 0 | 125 |
| IRX—Utilities | 0 | 35 |
| IRX—COBOL 74 Compiler | 0 | 90 |