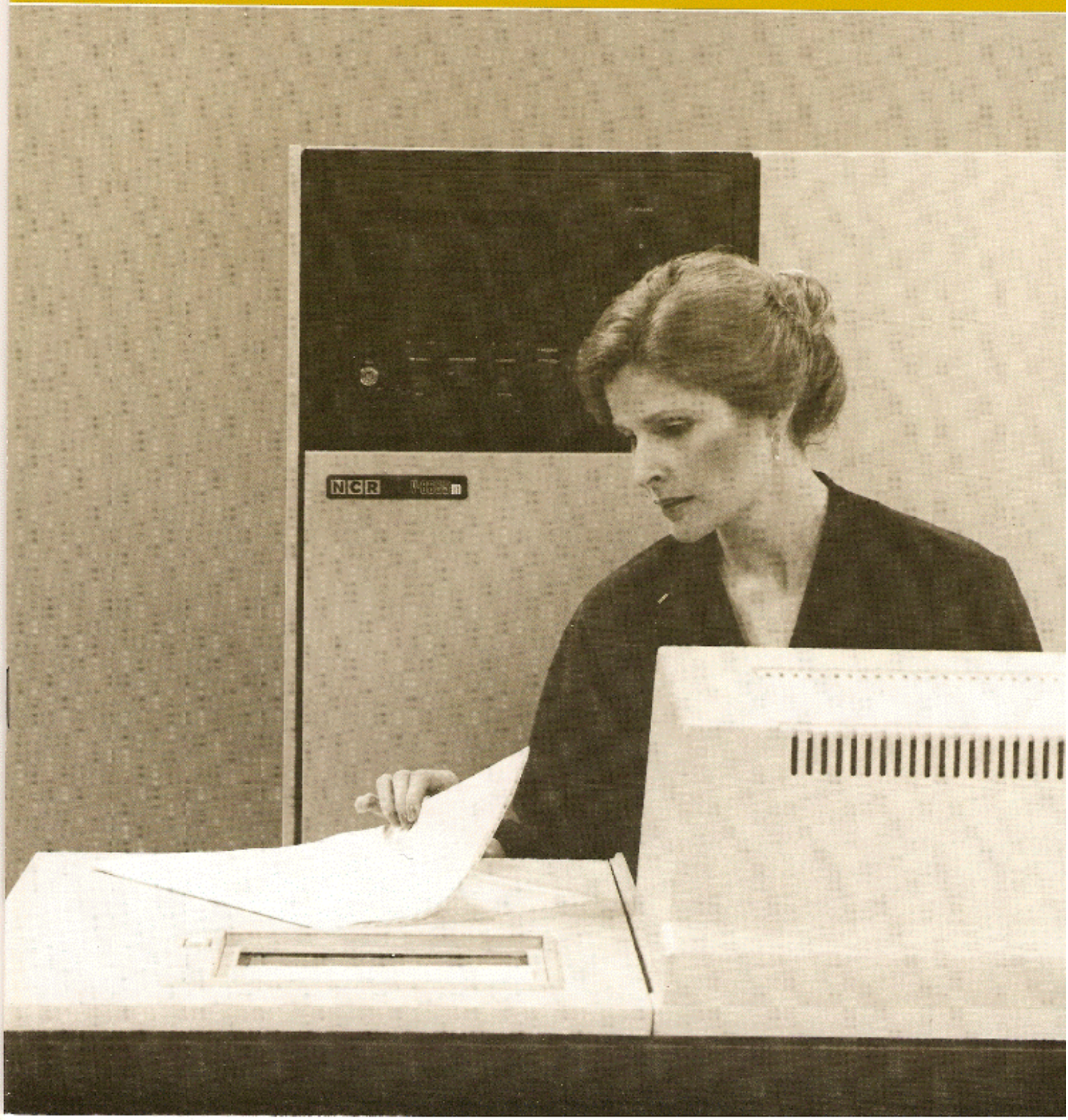
NCR

NCR V-8555M




NCR

NCR V-8555M

The NCR V-8555M is a medium-scale, general-purpose computer system that exploits the latest state-of-the-art technologies to set a new standard for data processing productivity.

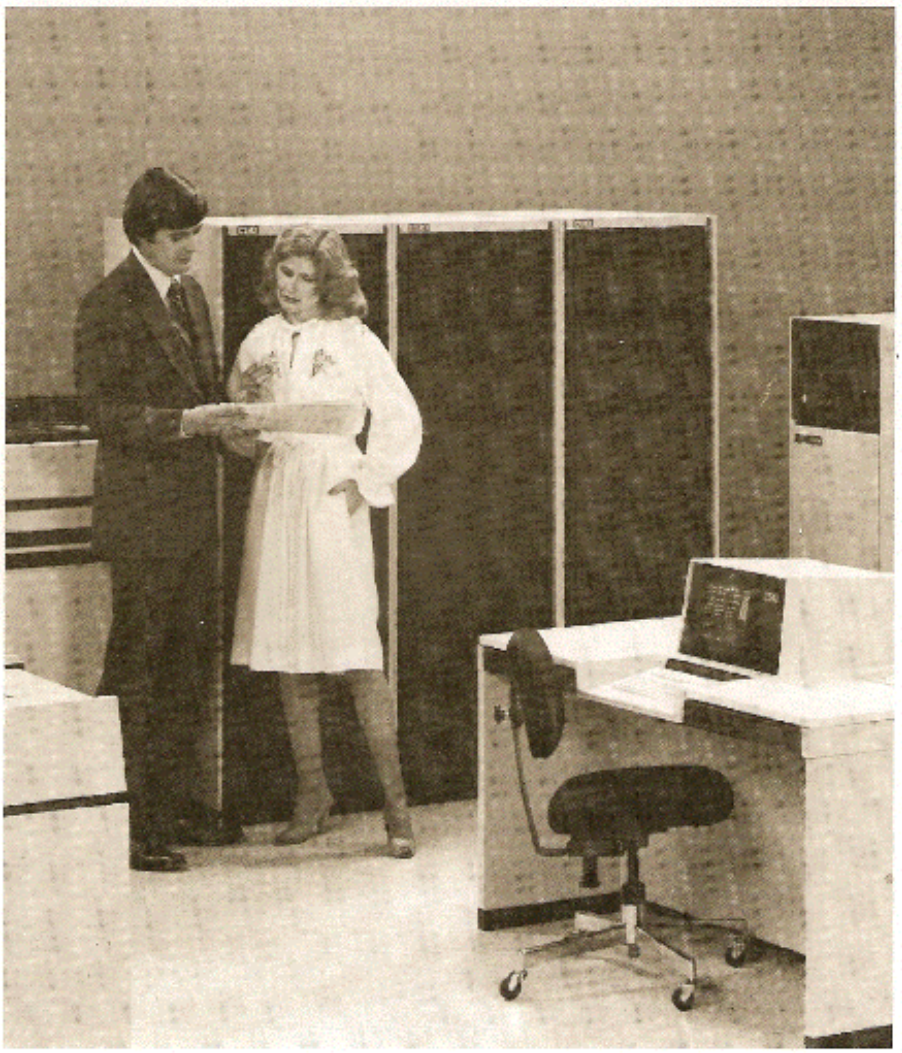
V-8500 system architecture employs multi-position, plug-in modules for ease of expansion and configuration flexibility. Extensive use of microcircuitry and advanced packaging technology means more power in less physical space.

A complete complement of mainframe features, peripherals and terminals, and comprehensive software allow total flexbility in hardware and operating environment selection.

V-8500 system design is based on a concept of modular, distributed intelligence that allows overall workload to be divided among internal modules, each with its own set of tasks. Features such as start-of-day confidence level checking, automatic internal memory error detection and correction, and specialized diagnostics mean greater reliability, serviceability, and productivity.

Flexible Multiprocessing

The NCR V-8555M uses the powerful Virtual Resource Executive (VRX) operating system. This proven operating system features full dynamic resource allocation, virtual memory with no rigid memory partitioning, and other features that provide ease of use and improved productivity. VRX-MP is an extension of this system which provides multiprocessing capabilities. Up to three additional processors can be tightly-coupled and share all system resources. VRX-MP provides the ability to link different members of the V-8500 family in a single multiprocessing complex.



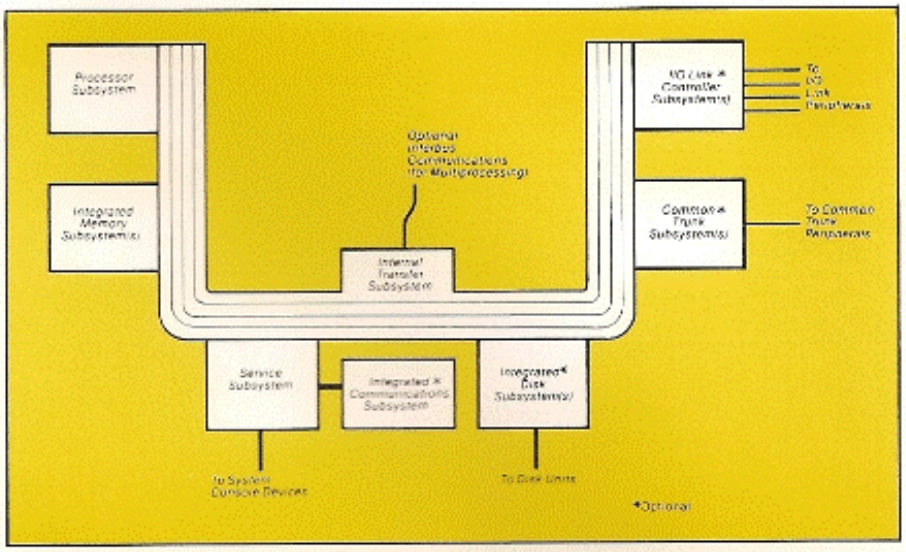
Hardware

NCR V-8555M hardware architecture employs the same modular approach that has consistently proved its viability since inception of the first 8500 family systems. Independent subsystems are grouped through modular architecture into an integrated base system. This modular architecture allows expansion of the base readily and economically by incorporating additional subsystems.

These subsystems can include up to three additional processors joined in a tightly-coupled multiprocessing environment that appears to be a uniprocessor system to operators, programmers, and application software. Multiprocessing systems extend the base architecture by incorporating high-speed Interbus Communication Adapters (ICA) to provide higher performance levels and greater reliability through inherent redundancies.

This flexibility has made it possible to:

- Implement new hardware components, affording greater speed and efficiency.
- Provide extensive back-up capabilities for maximum system availability and maintainability.
- Build in extensive, economical growth potential.
- Ensure the ability to incorporate new technologies and procedures as they emerge, to provide still higher levels of performance and reliability throughout the life of the system.



INTERNAL TRANSFER SUBSYSTEMS

The Internal Transfer Subsystem, which comprises a high-speed (56MB bandwidth), 4-byte wide internal transfer bus and its interfaces, handles all communications among the other subsystems. The bus is central to V-8500M architecture and allows subsystems to function concurrent with and independent of each other for maximum processing efficiency. It also permits the addition of new subsystems easily and economically.

Internal communications are prioritized so that the highest priority subsystem has use of the bus when two or more subsystems request it at the same time. No subsystem, however, can use more than one-half of the total cycles available, which means that a single, high-priority subsystem can never monopolize the bus for an extended period.

MEMORY SUBSYSTEM

The Memory Subsystem consists of four modules and the interface, timing, and control logic that allows it to function independent of other subsystems. High-speed RAM chips provide a read memory access time of 370 ns, and a write memory access time of 440 ns.

Error Detection and Correction

NCR V-8555M systems provide automatic single-bit memory error correction and double-bit memory error detection for high reliability.

Memory Sizes

Base V-8555M memory is 0.5 megabyte expandable in 0.5 megabyte increments to a maximum of 2 megabytes. (1 megabyte = 1,048,576 bytes.)


5V
-2V
ITB DISABLE
RUN
MAINT
RUN
NCR
V-8555

PROCESSOR SUBSYSTEM

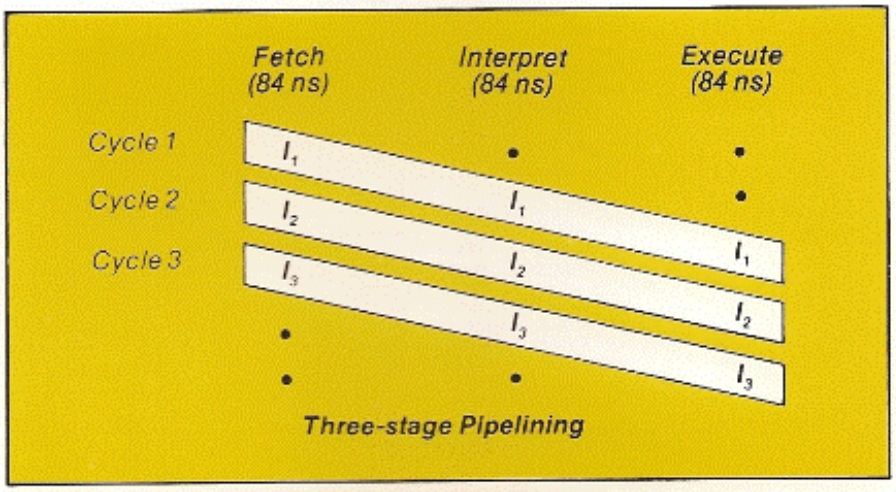
Software and application object code instructions are interpreted and executed by the Processor Subsystem under the direction of microprogrammed firmware. Firmware serves as the interface between software and each subsystem to ensure that hardware facilities are used in the most effective and efficient way to accomplish results required by system design. All V-8555M processor firmware resides in a high-speed (84 ns cycle time) instruction storage unit specifically tailored to meet higher performance requirements.

Pipelining

Pipelining is a technique of instruction overlapping that allows execution of one microcode instruction per processor cycle (84 ns) once the pipeline has been loaded. Instructions are divided into logical segments or stages of performance. The number of stages depends upon whether or not the instruction involves a memory access. Multiple stages can then be processed simultaneously to achieve one execution during every cycle.

SERVICE SUBSYSTEM

The Service Subsystem provides the interface between the Internal Transfer Subsystem and various devices for operator/system communications (keyboards, displays, console printers, system card reader, and flexible disk drive). It services these devices on an "interrupt" basis: a signal from any device, including the Internal Transfer Subsystem, causes the Service Subsystem to execute the firmware service routine for that device. The firmware routine then determines the cause of the interruption and performs the required service without having to interrupt the Processor Subsystem.



Three-stage Pipelining

INPUT/OUTPUT SUBSYSTEM

Input/Output Subsystem components and characteristics are determined by the types of peripherals attached to the system, but can include any or all of the following:

• **Input/Output Link Controllers** — I/O Link Controllers interface with peripherals through I/O Link Adapters, which are either built into individual peripherals or handle strings of peripherals, depending upon the nature of the device. Each I/O Link Controller supports up to four Link Adapters; the number of controllers per system will vary from none to a maximum of six, depending upon individual configuration requirements and I/O options selected.

• **Common Trunk Controller** — Interfaces for standard NCR common trunks can also be included in the system to permit migration of certain existing peripherals that are not adaptable to I/O Link architecture. A maximum of two low-speed (75KB transfer rate) trunks and one medium-speed (225KB) trunk may be attached to any system, together with any number of high-speed (1.2MB) trunks, so long as the total number of IOLC's and common trunks does not exceed six.

• **Integrated Disk Controller** — The system will also accommodate one or two Integrated Disk Controllers in addition to the maximum number of I/O Link Controllers and common trunks permitted. Each controller drives up to three strings of disk spindles and provides direct memory access, so that processing units do not have to be interrupted during data transfer. Two controllers operating on a system can transfer data simultaneously for two separate spindles residing on different strings.

TERMINALS AND PERIPHERALS

An extensive complement of terminals and peripherals allows maximum flexibility to meet individual user configuration requirements.

Terminals include general-purpose units, such as CRT displays and remote printers, and specialized terminals with varying degrees of intelligence for financial, retail, medical, educational, government, and commercial/industrial applications.

Paper Media File Peripherals include card readers, card punches, punched tape readers, and MICR sorters.

Printers provide a wide variety of printed output on single-, multi-part, and preprinted continuous forms at up to 2,000 lines per minute.

Magnetic Tape Handlers are available in PE, NRZI, and GCR modes, with recording densities up to 6,250 bits per inch and transfer rates up to 1.2 megabytes.

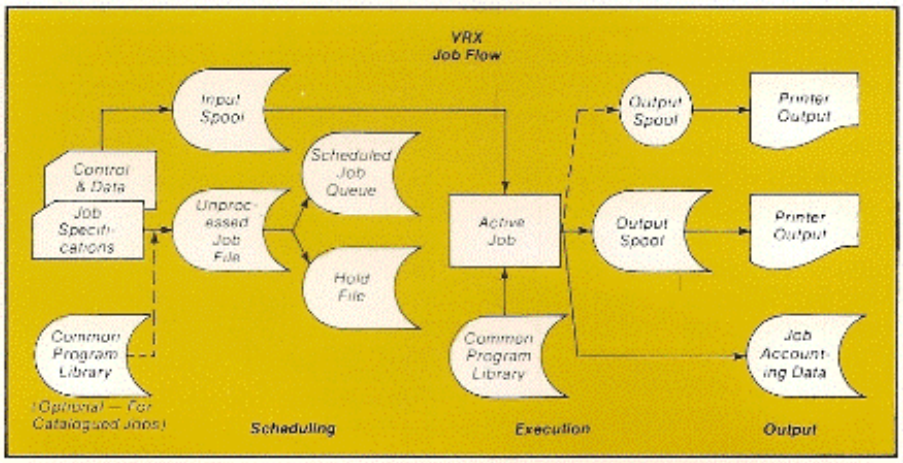
Disk Units include both removable and fixed disks with up to 1092MB capacity per unit and 1.2 megabyte transfer rates.

NCR V-8555M GENERAL SPECIFICATIONS

Processor Cycle Time	84 ns
Main Memory (Base)	0.5MB
Read Access Time	440 ns
Write Access Time	370 ns
Memory Increments	0.5MB
Maximum Main Memory	2MB
Integrated Disk Controllers (Maximum)	2
— Strings/IDC (max.)	3
— Spindles/String (max.)	8
Integrated Communications (Maximum)	20 lines

Software

Software development has been concurrent with hardware design from inception of the NCR 8000 Series. Costly redundancies have, therefore, been eliminated, and fully integrated, cohesive hardware/software systems have evolved. At the heart of this integrated development is the concept of design center engineering, which ensures that all NCR software takes full advantage of the resources available at each level of processing power. The user never has to pay the penalty of unnecessary software overhead to ensure upward compatibility.



VIRTUAL RESOURCE EXECUTIVE

The Virtual Resource Executive (VRX) is a group of software modules that make up a highly flexible, efficient operating system with multiprogramming, virtual storage, and multiple virtual machine capabilities. VRX functions include:

- Segmenting programs into logical paging divisions to take full advantage of virtual storage
- Scheduling jobs automatically for continuous processing in a multiprogramming environment
- Allocating system resources dynamically during operation
- Managing all data traffic.

This relieves the operator of most of the scheduling burden, yet still allows him to assume control of the system at any time.

Multiprogramming

VRX schedules and runs up to 35 jobs concurrently in either a single- or multi-processing environment. It automatically allocates memory, processor time, and peripheral use as needed. Each job can consist of one or more programs or tasks.

The user can exercise as much or as little direct control over job processing as he wishes.

When a job is first introduced into the VRX system, the executive stores its specifications and data cards in a spool file on disk and then validates the specifications. (Specifications for commonly run jobs will normally be stored on a common program library and called for by a single operator command.) Once a job has entered the system it passes through three phases under control of the operating system: scheduling, execution, and output.

Scheduling – During the scheduling phase, a job can be in any of several states. It is in an unprocessed state between acceptance and validation of specifications.

Following validation, the job can be delayed until some preceding event has occurred by temporarily placing it in a hold state. Otherwise, the job enters the scheduling state on a queue to await execution. As memory and other resources become available, VRX accesses the queue and attempts to execute the highest priority job. If sufficient memory and peripherals have not been released for a job, software, according to user-specified parameters, will scan the remaining jobs to see if one can be executed with the resources available or reserve the released resources until enough are available to execute the job.

Execution – A job competes with other jobs in the mix for processor and shared resource time when it enters the execution phase. During execution, control and user-specified data are supplied on demand from the input spool file. Print file output is also normally spooled onto disk or magnetic tape for later printing.

The executive manages memory dynamically during execution. It swaps low priority jobs in and out as higher priority job memory requirements increase or decrease.

• Multiprocessing

In a multiprocessing environment, processors share system resources equally, running under a single copy of the operating system. Multiprocessing systems permit each Processor Subsystem to execute at the same time in different tasks of the same job or different jobs.

NCR uses tightly-coupled multiprocessing because of its inherent

advantages over loosely-coupled processing. In a tightly-coupled system, the operating system can spread the pool of processing resources across requirements based solely on the priority of the various active tasks; any processor is capable of executing any task as it is dispatched.

Output Phase – Following execution, a job enters the output phase and remains there until any spooled print files have been printed. Printing order is also determined by priorities assigned in job specifications. At the end of the output phase, job accounting information is entered into a system log, and the job is removed from the system.

Job detail reports are printed automatically, providing a sequential record of activities and messages related to the job, and the statistics required for accounting.

VIRTUAL STORAGE

Virtual storage is a combination of a limited amount of real memory and a software controlled virtual memory residing on a high-speed, random-access peripheral device. As programs are executed in a virtual storage environment, VRX assigns to real memory those portions of virtual storage that are currently active.

Virtual storage is assigned in blocks of coding, called pages. VRX takes care of initial page structuring and subsequent page assignment automatically, so that the entire process is transparent to applications running in the system. Virtual storage:

- Expedites program design and development by freeing programmers from concern for memory constraints
- Simplifies program maintenance by allowing additions or changes to be made without fear of exceeding memory capacity
- Optimizes system operation by allowing rush jobs to be added to the workload at any time.

Virtual Storage Management under VRX – In a VRX virtual storage environment, a total of 16 million bytes of virtual address space are available to each active job. Under VRX, virtual storage management is functionally transparent. Storage mapping is completely automatic, and programs are totally unaware of the environments created for them. Other virtual storage management functions include:

- Optimizing memory usage globally by allocating only enough real memory to a job to ensure efficient execution and releasing memory to the resource pool as soon as it becomes available.
- Monitoring memory demands and system performance to detect excessive paging (thrashing) or under-utilization of resources (loafing) and automatically taking steps to correct either situation.
- Requesting pages from the page file and writing changed pages back to the file as necessary
- Relocating executing programs between main storage and secondary storage as required
- Allocating real memory to active jobs using dynamic address translation hardware to make allocated memory appear to be contiguous
- Recording resource utilization statistics on every run for use in fine-tuning systems.

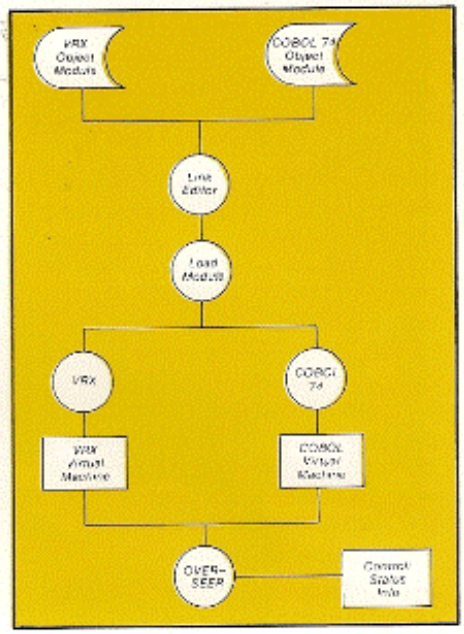
Protection Levels – Each paged segment is assigned three levels of access privileges (READ access) in either of two states (user state, privileged state). Thus, a program can contain pure procedural code, which is executable only. Any attempts to modify this code are treated as program errors. System data, which resides partly in local segments and partly in global segments, is generally accessible for reading only, in the user state, while most operating system code is executable only in the privileged state. User applications can execute only those operating system routines which have been defined as callable from the user state. Any attempts by application programs to execute privileged routines directly or to write in a global data area are also treated as program errors. In addition, each job is protected within its assigned eight megabytes of local area; no job may ever access another job's programs or data, and no user program in one job can harm either another job or the operating system itself. This feature is particularly valuable when testing new applications concurrent with "live" processing.

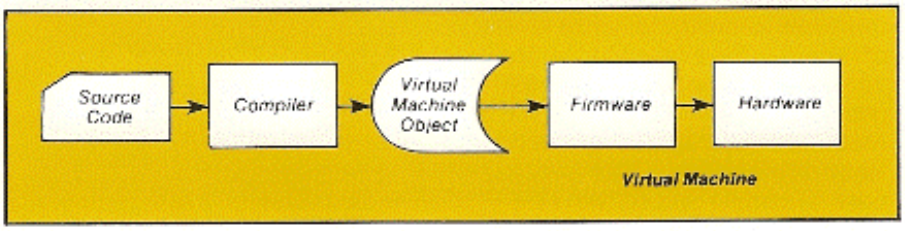
VIRTUAL MACHINES

One of the most significant characteristics of larger NCR 8000 Series systems is the ability to alter a machine's processing "personality" through programmable firmware. This ability makes it possible to tailor any system for optimum performance with a specific programming language. Compilers generate intermediate, object-level code that is interpreted directly and more efficiently by firmware (in most cases, one source code instruction translates to one object-level command). Therefore, programs compile and execute much faster than on conventional processors that are not language oriented. The result is less overhead, improved throughput, and better utilization of existing resources.

NCR V-8555M virtual machine options include:

- The basic VRX virtual machine, which provides direct migration for NCR Century and N-mode 8000 Series applications
- A COBOL virtual machine for ANSI COBOL '74 applications. In a multiprogramming environment, VRX and COBOL '74 programs, or modules within a program, can operate on individual virtual machines under VRX. Thus, jobs can be programmed to run on the virtual machine that provides the optimum performance characteristics to meet specific job requirements. Object modules are bound together by the VRX Link editor to create the load module used during execution. In the execution stage, virtual machine switching is managed by a firmware overseer, which handles all transfers and returns, and stores all necessary control and status information.

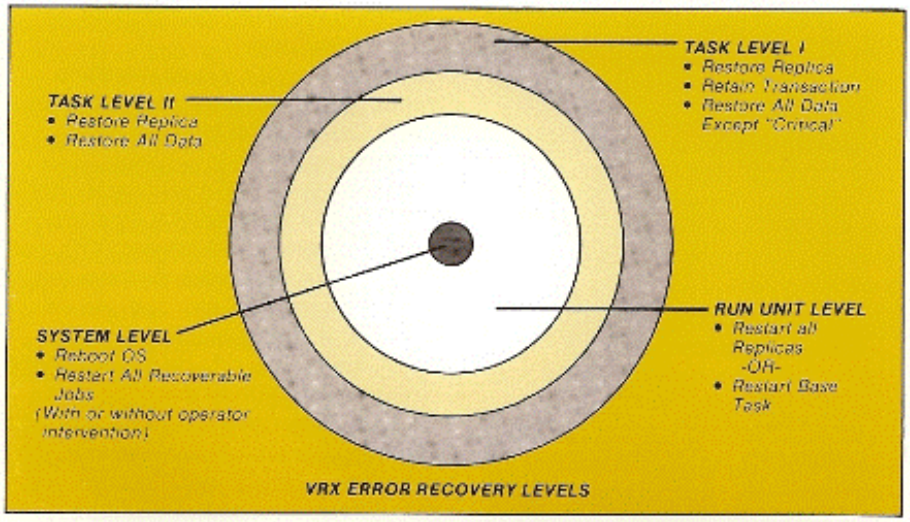




PROCESSING ENVIRONMENT

VRX provides application designers and programmers with an environment in which a large system can be easily segmented into a set of small, logical units. Each unit can be designed, coded, and implemented completely independent of every other unit. Addition or deletion of a unit will have no effect on any other unit. Each unit has complete memory and file protection, is independently recoverable, and can be initiated, run, and terminated independently and dynamically. Units can communicate with each other, when necessary, through a separate (i.e., not embedded in any unit) communication facility.

VRX will accommodate user-written re-entrant modules and also provide a parallel multi-tasking capability for COBOL programs. Parallel multitasking permits the replication of individual application units and the asynchronous execution of replicas. This facility allows each unit to use available processor power most effectively, ensuring optimum processor utilization under all circumstances. Replicas will execute completely independent of one another, and application programmers can write programs as if they were to perform a single task. If data is to be shared among replicas, the only additional programming effort is the inclusion of a few statements and data declarations.



ERROR RECOVERY

It is imperative that large, real-time systems be generally insensitive to errors. VRX provides multiple levels of error recovery to support transaction processing environments. Errors will not cause programs to terminate until all applicable levels of recovery have failed to restore normal operation, and insofar as possible, the effects of errors will be restricted to a single transaction. Recovery facilities, which encompass hardware- and software-detected user errors as well as errors due to system hardware, firmware, or software, have been designed to ensure system availability, prevent undetected data loss, and allow applications to resume operation without manual intervention. Basically, three entities are addressed in the error-recovery scheme: the task, the run unit, and the system.

Task-level recovery is applicable to COBOL programs running in parallel multitasking environments (i.e., programs using multiple replicas of the same task, each performing the same function simultaneously), and consists of two levels of recovery. The first level attempts to restore the replica in which the error occurred to normal operation, while allowing the user to retain knowledge of the transaction being processed at the time of the error.

The second level of task recovery is initiated in response to failure of the first level. It, too, attempts to restore the task to normal operation.

A run unit is a single program or several programs that have been link edited together. The purpose of run-unit recovery is to restore to normal operation any run unit that fails either because of task-level recovery failure or actual component failure in those run units to which task recovery is not applicable.

System level recovery allows the user to recover quickly from software malfunctions, requiring operator intervention only as a last resort.

FILE MANAGEMENT

NCR V-8555M systems employ a file management technique called Criterion Access Method (CAM), which has been specifically designed for high performance. The CAM file structure minimizes the need for file reorganization and allows rapid insertion of records. It eliminates most of the inefficiencies inherent in traditional random and indexed sequential access methods by incorporating several unique concepts in file layout.

- Indexes are integrated into the file, to avoid time-consuming hardware seeks between index and data block reading.
- CAM files have no overflow area in the traditional sense. Instead, during file creation, empty blocks are set aside in each cylinder, and empty cylinders are set aside within each file.

This technique eliminates overflow problems and considerably reduces the frequency with which files must be reorganized. CAM employs a block chaining method for logical data block sequencing. This allows software to access data sequentially without referring to 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.

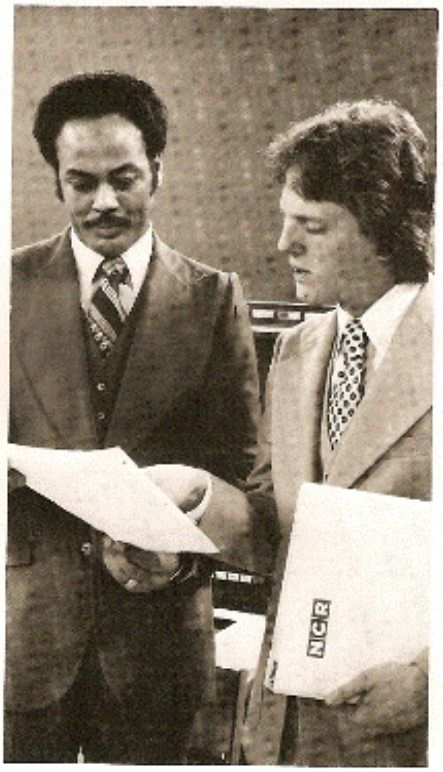
CAM structure is complemented by a high-level user programming interface for file and record manipulation, and largely automatic file maintenance, data protection, and recovery capabilities. The access method meets all COBOL '74 requirements for indexed, sequential, and relative file processing.

ONLINE PROGRAM DEVELOPMENT

NCR V-8555M systems include facilities for online, interactive program development, testing, and debugging to run concurrent with normal operations. Programmers can create, modify, and run programs through remote terminals, eliminating many time-consuming steps. Programs are entered directly into the system, as a job running in a multiprogramming environment, and can pass through the test and debug cycles without interferring with regular systems operations. Development tools allow the programmer to:

- Create, edit, copy, and renumber source files on disk for all supported languages
- Send messages to the system operator or other terminal operators
- Create and edit job control files
- Submit job control files to the operating system to create new jobs
- List and delete files using keyword references
- Create compilation job control files
- Interface with any job having the appropriate response mechanism
- Inquire into a job's status
- Call for a display of spooled output from any job where this is permitted
- Scan spooled output for a specified character string
- Perform such text editing functions as exchanging one character string for another wherever it occurs in a source file, with one command, or copy data from one source file to another, rearranging it where necessary.

Systems feature special error recovery logic for interactive program development to ensure that hardware or software failures normally result only in loss of the last change made to a source file.



Data Base Management

As computer systems are used to control larger amounts of data, traditional file management methods must cope with ever-growing diversification, more complex interrelationships, higher frequency of accesses, and increasing vulnerability to external influences. Data is also used in a more sophisticated manner for multiple purposes by multiple users, who require increasingly shorter response times. In such an environment, conventional mechanisms, which handle data on a file-by-file basis, do not meet the needs for a total management information system. Instead, information must be centralized and organized on an integrated, non-redundant basis that allows creation, maintenance, and association of a virtually unlimited number of data sets. Such an organization becomes a data base, and the mechanism for its implementation, maintenance, and operation is a data base management system. Larger NCR general-purpose systems, like the V-8500 family, offer the user a comprehensive data base management system called NCR TOTAL, one of the most widely and successfully used systems in the industry.

In the UK, NCR TOTAL is marketed and supported by CINCOM Systems Limited in conjunction with NCR.

DATA BASE ORGANIZATION

A TOTAL data base consists of two types of file sets, master and variable. Master data sets can be completely independent, with contents (logical records) directly accessible through control keys. Variable data sets are dependent upon and attached to master data sets, through which they are accessed. A master set can have multiple variable sets attached to it, and a variable set can be attached to multiple master sets. This approach allows groups of data sets to be associated into a network that is defined, described, and maintained completely independent of applications. Thus the data base is free to evolve through the addition of new records, new data sets, or new relationships among data sets without impacting existing programs. Data is related by associations that are defined only as needed. Access paths are stored within data records, eliminating the need for separate cross-reference or linkage files. Key (master record) information can be accessed directly, and through it, associated (variable record) information can also be accessed directly, so redundant data can be eliminated. When multiple associations exist, the same data can be accessed through many different paths, allowing direct mapping of logical entities to and from physical storage devices to take advantage of direct access characteristics for higher performance.

MANAGEMENT

The network of data sets is defined, described, and maintained as a unit, separate from application programs, by the NCR TOTAL DBMS. Each application task works only with the portion of the data base it needs, providing the operations and selection criteria, while TOTAL handles all accesses and data transfers. Keeping definition, description, and control of the data base within the management system provides the user with certain inherent advantages:

- **Operating Environment Independence** — TOTAL can run with online or batch jobs in a dedicated or multiprogramming environment, under any host programming language and using any physical storage device the operating system will accommodate.

- **Application Independence** — TOTAL provides its own Data Base Definition Language to define data and its associations, so there is no need to change existing application programs every time the data base is modified or expanded. Conversely, the data base is accessed and manipulated through CALL commands from the application programs, using an independent Data Management Language, so there is no need to change existing data base definitions every time application programs are added or modified.

- **User Orientation** — Users are concerned only with logical entities during data access; physical (hardware and software) entities are transparent. Both the Data Base Definition Language and the Data Base Management Language are in a readable, key-phrase format that approximates natural language and syntax. Multi-level logical element definitions within a data record are permissible, and a data element at any level can be independently addressed.

- **Implementation Ease** — TOTAL provides a standard data access method and a standard discipline for designing and programming applications. Comprehensive diagnostic messages aid debugging during data base and program preparation. The data base organization, once established, is just as effective for large, complex data bases as for small, simple ones, making the data base portable and open-ended, to accommodate modification and growth.

- **Resource Economy** — Considerable effort went into designing a data base management system that would optimize use of computing time, main and secondary storage facilities, and I/O channels. TOTAL data base network structures eliminate the need for redundant copies of data, indexes, and overflow areas. Deleted records' space is immediately reusable without requiring record reorganization. Associated records tend to be placed in close physical proximity to reduce access times. I/O buffers can be unique to a given data set or shared by multiple data sets to conserve core buffer requirements. During information retrieval, a block of records is brought to main storage and written back to the data base only if it has been modified and the DBMS has determined that it does not contain the next requested record. Since the probability of processing contiguous records in a given sequence is high, this scheme effectively reduces the number of physical accesses.

Telecommunications

NCR V-8500M hardware and software architecture provides all the facilities necessary to support fully integrated telecommunications processing. Systems can function in a dedicated, transaction-driven mode, in a multiprogramming mode that includes batch applications running concurrent with the online system, or as host processors in an NCR Data Transporting Network.

TELECOMMUNICATIONS HARDWARE

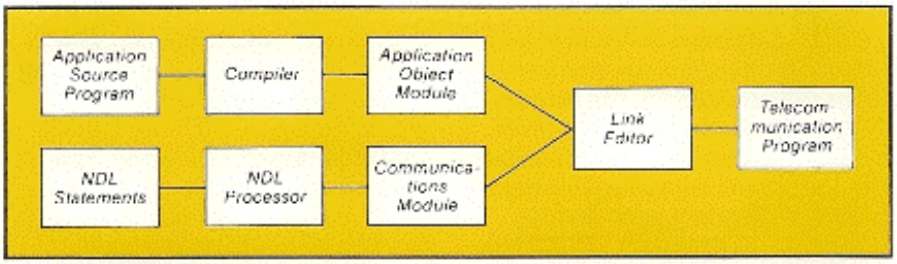
NCR telecommunications hardware includes adapters, multiplexers, integrated and free-standing data sets, and communication processors that can be configured to handle any online, real-time network requirements.

Multiplexers are self-contained units that supervise communications I/O. They control up to 253 adapters each. Centralized control functions include character parity checking, transmission control character detection, message checking, and termination queuing. This eliminates the need to duplicate them in individual adapters and reduces software overhead.

Systems can also be configured with an optional integrated communications subsystem that handles from 1 to 20 communication lines.

Communication processors are also available to handle all network control functions, so that telecommunications are transparent to host processors and application programs.

Systems with high reliability requirements can duplicate multiplexers or communications processors for backup. In this way, if one multiplexer or CP becomes inoperative, online processing can be resumed by switching adapter control to the other.



VRX TELECOMMUNICATIONS SOFTWARE

The VRX operating system supports multiple online, real-time user applications. In an online/batch multiprogramming mix, VRX balances tasks so that online operations monopolize system resources only during peak transmission periods, and batch applications are assigned the majority of resources during periods of low online activity, allowing online jobs to reside in virtual memory throughout the processing day, to be called up automatically as needed.

VRX telecommunications software has been designed to simplify the application programmer's task by freeing him from concern for network considerations and communication protocols. An easy-to-use high-level Message Control System allows online COBOL programs to transmit messages using logical source/destination names without reference to terminal characteristics. It employs only five verbs — SEND, RECEIVE, ENABLE, DISABLE, and ACCEPT (message count) — and message control queues, or lists that the verbs reference.

A Low-level Interface is available for those programmers who require closer control of activity on the communication link.

Both the Message Control System and the Low-level Interface interact with communications drivers that reside in telecommunications software and perform all physical communications with the terminals. The drivers:

- Maintain error and frequency tallies
- Provide data capture and error capture facilities
- Buffer message blocks
- Provide encode/decode facilities where required
- Handle retry and time-out conditions
- Perform message integrity checks

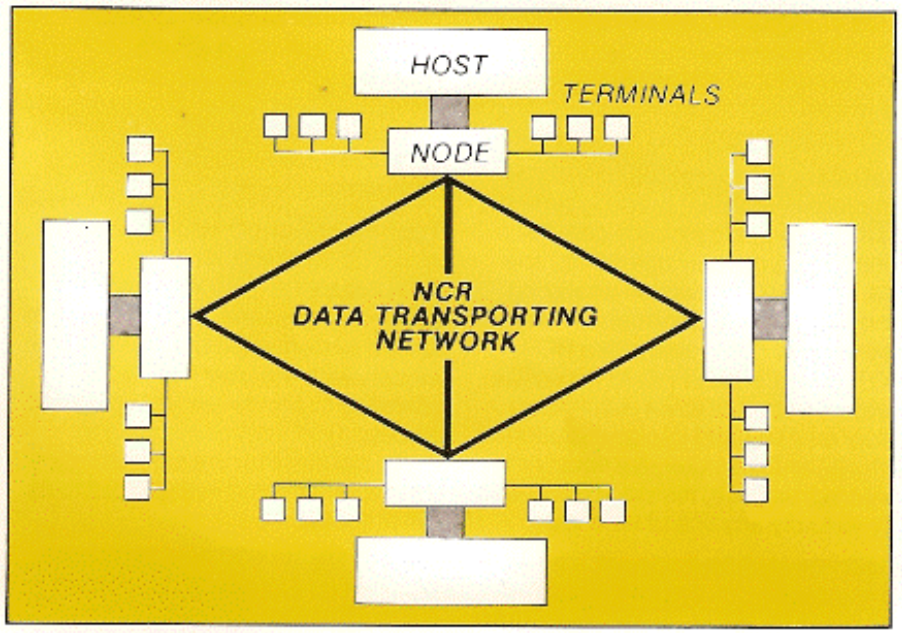
Where appropriate, communications drivers will perform all line discipline functions, including polling. Data is decoded where required, and a complete message block is passed to interfaces only if transmission has been error-free.

A Network Description Language and NDL Processor permit users to specify configurations at link-edit time, eliminating the need to "tailor" code to a specific network at compile time. NDL statements, which provide a simple, straightforward method of specifying terminals and links, are used by a Network Description Language Processor to create tables for online operation. Tables are subsequently combined with programs by a Link Editor.

NCR TRAN-PRO
(Transaction Processing System)

NCR VRX software contains all the elements necessary to design, implement, and maintain large, real-time transaction processing networks. The average user, however, will lack either the resources or the desire for such an undertaking.

For this reason, NCR has developed TRAN-PRO, a comprehensive system that handles all the procedural requirements involved in processing transactions through an online network. It allows systems analysts and programmers to concentrate exclusively on application design, without concern for communication disciplines, terminal characteristics, I/O processing, data formats, or even interfaces to the operating system and the data base. By effectively insulating the application programmer from procedural considerations, TRAN-PRO allows him to code small, discrete routines that process individual transaction types, and then "attach" these routines through standard interfaces. From that point on, TRAN-PRO, in conjunction with VRX, handles all procedures required to deliver transactions to and from processing, interface with the data base, recover or restart the system in the event of errors, and enforce security. Unlike many similar systems, TRAN-PRO has been designed to take full advantage of all the telecommunications features already built into the operating system (in this case, VRX). This means that the system can be implemented without having, in effect, to impose a second — communications-oriented — operating system on top of the base operating system, for a considerable saving in processor time and memory overhead.



NCR DISTRIBUTED NETWORK ARCHITECTURE

V-8500 hardware and software conform to NCR Distributed Network Architecture, which consolidates and unifies telecommunications processing across the entire NCR product line. The standardized structure of NCR/DNA permits all NCR products, and selected products from other vendors, to be interconnected regardless of internal architecture and ensures avenues for continued growth without interruption in service.

A typical NCR/DNA data transporting network comprises multiple host processing systems, each of which has its own terminals. Any application, whether it resides in a terminal or the host itself, is capable of accessing any other application in the network. Each node in the network is normally connected to at least two other nodes, to provide multiple message routing paths and alternate paths in the event of node or link failure. Since each node shares in the task of regulating and directing message flow, networks are not vulnerable to the failure of a single element, a major weakness in networks controlled by a single host processing system. Distributed control also allows the use of relatively small node processors and permits more efficient use of network capacity. The result is greater reliability, lower cost, and better performance.

Service and Support

NCR V-8500 systems are supported by a comprehensive array of products and services to ensure that the user receives a full return of performance and reliability from his investment.

Software Support includes highly efficient compilers, preprogrammed utility routines to simplify conversion and day-to-day operation, special software to assist in analyzing and fine-tuning performance, comprehensive subsystems like NCR TOTAL and TRAN-PRO to maximize system potential while minimizing programming and implementation efforts, and an extensive library of preprogrammed, tested applications for virtually any line of business.

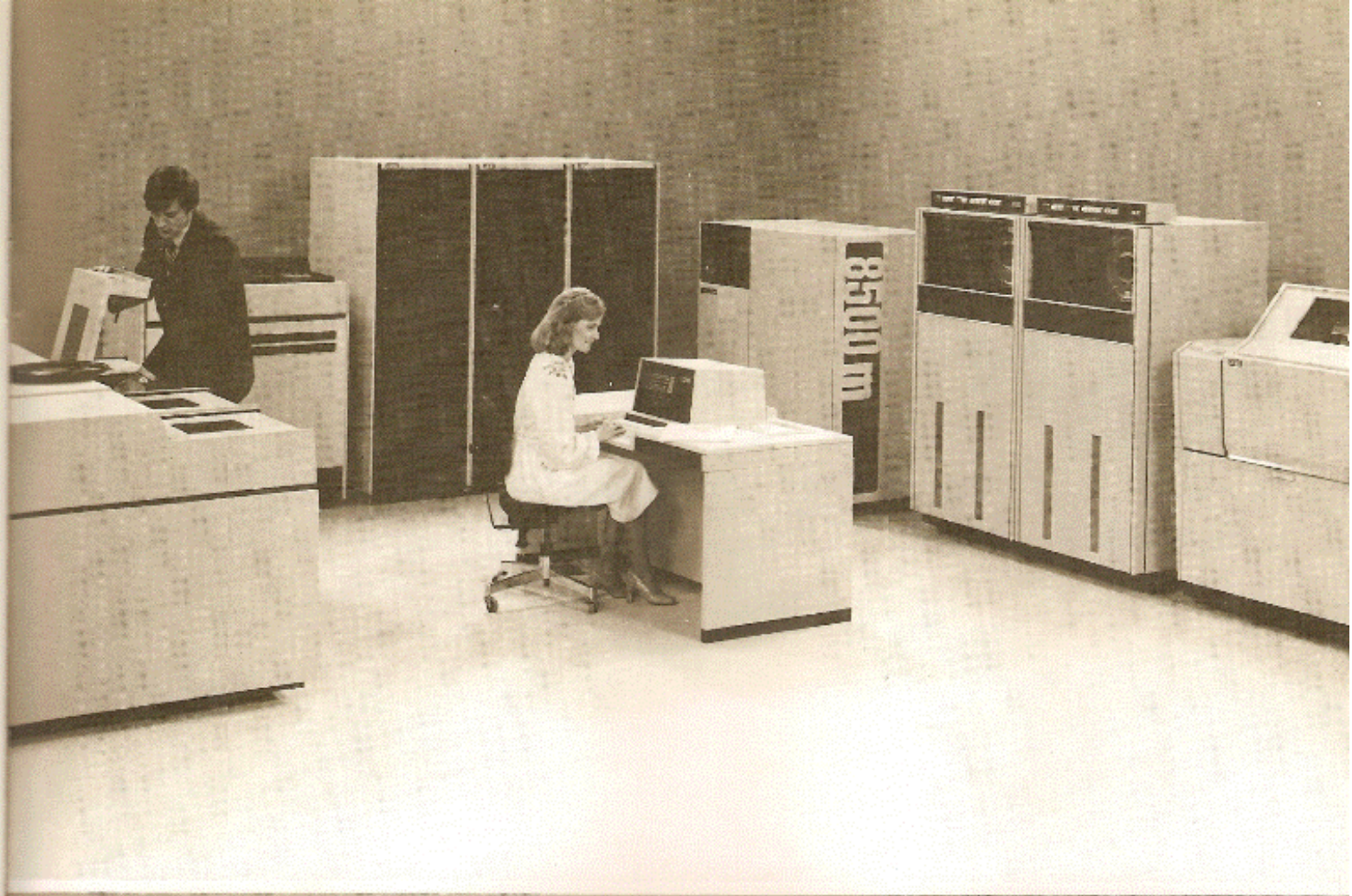
Documentation Support is an ongoing service that keeps NCR's comprehensive library of user reference manuals continually current through regular updates.

Educational Support provides whatever training customer management and personnel may require through strategically located education centers and convenient self-study courses employing the latest instructional technologies.

Technical Support puts the user in direct contact with experienced NCR personnel who will assist in every way possible. Teams of highly skilled systems specialists will work closely with the user from initial planning to pre-delivery staging and through final implementation to make certain that the system meets specifications and is exploited to its full potential.

Thoroughly trained field engineers, as close as the nearest telephone, will ensure that systems continue to deliver maximum performance and reliability following installation. Remote diagnostic features can put backup specialist teams in direct, online contact with systems, regardless of geographic location.

NCR V-8500M Systems represent the sum of nearly a century of experience in serving business around the world. Your local NCR representative is a dedicated professional who can show you that NCR can provide a total system solution to your information processing problems.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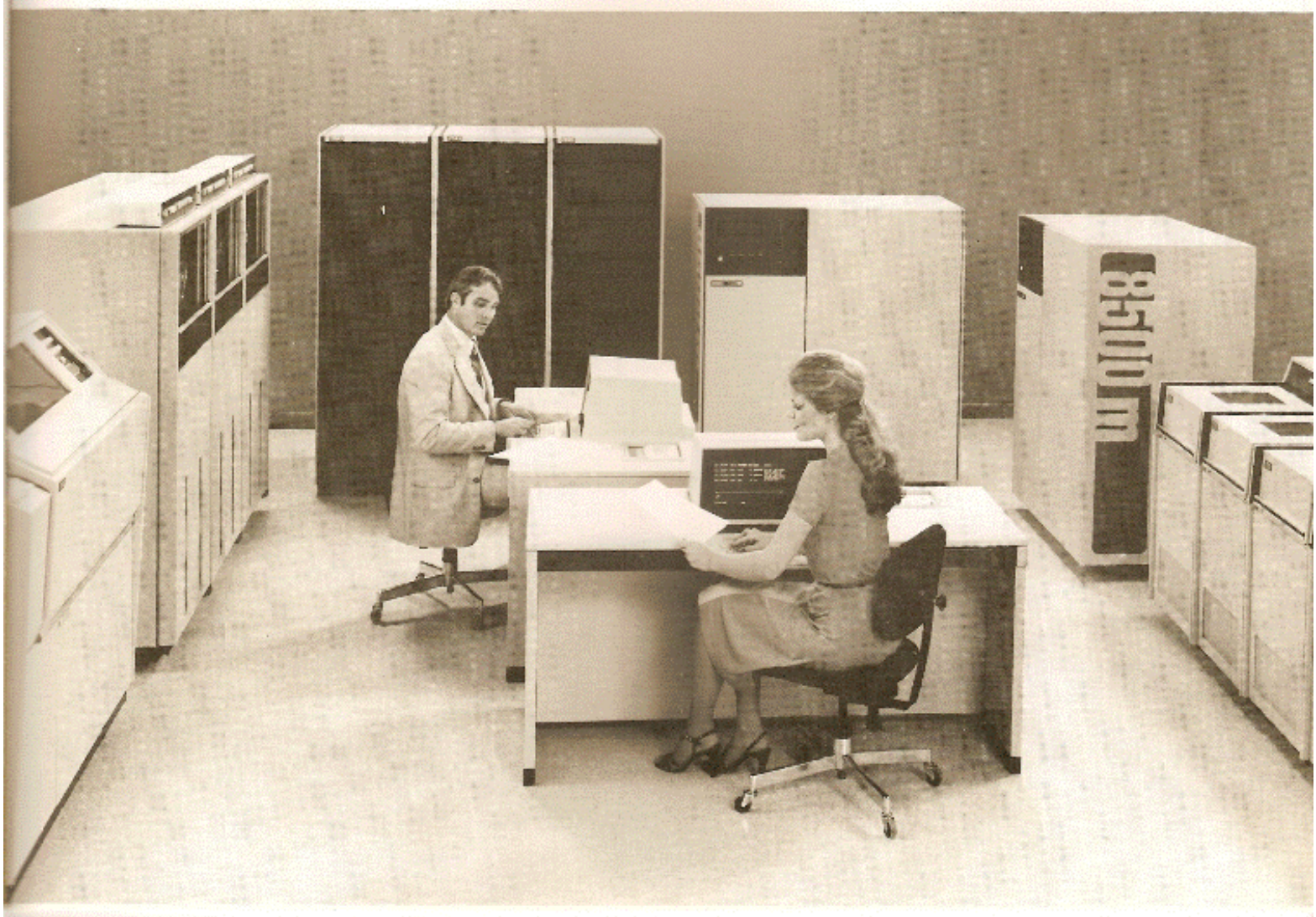
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In-depth Support

Many NCR specialists function as a professional team to assure the success of every installation. . .

NCR VOCATIONAL SPECIALISTS assist in planning, coordinating, and implementing your system.

NCR EDUCATION SPECIALISTS test and train your personnel.

NCR SOFTWARE SPECIALISTS continually enhance existing software.

NCR DOCUMENTATION SPECIALISTS provide a complete library of hardware and software reference manuals for ease of operation.

NCR FIELD ENGINEERING SPECIALISTS maintain and assure maximum efficiency of your hardware.

Thorough, ongoing training programs keep the skills of these specialists constantly updated. This highly skilled, worldwide group of professional men and women are trained and ready to serve you.

NCR

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