NCR 9800 Systems

MANAGEMENT SUMMARY

With its new 9800 Systems NCR has entered a fast expanding section of the data processing market, transaction processing and fault tolerance. The demand for transaction processing systems is estimated to grow by 35 percent annually. Airlines, travel agencies, banks, credit bureaus, brokerage houses, retailers, and the military are the primary users of transaction processing systems. To be truly reliable, a transaction processing system must have fault tolerance. The multiprocessing hardware of the 9800 Systems provide just such continuous on-line operation by detecting and automatically correcting any system fault, without interrupting operations.

The 9800 Systems are a radical departure from the previous V8500 and V8600 system architecture. The 9800 uses a modular, incremental architecture based on loosely coupled, multiple function-specific processors. A system contains at least two processors, one Application Processor and one Data Storage Processor, a dual-channel Interprocessor Bus, and related peripheral components all located in the same cabinet. The system can be expanded by adding new processors. Up to eight Application Processors and up to four Data Storage Processors may be combined for the high-end System 9884. The Application Processor manages low-speed peripherals and executes application programs. When two or more Application Processors are present in a system they are loosely coupled with each Application Processor using its own copy of the operating system software and running independently of the other Application Processors in the system. The Data Storage Processor controls input/output, data, and file management. Up to two strings of four fixed-disk drives can be attached and together with the I/O cache create a globally accessible repository of data called the system memory. All Application Processors and Data Storage Processors are intercon-

The NCR 9800 Systems are medium-scale computer systems for commercial data processing. The modular 9800 Systems consist of a series of function-specific processors. The incremental architecture is designed for on-line, high-volume transaction processing.

MODELS: 9811, 9821, 9822, 9832, 9842, 9863, 9884.
CONFIGURATION: The NCR 9800 Systems are available in seven different configurations. Depending on the model, a system can contain from one to eight application processors and one to four data storage processors. The application processor and storage processor each have from two to four megabytes of memory, up to a total of 48 megabytes.
COMPETITION: Burroughs A 3, A 5; Digital Equipment Corporation 8200, 8300; IBM 4300.
PRICE: Basic system prices range from $41,220 for the two-processor Model 9811 to $340,580 for the 12-processor Model 9884.

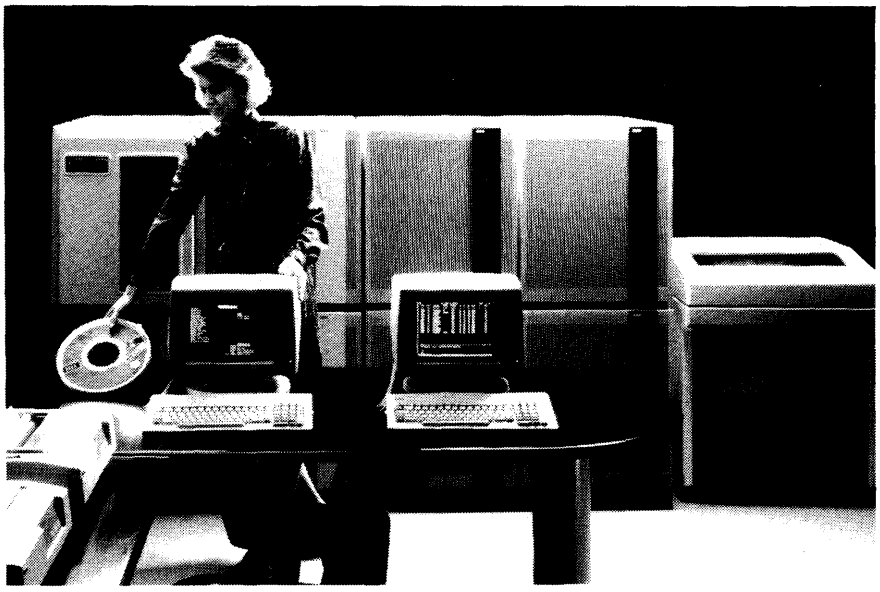
CHARACTERISTICS

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

MODELS: NCR 9811, 9821, 9832, 9842, 9863, 9884.

DATA FORMATS

BASIC UNIT: 32-bit word plus 7 error-correcting bits.



The NCR 9800 is an on-line transaction processing system, based on multiple function-specific processors. The 9842 model is a mid-range configuration consisting of four application processors and two data storage processors. Each processor can contain up to 4 megabytes of memory.

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TABLE 1. SYSTEM COMPARISON

MODEL	9811	9821	9822	9832
SYSTEM CHARACTERISTICS				
Date announced	April 1986	April 1986	April 1986	April 1986
Date first delivered	Third quarter 1986	Third quarter 1986	Third quarter 1986	Third quarter 198
Field upgradable to	9821	9822	9832	9842
Relative performance	—	—	—	—
Number of processors	1 AP, 1 DSP	2 APs, 1 DSP	2 APs, 2 DSPs	3 APs, 2 DSPs
Cycle time, nanoseconds	150	150	150	150
Word size, bits	32	32	32	32
Operating systems	VRX/E	VRX/E	VRX/E	VRX/E
MAIN MEMORY				
Type	64K IC	64K IC	64K IC	64K IC
Minimum capacity, bytes	4MB	6MB	8MB	10MB
Maximum capacity, bytes	8MB	12MB	16MB	20MB
Increment size, bytes	2MB	2MB	2MB	2MB
Cycle time, nanoseconds	120 AP, 150 DSP	120 AP, 150 DSP	120 AP, 150 DSP	120 AP, 150 DSP
BUFFER STORAGE				
Minimum capacity	1MB DSP	1MB DSP	2MB DSP	2MB DSP
Maximum capacity	3MB	3MB	6MB	6MB
Increment size	—	—	—	—
INPUT/OUTPUT CONTROL				
Number of channels:				
Byte multiplexer	—	—	—	—
Block multiplexer	—	—	—	—
Word	—	—	—	—
Other	4	8	12	16

nected over the dual-channel Interprocessor Bus with an individual channel transfer speed of 3 megabytes per second. Each Interprocessor Bus channel is implemented as a star, with two Interprocessor Buses and Star Couplers in all 9800 models. Traffic is normally shared by the two Interprocessor Buses, but in the event of the failure of one bus, all Application Processors and Data Storage Processors can communicate over the remaining Interprocessor Bus.

Multiple processor architecture results in a system that is inherently fault tolerant, assuring a high availability of all computerized functions for business operations. Since fault tolerance is achieved with all system components actively contributing to processing the work load, no part of the system waits unproductively to provide backup in the event of component failure. To further ensure high system availability, the new feature "file mirroring" assures that operation of critical applications can continue despite disk or Data Storage Processor failures. The system automatically maintains exact copies of selected files.

A single console is used to control the entire system, regardless of the configuration size. On-line or batch applications are automatically routed to the proper processor element. The system operator can at any time communicate with individual processors to inquire about running jobs and receive messages from all system components. Two consoles are included on all fault-tolerant systems.

COMPETITIVE POSITION

The 9800 Systems will compete with the A 3 and A 5 systems from Burroughs in the banking and medical fields where both vendors have traditional strongholds. NCR gives a power range of 0.6 to 4.0 batch processing MIPS (Millions of Instructions per Second) or 1.0 to 8.0 transaction MIPS, depending on the number of processors in each

FIXED-POINT OPERANDS: Can range from 1 to 256 bytes in length in either decimal of binary mode.

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: 16 or 32 bits in length, specifying one or two memory addresses, respectively.

INTERNAL CODE: EBCDIC(Extended Binary-Coded Decimal Interchange Code.

MAIN MEMORY

The Application Processor (AP) and the Data Storage Processor (DSP) each contain from one to two memory boards. Each memory board provides two megabytes of memory for a maximum memory capacity of eight megabytes. Memory access time on a 32-bit boundary is 360 nanoseconds for the AP and 450 nanoseconds for the DSP.

STORAGE TYPE: 64K-bit RAM Integrated Circuit (IC) packs.

CAPACITY: 2 to 48 megabytes. See Table 1 for capacities of individual models.

CYCLE TIME: 120 nanoseconds (AP), 150 nanoseconds (DSP).

CHECKING: The Address Translation Chip performs error checking and error correction.

RESERVED STORAGE: Information not supplied by vendor.

CENTRAL PROCESSORS

The 9800 System architecture consists of multiple, loosely coupled Application Processors and Data Storage Processors. They are interconnected in a network by a dual-channel interprocessor bus subsystem. The computer system size may vary from small-, with one Application Processor (AP) and one Data Storage Processor (DSP), to large-scale, with eight Application Processors and four Data Storage Processors.

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TABLE 1. SYSTEM COMPARISON

MODEL	9842	9863	9884
SYSTEM CHARACTERISTICS			
Date announced	April 1986	April 1986	April 1986
Date first delivered	Third quarter 1986	Third quarter 1986	Third quarter 1986
Field upgradable to	9863	9884	—
Relative performance	—	—	—
Number of processors	4 APs, 2 DSPs	6 APs, 3 DSPs	8 APs, 4 DSPs
Cycle time, nanoseconds	150	150	150
Word size, bits	32	32	32
Operating systems	VRX/E	VRX/E	VRX/E
MAIN MEMORY			
Type	64K IC	64K IC	64K IC
Minimum capacity, bytes	12MB	18MB	24MB
Maximum capacity, bytes	24MB	36MB	48MB
Increment size, increment	2MB	2MB	2MB
Cycle time, nanoseconds	120 AP, 150 DSP	120 AP, 150 DSP	120 AP, 150 DSP
BUFFER STORAGE			
Minimum capacity	2MB DSP	3MB DSP	4MB DSP
Maximum capacity	6MB	9MB	12MB
Increment size	—	—	—
INPUT/OUTPUT CONTROL			
Number of channels:			
Byte multiplexer	—	—	—
Block multiplexer	—	—	—
Word	—	—	—
Other	8	12	16

configuration. Estimated batch MIPS ratings for the A 3 are 0.6 to 0.9, and 1.6 for the A 5.

As usual, IBM is present in all market sectors, and the 9800 Systems will have the IBM 4300 as a competitor. The main memory capacity of the IBM 4300 ranges from 2 to 32 megabytes, compared to the maximum 48 megabytes of memory for the 9800. And only the 4381 dual-processor systems use multiprocessing with shared storage. Batch MIPS ratings for the 4361 range from 0.3 to 1.1.

The new 8200 and 8300 systems from Digital Equipment have a main memory ranging from 4 to 24 megabytes and are designed for general-purpose business applications. The 8300 system has an estimated batch MIPS rating of 1.9. The 8200 system, with a 4-megabyte memory, is priced at $79,000. The 9811 model, with a 4-megabyte memory, costs $41,220. NCR definitely has the price advantage here.

Because of the multiprocessing hardware and software support of several fault-tolerant features, the 9800 system will face competition with the fault-tolerant vendors. Tandem with its NonStop systems owns the largest slice of the fault tolerant pie, with Stratus and its OEM partner, IBM, a distant second.

ADVANTAGES & RESTRICTIONS

The 9800 Systems are compatible on the object level with the V8500 and V8600 Systems. Current file structures from the V8000 systems can be transferred to the 9800 Systems by using Virtual Volumes, a migration device provided by the system software. The upward-compatible and highly configurable 9800 system will provide an attractive migration path for V8500 and V8600 users, offering a more attractive price/performance factor than these current sys-

The Application Processor is the main transaction processor for the 9800 System. The AP uses microcode for instruction execution, internal interrupt handling, and unit I/O operations from both the Interprocessor Bus and peripherals, including the system console. The AP supports all system I/O peripherals other than the disks and magnetic tapes containing system memory.

The Application Processor consists of the following components: the Processor Element (PE) Board, the System Bus Adapter/Star Coupler Board, the Writable Control Store Board, the Trace Board, the No-Match Assist Board, and the Memory Boards. The Processor Element (PE) Board contains a 32-bit processor-to-memory bus, maintenance registers, related logic circuits, and a 155-nanosecond VLSI chip set with five different chip types. The Central Processor Chip (CPC) performs the microcode instructions supporting the operating system and all input/output (I/O) with a three-stage pipeline of access, interpret, and execute. The CPC includes the necessary register storage units, jump registers, and on-chip external register units. The NEAT Assist Chip (NAC) contains the 15 most commonly used NEAT index registers and instruction-related logic to perform 29 of the NEAT/VS object instructions. The Address Translation Chip (ATC) performs all of the virtual and real memory operations, including memory refreshing, error checking and correction. The Extended Arithmetic Chip (EAC) performs most of the arithmetic calculations for the CPC, returning the results through the processor-to-memory bus. The System Interface Chip (SIC) provides the controller interface between the processor and all external I/O. The SIC is programmable to operate in either the interprocessor bus mode or the bit-serial mode.

The System Bus Adapter/Star Coupler Board is mounted one the PE Board. The System Bus Adapter provides the circuits to transmit and receive the interprocessor communications. The Star Coupler circuitry receives, repowers, and retransmits these messages to all the processors on the bus. The Writable Control Store Board is also mounted on the PE Board; it contains 128K-bit RAM memory and stores the firmware microcode as an instruction storage unit. A 16K-bit PROM memory provides the initial power-on load boot and level 0 diagnostics firmware. The Trace Board is an optional feature to be mounted on the PE Board to provide firmware control register tracing for unit servicing. The No-Match Assist Board operates in conjunction with the ATC to service the dynamic address translation, 16-entry associative memory register.

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tems. Fault tolerance, dynamic load balancing, and the VRX/E operating system, including an IBM SQL/DS-compatible relational data base, might tempt the current user base to migrate to the new system. The VRX/E operating system retains the strong batch processing capabilities of the VRX operating system, and the VRX/E Cobol compiler can be used in either interactive or batch mode.

A disadvantage of the 9800 System is its small, 8-megabyte memory address space. According to the vendor, this problem will be remedied when the 256K-bit RAM memory packs become available. Local memory capacity will be expanded to offer 2- to 16-megabyte options. The 9800 System's speed also needs improvement; system throughput approximately equals the performance of an V8555 II.

USER REACTION

The first customer shipments of the 9800 Systems did not take place until the third quarter of 1986, therefore no user ratings are available. At the 1986 NUCON (NCR Users Conference) in Phoenix NCR users seemed impressed with the new 9800 System and gave it a favorable rating. □

The Memory Boards are described in the Main Memory section of this report.

The Data Storage Processor hardware construction is similar to that of the Application Processor and contains the same components. Exceptions are the addition of a Time-of-Day (TOD) clock circuit with battery backup, in place of the Star Coupler circuit on the System Bus Adapter, and the absence of the No-Match Assist Board and the EAC chip. The DSP also contains an LLCS Control Module Board with two Console Line Modules and four terminal lines operating as a Console Interface Board to accommodate the system console and printer.

The DSP is the data file controller processor for system memory. It can support one or two bit-serial disk controllers with up to four fixed disk drives each for program library and data file storage. The data storage processor firmware runs object instructions, maintains the various task tables, provides call/return routines, services internal and external I/O interrupts including those of the interprocessor bus, and provides a unit interval timer facility and system time-of-day (TOD) clock. Under software control, the DSP maintains file queues and locks, as well as one- or three-megabyte cache memory for temporary file storage in local memory. The data storage processor performs all memory addressing in realtime, with the majority of the operating system residing in that portion of local memory not dedicated to the cache. Overlays are called from disk virtual memory to provide software for exception conditions.

The Interprocessor Bus subsystem (IB) provides intelligent intersystem communications between processors through a dual-channel serial connection with broadcast capabilities. Each channel of the Interprocessor Bus subsystem, channel A and channel B, operates independently of the other. Both carry high-speed, bit-serial data between the various units of the system, operating in the full-duplex mode. The Interprocessor Bus subsystem is composed of two full-duplex, twisted-pair cables to each processor; one or two electrical Star Coupler boards, each housed in separate Application Processors; and a system bus adapter board with I/O controller microcode and object code. A 6-megabyte bandwidth is achieved for the dual-channel bus through an individual channel transfer rate of 3 megabytes per second, transmitting at 24 megahertz.

SPECIAL FEATURES: The 9800 System departs from past NCR mainframe designs by using a modular, multiple-processor-based, incremental architecture which offers system expansion by simply adding extra processors; up to eight APs and four DSPs can be configured. The combination of multiple Application and Data Storage Processors, the dual-channel Interprocessor Bus network, and the VRX/E operating system provide a system tolerant of single-point failures. Operational problems with either a channel of the bus or one of the processors in the network will not cause a system failure; production will continue in a degraded mode using the remaining resources.

PHYSICAL SPECIFICATIONS: The 9800 System's single cabinet containing two processors measures 29.3 inches in height, 22 inches in width, and 34.5 inches in depth, the weight is 200 pounds. The processor power supplies require a voltage of 120 to 125 VAC or 220 to 240 VAC at 50 to 60 hertz. A power loss of 100 milliseconds can be sustained. A computer room temperature range of 59 to 90 degrees Fahrenheit with a relative humidity of 30 to 60 percent is acceptable.

CONFIGURATION RULES

The basic 9811 System consists of one Application Processor with up to four megabytes of memory, one Data Storage Processor with up to four megabytes of memory, up to three megabytes of cache, one console display terminal with keyboard, one console table, five cables, and two cabinets to accommodate future expansion. The 9811 System can be field-upgraded to a 9821 System. System upgrades are accomplished with the addition of extra processors.

The high-end 9884 System consists of eight Application Processors with up to 32 megabytes of memory, four Data Storage Processors with up to 16 megabytes of memory, up to 12 megabytes of cache, two console display terminals with keyboards, two console tables, 26 cables, and eight cabinets.

Peripheral and communications devices are not included in the 9800 Systems package, but have to be added before the system becomes operational. A minimum of one printer, one GCR tape drive, and one 279.3-megabyte disk drive are required.

INPUT/OUTPUT CONTROL

The input/output functions are handled by the Processor Element Board, a component of both the Application Processor and the Data Storage Processor. Three System Interface Chips (SICs) are mounted on the PE Board; one SIC is dedicated to high-speed, input/output multiplexing up to eight bit-serial links operating at up to 16 megabits per second. The second SIC multiplexes up to six low-speed I/O links operating at one megabit per second. The third SIC multiplexes the two Interprocessor Bus channels operating at 24 megabits per second. Bit-serial type peripheral devices directly attached to each AP include disks, printers, magnetic tapes, integrated communications (LLCS), and communication front-end processors. Peripheral sharing between APs is accomplished through the use of 6280 Electronic Switch units. The DSP can support one or two bit-serial disk controllers with up to four fixed disk drives each. Also supported are the magnetic tape drives used during system installation.

MASS STORAGE

For disk storage devices qualified on the 9800 Systems, see Table 2.

INPUT/OUTPUT UNITS

Tape drives and printers are covered in Table 3.

TERMINALS

The 9800 Systems support numerous general-purpose and special-purpose terminals; for more information refer to Table 4.

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TABLE 2. MASS STORAGE

MODEL	6099-5103	6099-5203	6099-5403	6540
Cabinets per subsystem	1	1	1	1
Disk packs/HDAs per cabinet	1	2	4	2
Capacity	415.2MB	830.4MB	1.6GB	135MB
Tracks/segments per drive unit	—	—	—	—
Average seek time, msec.	20	20	20	21.7
Average access time, msec.	28.3	28.3	28.3	30
Average rotational delay, msec.	8.3	8.3	8.3	8.3
Data transfer rate	1.8MB	1.8MB	1.8MB	1.2MB
Controller model	Included	Included	Included	—
Comments				

COMMUNICATIONS

The *Link Level Communications Subsystem (LLCS)* is the integrated communications controller for the 9800 Systems. A single link-level communications subsystem can support up to 18 lines of NCR ISO Async, Bisync, or Data Link Control (DLC) lines, or up to 36 lines for teletype (TTY)-compatible terminals. These lines are interfaced to a single, low-speed bit-serial, one-megabit serial line from the processor. The LLCS connects to an Application Processor through a low-speed link, and handles an aggregate transmission rate of 120K bytes for all its lines. The link-level communications subsystem is housed in a communications module, and consists of up to two subsystem control modules, 18 individual line interface boards, and its own power supply and cooling fan.

The link-level communications subsystem includes five line module types and two features, including the console line module, the Base Mode Communications (BMC) line module, the DLC common carrier secondary line module, the teletype (TTY) line module, the X.25 line module, the backup interface feature, and the line status display feature.

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

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

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

The *3690 Communications Processor* is a large-scale processor for complex and demanding networks. It can support up to 512 duplex communications lines for up to eight channel-attached processors in a local or remote configuration.

SOFTWARE

OPERATING SYSTEM: The *Virtual Resource Executive/Extended (VRX/E)* operating system supports object code compatibility from the V-8500 and V-8600 Systems. It maintains the same process and management disciplines as in the VRX. The VRX/E supports interactive and batch processing in a multiprocessing, multiprogramming environment. The VRX/E software automatically allocates virtual and actual memory depending on the requirements of each job. Errors are detected and automatic recovery is at the job level and at the system level. Several other levels of error recovery designed for specific applications include the use of CAM (Criterion Access Method) routines, and own-code intervention to recover NEATVS jobs and save telecommunications tables. During system operations, the VRX/E operating system performs a number of tasks either automatically or in response to user direction. The VRX/E *File Catalog* serves as a central directory for all cataloged disk files in the system in either the interactive or batch mode. *File Interleaving* allows selected files to be split across multiple DSPs by the system, making more cache memory available to a given file and reducing I/O time. *File Sharing* permits most files to be accessed by more than one job at the same time. With the *Mirror File* feature, users can elect to duplicate certain critical files, and the software will keep a copy of the file physically separate from the original file to prevent the DSP or controller from denying access to the file in case of drive failure. *Job Scheduling* is accomplished automatically by the software, depending on their assigned priority and the peripheral and memory available.

The *Inter-Host Management Facility (IHMF)* is a group of software modules controlling all the interhost activities of a loosely-coupled multiprocessor system. The two major capabilities provided by IHMF are *Shared System Storage*, permitting files stored on disk units connected to a DSP to be shared among the APs of the system, and *Instant Ready Operations*, which allows for duplicate application programs to be written to configure a mutual backup system. If either the active application or the Application Processor in which it is running fails, the duplicate *Instant Ready* application can automatically assume the processing responsibilities.

PROGRAMMING LANGUAGES: The high-level languages for the development of application programs supported by the 9800 System are VRX/E Cobol, NEATVS, C, and IVS Basic.

DATA BASE MANAGEMENT: The *NCR-Total* data base management system is a licensed software product running under the VRX/E operating system and is available in two versions. *Total Basic* is single-threaded, with a copy of Total bound to each active task. *Total Central* is multithreaded and is located in its own job region. The structured *Data Base Definition Language* provides for the initial generation of a Total data base descriptor module, and all subsequent modifications. The *Data Management Language* interfaces to the operating system and the application program for all communications with the Total data base. *File Sharing* under Total Basic uses file locks when an update to a data set is to occur. Total Central uses a combination of file sharing options and a record-locking facility to protect files to be updated. The Total *Logging Facilities* consist of Before-Image Logging, After-Image Logging (Total Central only), and a User-Written Logging Routine with two optional log commands, Mark-Log and Log-Quiet. The Total Basic Recovery System is parameter driven and identifies the data base and the data sets to be recovered. The Total Central Recovery System serves as a log file utility program and performs three different support functions, Log File Clear, Log File Report, and Log File Print. Before-Image Processing and After-Image Processing functions are also supported.

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

The *DMS/Directory* is an integrated dictionary/directory that simplifies documentation and control of data bases, files, records, data elements, software, hardware, and networks. *DMS/Logical View* is a relational interface to data base files providing both a high-level view of data and independence of data files and data bases. The on-line inquiry and reporting tool *DMS/Query* is

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TABLE 3. INPUT/OUTPUT UNITS

Magnetic Tape Units	Number of Tracks	Recording Density, Bits/Inch	Encoding	Tape Speed, Inches/Sec.	Transfer Rate, Bytes/Sec.
6370	9	1600	PE	200	120K to 320K
6370	9	6250	GCR	75, 125	469K to 1.25M
6373	9	1600	PE	75	120K
6373	9	6250	GCR	25, 75	469K
6376	9	1600	PE	200	320K
6376	9	6250	GCR	200	1.25M

Printers	Printing Speed	Print Positions	Horizontal Spacing, Chars./Inch	Vertical Spacing, Lines/Inch	Form Size, Inches
6420	1130 lpm	132	10	6 or 8	Industry std.
6411	120 cps	80	10	6 or 8	8½ x 11
6471	2000 lpm	132	10	6 or 8	Industry std.
6455	33 cps	—	10	6 or 8	8½ x 11
6430	720 lpm	132	10	6 or 8	Industry std.

directory driven and provides an information retrieval system for the user. The *DMS/Reporter* is an off-line report writer for batch generation of large reports with extensive data manipulation and sorting. *DMS/Data Entry* is an on-line, source-data entry system for batch processing allowing batches of data to be entered at the originating point of the transaction. *DMS/Tran-Pro III* is a transaction processing monitor for the on-line, realtime business processing environment designed for users with large high-volume network and data base requirements. Each of the NCR-DMS software tools are available separately and provide specific data management services.

DATA COMMUNICATIONS: The *System Telecommunications Access Method (STAM)* software includes a group of products for the design of flexible telecommunications networks. The *Local Environment Definition Processor (LEDP)* processes input statements defining queues, tasks, and end points in the communications network for an application program, and produces a tables module. The *Communications Access Interface Software (CAIS)* provides for the transfer of messages between the application program and the Link Communications Management (LCM) job. The *Network Definition Processor (NETDEF)* processes input statements defining links and terminals, and produces a tables module. This module is then combined with the Link Communications Management software to create the LCM job. The *Link Communications Management (LCM)* software (job) manages the use and status of the communications network for the system, and also provides network monitoring and control functions for the system operator. The *Terminal Management System (TMS)* software runs as part of the LCM job and permits specified terminals within the network to dynamically access different jobs. The *Communications Backup Facility (CBF)* software provides for continuing link operation in case of an Application Processor, Link Communications Management job, or a Control Module failure.

The *Basic Telecommunications Software* can be used instead of the STAM software. However, the basic software does not provide for access by any application to terminals connected to any Application Processor, or terminal switching between applications, nor does it provide the Communications Backup Facility. The *Network Description Language (NDL)* defines a communications network and the queue arrangement to be used by an on-line program. The NDL also defines the queue arrangement to be used with a multiple-task on-line program or with a multiple-task batch program. The *Network Description Language Processor (NDLP)* reads NDL statements, processes them, and creates an object module that contains a table defining the communications network. The *Message Control System (MCS)* is a software interface that permits a NEATVS or Cobol program to communicate with remote terminals. The *Low Level Interface (LLI)* is a group of software routines that permits a NEATVS program to communicate with remote terminals.

The *Telecommunications Access Method (TAM)* is a software interface that permits a Cobol or NEATVS application program to communicate within a network that includes an NCR Comtem communications processor attached directly to an Application Processor.

The *Terminal Driver Software* includes a number of software modules that are stored in memory. Because of its modular design, additional capabilities can be added when new devices become available. The *Teletype Telecommunications Driver (TTY TCD)* with the remote printer feature; the *Binary Synchronous Telecommunications Driver (BSC TCD)* operating with private and switched links; the *Polled CRT Telecommunications Driver (CRT TCD)* operating only with private 4-wire links; the *Financial Terminals Telecommunications Driver;* the *Standard Message Format Telecommunications Driver (SMF TCD);* and the *3270* and *NCR 721 Telecommunications Drivers*, are among the different terminal drivers available for the 9800 Systems.

PROGRAM DEVELOPMENT: The *Mantis* application development system is a licensed software product that runs under the VRX/E operating system and can be implemented with DMS Tran-Pro. Mantis is available through a marketing agreement with Cincom Systems, Inc. For a description of Mantis, refer to Page SW15-153MY-101 in Volume 3.

The *Software Development Environment (SDE)* provides a set of development tools, including a uniform command language, an on-line Help facility, and an integrated, interactive self-instruction course. Using the interactive SDE command language, application software developers can perform tasks that previously required the coding of single-use, throwaway programs and job control, and can also track and control changes in programs and data sets through simple, on-line documentation utilities. Developers can generate test programs and data automating the quality assurance process and integrating it into the development cycle.

UTILITIES: The following utility routines are offered for the 9800 Systems: data-related copy, print, and sort. Interactive file-related copy, print, compare, backup, and delete. Magnetic media initializers, system maintenance, and program debug. CAM file handling, time-ordered index CAM file handling, and program development.

OTHER SOFTWARE: *Multi-Tran (MT)* is a transaction monitor for the 9800 System architecture. MT supports transaction distribution and load leveling, and also offers walk-through screen menus, security and validation checking, debugging tools, and utilities. Multi-Tran consists of a Terminal Manager Job (TMJ) and an Applications Manager Job (AMJ). The AMJ is a multithreaded monitor serving multiple terminals. Multi-Tran provides an

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TABLE 4. TERMINALS

MODEL	7910	7950	7930
DISPLAY PARAMETERS			
Max. chars./screen	2000, 3300	1920, 2580	2000
Screen size (lines x chars.)	25 x 80	25 x 80/132	24/32 x 80
Symbol formation	7 x 9, 5 x 9 dot matrix	7 x 9 dot matrix	7 x 9 dot matrix
Character phosphor	Amber	Green P31	Green P31
Total colors/no. simult. displayed	—	—	—
KEYBOARD PARAMETERS			
Style	Typewriter	Typewriter, data entry	Typewriter, numeric pad
Character/code set	128 ASCII	96 ASCII, EBCDIC	128 ASCII
Detachable	Standard	Standard	Standard
Program function keys	—	24	12-24
OTHER FEATURES			
Buffer capacity	12K	—	—
Tilt/swivel	Standard	Standard	Standard
Graphics capability	32 symbols	—	—
TERMINAL INTERFACE	RS-232-C, RS-422	RS-232-C	LLCS

interface and support for the DBSR/SQL data base management system as well as direct access to the Record Management System. The DBSR/SQL relational query/update access system provides an SQL/DS IBM-compatible interface. The DBSR kernel, which contains the relational table management, can be linked with a Multi-Tran AMJ, or to any user application.

PRICING & SUPPORT

POLICY: NCR offers the 9800 Systems for purchase only. The basic maintenance charge covers maintenance of the equipment for nine consecutive hours between 8 a.m. and 5 p.m., Monday through Friday. Charges for maintenance coverage beyond this period are calculated by adding a percentage premium to the basic maintenance rates.

SUPPORT: Remote hardware support includes any local on-site hardware support that is necessary. A software maintenance contract is mandatory for VRX/E system software products when a customer contracts for remote hardware support. NCR's software maintenance plan has a toll-free number to call for assistance. If the problem cannot be resolved over the phone, on-site fault isolation activity and software updates are supplied at the current hourly rate.

EDUCATION: All educational services are separately priced.

TYPICAL CONFIGURATION: The following configurations illustrate a typical low-end and a typical high-end 9800 System. The quoted prices include all necessary hardware components, but no software.

9811 System:

One application processor with 2MB memory, 1 data storage processor with 2MB memory, 1 system console, and 2 cabinets	$ 41,220
2 6543 516MB fixed disk drives	44,630
2 6373 tape drives and controller 180MB GCR	51,980
1 LLCS communications module with 8 TTY lines	8,475
1 6280 serial switch	4,295
1 6471 2000 lpm printer	46,790
1 6455 33 cps letter quality printer	3,075
10 7930 workstations	35,000
TOTAL PURCHASE PRICE:	$235,465

9884 System:

Eight application processors with 32MB of memory, four data storage processors with 16MB of memory, 2 system consoles, and 8 cabinets	$ 340,580
8 6543 516MB fixed disk drives	178,520
8 6373 tape drives and controller 180MB GCR	207,420
1 3690 front-end communications processor	66,000
2 6280 serial switches	8,590
4 6471 2000 lpm line printers	187,160
2 6455 33 cps letter quality printers	6,150
30 7930 workstations	105,000
TOTAL PURCHASE PRICE:	$1,029,420

EQUIPMENT PRICES

		Purchase Price ($)	Annual Maint. ($)	One-Year Rental* ($)
PROCESSOR AND MAIN MEMORY				
9811-0202	System includes 1 Application Processor with 2MB memory, 1 Data Storage Processor with 2MB memory, 1 system console, 5 cables, and 2 cabinets	41,220	3,241	NA
9811-0404	System includes 1 Application Processor with 4MB memory, 1 Data Storage Processor with 4MB memory, 1 system console, 5 cables, and 2 cabinets	58,960	3,541	NA

NCR 9800 Systems

PROCESSOR AND MAIN MEMORY (Continued)		Purchase Price ($)	Annual Maint. ($)	One-Year Rental* ($)
9821-0202	System includes 2 Application Processors with 2MB memory each, 1 Data Storage Processor with 2MB memory, 1 system console, 7 cables, and 2 cabinets	61,400	5,291	NA
9821-0404	System includes 2 Application Processors with 4MB memory each, 1 Data Storage Processor with 4MB memory, 1 system console, 7 cables, and 2 cabinets	86,490	5,741	NA
9822-0202	System includes 2 Application Processors with 2MB memory each, 2 Data Storage Processors with 2MB memory each, 2 system consoles, 10 cables, and 3 cabinets	81,250	5,682	NA
9822-0402	System includes 2 Application Processors with 4MB memory each, 2 Data Storage Processors with 2MB memory each, 2 system consoles, 10 cables, and 3 cabinets	95,950	5,982	NA
9822-0404	System includes 2 Application Processors with 4MB memory each, 4 Data Storage Processors with 4MB memory each, 2 system consoles, 10 cables, and 3 cabinets	116,740	6,282	NA
9832-0404	System includes 3 Application Processors with 4MB memory each, 2 Data Storage Processors with 4MB memory each, 2 system consoles, 12 cables, and 4 cabinets	145,610	8,482	NA
9842-0404	System includes 4 Application Processors with 4MB memory each, 2 Data Storage Processors with 4MB memory each, 2 system consoles, 14 cables, and 4 cabinets	173,160	10,682	NA
9863-0404	System includes 6 Application Processors with 4MB memory each, 3 Data Storage Processors with 4MB memory each, 2 system consoles, 20 cables, and 6 cabinets	256,870	15,432	NA
9884-0404	System includes 8 Application Processors with 4MB memory each, 4 Data Storage Processors with 4MB memory each, 2 system consoles, 26 cables, and 8 cabinets	340,580	20,182	NA
SYSTEM AND MEMORY UPGRADES				
9811-9821-AP02	System Upgrade; 9811 to 9821, 1 additional Application Processor with 2MB memory, and 2 cables	20,180	2,050	NA
9811-9821-AP04	System Upgrade; 9811 to 9822, 1 additional Application Processor with 4MB memory, and 2 cables	27,530	2,200	NA
9821-9822-DS02	System Upgrade; 9821 to 9822, 1 additional Data Storage Processor with 2MB memory, 1 cabinet, 1 console, and 2 cables	19,860	391	NA
9821-9822-DS04	System Upgrade; 9821 to 9822, 1 additional Data Storage Processor with 4MB memory, 1 cabinet, 1 console, and 2 cables	30,250	541	NA
9822-9832-0404	System Upgrade; 9822 to 9832, 1 additional Application Processor with 4MB memory, 1 cabinet, and 2 cables	28,870	2,200	NA
9832-9842-0404	System Upgrade; 9832 to 9842, 1 additional Application Processor with 4MB memory, and 2 cables	27,550	2,200	NA
9842-9863-0404	System Upgrade: 9842 to 9863, 2 additional Application Processors with 4MB memory, 1 additional Data Storage Processor with 4MB memory, 2 cabinets, and 6 cables	83,710	4,750	NA
9863-9884-0404	System Upgrade; 9863 to 9884, 2 additional Application Processors with 4MB memory, 1 additional Data Storage Processor with 4MB memory, 2 cabinets, and 6 cables	83,710	4,750	NA
9800-AP02	Memory Upgrade; additional 2MB memory for the Application Processor	11,550	400	NA
9800-DS02	Memory Apgrade; additional 2MB memory for the Data Storage Processor	11,550	400	NA
SYSTEM OPTIONS				
1003-A101777	System Cabinet; may contain any two of the following: Application Processor, Data Storage Processor, LLCS Communications Module, 6280 Switch Module	1,310	NC	NA
98X1-0000	7930 Visual Display Terminal Console with cable	1,160	191	NA
98X2-0000	6411-8521 Printer Console; 80 columns, 180 cps, with cable	1,060	89	NA
98X3-0000	Console Table	1,660	NC	NA
9800-P001	Four additional high-speed BSL Links for the Application Processor	1,050	150	NA
9800-P002	Three additional low-speed BSL Links for the Application Processor	525	100	NA
0658-P005	Disk Latch Down Kit; required to utilize 658 disks on a Data Storage Processor	42	NC	NA
6280-0403X43	ELCS Switch Module; includes 4 2x2 link or channel switches	4,740	120	205
6280-1403	ELCS Switch Module; includes 4 2x2 link or channel switches	4,740	120	205
6032-0707	Auxiliary Cabinet	1,500	NC	55
MASS STORAGE				
6099-5103	Disk Subsystem; includes 1 415.2MB fixed disk unit, 1 buffered controller, 1 cabinet, and 1 BSL cable	29,035	1,296	1,390
6099-5203	Disk Subsystem; includes 2 415.2MB fixed disk units, 1 buffered controller, 1 cabinet, and 1 BSL cable	44,260	1,788	2,105
6099-5403	Disk Subsystem; includes 4 415.2MB fixed disk units, 1 buffered controller, 1 cabinet, and 1 BSL cable	80,095	3,276	3,810
6543-7404	Add-On Fixed Disk Unit; 415.2MB, including cables and mounting hardware	19,000	660	865
6540-2403	Disk Subsystem; includes 1 27MB and 1 135MB disk unit, 1 I/O Link Adapter, 1 cabinet, 1 BSL cable, and 1 cabinet	23,655	2,592	1,248

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		Purchase Price ($)	Annual Maint. ($)	One-Year Rental* ($)
MAGNETIC TAPE UNITS				
6376-0201	Magnetic Tape Subsystem; 200 ips, PE/GCR, includes 1 controller	49,510	5,050	2,505
6376-0202	Magnetic Tape Unit; 200 ips, PE/GCR, includes connection cable to controller	23,190	2,950	1,230
6373-0101	Magnetic Streaming Tape Subsystem; 75 ips	25,990	2,988	1,350
6373-0102	Magnetic Streaming Tape Unit; 75 ips, includes connecting cable to controller	17,745	2,280	945
6370-0601	Magnetic Tape Subsystem; 125 ips, PE/GCR, includes 1 tape transport, 1 formatter, 1 I/O Link Adapter, 1 BSL cable, and 1 cabinet	47,303	5,316	2,411
6370-0602	Magnetic Tape Unit; 125 ips, PE/GCR, includes 1 cabinet, and 1 tape drive cable	19,620	3,189	999
1401-C161	Cable to connect the 6373 and 6376 Magnetic Tape Subsystems to the Application or the Data Storage Processors	330	NC	NA
1401-C128	Cable to connect the 6373 and 6376 Magnetic Tape Subsystems to the 6280 Switch	180	NC	NA
PRINTERS				
6430-G002	Band Printer Subsystem; 720 lpm, includes adapter, DPI interface, and cables	2,930	144	137
6471-G003	Band Printer Subsystem; 2,000 lpm, includes power stacker, DPI adapter, line counter, 64-character print band, and cables	46,790	5,284	2,482
1401-C226-0152	Cable to connect the 6471 Printer Subsystem to the Application or Data Storage Processor	395	NC	NA
6455-2310	Printer; letter quality, 33 cps with 19 inch carriage	3,075	480	210
6420-2301	Band Printer Subsystem; 1,130 lpm includes 1 cabinet	21,400	4,174	1,289
6420-K010	Print Band; 64 characters, 10 cpi	350	NC	27
COMMUNICATIONS				
9800-0600-1000	Communications Module; contains 1 control module and 1 processor attachment cable	5,115	220	NA
9800-0600-1008	Communications Module; contains 1 control module, 4 dual TTY line modules, and 1 processor attachment cable	8,475	340	NA
9800-0600-1016	Communications Module; contains 1 control module, 8 dual TTY line modules, and 1 processor attachment cable	11,870	460	NA
9800-0600-1024	Communications Module; contains 1 control module, 12 dual TTY line modules, and 1 processor attachment cable	16,350	580	NA
9800-0600-1032	Communications Module; contains 1 control module, 16 dual TTY line modules, and 1 processor attachment cable	19,605	700	NA
9800-P611	Communications X.25 Line Module; supports 1 line connected to a Telenet X.25 Network	1,375	148	NA
TERMINALS				
7910	Video Display Terminal; half/full duplex, asynchronous	1,995	18	NA
7950	Video Display Terminal, half/full duplex, synchronous	1,395	46	NA

**Includes maintenance.*
NA—Not available.
NC—No charge.

SOFTWARE PRICES

		Onetime License Fee ($)	Monthly License Fee ($)	Monthly Software Maint. ($)
VRX/E BASIC SYSTEM SOFTWARE				
D011-0013-0001	VRX/E Operating System; 9811 and 9821, requires 1 magnetic tape unit attached to the Data Storage Processor	0	0	75
D011-0013-0002	VRX/E Operating System; 9822, 9832, 9842, requires 1 magnetic tape unit attached to the Data Storage Processor	0	0	150
D011-0013-0003	VRX/E Operating System; 9863 and 9884, requires 1 magnetic tape unit attached to the Data Storage Processor	0	0	225
D011-0014-0000	VRX/E STAM; System Telecommunications Access Method	0	0	25
D011-0015-0000	VRX/E TRAN-PRO; Transaction Processing	0	0	100
D011-0017-0000	VRX/E System Performance Monitor	0	0	25
D011-0018-0000	VRX/E IVS Basic	3,900	130	50
D011-0019-0000	VRX/E Cobol Compiler; includes VRX/E C Runtime System	5,000	167	65
D011-025-0000	VRX/E C Runtime System	1,000	34	5
G1A6-0001-0000	VRX/E Data Management (DMS) Tools Package	10,000	334	100

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		Onetime License Fee ($)	Monthly License Fee ($)	Monthly Software Maint. ($)
COMMUNICATIONS SOFTWARE				
D011-0007-0000	VRX/E Binary Synchronous 3270 Telecommunications Driver (BSC TCD)	1,200	40	6
D011-008-0000	VRX/E Telecommunications Access Method (TAM)	755	25	5
G1A6-0006-0000	VRX/E Remote Job Entry (RJE)	2,500	84	13
G1A6-0007-0000	VRX/E Remote Batch Subsystems for Networks (RBS/NET)	2,200	74	11
G100-0040-0000	VRX/E Data Management System/Data Entry (TP)	2,000	67	12
D011-0010-0000	VRX/E X.25 Data Terminal Equipment (DTE) Base	5,500	184	25
D011-0011-0000	VRX/E X.25 Data Terminal Equipment (DTE) RTS	1,000	34	5 ■