National CSS Inc.
NCSS 3200 System

MANAGEMENT SUMMARY

Since the establishment of the IBM plug-compatible processor market in 1975, these offerings have been largely directed toward the upper end of the IBM product line, from the System/370 Model 148 through the new 303X series. The initial IBM plug-compatible processor, the Amdahl 470 V/6, was aimed at IBM's System/370 Model 168-3, and the subsequent early offerings of Itel and Control Data were aimed at the Model 148 and Model 158-3. Itel later added plug-compatible counterparts for the Model 168-3 and for IBM's successor product series, the Model 168-3 and for IBM's successor product series, the Model 303X processors. Thus, in this blossoming and highly competitive marketplace, it was predictable that the next target would be IBM's highly popular System/370 Model 138, one of two System/370 models that had been exempted from the price-slashing that followed the April 1977 introduction of the Model 3033 processor.

The first manufacturer to attack this high-potential market was Two Pi Company with its V32 processor, characterized by the vendor as a "System/370-compatible minicomputer." However, Two Pi, a subsidiary of U.S. Philips Corporation, chose the role of OEM supplier and elected to sell the V32 to system builders and service bureaus for use as the basis for IBM-compatible value-added systems.

National CSS, a leading data processing service company, has incorporated the Two Pi hardware into an impressive total system that includes: ▷

The National CSS 3200 system is based on an IBM plug-compatible processor manufactured by Two Pi Company, a subsidiary of U.S. Philips Corporation. The V32 processor offers the same performance levels as IBM's System/370 Model 138 and features greater memory capacity and the ability to use both IBM plug-compatible and standard OEM peripheral devices. National CSS markets the system both as a turnkey business system and as a vehicle for several proprietary software packages that were originally developed for its time-sharing customers.

CHARACTERISTICS

SUPPLIER: National CSS, Incorporated, Computer Division, 542 Westport Avenue, Norwalk, Connecticut 06851. Telephone (203) 853-7200.

MANUFACTURER: Two Pi Company, Incorporated, 3105 Patrick Henry Drive, Santa Clara, California 95051. Telephone (408) 988-1234.

MODELS: 3200-PC, 3208, 3216, 3232, 3248N.

DATA FORMATS

BASIC UNIT: 8-bit byte. Each byte can represent 1 alphanumeric character, 2 BCD digits, or 8 binary bits. Two consecutive bytes form a "halfword" of 16 bits, while 4 consecutive bytes form a 32-bit "word."

FIXED-POINT OPERANDS: Can range from 1 to 16 bytes (1 to 31 digits plus sign) in decimal mode; 1 halfword (16 bits) or 1 word (32 bits) in binary mode. ▶
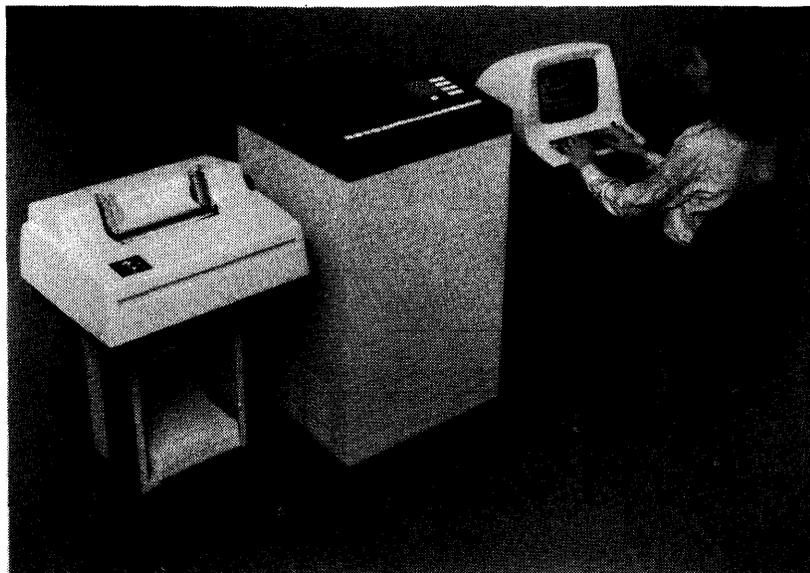
The basic National CSS 3200 system includes the CPU, 256K bytes of error-correcting MOS memory, a byte multiplexer channel, and a CRT console terminal and console printer. The CPU also contains an air conditioning unit that permits the system to be used in a standard office environment.

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▷ • An MVS/VM-like operating system.

• An established packet-switching network that touches 96 U.S. and Canadian cities plus London and Paris.

• Networking software packages that permit users to define and establish their own private data communications networks which may interface the NCSS packet-switched network.

• An extensive collection of specialized application software that has previously been available through the NCSS time-sharing facilities.

• The availability of low-cost backup services through the NCSS time-sharing facilities in the event of system failure.

The key hardware component of the NCSS 3200 system is the Two Pi V32, a 32-bit minicomputer that is functionally compatible with the IBM System/370 Model 138. The processor's manufacturer declines to provide specific timing information, stating that the machine "operates in the same performance class as the IBM 370/138." The processor and its I/O channels are built from 2901 four-bit-slice microprocessors and use an internal architecture similar to that of conventional mini-computers.

The V32 is intended for commercial data processing in a distributed processing environment; and, since Two Pi is pursuing the OEM market instead of the end user market, it is very likely that subsequent products based on this system will be announced by other value-added vendors.

The V32 processor offers two significant advantages over its IBM counterpart: a four-fold increase in memory capacity, 4 megabytes compared to 1 megabyte; and greater channel capacity, eight channels compared to three. But perhaps more important, the V32 can utilize not only IBM-manufactured and IBM plug-compatible peripherals, but also standard OEM peripherals. The V32 CPU includes standard IBM-compatible byte multiplexer and selector channels, and a block multiplexer channel will be offered later this year. In addition, both the manufacturer and National CSS are providing a series of controllers that interface standard OEM peripherals such as those manufactured by Control Data, ISS, Pertec, and Dataproducts. At present, controllers for disk, magnetic tape, line printers, and communications lines are offered.

Another significant feature of the V32 processor is its cooling system. It employs a self-contained refrigerated air cooling system that permits the system to be used in standard office environments without the need for a controlled environment. It also uses standard 115-VAC power.

The V32 offers the 181-instruction System/370 universal instruction set, the basic and extended control modes of operation, extended floating-point capabilities, program event recording, and dynamic address translation. The ▷

▶ **FLOATING-POINT OPERANDS:** 1 word, consisting of 24-bit fraction and 7-bit hexadecimal exponent, in "short" format; 2 words, consisting of 56-bit fraction and 7-bit hexadecimal exponent, in "long" format; or 4 words in "extended precision" format.

INSTRUCTIONS: 2, 4, or 6 bytes in length, specifying 0, 1, or 2 memory addresses, respectively.

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

MAIN STORAGE

TYPE: Metal oxide semiconductor.

CAPACITY: From 256K bytes to 4 million bytes in 256K-byte increments. NCSS currently offers a maximum of 2 million bytes of main memory.

CYCLE TIME: 750 nanoseconds. Access time is 200 nanoseconds per four bytes.

CHECKING: All data paths between the main memory and I/O channels are parity-checked by byte. During CPU/memory interchanges, an error-correcting code is substituted for the parity bits. (An 8-bit modified Hamming code is appended to each 8-byte "doubleword" of data.) When the data is retrieved, single-bit errors are detected and corrected automatically, and most multiple-bit errors are detected and signalled so that appropriate program action can be taken.

STORAGE PROTECTION: The Store and Fetch Protection features, which guard against inadvertent overwriting and/or unauthorized reading of data in specified 2048-byte blocks of storage, are standard in all models.

CONTROL STORAGE: The V32 processor includes 40K bytes of control storage, expandable to 160K bytes. The word size of the V32 control storage is 80 bits. The NCSS 3200 minimum system includes 80K bytes of control storage.

CENTRAL PROCESSOR

REGISTERS: The CPU has sixteen 32-bit general-purpose registers that can be used as accumulators, index registers, or base address registers, and four 64-bit floating-point registers. There are also up to sixteen 32-bit control registers that are available only to the operating system.

TRANSLATION LOOKASIDE BUFFER: The V32 processor employs a much larger Translation Lookaside Buffer (TLB) than does its IBM counterpart, the Model 3138 processor. The V32 TLB has the capacity for 1024 entries, while the Model 3138 TLB can contain only 8 entries. In addition, the V32 has an 8-entry Segment Table Origin buffer, which contains the 8 most recently used segment table origin entries.

INSTRUCTION REPERTOIRE: The V32 CPU supports the full IBM System/370 Universal Instruction Set, which includes 181 instructions divided into two groups, privileged and non-privileged.

The privileged group includes 4 CPU-Timer and Clock-Comparator instructions, 5 address translation instructions, and 18 system control instructions. Privileged instructions are valid only in the supervisor state.

The non-privileged instructions are valid at all times and include 92 standard data manipulation and control instructions (add, subtract, compare, load, store, branch, etc.) and 51 floating-point and extended floating-point instructions.

INSTRUCTION TIMING: Two Pi declined to supply individual instruction times for the V32 CPU. The company ▶

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COMPARISON OF THE TWO PI V32 AND IBM 370/138 PROCESSORS

	370/138	V32
SYSTEM CHARACTERISTICS		
Date of introduction	June 1976	April 1978
Date of first delivery	November 1976	June 1978
Virtual storage capability	Standard	Standard
Principal operating systems	DOS, DOS/VS, OS/MFT, OS/VS1, VM/370	VPS, DOS, DOS/VS, OS/MFT, OS/VS1, VM/370
MAIN STORAGE		
Type	MOS	MOS
Access time, nanoseconds	715-880	200
Cycle time, nanoseconds	935	750
Bytes fetched per cycle	2 or 4	4
Interleaving	None	None
Minimum capacity, bytes per system	524,288	262,144
Maximum capacity, bytes per system	1,048,576	4,194,304
Increment size, bytes	524,288	262,144
PROCESSING UNIT		
Machine cycle time, nanoseconds	275-1485	250
Control storage:		
Word length, bits	Not specified	80
Minimum capacity, bytes	131,072	40,960
Maximum capacity, bytes	131,072	163,840
Translation Lookaside Buffer	8 entries	1024 entries
Segment Table Origin Stack	None	8 entries
PROCESSOR FEATURES		
Clock Comparator & CPU Timer	Standard	Standard
Channel Indirect Addressing	Standard	Standard
Command Retry	Standard	Standard
Conditional Swapping	Standard	Standard
Dynamic Address Translation	Standard	Standard
Integrated Printer Adapter	Optional	Optional
Integrated Console Printer Adapter	Optional	Optional
Integrated 3203-4 Printer Attachment	Optional	None
Integrated File Adapter	Optional (3330/3340)	Optional (3330)
Integrated Communications Adapter	Optional (8 lines)	Optional (32 lines)
Channel Priority	Standard	Standard
Direct Control	Optional	None
APL Assist	Standard	None
System/370 Model 135 Mode	Standard	None
System/360 Model 20 Compatibility	Optional	None
1401/1440/1460 Compatibility	Optional	None
I/O CONTROL		
No. of channels per system, maximum	3	8
No. of selector channels per system	None	0 to 7
No. of block multiplexer channels	2	0 to 7
No. of byte multiplexer channels	1	1 to 8
Maximum I/O data rate, bytes per second	2,600,000	8,500,000

▷ microprocessor-based CPU has a 250-nanosecond cycle time. The V32 main memory cycle time is 750 nanoseconds, faster than the 935-nanosecond cycle time of the IBM 370/138 memory. The V32 selector channels feature an individual data rate of 1.5 million bytes per second. These are independent microprocessor-based units that operate simultaneously and independently, and do not interfere with processor operation. The maximum aggregate data rate of the V32 CPU is 4 million bytes per second, over 50 percent greater than that of the 370/138.

Some 370/138 features that are not currently available in the V32 are Direct Control, APL Assist, 370/135 Compatibility, 360/20 Compatibility, and 1401/1440/1460 Compatibility. ▷

▶ states that the overall throughput levels of the V32 system are similar to those of IBM's System/370 Model 138. The V32 I/O channels are self-contained and do not interfere with the CPU except when addressing the same memory module.

OPERATIONAL MODES: Like the System/370, the V32 computer can operate in either the Basic Control (BC) mode or Extended Control (EC) mode. The BC mode maintains general upward compatibility with the System/360 architecture and programming. In the EC mode, the Program Status Word (PSW) and the layout of the permanently assigned lower main storage area are altered to support Dynamic Address Translation and other system control functions; therefore, the virtual-storage-oriented operating systems must be used.

PROCESSOR FEATURES: The standard and optional features of the V32 processor are listed in the Characteristics Table on the third page of this report. ▶

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▷ The peripherals offered with the NCSS 3200 include a 200-megabyte disk drive similar to the Memorex 677; 75-ips and 125-ips magnetic tape drives similar to those offered by Pertec and Telex; and 300-, 600-, and 1,000-lpm line printers similar to those manufactured by Data Printer Corporation. An 8-line communications controller that can be expanded to 32 lines in 8-line groups is also offered; the lines can be synchronous or asynchronous in any mixture.

No card equipment is offered by either Two Pi or National CSS at this time. All data entry functions are performed through communications ports.

The VPS operating system supplied with each NCSS 3200 system is an outgrowth of the VP/CSS operating system that has been in use in the NCSS time-sharing facilities for more than 10 years. It includes functionality similar to that of IBM's MVS operating system, with TSO, RJE, batch, and OS compatibility. The system is divided into two parts, VP and CSS. VP controls the system resources and creates the user virtual machines. CSS controls all user-oriented facilities such as the conversational interface, supervisory services, disk space management, file I/O, terminal I/O, and program execution. It also provides networking capabilities that are compatible with IBM's VM/370, including spooling, high- and low-speed terminal support, inter-machine communications, and packet-switched software.

VPS supports most of the System/360 and System/370 access methods, including the Basic Sequential Access Method (BSAM), Queued Sequential Access Method (QSAM), Basic Direct Access Method (BDAM), Basic Partitioned Access Method (BPAM), Basic Indexed Sequential Access Method (BISAM), Queued Indexed Sequential Access Method (QISAM), and Virtual Storage Access Method (VSAM).

Languages supported by VPS include Assembler, COBOL, BASIC, FORTRAN, APL, and PL/1. All are compatible with IBM's versions. The IBM OS Sort/Merge program is also provided.

The VPS/BATCH control system permits noninteractive execution of batch jobs under the VPS virtual user environment. Jobs can be submitted to run immediately or deferred to run at a later time or date. Jobs can be submitted on-line or off-line, by interactive users, by other batch jobs, or by other programs. Batch jobs can make use of all the functions available to interactive jobs except through direct terminal input. However, terminal data may be entered through pre-defined parameter lists.

The VPS virtual environment is created by the operating system. It provides each user with the following virtual resources: 1 user console, 99 I/O terminals, 23 disk drives, 7 magnetic tape drives, 9 line printers, 1 card reader, and 1 card punch. The tape drives and terminals are subject to the real limitations of hardware available, but the disk drives and unit-record devices are simulated by ▷

INPUT/OUTPUT CONTROL

Two Pi offers IBM-compatible byte multiplexer and block multiplexer channels for the V32 processor. These channels conform to all IBM channel specifications. The manufacturer also offers a compatible selector channel with the V32, an option not available with the IBM counterpart. The V32 processor can be equipped with up to eight channels, including a disk controller device interface and a tape controller device interface. Three low-speed adapters—a line printer controller, a console printer control, and a communications controller—are attachable through the byte multiplexer channel.

National CSS includes one selector channel with the basic Model 3200 PC, which is the plug-compatible "swap-out" model for 370/138 systems.

The disk controller and tape controller device interfaces do not conform to IBM's interface standards at the device level, precluding the connection of IBM-manufactured or IBM plug-compatible disk drives or magnetic tape through these units. Instead, these units interface standard OEM devices such as those manufactured by ISS and Control Data, and also the OEM versions of the Memorex 7333 IBM plug-compatible disk drive. It should be noted, however, that the combination of the device controller and the OEM peripheral device still conforms to IBM's channel-to-controller interface specification. Also, IBM-conforming disk and tape drives can be attached to the system through the standard channels.

MASS STORAGE

200-MEGABYTE DISK STORAGE SUBSYSTEM: Two Pi and National CSS offer disk controllers capable of attaching up to four 200-megabyte disk pack drives. The controller is based on an AMD 2901 microprocessor and offers the same functionality as the IBM integrated file adapter that is offered with the Model 3138 processor. The controller does not use the IBM controller-to-device interface.

The 200-megabyte disk pack drives record data that is IBM-compatible on 20-surface packs that are interchangeable with IBM 3336-11 packs. Each 20-surface disk pack includes 19 data surfaces and one servo surface. Each data surface contains 808 tracks plus seven spares, and each track can contain as much as 13,030 bytes, assuming one data block per track. Average head-positioning time is 27 milliseconds, and average rotational delay is 8.3 milliseconds (3600 rpm). Data transfer rate is 806,000 bytes per second.

FIXED-HEAD DISK SUBSYSTEM: Two fixed-head disk drives, with data capacities of 2 and 4 megabytes, will also be offered by National CSS for use on the 3200 system. These disk drives employ a separate external controller and attach to the system through a selector channel. The media and fixed heads are enclosed in a sealed module similar to that used in "Winchester technology" moving-head disk drives. Average access time is 8.3 milliseconds, and data transfer rate is 1.21 million bytes per second.

INPUT/OUTPUT UNITS

CONSOLE: The V32 console functions are provided by a CRT terminal and a separate 120-cps dot-matrix printer, both of which are supplied with the basic system. The CRT terminal is a 1920-character unit that uses a 5-by-7 dot matrix to form the 64-ASCII-character set. The console printer is a serial impact-type unit capable of handling forms from 4 to 9.5 inches wide. The unit features an 80-character buffer.

MAGNETIC TAPE UNITS: The V32 tape controller is supplied by Two Pi. It can interface most OEM magnetic ▶

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▷ the system, requiring only one real device to support users.

National CSS also supplies NOMAD, a data base management system that was developed for on-line environments and is currently being used by hundreds of companies. NOMAD consists of three basic components: report writing, data base organization and security, and data handling and maintenance.

NOMAD report writing is designed to be done by nonprogramming personnel and reportedly can be learned in a single day. Users request information, and NOMAD will retrieve the data and print the finished report. Reports can be requested whenever they are needed, either automatically or on-line for immediate reporting of current information. The report writer features such capabilities as: automatic report formatting with sorting, calculations, totals/subtotals, page numbering, titles/subtitles, footings/subfootings, and column headings; textual output (if desired); user-controlled formatting for special forms; and optimized data retrieval. Special features such as creating new data bases from old ones, reporting from non-NOMAD files, and creation of new data relations are also available.

The data base organization and security features of NOMAD demand no specific data storage structure, as in many other systems. The data can be organized in sequential and hierarchical structures, as a relational configuration, or in any combination, depending upon user requirements. This flexibility enhances NOMAD's ability to handle a wide variety of applications, each requiring a specific data base design.

The NOMAD data base description is kept in a "scheme" which controls data base access and use through passwords, enciphering, item masks, and item limits. A single data base can have many subschemas, permitting the data base to present a different face (and different security) to each user.

NOMAD's data base organization and security features include: data organizations such as hierarchical, sequential, indexed, or relational; security and integrity in the form of passwords, subschemas, item masks, limits, enciphering, access rights, update procedures, and reporting procedures; data types such as alphanumeric items (up to 256 characters), numeric (integer, real, or packed), single or double precision, and calculated items; and such efficiency options as data base descriptions that can be expanded after implementation and different data bases that can be used at the same time.

Data handling and maintenance are offered with NOMAD in the form of user-specified needs. These features are included to insure the accuracy of the information. Changes to the data bases can be made automatically as well as on-line. The data handling language is easy to use. A NOMAD application can accept data from any combination of computer storage facilities in any format, or interactively from a terminal. Automatic data checking ▷

▶ tape units and can attach up to four drives. Like the integrated disk controller, the magnetic tape controller is microprocessor-based and employs AMD 2901 bit-slice microprocessors.

National CSS offers two types of magnetic tape drives, a 75-ips unit and a 125-ips unit. Both are 9-track units and are available with 800-bpi NRZI or 1600-bpi phase-encoded recording modes. The magnetic tape units employ vacuum-capstan drive mechanisms and vacuum-column tape buffers. Data transfer rates in the 1600-bpi mode are 120 KBS for the 75-ips model and 200 KBS for the 125-ips model.

LINE PRINTERS: The V32 printer controller is a single-device controller for most OEM line printers. National CSS offers a line printer that is available in three speeds: 300, 600, and 1000 lpm. All three models employ the same basic mechanism, a chain-train, in which 8-character print slugs are mounted on chain links which ride on a monorail track. Common specifications for the three printers include 132 print positions, 3.5 to 19.5-inch form width, buffering for one complete line, and an 8- or 12-channel paper-tape-controlled vertical form unit. The 1000-lpm model features a microprocessor controller (8080A) that is user-programmable for special operations, and motorized upper and lower tractors.

COMMUNICATIONS CONTROL

There are two functionally equivalent communications controllers offered with the 3200 system; one is a physically integrated unit, and the other is an external stand-alone model. Both connect to the 3200 system through the byte multiplexer channel and can support up to 32 synchronous or asynchronous lines in any mix. The basic controller can attach up to 8 lines, and three 8-line expansion features can be added for a total of 32 lines. Line interfaces are EIA RS-232-compatible. Synchronous line data rates can be as high as 9600 bps, and asynchronous data rates can be as high as 1200 bps. Up to four synchronous lines can support high-speed data rates between 19.2K and 50K bps. The subsystem can interface Bell 103, 113, 201, 202, and other equivalent modems. Other features include automatic data rate detection and reverse channel facilities.

The VPS operating system supports a wide range of interactive user terminals and features bisynchronous terminal support through both dial-up and leased lines. The 3200 system can function as an IBM HASP workstation using the bisynchronous protocol.

National CSS maintains an extensive packet-switched network that has terminals in more than 96 U.S. and Canadian cities. The system also has limited facilities in London and Paris. This network is available to users through modules in the VPS operating system. The National CSS network is also accessible through the TWX and Telex communications facilities.

NETWORKING

National CSS is exploring the procedures necessary to offer communications services later in 1978. NCSS 3200 systems will function as host processors in the NCSS international network. Users can create their own private networks by using the NCSS proprietary network software and procuring their own communications lines. NCSS also offers extensive consulting services to users wishing to establish private networks. Users can link these private networks to the company's packet-switched network to form even more extensive networks or to handle overflow situations.

SOFTWARE

OPERATING SYSTEMS: Since the V32 processor is plug-compatible with the IBM Model 3138 processor, all IBM ▶

▷ and calculation on the incoming information, prior to its being stored, further insure the accuracy of the data. Audit trails and exception reports are available, along with a set of "fail-safe" features that include user-controlled checking and system-controlled checking functions.

Networking is the most significant strength of the 3200 system. NCSS maintains a packet-switched network with more than 96 node points in North America and two in Europe. The VPS operating system contains the software modules to access the network, making it possible for widely distributed users to implement a private network by merely buying the terminal systems. Users can also purchase licenses for the NCSS communications terminal software packages and implement their own private networks, or they can implement "combination networks" that consist of terminal clusters at node points connected by the NCSS packet-switched network.

The NCSS 3200 system can also function as a terminal for accessing the NCSS time-sharing facilities. Users can augment their own systems by using the time-sharing facilities in the same manner as any other time-sharing user. Infrequently used specialized programs can be accessed and used without the need for licensing the package; only the standard usage fees need to be paid.

The NCSS network supports asynchronous transmission rates from 110 to 1200 bps and bisynchronous transmission rates from 2000 to 9600 bps.

The NCSS network and VPS operating system support remote workstations. These workstations communicate with VPS through the spooling functions. The types of devices that can be connected to the system include remote job entry terminals, minicomputers with emulator packages, and IBM computers using HASP or RSVP. The remote job entry terminals are generally non-intelligent and employ bisynchronous transmission protocols. Included in this group are the IBM 2780, 3780, 3741, and 3773 terminals and intelligent stations running compatible hardware emulator packages such as those from Cope, Data 100, Datapoint, Four-Phase, Sycor, Wang, and others.

National CSS is offering the NCSS 3200 system for purchase only. The company will arrange third-party leasing. The VPS operating system license charge is included in the system price. Other NCSS software packages are licensed upon payment of a one-time license fee or a monthly license fee. Software maintenance is included in the monthly license fee but must be purchased separately if the one-time fee is paid. NCSS offers a software license credit of 5 percent of the hardware price. This credit must be used within 18 months of purchase. One thing that National CSS does not provide for the NCSS 3200 system is a warranty period; maintenance services must be purchased immediately.

The company also offers unique backup facilities to 3200 system users. NCSS will maintain current user data files and user identifications on its time-sharing facilities. A ▷

▶ operating systems that are designed to run on the 370/138 can also run on a V32. These include OS/MFT, DOS, DOS/VS, OS/VS1, and VM/370. In addition, National CSS offers VPS, an interactive version of MVS. VPS is an outgrowth of the VP/CSS operating system that was developed for NCSS's remote computing customers and has been in commercial use for over 10 years in NCSS time-sharing systems.

The VPS Operating System is a virtual memory system that provides each user with up to 16 megabytes of virtual memory space, with 8 megabytes available to the user's programs and 8 reserved for operating system processes that may be required, such as the command language processor, editor, debugging and file system processors. Of the 8 megabytes available to the user, VPS normally assigns 256K bytes, which can be increased in three ways. The VPS directory definition of each user indicates the amount of virtual storage to allocate at login, and this amount can be set to any value from 256K bytes to 8 megabytes in increments of 64K bytes. At login time, the user can provide memory requirements for the session through the use of a keyword. At any time during the terminal session, the user can dynamically increase and decrease memory allocation as process requirements change.

Virtual Storage Protection (VSP) is provided to protect system control information from inadvertent modification by a running program. Virtual Storage Protection provides a means of monitoring and reporting any attempt to store data into protected areas of the user's virtual memory. The protected areas include most virtual addresses below 69,632, addresses above 9 megabytes, and other upper memory locations required for system usage. Attempting to write into protected areas will cause a protection exception, and Debug Mode will be entered. Additional benefits of Virtual Storage Protection include protection of the file system control information and data areas, thus increasing the level of data integrity and subscript checking that precludes users of high-level languages from violating rules of the language which would result in inadvertent access to protected memory areas.

VPS is a two-level operating system; one level (VP) controls hardware resources, and the other level (CSS) controls the user environment.

VP provides services to users through CPU and I/O scheduling and paging control. CPU and I/O device usage is scheduled to provide for maximum concurrent processing. Paging algorithms contained in VP schedule the use of main memory to minimize paging. CPU and I/O scheduling is accomplished by the dispatcher. The dispatcher characterizes running users as either terminal-bound, CPU-bound, or I/O bound. These classifications are based on the relationship between the amounts of each resource being used. A terminal-bound user executes heavy terminal input and output with little I/O and CPU usage. The I/O-bound user performs a great deal of reading and writing without much terminal I/O or CPU use. The CPU-bound user consumes a full time slice for processing each time he is given control.

Separate queues are maintained for each user class, with the amount of CPU time to each varying with the number of users in each queue, the overall system load, the number of processors on-line, and other considerations. The dispatcher rotates from queue to queue, dispatching all users waiting in one queue before moving to the next. For each run queue in the system, there are two wait queues for separate run priorities. Users will not be selected from the lower-priority wait queue as long as users are backed up in the higher-priority wait queue.

User virtual memory space ranges from a minimum of 256K bytes up to a maximum of 8 megabytes and is divided into 4K-byte pages that are maintained on disk storage. Program ▶

▷ customer wishing to use this service can connect a terminal to the nearest NCSS local dialing point and begin processing as any regular time-sharing customer. Processing charges are billed at standard rates. The charge to maintain one disk pack (1,333 cylinders) with one weekly update is $50.

The NCSS 3200 is offered in five basic model packages, starting with a minimal 3200-PC "swap-out" system for users who wish to use only the V32 processor in their systems. The next three models—the 3208, 3216, and 3232—provide differing amounts of main memory and peripheral equipment with the 3200 processor. The largest model, the 3248-NT, is a combination package that includes three processors and is intended to be used as the basis for a network. It consists of two Model 3208's and one Model 3232 package.

USER REACTION

The first deliveries of the NCSS 3200 are not scheduled until later this month, precluding the availability of any user experience data for this report. It is reasonable to expect, however, that the NCSS 3200 system package, including all the software and services offered by National CSS, will become a significant force in the small-to-medium-scale business computer market.□

▶ pages are brought into main memory through two mechanisms, demand paging and swapping. Demand paging brings in pages only when the user program requires their presence. Swapping is the normal replacement of pages due to segmentation by the virtual operating system. To minimize the possibility of disk thrashing, VP keeps track of the pages most often accessed by each program (the working set) and attempts to swap in this entire group of pages each time the program is first dispatched. Pages to be written onto the disk are chosen by a least-recently-used algorithm which ensures that interactive users with small working sets will experience minimal paging overhead.

When a user logs on the system, VPS creates a virtual environment which provides all the facilities of a real machine. The facilities made available to the user include I/O resources, virtual memory space, the CSS file system, the CSS Command Language, libraries, and utilities.

The virtual resources provided by VPS include a user console and up to 99 terminals, 23 disk drives, 7 magnetic tape units, 9 line printers, one card reader, and one card punch. The disk drives and unit record devices are simulated and therefore require only one real device of each type to support multiple on-line users, while magnetic tape units and terminals are subject to the real limitations of the physical hardware.

The operating system uses the concept of "user mini-disks" (logical disks), each of which is actually a specified number of contiguous "pseudo-cylinders" on a real disk which are treated as a full physical disk pack mounted on a separate virtual disk drive. Each user can have up to 23 of these mini-disks at any given time. Each mini-disk consists of both user information and the control information necessary to access the information.

Each pseudo-cylinder on a mini-disk is formatted into 150 blocks of 800 bytes. The maximum number of pseudo-cylinders is 1407, giving each virtual mini-disk a maximum capacity of about 169 million bytes. Mini-disks are assigned by the VPS system manager, but users can gain access to additional virtual storage through the ATTACH command.

Unit record devices are simulated by a spooling facility, which acts as a temporary buffer to hold print and punch files until the real physical devices are available to input or output them. User programs can access one card reader, one card punch, and nine line printers simultaneously, subject to hardware configuration. Each line printer and the punch has destination and forms information associated with it, as designated by the user and optionally altered by the system operator. Card decks are not automatically placed on the user's disk at the time they are physically read by the card reader; they are read into the spooling system and wait for user-issued commands to read them. Each spool file is given an eight-digit name indicating the day and time-of-day it was produced, and carries with it the user's current mailing/distribution address (if the spool file is print or punch). Users can request multiple copies of output spool files and save extra copies of read spool files after reading. CSS commands allow spool advance, alter, delete, purge and reroute operations.

Each mini-disk allocated to a user has a file directory associated with it. For each file on the disk, there is an associated 80-byte entry in the file directory called the File Status Table (FST). The FST contains information such as file name, file type, file mode, logical record length, record format, number of records, date last read, date last written, and location of the file blocks. The file directory is read into the user's virtual memory at log-in time and each time the user requests access to additional mini-disks via the ATTACH command. At appropriate intervals, selected portions of the file directory are written back to the user mini-disk through a function called LOGDISK. The portions selected are those FST's which have been changed during the interval. In addition, the user can call the LOGDISK function from within programs to update the disk file directory more often, thus providing increased disk file integrity in case of system failure during file processing.

The CSS file system supports variable-length and fixed-length record formats. It also simulates OS fixed, variable, and undefined record lengths.

CSS supports the following IBM System/360 and System/370 access methods by maintaining the appropriate OS-type control blocks and intercepting all access requests and converting them to the corresponding CSS read or write calls:

● Basic Sequential Access Method (BSAM)
● Queued Sequential Access Method (QSAM)
● Indexed Sequential Access Method (ISAM)
● Virtual Storage Access Method (VSAM)
● Basic Direct Access Method (BDAM)
● Basic Partitioned Access Method (BPAM)

The VPS system permits disk sharing but includes a three-level protection scheme to avoid inadvertent or unauthorized usage. The levels of access are Write, Update, and Read-Only. The Write level allows users to erase, extend, or edit files and to create new files; this highest level of access is virtually unrestricted. The Update level allows users to rewrite individual records of a given file but does not allow creation, erasing, extending, or editing files. The Read-Only level is the most restricted level and permits no alteration.

The file owner may further restrict the programs that other users run, the commands they issue, and the files they access, while they are using his disk. Every user identification requires a password, which the system demands at log-in time. This password may consist of from one to eight nonblank characters with the exception of the editing symbols. The user may also specify a RDSHARE password and a WRTSHARE password for each of the disks. When another user issues the ATTACH command for any of these disks, the system will demand one of these passwords before granting access. ▶

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The RDSHARE password is demanded when a user issues the ATTACH command, requesting read-only privilege; the WRTSHARE password is demanded when requesting update or write privilege. These passwords are the primary means by which dynamic access to any disk is controlled, and by which the access privileges afforded to any given user are determined. If passwords are not specified by the user, they are both set for convenience to be the same as the log-in password.

In addition to directory passwords, three other security facilities are available in the VPS system to protect a user who wishes to make certain files or programs available to others.

The first is a special file known as the PROFILE EXEC, which resides on disk. The PROFILE EXEC is automatically executed in one of two ways: by logging into the system, and by issuing the command IPL CSS. When a user logs into the VPS system or effects an IPL, CSS automatically searches the user's disk space for an EXEC file named PROFILE. If found, the file is automatically executed before any interaction can occur between the user and the system, and can be used to ask for an extra password, set up user environments, or set defaults automatically and invisibly. This program file is executed with SET ATTN ON, which makes it uninterruptible.

The second security facility is a special file, which may reside on the disk, known as the PROTECT EXEC. If a PROTECT EXEC is on the disk, it is automatically executed when the disk is attached. It can allow or restrict the use of any or all CSS commands and facilities, user programs, and data files; and it can use all of the facilities of the EXEC language.

A disk may also be marked PROPRIETARY. Under this protection scheme, the disk may have any of the preceding access attributes but is automatically detached from the user's virtual environment whenever a new copy of CSS is paged in. In addition, the system accounts for any type of usage of the disk.

In addition to defining the level of access which any user may have when attaching a disk, the owner may also define in the VPS user directory the concurrent usage to be permitted. The file owner has the option to restrict disk usage to one user at a time, to permit multiple concurrent read accesses, or permit multiple users to write in files. There are seven concurrent options which the owner may specify. These include write alone, write with read, write with update, update alone, update with read, and multiple read.

The VPS EXEC language is a control language that provides facilities for user prompting, condition testing, branching, looping, I/O operations, and error handling. EXEC provides users with a set of 24 control words that can be assembled into programs that automate job streams, provide conversational interaction with files, create multi-level security schemes, generate remote batch jobs, and augment CSS control commands. EXEC programs are stored in named files and are executable within one another.

EXEC has five types of variables, four that are system-defined and one that is user-defined. The four types include 20 alphanumeric input variables that can be used in calculations, 10 simple and 10 global index counters, and 10 non-calculatable alphanumeric variables. User-defined variables can be alphanumeric and have no restrictions.

The EXEC language also provides for the use of keywords, a special set of variables that contain system-controlled information which users may access but may not alter. Examples of these keywords are current date, time of day, current user's identification, current core size, name of EXEC file being executed, line number being executed, and status and characteristics of the user's output device.

EXEC contains certain specialized program files that are automatically run at specific times, such as when a user logs in, when a disk is attached, when batch jobs are run, or before debug mode is entered. These specialized EXEC files are PROFILE, PROTECT, and BATCH.

The PROFILE file is a user-created program that is initiated at log-in time. It is invoked before any interaction between the user and the system can occur, and is generally used to identify programs to ask for additional passwords, to establish terminal default, or to set up an indication of program execution time.

The PROTECT file is used by file owners to restrict access by requiring additional passwords or by specifying allowable access limitations (read-only, writable, or update only). This file can also store and pass on, to another EXEC file, such information as the user who attached the disk and the mode and level of access, providing a record of each access to the restricted files.

The BATCH file is a required user-created file that passes instructions for processing remote batch jobs to the VPS Batch Control System. The BATCH file is initiated automatically when the system operator starts a user in the batch environment.

The CSS Command Language includes 117 functional commands that help users specify details of program execution; file maintenance and manipulation; program processing, such as assembly and compilation; I/O device handling; and other system services. These commands can be issued from the terminal, from within EXEC procedures, and from within user programs. Most can also be issued within the edit and the debug environments. Each command consists of a command name and its operands, if any. Abbreviations have been established that allow the user to specify only the number of characters which serve to uniquely identify that command. These abbreviations are valid only when issued from the terminal, not when invoked from within EXEC, edit, debug, or a user program.

Each CSS command has a corresponding command program which resides either in user virtual memory (portions allocated to CSS) or on the CSS system disk. Users can create new commands or substitute programs for CSS commands by creating a core-image file of the program and assigning it a filename identical to that of the command it is to replace. This is possible because the CSS command processor searches users' disks before its own, loading and executing the first file found that meets the proper requirements. Any invalid command (one whose command program does not reside in CSS virtual memory or for which a core-image module cannot be located on disk) is ignored, and a message is typed at the terminal and an error return code returned to the calling process.

The VPS Operating System provides the system manager with various services designed to help manage available resources and provide reasonable service to a wide variety of applications requiring different levels of resource and support. The intention of these services is to provide the system manager with the tools required to set policies, schedule workflow, and measure the results. These system services include the VPS User Directory, Spooling Operations, Usage Accounting, Performance Monitoring, Deferred Batch, and Remote Job Entry.

The system manager can place a user in one of four user classes. These classes control access to privileged VP and CSS commands. Class A users are considered system operator users and have full access to operating commands. Class B users are considered system programmer users and have access to extra system information and control commands. Class C and D users get progressively less system information. In addition, A and B users must be given the privileged ▶

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status each time they log in by operator control. This protects against unauthorized usage of privileged user identification.

The system manager may also assign a dispatching priority from 1 to 15 for each user. The scheduling algorithms concurrently recognize three basic levels of priority: a lower level, a higher level, and a top priority level. The top priority level is 15. The dividing point between higher and lower level is set daily by the system operator as designated by the system manager. Each user is also assigned an account name and an associated billing address. When invoices are produced, they detail usage by individual user and summarize usage by common account name. The resulting invoice contains the associated billing address for easy distribution. Also, a user mailing/destination address is designated for use by VPS when producing line printer or card punch output for the user.

Directory maintenance is performed by a conversational program that reads in the existing directory, makes changes directed by the system manager, then writes out a new directory to be loaded at the next system start-up. The directory maintenance program performs disk space management, moving users to different physical locations on the appropriate pack for efficient space utilization. The system manager may also group users as workload requirements vary. The program creates a detailed listing for easy reference and creates a billing file with daily disk allocations. It also creates an audit trail of directory changes that can be used in case of system failure to recover directory integrity.

The directory also supports a novel feature called Rotor Groups. This feature allows the system manager to designate a list of user identifications as belonging to a rotored group. The users of these identifiers would then all log into the first one and be rotored up to the first available identifier in the list. This technique is useful in such instances as order entry applications when the information base is shared and no individual permanent files are created.

The spooling facility is designed to allow many users to automatically "share" a line printer, card reader, and card punch. Control of this facility is divided between users and the system operator. Users control the creating and routing of virtual devices, and the system operator carries out or oversees the operation of the real devices.

When preparing printer or punch output, users define the destination (data center or remote), the mailing/distribution address, the forms requirements (normal or special paper), and the number of copies. Users can also group many separate output files into one spool file to reduce handling requirements where practical. This output can come directly from user programs or from system utilities. VPS allows the users to be building up to 10 output spool files simultaneously (9 printer, 1 punch). The FILEDEF command provides for this output from user programs. User read card "decks" directly from the spooling area in the same way. The system operator must, therefore, have previously read the cards through an actual card reader. Normally, the read spool file is automatically deleted after the user reads it, but it can be saved using the SET CARDSAVE command. Users can query the status of spooling operations and delete or reroute spool files. They can also transfer files to other users by placing them into spooling designated as read files for specified users.

VPS provides query facilities that permit the operator to check the status of various spooling operations. Selection can be by destination or user, summarized or in detail. Commands are provided to alter, advance, restart, reroute, requeue, repeat, or delete. The system provides operator-controlled purging of all spool files more than a specified number of days old. The number can vary according to system manager specifications. This purging helps eliminate needless spool space build-up.

VPS produces a spool activity log that details all activity on spool files, whether local or remote. This log can be used for analyzing traffic volumes and tracing specific spool activities. A variety of remote workstations can be connected to the VPS spooling system by either leased or dial-up telephone lines. All remote work stations must employ bi-synchronous protocol as stand-alone hardware stations or computer stations using HASP techniques. Hardware and software emulations of these devices are allowed. The operator of this remote station can initiate and control activity through the station card reader or through a separate interactive terminal. The following devices, or emulations of them, are supported.

Method	Device
RSVP	IBM 360/370 under OS/VS
HASP Multi-Leave	IBM System/3
	IBM System/360, Model 20 or above
	IBM System/370, Model 115 or above
	IBM 1130
	IBM 2922
HASP Work Station Package	In any device
Stand-Alone RJE Stations	IBM 1130
	IBM 2770
	IBM 2780
	IBM 3741
	IBM 3773/4/5
	IBM 3780

VPS generates accounting information throughout the day for billing purposes, as well as monitoring resource usage and growth needs. The information is in two forms: operator logs, and billing records that are stored onto disk for use in generating invoices and usage reports at appropriate time frames. The operator logs record acitivity on all the peripherals and users logging in and out. The billing records are generated on a transaction basis and also on a predetermined time basis. An intermediate log-out transaction is also produced for every user every 15 minutes to save billing information in the event of a system failure that does not allow generation of a log-out transaction for each user.

VPS also has performance monitoring functions. Various reports provide summary information that can be used for proper forcasting and planning of future resource needs as well as for detecting potential problems. These include:

● A daily usage report, showing usage by shift and in total.

● Response graphs, showing response times through the day for each of the various queues requesting services.

● Activity graphs, showing disk I/O per second for each channel, paging activity per second, size of disk accessing queues, etc.

● Efficiency graphs, showing wait state percentages, supervisor state percentages, and problem state percentages.

● A data communications report, which shows telephone line usage by hour on each of the lines coming into the data center. This allows the system manager to anticipate telephone port needs and order them in advance of requirements.

● A remote printer report showing, for the intermediate-speed printers which are logged in all day, how many minutes per hour each of them was active. The system ▶

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manager can then increase or decrease the bandwidth of any line, depending upon the rate of printer activity for each remote location.

The VPS Batch Control System provides for noninteractive execution of jobs under the VPS virtual user environment. Several different types of service are available. Jobs can be submitted to run intermediately, deferred, overnight, or on a specified date. Jobs can be submitted on-line or off-line, by interactive users, by other batch jobs, or by any program. Batch jobs can make use of all the functions performed by the VPS system with the exception of terminal input. However, terminal input can be redirected by use of the FILEDEF command or the terminal input STACK feature of the EXEC language. The job stream is set up by the interactive user in a file called BATCH EXEC. This file contains the CSS commands to be executed with the surrounding EXEC control logic. The job is then submitted using the CSSBATCH command. This command allows the user to specify the job priority, the limits of CPU and I/O processing, the amount of virtual memory to allocate, and, optionally, a specific date or number of days to wait before running the job and whether or not it can be rerun in case of system failure.

The system operator controls the actual execution of these jobs, deciding when to start each, how many to run concurrently, and how many to defer. If a job loops, it is automatically killed when it exceeds DPU and/or I/O limits set by the user. If a job becomes dormant, the operator can kill it. The Batch Control system automatically produces a list file, called CONSPOOL, which contains all the output that would normally have gone to the user's terminal had the job been run in the interactive mode. Normally, this listing is printed on the user's defined virtual printer. The user may elect to have it placed in a specified virtual card reader or not be produced at all. The user may also check the status of jobs submitted and delete any job not yet run. The listing also indicates the reason for termination if the job is abnormally terminated. Jobs with a RUN status indicate the amount of CPU and I/O resources used, the elapsed time, and the date and time started.

The system manager has other services that can be made available to users. These user services, which require varying amounts of maintenance on the system manager's part, include:

● User file backup and restore

● On-line tape and disk library

● Invoicing

● Usage summary reporting

● On-line documentation

● On-line information

The restoration of files inadvertently destroyed by system failure or user intervention is a major problem in any data processing installation. Protecting against such catastrophes can require extensive time and effort on the part of the system manager and operator. VPS provides a backup/restore system which is said to be efficient, easy to run, and easy to manage. Rather than dump full packs daily, the backup/ restore system dumps files on a user mini-disk basis according to a file usage. The system will selectively dump the files of users active during that day and keep a record of user identification, file names, file types, the data, and the tapes on which these files are located. The operator can determine which backup tape the user is on for a given day and issue a search command to locate the user's files on that tape. To supplement the selective daily dumping process, the system manager can produce full dumps on a regular basis. These full dumps work in the same format as selective dumping, but all files of all users are dumped regardless of usage. Full dump tapes can be used to restore all users on backup hardware provided by National CSS in the case of major system hardware failure.

The VPS system produces billing information from several sources which provide detailed information on resource usage. The details include:

● Connect time

● CPU time

● Selector I/O

● Multiplexer I/O

● Virtual memory allocations

● On-line disk storage

● Off-line tape and disk allocation

● Tape and disk mount time

● Processor and application usage

Two separate VPS facilities provide information and assistance to on-line users. These facilities are available to users by way of the HELP and INFO commands. The information base is augmented and maintained by the system manager.

Documentation of CSS commands can be retrieved on-line by use of the HELP command. In this command's simplest form, users can request explanations of any particular command option or error return code. This information is meant as a convenient supplement to the VPS Reference Manual. The system manager can add to the basic information provided by VPS as desired. In addition, the INFO command provides current documentation about new or changing features of the VPS system or facilities and procedures of the user installation. The basic information provided concerns VPS features. The system manager adds to this information concerning his own installation. The user may request an INDEX which lists every topic available, the date it was last updated, and a brief descriptive phrase. The INDEX will also indicate how many lines are in each INFO file, so the user can decide whether to print the file on his terminal or on the off-line printer. The system manager can also set a log-in message which will be typed on each user's terminal each time he logs in. This allows the system manager to disseminate timely or critical information to users automatically.

NOMAD DATA BASE MANAGEMENT SYSTEM: NOMAD is a self-contained data base management system designed and developed by National CSS. It was designed to support relational, hierarchical, and sequential structures and to provide users with a means to break down problem requirements into their related parts and implement a solution. NOMAD is a single-level command-oriented system that emphasizes three major areas of data base management, data base organization, data base maintenance, and report generation.

Some of the important features of NOMAD include:

● Support for both hierarchical and relational structures, including full relational (Boolean) algebra.

● Simultaneous support for multiple input/output files and multiple data bases.

● Ability to reorganize data bases without a dump and reload and without rewriting maintenance or reporting procedures.

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► ● Automatic data base restoration in the event of system failure.

● Full physical data independence.

● Language interfaces that support COBOL, PL/1, FORTRAN, and Assembler.

● Support for sequential or indexed sequential external files.

Data base maintenance is accomplished through the NOMAD procedural language and the NOMAD programmer interface. The procedural language is used to create programs that move interactively through the data base, issuing individual editing commands such as change, delete, or insert. The commands that control movement through the data base include LOCATE, NEXT, PREVIOUS, FIRST, and LAST. A PROMPT command prompts users with item names when new data is being entered. The procedural language also has the capabilities of conditional and unconditional branching, computation, and error handling. The LOAD process command can perform additions and changes to a data base from a transaction file.

The NOMAD Programmer Interface (NPI) allows user application programs to access records in a NOMAD data base. NPI calls out subroutines that interface with the application programs. The arguments of these calls identify records to be retrieved and identify how these records will be added, changed, or deleted. The subroutine calls also allow access to NOMAD's procedure language and variables. The application program performs all data management operations on the data base. The NPI's ability to give the user information on the structure of the data base (names of segments and items, data types, lengths, etc.) allows the application program to perform dynamic data management operations without a previous knowledge of the format. NPI application programs can be written in IBM 360/370 languages such as COBOL, PL/1, FORTRAN, or Assembler.

The NOMAD reporting facilities place very few restrictions on the content or format of a report. NOMAD reports are produced by a single command, LIST, followed by the information needed from the data base and the format in which the information will appear. A LIST request is an English-language statement containing NOMAD keywords and the names of items within the data base. The report language was designed so that no data processing knowledge is required. Functionally, the LIST command allows the user to:

● Retrieve information from the data base;

● Sort and summarize data both horizontally and vertically;

● Evaluate functions such as COUNT, MIN, MAX, AVERAGE, FIRST, and LAST;

● Perform computations with data base items or the results of functions;

● Define report titles, subtitles, footings, and subfootings;

● Produce reports on terminals or off-line; and

● Do table-lookups as the report is being printed.

In addition to the features available in most sophisticated data base reporting systems (sums, totals, percentages, complex calculations, etc.), NOMAD provides discrete screening and filtering capabilities, the ability to define new information "on the fly," and the ability to produce a narrative report rather than a standard column and row format.

One of the important features of the LIST command is the ability to generate disjoint reports and to do disjoint sorting in a single pass through the data base. A disjoint report contains data that is unrelated, such as a report containing two lists of names, the first column in order by last names and the second column containing the very same names, but in order by first names. Such a report would normally require two sorts of the same names, and the ability to write one report with output from both sorts. The second sort is called a disjoint sort. In the same way, NOMAD can produce reports on disjoint information.

The CREATE command has all of the capabilities of LIST except the formatting options. The command is used to spin off smaller data bases or to create sequential files for other applications.

LANGUAGES: The following programming languages are available on the NCSS 3200 system:

● Assembler
  F-level
  H-level

● APL

● BASIC

● COBOL

● FORTRAN

● FORTRAN IV
  H-Extended
  G1

● WATFIV (see Report 70E-886-03)

● PL/1

The full-language versions of the IBM F-level and H-level Assemblers are available under VPS. These processors, when invoked, provide rapid program assembly and on-line diagnostics. The H-level Assembler provides extended macro-processing and cross-referencing of literals. The ADEBUG facility allows symbolic debugging of Assembler programs; it has been specifically designed for programmers who need access to machine-instruction debugging. use of ADEBUG requires no modification to the program yet allows the user to reference labels symbolically and to trace SVC's and/or individual machine instructions.

APL/VPS offers IBM's latest VS APL processor plus a complete working environment. It includes such enhancements as a sophisticated formatter, adjustable workspace, support for a variety of I/O devices, and a wide selection of library routines. Current IBM codes require little or no conversion. IBM's VP APL processor provides the basis of a complete working environment. It has been enhanced with such features as a sophisticated formatter, adjustable work-space, and easy-to-use I/O. APL execution can be inter-active or batch.

BASIC/VPS provides a simple method for obtaining solutions to business problems. The IBM VS BASIC processor produces efficient machine code and provides extensive language debugging capabilities. From the BASIC/VPS environment, a user can access the VPS line number editor, a number of programming aids, and three libraries of more than 100 prewritten mathematical, statistical, and business analysis programs. The debugging of BASIC programs is accomplished through an interactive facility. Test statements may be generated, traces may be initiated, and temporary patches may be applied to help the user quickly arrive at an executable program. ►

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► NCSS offers the latest IBM VS processor. A single command compiles and/or executes multiple programs containing arithmetic, character and array manipulations, predefined and user-defined functions, and stream and record I/O. In addition, an XBASIC (Extended Basic Interpreter) processor is available for linking to COBOL, FORTRAN, and PL/1 routines.

COBOL/VPS offers a total package of program development facilities as well as a flexible environment for running production systems. The package includes IBM compilers, a symbolic debugging facility, coding aids, and full file manipulation capabilities. Current IBM code requires little or no conversion.

The CDEBUG, or COBOL Symbolic Debugging facility, allows users to determine where (paragraph-name, line, verb) a program interrupt occurred and restart the program following an interrupt. Optionally, users may display or change memory storage values by data name, set breakpoints at paragraph-names or line numbers, turn traces on/off, and alter program logic to selectively test parts of a program. A macro facility allows CDEBUG requests to be grouped and conditionally executed at trace or breakpoints. In addition, data-names may be monitored for changing values.

NCSS provides three IBM OS COBOL compilers: IBM OS Full ANS, Version 4; IBM OS/VS COBOL; and IBM COBOL (F). Using any of these processors, COBOL programs are compiled by command, with diagnostics being displayed at the user's terminal. Both CSS-supplied and IBM compile-time options may be specified to produce listing files, data-name cross-referencing, optimization of object code, and other useful actions ¯¯ desired.

The FORTRAN/VPS programm. environment offers three FORTRAN compilers, each meeting different objectives. Using any one of these facilities, FORTRAN programs can be compiled or executed upon command. Files may be assigned to the user's terminal, disk, or other I/O devices. Current IBM code requires little or no conversion. The FDEBUG facility allows a FORTRAN program to be monitored or controlled during execution. The user can set breakpoints, display and alter variables, trace flow, trace variables, and construct complex commands which can be conditionally performed at breakpoints.

IBM OS FORTRAN IV (H-Extended) compiler is intended for use by production programs. This compiler produces code which is said to execute substantially faster than any other compiler available on an IBM system.

IBM OS FORTRAN IV (G1) has been enhanced by NCSS to provide useful extensions, improved performance, and the ability to generate information required by the FORTRAN debugging facility.

WATFIV, from the University of Waterloo, is a FORTRAN compile-and-go system for extremely fast compilation, extensive error monitoring, and comprehensive diagnostic messages.

The PL1/VPS environment includes the IBM PL/1-F compiler, checkout compiler, and optimizing compiler. The PL/1-F compiler is no longer supported by IBM, but is available for use under the VPS operating system with all features offered by IBM in the last release. The VPS version of the checkout compiler also supports the PL/1 internal sort.

In addition to these programming languages, a selection of graphics capabilities is also available on the system, including numerous hardware interfaces and extensive subroutine libraries to facilitate drawing plots.

APPLICATIONS SOFTWARE

National CSS offers selected applications programs for use on 3200 systems under a software license agreement. A more extensive library of other application programs is available through NCSS's time-sharing services under the normal time-sharing usage arrangements. Users can access these programs through their 3200 systems by dialing into the NCSS time-sharing host systems. Examples of these specialized packages are:

Data Base Management Systems

RAMIS/RAMIS II (Mathematica, Inc.)
MARK IV (Informatics, Inc.)

Engineering

ISPICE (electronic circuit analysis)
LOGCAP (network analysis and design)
PROPNESY (failure rate prediction)
All major microprocessor development packages
COMPACT (microwave circuit design)
GASSS/GASUS (gas piping systems simulator)
LIQSS/LIQT (liquid piping system simulator)
STRUPAK (structional analysis)
ACCOS V (lens design and image evaluation)

Business Control and Planning

EMS (economic modeling and forecasting)
MLE (Merrill Lynch Economics Data Base)
CSS/INFOTAB (tabular data handling)
LAS (lease analysis)
ONSITE (census and demographic analysis)
CENSAC (census of housing and population)
STX/TIME (statistical analysis and forecasting, Box-Jenkins X11)
BAS (payables, receivables, and general ledger)
SPX (social science statistical analysis)
TELSTAT (daily information on stocks and bonds)
DYNAMO, SIMSCRIPT (simulators)

PRICING

EQUIPMENT: National CSS offers the NCSS 3200 computer system in five system packages. These configurations can be considered typical user systems. Pricing for the NCSS 3200 packaged systems is shown in the Equipment Prices section of this report along with brief summaries of the system components.

POLICY: NCSS offers the 3200 system on a purchase-only basis. Maintenance is priced separately. All system software is licensed separately. VPS is licensed to system users at no additional charge. Software licenses for all other programs are offered for either a single one-time license payment or for an annual license fee. Users who elect to pay the one-time license fee must also purchase software maintenance from NCSS. The software maintenance fee is included in the annual license fee. Users may apply up to 5 percent of the hardware price toward software license fees. The credit must be used within 18 months of installation. NCSS will arrange for the leasing of a 3200 system through a third party. Terms will be quoted upon request.

There is no warranty period on the NCSS 3200 system. All maintenance, both corrective and preventive, must be obtained through a Maintenance Service Agreement. The monthly maintenance charges entitle users to service during the period of 8:30 a.m. to 5:30 p.m., Monday through Friday, exclusive of holidays. Maintenance service provided outside this period will be charged at the prevailing NCSS per-call rate. The current per-call rate is $55 per hour. ►

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▶ The VPS Operating System carries a warranty provision specifying that when delivered and installed by NCSS, VPS will perform in accordance with the VPS Operating Manual.

National CSS offers 3200 system users a back-up service in which the company will, for a fee, maintain current data files and user identifications on its time-sharing facilities. The service is useful as a backup measure or to provide relief from overflow situations. The current price to maintain up to 30 identifications and passwords, updated once weekly, at one NCSS data center is $50 per month. Users can also

maintain one disk pack with correct file allocation and data, updated once a week, for $50.

The NCSS Installation Services Package includes up to four man-weeks of education, at either the customer site or one of NCSS's branch offices, and up to 10 sets of user documentation and one set of operator documentation.

NCSS also offers contract services which provide consulting, programming, system design, and project management services.■

EQUIPMENT PRICES

		Purchase Price	Monthly Maint.
PROCESSOR AND MAIN MEMORY			
3200 Processor with 256K bytes of memory, byte multiplexer channel, console CRT and printer, and VPS operating system		$145,000	$790
Additional memory, 256K bytes		15,000	69
3200 Selector Channel		13,500	85
PACKAGED SYSTEMS			
3200-PC	Includes one 3200 processor, 256K bytes of main memory, one byte multiplexer, one selector channel, CRT console and printer, and VPS operating system	158,500	875
3208	Includes one 3200 processor with 512K bytes of main memory, one byte multiplexer channel CRT console and printer, one 200-MB disk drive and controller, one 75-ips magnetic tape drive and controller, an 8-line communications subsystem, and VPS operating system	238,650	1,572
3216	Includes one 3200 processor with 768K bytes of main memory, one byte multiplexer channel, CRT console and printer, two 200-MB disk drives and controller, one 75-ips magnetic tape drive and controller, a 300-lpm printer, a 16-line communications subsystem, and VPS operating system	296,500	2,123
3232	Includes one 3200 processor with one megabyte of main memory, one byte multiplexer channel, CRT console and printer, four 200-MB disk drives and two controllers, a fixed-head disk subsystem, one 125-ips magnetic tape drive and controller, a 600-lpm printer, a 32-line communications subsystem, and VPS operating system	393,650	3,246
3248-NT	Network System; includes three processors; consists of two 3208 systems and one 3232 system; network software also provided	890,100	6,390
MASS STORAGE			
3200 Disk Controller		22,000	75
Disk Drive, 3330-type, 200 megabytes		19,150	200
INPUT/OUTPUT UNITS			
3200 Tape Controller		17,000	59
9-Track Tape Drive, 800/1600 bpi, 75 ips		11,000	127
9-Track Tape Drive, 800/1600 bpi, 125 ips		13,000	147
3200 Printer Controller		8,200	25
Printer, 300 lpm		10,000	185
Printer, 600 lpm		16,000	220
Printer, 1000 lpm		20,000	320
COMMUNICATIONS			
3200 Communications Controller, 8 lines		9,500	252
Line Expansion; provides 8 additional lines; maximum of 3 per system		5,500	72

National CSS Inc.
NCSS 3200 System

SOFTWARE PRICES

	Purchase Price	Monthly Maint.	Annual License & Maint.
IBM Languages (VSBASIC, ANS COBOL, FORTRAN-H, PL/1, VSAPL, and ASSEMBLER-H)	1,200 each	IBM fee	—
HASP, RSVP	2,500	25.00	900
File/Printer Spooling	5,000	50.00	1,800
Packet-Switched Terminal Comm.	10,000	100.00	3,700
User Accounting	1,000	10.00	375
System Monitoring	250	2.50	95
File Back-Up	500	5.00	185
Text (Script Editor)	500	5.00	185
NCSS Languages (XBASIC, COBOL-F, FORTRAN-G, PL1-F, ASSEMBLER-F, OSSORT)	750	7.50	280
NOMAD	35,000	150.00	10,500