# Wang Laboratories VS Systems

## MANAGEMENT SUMMARY

The Wang VS systems originated in October 1977 with the introduction of the WCS-60 and WCS-80 systems, which were later renamed the VS-C and VS-E, respectively. In mid-1978 Wang rounded out the VS line with the introduction of the VS-B. The VS-C and VS-E were subsequently dropped, and the VS-100 was announced in June 1979. In May 1980, Wang announced the VS-50.

Though similar in many ways to earlier and smaller Wang computer systems, the VS systems are significantly different in design and aimed at a different market. The highly interactive, commercially oriented, multi-user VS systems are targeted at the distributed data processing and office automation requirements of large corporations that wish to provide remote-site computer power in their divisions, plants, and warehouse sites, down to operating department levels. They are also intended to interest first-time users who require multiprogramming capabilities as well as current computer users who want to upgrade from a batch to an interactive computing system. Wang also seeks to interest its own users whose processing and storage requirements are beginning to reach the limits of the previously available 2200-based configurations.

The capacities and capabilities of the VS systems are designed to match the performance of IBM's product line from the System/34 through the System/370 Model 158, the 4300 and the 3032, serving as System/3 and System/34 replacements at the low end. Wang also expects the systems to compete with such offerings as the HP 3000, DEC's PDP-11/44 and 11/70, and DG's CS and to prove attractive to users who would upgrade to System/38. Wang positions the VS-50, VS, and VS-100 power with the 370/125, the 370/135, and the 370/158, respectively.

**The VS-50, VS, and VS-100, Wang's current line of medium-scale business systems, employ virtual memory and stack architecture. Multiple intelligent Input/Output Processors built around microprocessors control peripheral equipment and provide direct access to memory. Input/output and processing overlap. Prices start at $19,000.**

**MAIN MEMORY: 128K to 2,048K bytes**
**DISK CAPACITY: 308K to 4.6 billion bytes**
**WORKSTATIONS: Up to 32 on the VS-50 and VS; up to 128 on the VS-100**
**PRINTERS: 40 cps to 600 lpm**
**OTHER I/O: Magnetic tape**

## CHARACTERISTICS

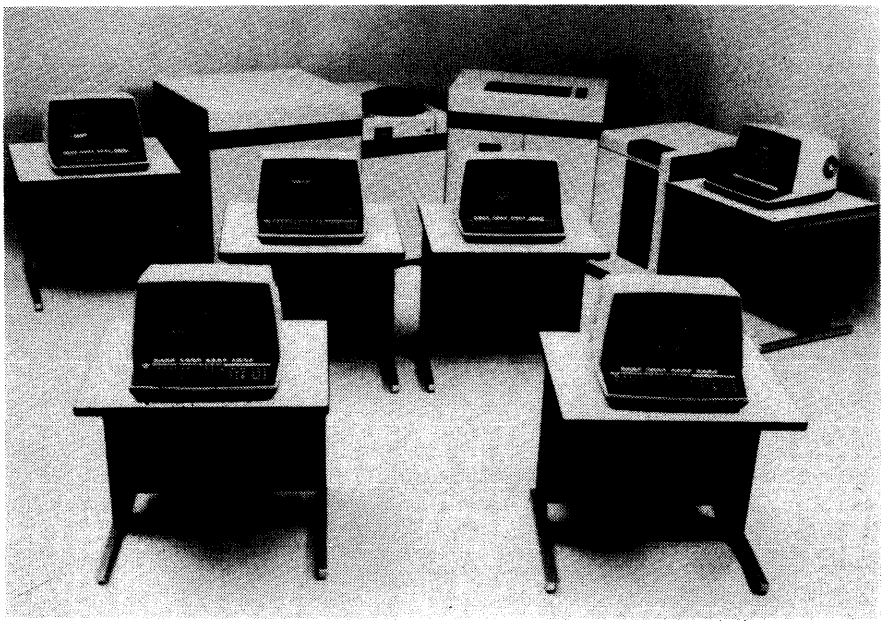
**MANUFACTURER: Wang Laboratories, Inc., One Industrial Avenue, Lowell, Massachusetts 01851. Telephone (617) 459-5000.**

**Wang Laboratories was one of the first companies to produce programmable calculators. These products have now been expanded into a broad range of minicomputer-based business computing and word processing systems. Wang Laboratories maintains sales and service offices in over 300 cities worldwide.**

**MODELS: VS-50, VS, and VS-100 systems.**

**DATA ANNOUNCED: October 1977 (VS); May 1980 (VS-50); June 1979 (VS-100).**

**DATE OF FIRST DELIVERY: December 1977 (VS); November 1980 (VS-50); second half of 1980 (VS-100).**



Features of the VS-100, top of Wang's VS family of virtual storage systems, include up to two megabytes of main memory, a 32K-byte cache memory, and 32-bit architecture. The VS-100 supports up to 4.6 billion bytes of disk storage and 128 workstations. The existing VS languages—COBOL, BASIC, RPG II, Assembler, and Procedure—are to be complemented by the addition of FORTRAN and PL/1. Prices for the VS-100 start at $69,000.

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The VS systems employ virtual memory, stack architecture, and an IBM 360/370-type instruction set. Another noteworthy feature is the use of multiple intelligent input/output processors (IOP's) built around microprocessors. Each IOP controls a peripheral subsystem, handling all data transfers between the devices and memory on a direct path. The IOP's allow I/O processing to occur simultaneously with computer instruction processing.

The VS systems are modular and can be expanded from minimal configurations to larger systems by installing optional memory plus peripheral devices such as disk drives, printers, magnetic tape drives, telecommunications devices, and workstations. The systems are currently offered in three models designated the VS-50, the VS, and the VS-100.

The VS-50 and VS are available with from 128K to 512K bytes of main memory, eight IOP slots for the VS and seven for the VS-50, and up to 32 workstations. They can support 2.3 billion bytes of disk storage. VS-100 models have from 256K to 2,048K bytes of main memory, sixteen IOP slots, and up to 128 workstations. A VS-100 can support 256 devices, and disk storage on the VS-100 can go as high as 4.6 billion bytes.

The VS-50 is fully peripheral- and software-compatible with other VS systems. Data processing, word processing, electronic mail, and telecommunications can all be handled from the same workstation. An internal dual-sided, double-density diskette coupled with a workstation forms what Wang has designated an "archiving workstation" facility. This provides for the archiving of word processing documents; data interchange with IBM 3741-type devices; storage and processing of VS/DP files; backup data processing files using dual-sided, double-density diskettes; and dual-sided, double-density diskette file interchange compatibility with IBM-compatible computers and with other Wang systems. The 2246C, an integrated information terminal, can be used with a VS-50 and supports both data processing and word processing. A 28-megabyte, internal, Winchester disk drive is standard on the VS-50. The VS-50 is scheduled for initial U.S. delivery in November 1980. International delivery will begin in December.

The VS-100 maintains complete compatibility within the existing VS product line. The VS-100's features include 32-bit hardware architecture, a 64-bit high-speed system bus, 32K bytes of cache memory, bus adapters which facilitate the addition of input/output processors, increased memory and disk storage capacity, expanded local and remote workstation capacities, telecommunication options which complement the VS-100's operation in a distributed environment, and an integrated information terminal, the 2246C, designed to support word processing, data processing, and office system software functions. The bus adapters on the VS-100 act as a buffer between up to eight input/output processors and the central processor and main memory. This approach improves the rate of data transfer between devices, thereby increasing system

## DATA FORMATS

**BASIC UNIT: 16-bit halfword (VS-50 and VS); 32-bit word (VS-100).**

**INSTRUCTIONS: 170 + 5 privileged.**

**INTERNAL CODE: ASCII.**

### MAIN STORAGE

**STORAGE TYPE: MOS random-access memory (RAM).**

**CYCLE TIME: 660 nanoseconds per two bytes on the VS-50 and VS; figure not yet available for the VS-100.**

**CAPACITY: The VS and VS-50 are sold with a minimum of 128K bytes of user memory and can be expanded to a maximum of 512K bytes. The VS-100 is sold with a minimum of 256K bytes of user memory and can be expanded to a maximum of 2,048K bytes in 256K-byte increments. A 32K-byte cache memory is standard on the VS-100 and supports high-speed read access to the central processor.**

**CHECKING: A built-in method of main-memory parity checking provides for automatic correction of single-bit errors on the fly, detection of all two-bit errors, and detection of most multi-bit errors involving more than two bits.**

**STORAGE PROTECTION: Provided, but Wang has not released any details to date.**

### CENTRAL PROCESSOR

**GENERAL: The CPU for the VS systems contains the VS central processor, a memory controller, and multiple input/output processors. The VS accesses and executes operating system and user program instructions and provides high-speed registers into which data can be loaded, operated on arithmetically and logically, and stored back into main memory. One of the registers serves as an interval timer to provide time-of-day and date. System and user programs are executed in machine instruction (object code) format. The instruction set used for the VS systems is based on the IBM 360/370 instruction set with additional stack management, queue management, and data manipulation instructions.**

**The memory controller in the CPU provides the system's I/O processors with their own paths to memory for concurrent I/O operations.**

**REGISTERS: There are sixteen 32-bit general-purpose registers used for memory addressing and for binary (fixed-point) arithmetic, four 64-bit floating-point registers used for floating-point arithmetic, and eight 32-bit special control registers for use by the central processor.**

**ADDRESSING: Each position of the VS memory can be directly addressed by the VS processor. Addresses 0 to 4095 can be generated without a base address or index. These addresses include all reserved addresses used by the system for fixed purposes.**

**INSTRUCTION REPERTOIRE: The VS systems have an IBM System/360-style instruction set. There are 170 instructions including the following types: fixed point, decimal, floating-point, logical, linked list, semaphore manipulation, and stack-oriented. In addition, there are five privileged instructions.**

**INSTRUCTION TIMING: Wang has not released any instruction timing information to date.**

**INTERRUPTS: The interrupt system permits the central processor to change state as a result of conditions in I/O**

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| DEVICE | DESCRIPTION AND SPEED | MANUFACTURER |
|---|---|---|
| **MAGNETIC TAPE** | | |
| 2209V | Magnetic tape drive; 9-track, 1600 bpi, 75 ips, 120K bps | Kennedy |
| 2209V-2 | Dual-density magnetic tape drive; 9-track, 800/1600 bpi, 75 ips | Kennedy |
| 2209V-3 | Magnetic tape drive; 7-track, 800-bpi, 75 ips, 60K bps | Kennedy |
| **PRINTERS** | | |
| 2221V | Matrix printer; 132-position, 96-character, 200 cps, with stand | Wang |
| 2231V-2 | Matrix printer; 132-position, 96-character, 120 cps | Wang |
| 2273V-1 | Band printer; one utility band (other character sets available), 250 lpm, for use only with 2246R remote workstation | Dataproducts |
| 5521 | Matrix character printer; 132-position, 96-character, 9 x 9 dot matrix, 200 cps, with stand | Wang |
| 5531-2 | Matrix character printer; 132-position, 96-character, 7 x 9 dot matrix, 120 cps | Wang |
| 5570 | Line printer; 132-position, 64-character, chain, 600 lpm | Data Printer |
| 5571 | Line printer; 132-position, 96-character, Courier font, chain, 430 lpm | Data Printer |
| 5573 | Band printer with one utility band (other character sets available), 250 lpm | Dataproducts |
| 5574 | Same as 5573 but 600 lpm | Dataproducts |
| 6581W | Wheel printer; 132- or 158-position, 86-character, daisy wheel, 40 cps, bi-directional, red and black ribbon, programmable underscoring, for word processing or data processing use | Wang |
| 6581WC | Same as 6581W with wide carriage | Wang |
| **WORKSTATIONS** | | |
| 2246C | CRT combined (data processing/word processing) workstation; includes 12-inch CRT display, alphanumeric keyboard, numeric keypad, special function keys, 24 lines of 80 characters, for word processing and data processing use | Wang |
| 2246P/S | CRT workstation; includes 12-inch CRT display, alphanumeric keyboard, numeric keypad, special functions keys, 24 lines of 80 characters | Wang |
| 2246R | Remote CRT; same features as 2246P/S with controller and printer interface | Wang |

throughput and performance. Wang claims that this increase is from eight to ten times over the performance of the other VS series. The VS-100's main memory is augmented by a 32K-byte cache memory that provides high-speed access to the central processor, allowing the central processor to operate at maximum speed. A central processor "look-ahead" feature can also initiate the pre-fetching of data from main memory in anticipation of the processor's need for this data. The VS-100 will not support parallel devices. Delivery is scheduled for the second half of 1980.

Any combination of printer, disk, tape, and communications IOP's is allowed, restricted only by the number of IOP slots available in the CPU. Eleven available printers offer a choice of printing speeds and include matrix, wheel impact, band, chain, and image printers and photocomposition. Nine-track or seven-track, 800- or 1600-bpi magnetic tape drives are available, as well as telecommunications options with a wide range of transmission rates and most of the common industry protocols.

Each workstation attached to a VS system consists of a 24-line, 80-character-per-line CRT display and keyboard. Multiple jobs can be run concurrently, and the total number of interactive jobs and users is limited only by the number of workstations attached to the system. In a multi-workstation configuration, one of the workstations is designated as the system console/user work-

**devices or in the processor itself. Five classes of interrupt conditions are possible: I/O, clock, program, supervisor call, and machine check.**

**PHYSICAL SPECIFICATIONS: The CPU chassis is 41 inches high, 36 inches wide, and 32 inches deep. Power requirements are 230 VAC ±10 percent at 60 Hz. The operating environment is 50 to 90 degrees F. and 20 to 80 percent relative humidity. The recommended relative humidity range is 35 to 65 percent.**

### INPUT/OUTPUT CONTROL

**The VS CPU uses microprocessor-based controllers that Wang calls I/O processors (IOP's). Each IOP controls several devices, handling all data transfers between them and memory on a direct path and handling error checking and corrections. The six IOP types and their functions include:**

- **22V01 Printer/Workstation IOP—supports one printer and up to three 2246P workstations or four 2246P workstations.**
- **22V02 Diskette—supports one 2270V 315,000-byte diskette drive.**
- **22V08 75/228/30/60/90-Megabyte Removable Disk Drive IOP—supports any combination of up to four 2280V-1, -2, and -3; 30-, 60-, and 90-megabyte fixed/removable disk drives; 2265-1 75-megabyte removable disk drives; and 2265V-2 288-megabyte removable disk drives in any combination.**
- **22V05 7/9-Track Tape Drive IOP—supports up to four 2209V magnetic tape drives.**

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station. Data processing work and functions can be done from the system console, but word processing is prohibited.

The Virtuial Storage Operating System available with the VS systems provides virtual memory capability, automatic print spooling, automatic program sharing, file management, data security to the record level, and background processing. Both sequential and indexed sequential files are allowed with fixed, variable, and compressed records.

Files can be shared for consecutive update and retrieval. The VS memory management technique allows each workstation on the system a virtual memory capacity of one million bytes. A job control language is not employed with the VS processors; the system's operations are controlled through operator communications via the system workstation. There is, however, a Procedure language for running single or multiple programs in a stream or for certain logical operations.

Software for the VS systems includes a macro assembler as well as interactive BASIC, COBOL, RPG II, PL/1, and FORTRAN compilers. This marks the first time Wang has offered support for programming languages other than BASIC. Program modules can be written in any of the supported languages and linked together. PL/1 and FORTRAN will be available in December 1980 and April 1981, respectively. The user's choice of one of the five compilers is bundled with the systems.

A VS-50 system with 128K bytes of main memory, seven IOP slots, a 1.2-megabyte diskette drive, a 28-megabyte internal fixed-disk drive, a workstation, operating system, resource management software, assembler, and a choice of one compiler (BASIC, COBOL, RPG II, PL/1, or FORTRAN) costs $32,900 with a monthly maintenance fee of $450. The same configuration with 512K bytes of memory costs $53,900 with $714 monthly maintenance.

A VS CPU with 128K bytes of main memory, a 308K-byte diskette drive and IOP, a chassis with seven available IOP slots, cabinets, operating system, resource management software, assembler, and the user's choice of one compiler is priced at $19,000 with monthly maintenance at $264. A similar system with 512K bytes of memory costs $37,000 with $525 monthly maintenance.

The VS-100 starts with a CPU which includes a 256K-byte main memory, a 32K-byte cache memory, a chassis with 16 IOP slots, a bus adapter with interface for eight IOP's, operating system, resource management software, programming and operations utilities, assembler, and a choice of one compiler at $69,000 with monthly maintenance of $572. Increasing memory to 2,048K bytes raises the price to $125,000 and monthly maintenance to $1,034.

- **22V06 Communications IOP—available in three models to support one, two, or three bisynchronous telecommunications lines.**
- **22V07 Serial IOP—available in two models to support either eight or sixteen 2246S/C workstations or serial printers.**

**SIMULTANEOUS OPERATIONS: All I/O devices on the VS systems are connected to the VS processor by means of the Input/Output Processors (IOP's). The IOP's permit data processing to proceed concurrently with I/O operations and I/O operations on different IOP's to occur concurrently.**

### CONFIGURATION RULES

**Memory for the VS-50 and VS can be expanded from 128K bytes to 512K bytes. For the VS-100, memory can be expanded from 256K bytes to 2,048K bytes in increments of 256K bytes.**

**The VS-50 and VS have eight IOP slots, while the VS-100 has sixteen. Any combination of printer, disk, tape, and communications Input/Output Processors is allowed, restricted only by the number of IOP slots available in the CPU.**

**The VS-100 is a serial processor and will not support parallel interfaces.**

**WORKSTATIONS: The VS-50 and VS can support up to 32 workstations, and the VS-100 can support 128. In multi-workstation configurations, one of the workstations is designated as the system console. The 22V01 printer/workstation I/O processor (for use with the VS-50 and VS) will control up to four 2246P workstations or up to three workstations and one printer. The two models of the 22V07 serial I/O processor will support eight or sixteen 2246S/C workstations or serial printers.**

**DISK STORAGE: The VS-50 and VS can support up to 2.3 billion bytes of disk storage, and the VS-100 can support 4.6 billion. All of the cartridge and pack disk drives require independent Input/Output Processors. Each IOP controls one or more I/O devices and has a direct path to main memory. Up to eight 2265V and 2280V disk drives can be supported by the VS-50 and VS processors and up to sixteen by the VS-100. A 308K-byte diskette is an integral part of the VS CPU, and a 28-megabyte Winchester disk drive is integrated into the VS-50.**

**MAGNETIC TAPE UNITS: Each 22V05 tape drive IOP will support up to four drives.**

**PRINTERS: See WORKSTATIONS above.**

### MASS STORAGE

**2280V FIXED/REMOVABLE DISK DRIVE: The three models of the 2280V can store 30, 60, or 90 megabytes. The removable disk cartridge and the first fixed disk each contain 15 megabytes, and the second and third fixed disks, when present, each contain 30 megabytes. The operational characteristics are the same as those of the 2265V disk drives, below.**

**2265V DISK DRIVES: There are two models of the 2265V: the 2265V-1, which stores 75 megabytes on five platters; and the 2265V-2, which stores 288 megabytes on 19 platters. Aside from capacity, their operational characteristics are the same. The disks revolve at 3600 rpm. Average rotational delay is 8.33 milliseconds. Average access time is 38 milliseconds. The data transfer rate for both the 2265V-1 and 2265V-2 is 1.2 megabytes per second. The drives are manufactured by Control Data.**

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## USER REACTION

Twenty-nine users of Wang VS systems responded to Datapro's 1980 user survey, reporting on a total of 35 installed systems.

The users included a supplier of hospital services, an international educational institute, data processing service bureaus, a large bank, manufacturers, consulting firms, a medical care evaluation unit, and an employee benefits department. The principal applications reported were accounting, word processing, payroll and personnel, transaction processing, service bureaus, distributed processing, construction, medical/health care, transportation, inventory control, manufacturing, insurance, government, banking/finance, engineering/scientific, and retail. Other applications reported included stock quotations, software development, and management consulting.

The 35 systems are supporting 256 workstations, with 32 being the largest number on a single system. There were 56 printers reported, with 16 on one system (the same system which, incidentally, has the 32 workstations).

In-house personnel wrote applications programs for 23 of the users. Other applications programs had come from contract programming houses, from vendors of proprietary software packages, and from Wang in the form of "ready-made" programs. COBOL, BASIC, RPG II, and assembler were the programming languages in use. The systems had been in use an average of twelve months. Fifty-seven of the systems have been purchased, 25 are leased, and 18 are rented.

One user plans to replace his system in 1980 with other Wang equipment. Planned acquisitions or implementations include expanded data communications facilities, integrated word processing capabilities, software from suppliers other than the vendor, distributed processing capabilities, and additional software from the vendor.

The ratings assigned by these 29 VS system users are tabulated below.

| | Excellent | Good | Fair | Poor | WA* |
|---|---|---|---|---|---|
| Ease of operation | 23 | 6 | 0 | 0 | 3.8 |
| Reliability of mainframe | 19 | 10 | 0 | 0 | 3.7 |
| Reliability of peripherals | 13 | 16 | 0 | 0 | 3.4 |
| Maintenance service: | | | | | |
| Responsiveness | 14 | 6 | 8 | 1 | 3.1 |
| Effectiveness | 12 | 11 | 6 | 0 | 3.2 |
| Technical support: | | | | | |
| Trouble-shooting | 8 | 13 | 6 | 2 | 2.9 |
| Education | 1 | 10 | 9 | 6 | 2.2 |
| Documentation | 0 | 15 | 7 | 7 | 2.3 |
| Manufacturer's software: | | | | | |
| Operating system | 19 | 9 | 1 | 0 | 3.6 |
| Compilers and assemblers | 15 | 13 | 1 | 0 | 3.5 |
| Applications programs | 6 | 6 | 1 | 1 | 3.2 |
| Ease of programming | 22 | 7 | 0 | 0 | 3.8 |
| Ease of conversion | 11 | 10 | 3 | 0 | 3.3 |
| Overall satisfaction | 17 | 12 | 0 | 0 | 3.6 |

*Weighted Average on a scale of 4.0 for Excellent.

**For each 2K-byte block on the 2265V and 2280V, a 35-bit error correction code is written that is capable of correcting up to 12 contiguous bit errors and of detecting errors of more than 12 bits.**

**2270V DISKETTE DRIVE: This drive is an integral part of the VS CPU. It has 77 cylinders with 1 track per cylinder, 16 sectors per track, and 256 bytes per sector for a total capacity of 315,400 bytes. Rotational speed is 360 rpm and average rotational delay is 83 milliseconds. Average access time is 508 milliseconds. The data transfer rate is 31K bytes per second. The 2270V Diskette Drive is manufactured by Control Data.**

**VS-50 INTEGRAL DISK DRIVE: A 28-megabyte Winchester disk drive is integrated into the VS-50 (only). Average access time is 64 milliseconds, and data transfer rate is 899 megabytes per second. The drive is manufactured by Shugart.**

## INPUT/OUTPUT UNITS

**Please see the Peripherals/Terminals table.**

## COMMUNICATIONS CONTROL

**22V06 COMMUNICATIONS IOP: Available in three models to support one (22V06-1), two (22V06-2), or three (22V06-3) bisynchronous lines, this IOP occupies one slot in the CPU. It supports emulation of the IBM 2780, 3270, and 3780 workstations and also supports remote 2246R workstations. At least one bisynchronous line supports an automatic calling unit. Line speeds include 1200, 2400, 4800, 9600 bits per second. On the multiple-line IOP's, each line is independently programmed so that it is possible to run different protocols on separate lines concurrently from the same IOP.**

## SOFTWARE

**OPERATING SYSTEM: The *Virtual Storage Operating System* available with the VS systems is an interactive, multi-user operating system that is resident on disk media. It consists of four functional areas: 1) supervisor services, including task scheduling, interrupt handling, page fault handling (system software support for the hardware virtual memory scheme), and link/unlink support; 2) data management support, including disk volume management and file security; 3) command/debug processor for running a program or procedure and interactive debugging; and 4) system tasks, including a system console task responsible for unspooling and background processing and a file sharer task which gives multiple users shared access to the same set of files. The operating system occupies from 13K to 25K bytes of main memory, depending upon the task.**

**DATA BASE SYSTEMS: *VS-ADMS,* Wang's Advanced Data Management System, features logical data independence, automatic restart and recovery, a multi-user update capability, a data dictionary which allows for centralized control of data and application systems, and multiple access paths. Existing programs will run under VS-ADMS without conversion. VS-ADMS permits centralized organization and control of a company's entire data base, allows program-independent data description, facilitates shared access to common information, and provides data security features. The separation of the data description function from programs using the data provides control over the data base and insulates application programs from most changes to the data descriptions. Two types of data security are provided: 1) protection against unauthorized use and modification of data and 2) assurance of data integrity. VS-ADMS is available at no cost to the user.**

**With *VS-DBMS,* the Data Base Management System (an extended network data model), all data descriptions relating**

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Thirteen of the users reported that they had experienced problems with their systems. Seven had encountered late delivery or installation of the equipment; four said that all promised software and support had not been provided; four felt that enhancements and changes to hardware and software are hard to keep up with; and three had experienced late delivery of software. Two complained about noisy equipment (6581 printers and workstations), and one said he has "no local service personnel."

On the other hand, almost every possible advantage was checked on at least one survey form. Sixteen users are happy with their systems' response time; twenty feel that the systems are easy to expand or reconfigure; and twenty-two users feel that their programming costs are kept down by available productivity aids.

We feel that one user's additional comments are worth quoting at length. This particular user's system has 320K bytes of memory, 225 megabytes of disk storage, 308K bytes of diskette storage, a mag tape drive, four printers, and ten workstations and has been in use since February 1979. He wrote, "We have been extremely pleased with the Wang VS. The integrated Text Editor, User Aids... make programmers productive and happy. Price/performance is best I have seen. Have used 360's from Mod 20 to 65, DOS & OS/MVT and Univac 1108—none can match Wang for ease of operation and ease of program development. I evaluated Univac 90/30, H-P 3000 Series III, DG C350, and Harris 120 before selecting the Wang VS. The Wang VS was selected based on ease and speed of COBOL conversion and price/performance. We are continually amazed at the power of this system."

Another user wrote, "The Wang serviceman calls *me* and asks if there are any problems! Program development is the easiest I've seen on minicomputers or mainframes."

Twenty-eight of the reporting users said that they would recommend the Wang VS system to other users. One user did not answer this question. □

to the organization of the data base are entered and manipulated interactively via Wang's data description processor at the workstation. VS-DBMS features physical data independence (physical storage descriptions of data are created and maintained independently of logical descriptions); the ability to define complex relationships among records in the data base, and set modelling capabilities, ranging from simple hierarchies to complex networks; special data management language extensions to each of the high-level languages, including verbs which facilitate accessing, modifying, storing, and deleting records in the data base; and a variety of access paths for fine-tuning the data base relational characteristics to facilitate query language capabilities.

LANGUAGES: Four interactive programming languages are currently provided for the VS systems: *COBOL, RPG II, BASIC,* and *Assembly* language. There is also a *Procedure* language used to simplify the routine running of operational programs. PL/1 and FORTRAN compilers will become available in December and next April, respectively.

The *COBOL* language meets all ANSI 1974 Level 1 specifications and most Level 2 specifications. Also, many Wang extensions have been incorporated, primarily to simplify interactive use of the workstations.

*RPG II* is implemented with language extensions to support interactive programming from workstations. These features facilitate the creation of formatted displays and the acquisition and validation of user input. Other features of Wang RPG II include support for demand files and exception output; direct files and ADDROUT files (which contain relative record numbers and are used for the RPG II sort address output files); limited interprogram communication with the capability to call assembler programs and pass parameters; and disk file processing, calculations, and output specifications that are compatible with IBM System/3 RPG II.

The *Procedure* language can also be used to standardize the serial operation of production programs in a prescribed way. This language permits pre-entry of operator input, backward referencing to file names from previous programs in the procedure, "nested" procedures within procedures, and the ability to test any program's completion code.

Wang VS *PL/1* is a superset of the G subset language currently under adoption review by ANSI. PL/1 provides the most useful features such as block structure, data types, flexible I/O constructs, and programmer control of exception handling. Interactive extensions to the VS PL/1 language enable the programmer to display, accept, and validate data from the workstation for processing. Screen format, like printer output, may be controlled by system defaults or set by the programmer.

Wang VS *FORTRAN* is in compliance with ANSI FORTRAN 77 (X3.9-1978), which offers the functional capability to process a high volume of integer, real (floating point), double-precision, complex, and Boolean data types. VS FORTRAN supports logarithmic and trigonometric operations, as well as truncation, absolute value, and square root functions; character string data types; multidimensional arrays (up to seven dimensions); mixing of integer, real, double-precision, and complex operations in arithmetic expressions; expanded DO loop capabilities; internal files; list-directed formatting; a control information list composed of six specifiers; and the ability to determine the current status of file attributes during program execution.

The *Assembly* lanaguage is an IBM 360/370-like source language which permits a programmer to write programs at the machine-instruction level. The assembler has a macro capability, allowing the user to precode routines, place them in a macro library, and custom-fit them into the program at assembly time. The assembler supports stack and queue manipulation operations, interprogram communication with semaphore and message buffer manipulation, and data compaction for more efficient use of storage.

All of the languages support Wang's implementation of data compaction. Up to 127 consecutive characters of the same kind (all kinds of characters can be compressed) are compressed to two characters: a count and the character. The data is compressed or decompressed upon request at the time it is transferred between the I/O buffer and the user work area.

UTILITIES: The VS utilities include both programmer utilities and operational utilities. They are:

- ASSEMBLE—Assembles a source program written in VS macro assembler language.
- BACKUP—Creates backup copies of and restores important volumes.
- CONDENSE—Creates a data file with a single record type from a file with multiple record types so that

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a report can be generated based on the multiple record types.

- CONTROL—Used to define attributes and validation criteria for a data file in conjunction with DATAENTRY, REPORT, and EZFORMAT.
- COPY—Copies files, libraries, or entire volumes from one location to another.
- COPY WP—Converts word processing (WP) documents to VS data processing (DP) files and vice versa, providing a method of information exchange between the Wang VS and Word Processing Systems.
- COPY 2200—Copies and automatically converts file from 2200 format to VS format and vice versa.
- DATAENTRY—Used to creat and update files; automatically formats a user screen.
- DISKINIT—Initializes a new disk volume in VS format, with a volume label and volume table of contents.
- DISPLAY—Displays the contents of a file on the workstation screen.
- DUMP—Produces a printed copy of a task dump previously written to diskette with the DUMP AND CANCEL function of the Debug Processor.
- EDITOR—An integrated editor used to enter, edit, and compile source program text and also to execute ojbect code. An external copy option builds program from library source text.
- EZASM—Creates an integrated programming environment for the development of assembler programs.
- EZBASIC—Creates an integrated programming environment for the development of BASIC programs.
- EZCOBOL—Creates an integrated programming environment for the development of COBOL programs.
- EZFORMAT—Used to create display files for formatting the workstation screen; generates source code describing the screen.
- EZRPGII—Creates an integrated programming environment for the development of RPG II programs.
- FLOPYDUP—Duplicates a flexible diskette.
- FORMCNTL—Allows user to create a forms control definition, which is placed in a Forms Definition file for VS serial printers.
- INQUIRY—Interrogates and tests a data file for user-specified field values.
- LINKER—Combines two or more program modules into a single executable program.
- LISTVTOC—Produces complete or selective listings of a specified volume's table of contents and examines the VTOC for errors.
- PATCH—Modifies an object program file.
- PRINT—Prints the contents of a print file.
- REPORT—Used to produce customized reports from a data file.
- SORT—Sorts a data file, with an optional capability to merge two or more sorted files.
- TAPECOPY—Copies files bestween disk and tape or between two tape drives.
- TAPEINIT—Initializes new tape volumes.
- TRANSL—Automatically translates the contents of a specified file from EBCDIC to ASCII (the code used internally by the 2200VS) or vice versa.

APPLICATION PROGRAMS: Most of the currently available applications programs have been developed by users and software vendors. Wang's in-house software group has produced the utilities, standard subroutines, statistical analysis package, and accounting packages.

A description of the Wang *General Business Systems (GBS)* follows. GBS/VS, written in COBOL, supports up to 32 users and requires 512K bytes of memory. Wang does not quote prices on the programs because they are sold through contracted software vendors.

*GBS Invoicing System:* Accepts and edits invoice data entered by the operator and accesses and updates the customer file, inventory file, salesmen sales analysis file, and accounts receivable open item file. Invoices can be printed interactively as they are entered or printed subsequent to entry. A detail invoice register is also generated.

*GBS Accounts Receivable:* Creates and maintains an open item or balance forward file. On balance forward customers, all cash is entered as general payments. For open item customers, cash may be applied to specific items or entered as general payments. The mouth-end cycle includes aging and service charge computation, aged trial balance, customer statements, and file purge.

*GBS Sales Analysis:* Accumulates and reports sales analysis data by customer, by salesman, and by product. These three reports indicate sales for the current period and year to date. Sales are shown as a comparison to cost for the indicated periods.

*GBS Order Entry:* Accepts and edits order data entered by the operator. Customer files and inventory files are accessed for validation purposes. The quantity ordered is checked for availability on inventory files; the operator is notified where an overallocation situation exists; shipping papers are printed; and the open order file is updated. Orders are then accessible for adjustment and/or reprint. The shipping confirmation program then accesses individual orders to be invoiced. Corrections or changes may be entered at confirmation time.

*GBS Inventory Control:* Creates, maintains, and updates the inventory master file. Reporting includes sales analysis, stock status reporting, low stock/inactive items reports, physical inventory sheets, inventory variance reports with file adjustment, and various file inquiry reports.

*GBS Acounts Payable:* An open item accounts payable system in which vouchers are entered, edited, and verified through the CRT/keyboard and distribution to the general ledger is provided. Items are selected for payment by a specified due date or by keying specific vendor/invoice numbers. A provision is made for passing manually written checks through the system. Full file maintenance and inquiry capabilities are provided.

*GBS General Ledger:* A complete general ledger reporting system which takes the user from keying in journal entries, through the trial balance and its subsequent correcting

# Wang Laboratories VS Systems

entries, into the income statement, balance sheet, budget reports, and various schedule reports. Formats of the various reports are controlled by codes in the chart of accounts master file.

## PRICING

POLICY: The Wang VS systems are available for purchase, rent, or lease. Leases are for one, two, three, or five years, with separate service contracts mandatory for one year on leased equipment. Users must contact the vendor for lease prices.

SUPPORT: The equipment is sold with a 90-day warranty on parts and labor plus a one-year warranty on parts manufactured by Wang Laboratories. Maintenance beyond the 90-day warranty is offered on a contract basis depending on the nature of the equipment.

There is no installation charge for initial installation and testing of system(s). For add-on equipment which does not include a CPU (i.e., a workable system), there is an installation charge for both rental and purchase equipment. For workstations and/or printers, the charge is 1% of the purchase price. For all other peripherals, disks, memory, software options, etc., the charge is 3% of the purchase price. The minimum charge is $100 per order.

Sales personnel are trained at company headquarters and assigned to over 300 sales office located throughout the world. The company also has subsidiary offices and representatives in major countries throughout the world.

EQUIPMENT: VS systems and prices are listed in the following EQUIPMENT PRICES section.

## EQUIPMENT PRICES

| | | Purchase Price | Monthly Maint. |
|---|---|---|---|
| **PACKAGED CONFIGURATIONS** | | | |
| VS-4S | VS-50 CPU with 128K-byte main memory; chassis with seven available IOP slots; 28-megabyte internal, sealed, fixed disk drive; 1.2-megabyte internal diskette drive; one workstation; operating system, resource management software, assembler, and choice of (one only) BASIC, COBOL, RPG II, FORTRAN, or PL/1 | $ 32,900 | $450 |
| VS-8S | Same as VS-4S with 256K-byte memory | 39,900 | 538 |
| VS-12S | Same as VS-4S with 384K-byte memory | 46,900 | 626 |
| VS-16S | Same as VS-4S with 512K-byte memory | 53,900 | 714 |
| VS-4B | VS CPU with 128K-byte main memory, one 308K-byte diskette drive and 22V02 IOP, chassis with seven available IOP slots, cabinets, operating system, resource management software, assembler, and choice of (one only) BASIC, COBOL, RPG II, FORTRAN, or PL/1 | 19,000 | 264 |
| VS-8B | Same as VS-4B with 256K-byte memory | 25,000 | 352 |
| VS-12B | Same as VS-4B with 384K-byte memory | 31,000 | 440 |
| VS-16B | Same as VS-4B with 512K-byte memory | 37,000 | 525 |
| VS-8F | VS-100 CPU with 256K-byte main memory, 32K-byte cache memory, chassis with 16 IOP slots, bus adapter with interface for eight IOP's (one additional bus adapter is optional), operating system, resource management software, programming and operations utilities, assembler, and choice of (one only) BASIC, COBOL, RPG II, FORTRAN, or PL/1 | 69,000 | 572 |
| VS-16F | Same as VS-8F with 512K-byte memory | 77,000 | 638 |
| VS-24F | Same as VS-8F with 768K-byte memory | 85,000 | 704 |
| VS-32F | Same as VS-8F with 1024K-byte memory | 93,000 | 770 |
| VS-40F | Same as VS-8F with 1280K-byte memory | 101,000 | 836 |
| VS-48F | Same as VS-8F with 1536K-byte memory | 109,000 | 902 |
| VS-56F | Same as VS-8F with 1792K-byte memory | 117,000 | 968 |
| VS-64F | Same as VS-8F with 2048K-byte memory | 125,000 | 1,034 |
| CO-1001 | Optional bus adapter for VS-100 CPU's, to support up to eight more IOP's | 6,000 | 276 |
| **MEMORY** | | | |
| 200-02VS-1 | 128K-byte memory expansion for VS and VS-50 | 7,000 | 88 |
| 200-02VS-2 | 256K-byte memory expansion for VS and VS-50 | 14,000 | 176 |
| 200-02VS-3 | 384K-byte memory expansion for VS and VS-50 | 21,000 | 264 |
| 100-VS-F | 256K-byte memory expansion for VS-100 | 9,000 | 77 |
| **MASS STORAGE** | | | |
| 2265V-1 | Removable disk pack disk drive; 75 megabytes, without IOP | 17,000 | 173 |
| 2265V-2 | Same as 2265V-1 with 288 megabytes | 34,000 | 405 |
| 2280V-1 | Fixed/removable disk drive; 30 megabytes, without IOP | 17,000 | 195 |
| 2280V-2 | Same as 2280V-1 with 60 megabytes | 18,000 | 216 |
| 2280V-3 | Same as 2280V-1 with 90 megabytes | 19,000 | 238 |
| **MAGNETIC TAPE EQUIPMENT** | | | |
| 2209V | Magnetic tape drive; 9-track, 1600 bpi, 75 ips, 120K bps, without IOP | 13,000 | 103 |
| 2209V-B | Second thru fourth drives to be used with 2209V | 12,000 | 92 |
| 2209V-2 | Dual-density magnetic tape drive; 9-track, 800/1600 bpi, 75 ips, without IOP | 14,000 | 114 |
| 2209V-2B | Second thru fourth drives to be used with 2209V-2 | 13,000 | 103 |
| 2209V-3 | Magnetic tape drive; 7-track, 800 bpi, 75 ips, 60K bps, without IOP | 13,000 | 103 |
| 2209V-3B | Second thru fourth drives to be used with 2209V-3 | 12,000 | 92 |

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## EQUIPMENT PRICES

| | | Purchase Price | Monthly Maint. |
|---|---|---|---|
| **PRINTERS** | | | |
| 2221V | 132 positions, matrix, 96 characters, 200 cps, with stand, without IOP | $ 5,000 | $ 60 |
| 2231V-2 | 132 positions, matrix, 96 characters, 120 cps, without IOP | 3,200 | 35 |
| 5570 | Serial chain printer, 64 characters, 600 lpm, without IOP | 16,600 | 168 |
| 5571 | Line printer, 132 positions, 96 characters, Courier font, 430 lpm, without IOP | 17,500 | 184 |
| 5521 | Serial matrix printer, 200 cps, with stand, without IOP | 5,600 | 60 |
| 5531-2 | Serial matrix printer; 132 positions, 120 cps, without IOP | 4,500 | 51 |
| 2273V-1 | Band printer, one utility band, 250 lpm, other character sets available, for attachment to 2246R remote workstation only | 9,000 | 93 |
| 5573 | Band printer, one utility band, 250 lpm, other character sets available, without IOP | 9,000 | 93 |
| 5574 | Same as 5573 with 600 lpm | 12,500 | 131 |
| 6581W | Serial daisy wheel output writer (Wang), 40 cps, without IOP; WP or DP use | 6,000 | 44 |
| 6581WC | Same as 6581W with wide carriage | 7,000 | 44 |
| OP-121 | Adjustable pin-feed forms tractor for 6581W | 280 | N/C |
| **WORKSTATIONS** | | | |
| 2246C | CRT combined workstation with 12-inch CRT display, 24 x 80 characters; connects to 22V07 for local use only via coaxial cable, maximum distance 2000 ft., alternately performs WP or DP functions | 4,300 | 24 |
| 2246P | CRT parallel workstation with 12-inch CRT display, 24 x 80 characters; connects to 22V01 only, maximum distance 500 ft. | 2,800 | 18 |
| 2246R | CRT remote workstation with 12-inch CRT display, 24 x 80 characters; includes communications controller for remote stand-alone operation and printer interface | 4,300 | 42 |
| 2246S | CRT serial workstation with 12-inch CRT display, 24 x 80 characters; connects to 22V07 only via coaxial cable, maximum distance 2000 ft. | 3,200 | 24 |
| **I/O PROCESSORS** | | | |
| 22V01 | Printer/workstation IOP; controls one printer and up to three 2246P workstations or up to four 2246P workstations; not for VS-100 | 2,000 | 10 |
| 22V05-2 | Magnetic tape IOP; controls up to four 2209V, 2209V-2, or 2209V-3 drives | 3,000 | 17 |
| 22V06-1 | Telecommunications IOP; provides one bisynchronous line adapter; field-upgradable to 22V06-2 or 22V06-3 | 2,500 | 44 |
| 22V06-2 | Telecommunications IOP; provides two bisynchronous line adapters; field-upgradable to 22V06-3 | 3,300 | 55 |
| 22V06-3 | Telecommunications IOP; provides three bisynchronous line adapters | 4,100 | 66 |
| 22V07-1 | Serial workstation and printer IOP; provides up to eight serial ports supporting the 2246S/C workstation and/or serial printers | 2,500 | 18 |
| 22V07-2 | Same as 22V07-1 with up to 16 serial ports | 3,000 | 30 |
| 22V08 | 75/288/30/60/90-megabyte disk IOP; controls up to four models of any supported drive in any combination; limit of two 22V08 IOP's per VS-50 or VS CPU, four on VS-100 | 4,000 | 27 |
| 2247V-4 | Four-port modem sharing unit to support 2246R only; provides RS-232 interface; maximum cable length 2000 ft. | 700 | 25 |

## SOFTWARE PRICES

The Virtual Storage Operating System, assembler, procedure language, all system utilities, and one of the compiler languages (BASIC, COBOL, RPG II, FORTRAN, or PL/1) are bundled with the system. The choice of one language compiler is included in any VS CPU purchase price. The compiler can be used only on the system with which it was ordered. Additional languages can be purchased.

| | | Purchase Price | Monthly Maint. |
|---|---|---|---|
| 195-5300-3 | BASIC compiler | 3,000 | 25 |
| 195-5100-3 | COBOL compiler | 3,000 | 25 |
| 195-5200-3 | RPG II compiler | 3,000 | 25 |
| 195-2086-3 | PL/1 compiler (when available) | 3,000 | 25 |
| 195-2122-3 | FORTRAN 66 compiler (when available) | 3,000 | 25 |
| 195-2087-3 | FORTRAN 77 compiler (when available)<br>Note: FORTRAN ANSI 66 will be available in April 1981; will be replaced later by a compatible ANSI 77 compiler at no additional charge to customer. | 3,000 | 25 |
| 195-2078-3 | Word processing | 5,000 | 40 |
| 195-2088-3 | Data Base Management (when available) | 15,000 | 125 |
| 195-2083-3 | Mailway (electronic mail) | 2,000 | 30 |
| 195-2089-3 | TC-3270 emulation | 1,500 | N/C |
| 195-2090-3 | TCI-2780/3780 emulation | 1,000 | N/C |
| 195-2091-3 | TC-remote workstation protocol | 500 | N/C |

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## SOFTWARE PRICES

| | | Purchase Price | Monthly Maint. |
|---|---|---|---|
| HRMS-02 | Super Payroll (custom generated) | 37,000 | N/C |
| HRMS-03 | Super Payroll | 30,000 | N/C |
| HRMS-04 | Super Personnel | 42,000 | N/C |
| HRMS-05 | Super Pension | 37,000 | N/C |
| HRMS-06 | Super Payroll/Personnel (HRMS-02 and HRMS-04 bundled) | 64,500 | N/C |
| HRMS-07 | SuperPayroll/Personnel/Pension (HRMS-02, HRMS-04, and HRMS-05 bundled) | 99,500 | N/C |
| HRMS-08 | Super Personnel (add on to customer's existing Super Payroll) | 27,500 | N/C |