Control Data Cyber 900 Models 932/960/962

MANAGEMENT SUMMARY

UPDATE: *In 1988, Control Data Corporation (CDC) replaced its entire mainframe line and continued to bolster its once sagging line. The magnitude of these accomplishments is no exaggeration—this company suffered some of the biggest losses in industry history just a few years ago. To remain profitable, the Minnesota mainframe maker replaced all its systems in a single year and continues to implement a long-term connectivity and compatibility strategy. As part of its strategy, the firm has been adopting products that meet industry standards for connectivity and portability such as AT&T's UNIX operating system, the ORACLE relational data base, and the TCP/IP networking protocol. The company also brought out a new version of its NOS/VE proprietary operating system. The latest version allows the clustering of multiple systems in loosely coupled configurations and provides for additional connectivity features.*

Changes to Control Data's product line have been extensive and wide ranging. The new Cyber 900 family, consisting of 13 models, replaces the aging Cyber 180 line, which has eight models. In addition, the company continues to enhance its 910 Series of scientific workstations at the low end.

The line now consists of three entry-level 932 departmental processors, six 960/962 midrange systems, and four 990 high-end mainframes. All the systems run the NOS/VE operating system and are based on Cyber 180 architecture, enabling users to migrate applications from one system to another without performing extensive code conversion. To further enhance software portability, CDC plans to introduce a native version of UNIX during the fourth quarter of 1989. The CDC version will be based on UNIX System V and conform to the emerging POSIX

The Cyber 900 Series, consisting of three product families, now replaces the previous Cyber 180 line. The 900 line includes models that address the high-end, midrange, and departmental processing market segments. Similar to earlier products, Cyber 900 products are sold to traditional Control Data vertical markets such as the petroleum industry, electric utilities, computer-aided design/computer-aided manufacturing (CAD/CAM), government, and higher education.

MODELS: Cyber 900 Models 932-11, 932-31, 932-32, 960-11, 960-31, 960-32, 962-11, 962-31, and 962-32.
CONFIGURATION: From 8 to 256 megabytes of main memory, 5 to 30 peripheral processors, and up to 24 standard channels and up to 36 direct memory access channels.
COMPETITION: Digital Equipment VAX 8250/8350 and 6200 Series; Honeywell Bull DPS 7000, DPS 8000, and DPS 90; IBM 9370, 4381, and 3090 Series; Unisys A Series, 2200/200, 2200/400, and 2200/600.
PRICE: Purchase prices range from $59,900 to $1,570,250.

CHARACTERISTICS

MANUFACTURER: Control Data Corp., 8100 34th Avenue South, Minneapolis, Minnesota 55440. Telephone (612) 853-8100. In Canada: Control Data Canada, Ltd., 50

The new, compact Cyber 932 models are air-cooled superminis designed to work in a typical office environment. They run under the NOS/VE operating system and feature 8 to 128 megabytes of main memory and 6 to 12 I/O channels.

Control Data Cyber 900 Models 932/960/962

TABLE 1. SYSTEM COMPARISON

MODEL	932-11	932-31	932-32
SYSTEM CHARACTERISTICS			
Date announced	April 5, 1988	April 5, 1988	April 5, 1988
Date first delivered	July 1988	July 1988	July 1988
Field upgradable to	932-31, 932-32	932-32	—
Relative performance	2.0 MIPS*	Not specified	5.6 MIPS
Number of processors	1	1	2
Cycle time, nanoseconds	50	50	50
Word size, bits	64	64	64
Operating systems	NOS/VE	NOS/VE	NOS/VE
MAIN MEMORY			
Type	1M-bit DRAM	1M-bit DRAM	1M-bit DRAM
Minimum capacity, bytes	8M	8M	16M
Maximum capacity, bytes	128M	128M	128M
Increment size, increment	8M, 16M, 64M	8M, 16M, 64M	8M, 16M, 64M
Cycle time, nanoseconds	400	400	400
BUFFER STORAGE			
Minimum capacity	32KB	32KB	32KB
Maximum capacity	32KB	32KB	32KB
Increment size	0	0	0
INPUT/OUTPUT CONTROL			
Number of channels:			
Byte multiplexer	0	0	0
Block multiplexer	0	0	0
Word	0	0	0
Other	6 to 12	6 to 12	6 to 12
PURCHASE PRICE	$59,900	$125,900	$213,800

**Millions of instructions per second.*

standard. UNIX will run on all its systems—workstations, mainframes, and ETA10 supercomputers. ETA Systems, which makes supercomputers, is a CDC subsidiary.

The availability of new mainframes, in addition to workstations and supercomputers, represents part of a calculated attempt to broaden the CDC customer base. The plan is to draw new users outside the traditional engineering/scientific base. The company markets systems to new office automation customers in addition to its existing base of government users and petroleum, utilities, and manufacturing concerns.

With the introduction of the new 900 family, Control Data doubled main memory capacities, augmented channel options, and improved processor and memory cycle times by using the latest chip technologies.

The entry-level 932 Series includes the 932-11 and 932-31 single processors and the 932-32 dual processor. Announced in April 1988, the 932 line replaces the earlier 930 processors. With the use of new one-megabit memory chips, the new models have twice the memory range of the earlier systems. Memory now ranges from 8 to 128 megabytes. Denser circuit technology also allows the company to package the systems using fewer boards. Cyber 930 models use 256-kilobit memory chips. To double memory capacity to 128 megabytes, 930 customers can purchase expansion boards. Cyber 930-31 users can also upgrade to a dual 932-32 system. The enhanced 932 systems first became available in July 1988.

Similar to the earlier 930s, the replacement models provide a low-cost entry into the Cyber 900 family. The compact systems can operate in a typical office setting without the need or expense of a traditional computer

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MODELS: Cyber 900 Models 932-11 and 932-31, single processors; 932-32, dual processor; 960-11 and 960-31, single processors; 960-32, dual processor; 962-11 and 962-31, single processors; and 962-32, dual processor.

DATA FORMATS

BASIC UNIT: Eight 8-bit characters (full ASCII) in main storage and central processors and a 16-bit word in peripheral processors and input/output (I/O) channels.

FIXED-POINT OPERANDS: Sixty-four bits in central processors and sixteen bits in peripheral processors.

FLOATING-POINT OPERANDS: Eight 8-bit characters, consisting of a 48-bit coefficient and a 16-bit exponent. (Unrounding floating-point operations generate double-precision results. The upper and lower halves—each consisting of a 48-bit coefficient and 16-bit exponent—can be separately recovered.)

INSTRUCTIONS: Cyber 900 central processor instructions use 64 bits for data. This allows two 16-bit instructions and one 32-bit instruction to be stored as one central processor word. Instructions vary in length by byte multiples. Instructions less than a full 64-bit word can be packed together; that is, two 16-bit and one 32-bit instruction or four 16-bit instructions can be stored in the central processor as one word.

All operands are in the twos complement form and are 64-bit-long integers with 32-bit integer operands. Both words and bytes may be addressed. Word-oriented instructions or 64-bit operand arithmetic always uses a word boundary. The 64 bits are not split among bytes of two different words.

Control Data Cyber 900 Models 932/960/962

TABLE 1. SYSTEM COMPARISON (Continued)

MODEL	960-11	960-31	960-32	962-11	962-31	962-32
SYSTEM CHARACTERISTICS						
Date announced	April 18, 1988	April 18, 1988	April 18, 1988	April 18, 1988	April 18, 1988	April 18, 1988
Date first delivered	3Q88	3Q88	3Q88	3Q88	3Q88	3Q88
Field upgradable to	960-31	960-32	Not applicable	962-31	962-32	Not applicable
Relative performance	1.0	1.67	3.0	1.0	1.67	3.0
Number of processors	1	1	2	1	1	2
Cycle time, nanoseconds	11	11	11	11	11	11
Word size, bits	64	64	64	64	64	64
Operating systems	NOS-NOS/VE (dual state)	NOS-NOS/VE (dual state)	NOS-NOS/VE (dual state)	NOS/VE	NOS/VE	NOS/VE
MAIN MEMORY						
Type	1M-bit DRAM	1M-bit DRAM	1M-bit DRAM	1M-bit DRAM	1M-bit DRAM	1M-bit DRAM
Minimum capacity, bytes	64M	64M	64M	32M	64M	64M
Maximum capacity, bytes	256M	256M	256M	256M	256M	256M
Increment size, bytes	64M	64M	64M	32M, 64M	64M	64M
Cycle time, nanoseconds	308	308	308	308	308	308
BUFFER STORAGE						
Minimum capacity	32KB	32KB	32KB per CPU	32KB	32KB	32KB per CPU
Maximum capacity	32KB	32KB	32KB per CPU	32KB	32KB	32KB per CPU
Increment size	0	0	0	0	0	0
INPUT/OUTPUT CONTROL						
Number of channels:						
Byte multiplexer	0	0	0	0	0	0
Block multiplexer	0	0	0	0	0	0
Word	0	0	0	0	0	0
Other	Up to 24 std., up to 28 DMA*	Up to 24 std., up to 28 DMA	Up to 24 std., up to 28 DMA	Up to 36 DMA	Up to 36 DMA	Up to 36 DMA
PURCHASE PRICE	$705,000	$1,057,500	$1,671,000	$533,500	$951,750	$1,570,250

**Direct memory access.*

room environment. Control Data has positioned them as departmental processors that can handle commercial and numeric-intensive work loads and as applications development systems. The Model 932s can be used in multivendor installations and support a variety of micros, terminals, and workstations, including the Control Data Cyber 910 family of Integrated Graphics Workstations.

The 960 Series, announced in April 1988, replaces Cyber 800 mid-level systems. The series consists of three 960 models and three 962 models. Each model group consists of two single processors and a dual processor. The 960 versions use a dual-state architecture capable of running NOS/VE or the earlier NOS operating systems. Central processors are designed to accept code written for either operating system version. The 962 versions, which operate under NOS/VE, can only recognize NOS/VE code.

The air-cooled 960 versions are faster and more compact than their predecessors. CPU cycle time is now 11 nanoseconds compared to 16 nanoseconds for the Cyber 800s. To achieve faster and smaller systems, CDC replaced 256-kilobit memory chips with 1-megabit dynamic random access memory (DRAM) chips and introduced Emitter Coupled Logic (ECL) chips. The 960s use a special hybrid chip that combines logic and memory circuits on the same chip.

To improve system throughput, the company shortened the physical distance between memory and central processing using a new modular board technology. The modular technology eliminates hand wiring and improves manufacturing efficiency. The design also lets the company cut production time and makes it easier to implement configuration changes. Control Data cools the systems using ambient air rather than the liquid cooling of its previous systems.

Peripheral processor instructions are 16 or 32 bits (one or two words) in length. The Cyber 900 16-bit format consists of an 8-bit operation code and an 8-bit operand address or literal operand.

INTERNAL CODE: Eight-bit ASCII is standard.

MAIN MEMORY

Memory design and structure vary by processor family. Cyber 932 central memory consists of four interleaved banks. Total memory bandwidth is 80 megabytes per second. Central memory access between the CPUs and I/O clusters occurs over multiple buses, managed by a bus arbitrator. The 932s use single error correction/double error detection (SECDED) logic.

Cyber 960/962 Series memory is divided into eight banks. Memory handles data as 64-bit words plus 8 bits used in SECDED circuitry. In addition to SECDED, all address paths are parity protected. Memory bandwidth averages one 64-bit word every 44 nanoseconds or 180 megabytes per second.

STORAGE TYPE: 1-megabit dynamic random access memory (DRAM), 932, 960/962 Series.

CAPACITY: From 8 megabytes to 256 megabytes. For the capacities of specific models, please refer to Table 1.

CYCLE TIME: See Table 1.

CHECKING: In all models, a single-bit error-correction, double-bit error-detection Hamming code, eight bits in length, is appended to each of 10 six-bit main memory characters. Upon reading from memory, a single-bit error is automatically corrected and transferred, while multiple-bit errors are detected and flagged for appropriate action.

A parity bit is generated with each 16-bit word stored in the Peripheral Processor Subsystem (PPS).

RESERVED STORAGE: Vendor does not specify.

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TABLE 2. MASS STORAGE

MODEL	885-11	887	895-1 & -2	9730/9836	9853
Cabinets per subsystem	Up to 8	Up to 4	4	1	1 or 2
Disk packs/HDAs per cabinet	2	1 or 2	4	2	1 or 2
Capacity	1.3G 6-bit bytes	550MB per spindle	2.4GB	414M 8-bit bytes per unit	1.15GB per disk spindle
Tracks/segments per drive unit	—	—	53,100	—	—
Average seek time, msec.	25.0	16.0	16.0	20.0	16.0
Average access time, msec.	33.3	24.3	24.3	28.33	24.3
Average rotational delay, msec.	8.3	8.3	8.3	8.33	8.3
Data transfer rate	1.19M bytes/sec	12.0M bytes/sec	3.0M bytes/sec	14.5M bits/sec	3.0M bytes/sec
Controller model	7155	Integrated	7165	Integrated	Integrated
Comments	—	Model 877 uses four writing heads to achieve parallel transfer of datastreams at 12M bytes per second	Model 895-1 contains control logic for up to three 895-2 units.	Model 9836 is a rack-mounted system for 930 processors; the 9836 is also part of the 9730 tape/disk subsystem designed for the 930.	—
Purchase Price	$40,732	$120,000	$40,600/$30,000	$49,200/$28,800	$63,090

A dash (—) indicates the information was not available.

The 960 machines require 26 square feet of floor space. Users can install an additional CPU and up to 256 megabytes of memory without having to move to a larger cabinet. Systems don't physically grow until users begin to significantly augment input/output (I/O) capacity.

In addition to new mainframes, Control Data released a new version of the NOS/VE operating system in April 1988. As part of this major system upgrade, CDC added more full-production features, enhanced connectivity, and improved both networking and applications development features. Production features consist of scheduling enhancements, user/project validation and control, logon security, and mass storage management. Some new connectivity features are a mainframe clustering option and CDCNet improvements. Applications development enhancements include Fortran and Lisp compiler performance improvements and the addition of the Ada/VE compiler, the approved standard computer language of the U.S. Department of Defense. In July 1988, the Ada compiler received a federal validation certificate.

The new NOS/VE 1.3.1 clustering option lets users cluster up to eight NOS/VE-based Cyber systems to share files and access the resources and processing power of multiple systems. Users can also simultaneously execute multiple jobs on different clustered processors.

As part of its open systems and connectivity strategy, Control Data now offers the ORACLE relational data base. Control Data signed an agreement with Oracle Corporation to port its popular ORACLE relational data base management system to the NOS/VE environment. Similar to the UNIX strategy, Oracle is consistent with CDC plans to embrace products that conform to industry standards. ORACLE, for instance, supports SQL, the ANSI-standard language for program and user interface to data bases. In July, CDC upgraded the product with new features and enhancements contained in Version 5.1. One additional component, SQL*STAR, lets users distribute ORACLE applications and data bases within a computer network.

CENTRAL PROCESSORS

Cyber 900 central processors, based on Cyber 180 architecture, use a pipelined architecture and come in single and tightly coupled dual-processor configurations. Dual processors use a symmetrical multiprocessing approach with each CPU acting as peers. Each is equally capable of handling I/O tasks and instruction processing.

The 932 systems are compact, departmental systems that use densely packaged CMOS technology. The systems include rack-mounted disk and tape units and are air cooled, making it possible to install them in an office environment. The machines feature high-speed arithmetic units composed of five autonomous, functional processing sections. They support business data processing instructions, address calculations, integer, Boolean, shift, and floating-point operations. The series incorporates two three-word pipelines which support historic branch prediction. To enhance system throughput, the pipeline approach allows multiple instructions to be in various stages of execution simultaneously. A 32-kilobyte cache memory also enhances CPU performance. The single-processor 932 systems can be field upgraded to the dual processors without increasing configuration size.

The six 960/962 models use Emitter Coupled Logic (ECL) circuitry. The three 960 models run both NOS/VE and the earlier NOS operating systems, while the three 962 models run only NOS. Specifically, the systems use large-scale integration (LSI) circuits featuring 200 and 6,300 ECL gate arrays in addition to one-megabit DRAM arrays for memory. ECL chips are mounted on an 18-layer printed circuit board. Thirteen circuit boards, which slide into cabinet racks spaced 1.5 inches apart, compose a single system. The tight board packaging leaves enough room to fit two CPUs in a single cabinet. Printed boards communicate with one another through printed circuit side panels. This design makes data transfers more efficient and eliminates the hand wiring of the previous Cyber 800 midrange systems.

To further enhance CPU performance, the 960/962 systems employ a 32-kilobyte cache memory per CPU and a five-stage pipeline, instruction look-ahead, and branch prediction.

Cyber 900s have 16 registers that can hold operands and can also be used for indexing. Each X register is 64 bits long. (A central memory word is 64 bits long.) The 16 X

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TABLE 3. INPUT/OUTPUT UNITS

Magnetic Tape Units	Number of Tracks	Recording Density, Bits/Inch	Encoding	Tape Speed, Inches/Sec.	Transfer Rate, Bytes/Sec.
639-1	9	1600	PE	25	40,000
	9	6250	GCR	25	156,250
	9	1600	PE	75	120,000
	9	6250	GCR	75	468,750
698-XX	9	1600	PE	200	320,000
		6250	GCR	200	1,250,000
9639-1	9	1600	PE	*25	40,000/156,250
		6250	GCR	75	120,000/468,750
9730	9	1600	PE	*25	40,000/156,250
		6250	GCR	75	120,000/468,750
Printers	**Printing Speed**	**Print Positions**	**Horizontal Spacing, Chars./Inch**	**Vertical Spacing, Lines/Inch**	**Form Size, Inches**
533-1	300 lpm	132	10	6 or 8	4 to 15 wide, 3 to 18 long
537	700 lpm	136	10	6 or 8	4 to 15 wide, 8 to 14 long
585-1	2,000 lpm	136	NA	6 or 8	NA

**Features both streaming and start/stop modes at 25 inches per second (ips) and streaming mode only at 75 ips.*
NA—Not available.

In the networking area, Control Data added TCP/IP file transfer support capabilities to NOS/VE and CDCNet, the company's networking architecture. TCP/IP lets CDCNet networks transfer files between NOS/VE hosts and non-Control Data hosts or workstations that also run TCP/IP and its file transfer application (FTP).

COMPETITIVE POSITION

Control Data has impressive survival instincts. After recovering from near financial collapse, it announced more new products last year alone than in the previous five. The company now offers scientific workstations, departmental superminis and midrange systems, large-scale mainframes, minisupers, and full-blown supercomputers. All these systems will be capable of running a native version of UNIX in late 1990. With UNIX, the product line will be applications compatible and span a performance range of 1 to 10,000. To tie it all together and make its products more attractive to both existing and new CDC customers, the company has developed a connectivity strategy called Transparent Computing Environment (TCE).

With so many new products and strategies in place, it seems hard to believe this is the same Control Data that racked up some of the biggest losses in industry history. When the company lost $567.5 million in 1985, industry experts declared it all but clinically dead.

Miraculously, a new management team turned the company around through a far-reaching restructure of the organization. CDC sold off subsidiaries to raise needed capital and refocused attention on its core computer businesses. As a result, CDC rebounded in 1987 with its first

registers are numbered X0 through XF using hexadecimal notation where X0 is the first register.

Sixteen 48-bit A registers hold the central memory addresses of the operands. They are given in the form of process virtual addresses. The 16 A registers are likewise numbered A0 through AF—A0 is the first register. Operations on the A registers have no effect on the X registers; operands can be loaded into or stored from any X register.

All Cyber 900 models use instruction look-ahead registers that hold prefetched instructions for subsequent execution. Depending upon the processor model, the instruction look-ahead registers hold from 8 to 48 instructions ahead of the current instruction in the regular program sequence.

Cyber 900 systems can perform integer and floating-point arithmetic; move, edit, and translate character strings; perform packed and unpacked decimal arithmetic; load or store fields on 64-bit word, byte, and bit boundaries; extract or insert bit strings of 1 through 64 bits; load or store multiple A and X registers; normalize floating-point numbers; perform logical and shift operations; perform branch tests and exchange jump operations; and perform call and return operations.

SPECIAL FEATURES: Users can cluster up to eight NOS/VE-based Cyber systems to share files and improve resource flexibility. A hardware component called Stornet and a NOS/VE file server feature implements clustering. The two components provide transparent file access among the clustered systems. Stornet contains 32 megabytes of memory and has eight channel connectors for data transfer between mainframes. In addition to file sharing, the system lets users access a virtually limitless amount of disk space. They can also simultaneously execute multiple jobs on different clustered processors.

To address numeric-intensive computing, the 990 models contain built-in scalar and vector processing. Integrated vector processing hardware is ideal for speeding up the processing of repetitive data expressed in the form of arrays or tables. On the software side, Control Data offers Fortran/VE 2, a compiler that automatically vectorizes

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profitable year since 1984. The company continued to post respectable profits through the first half of 1988, earning $16.9 million on revenues of $1.85 billion. For the same 1987 period, the company earned $1.7 million on revenues of $1.61 billion.

To continue the momentum, the company unleashed a barrage of new products during the first quarter of 1988 that included new mini and mainframe systems. In March 1988, CDC also purchased a 20 percent interest in Silicon Graphics, the company that has been supplying Control Data with its 910 line of 3-D graphics workstations. The 13 new systems all became available during the third quarter.

As CDC approached the critical fourth quarter, its marketing and sales force was still trying to turn a new and bigger product portfolio into even larger year-end profits. Early third-quarter orders were disappointing. An apparent dearth of orders in the government sector, together with a components shortage through the third quarter, forced the company to idle 2,500 workers without pay at five manufacturing plants for one week in August. The company was confident the bulk of new sales would come during the fourth quarter, a traditionally strong order period.

Control Data, despite its impressive comeback, continues to face an uphill battle. The market for the traditional large-scale mini/mainframe (primarily an upgrade and replacement business) remains soft. Most of the competing mainframe suppliers such as IBM, Unisys, and Honeywell Bull market their new products primarily to existing accounts. The strategy is effective for companies that enjoy relatively large user bases. Control Data, however, does not have this advantage. The company maintains a relatively small base comprising vertical markets, such as the petroleum industry, public utilities, education, and manufacturing concerns using CAD/CAM, in addition to government sales.

Many customers use CDC computers for processing engineering/scientific applications, which has been CDC's traditional market. At present, however, Control Data faces more competition within its own traditional technical computing markets. Several vendors now offer affordable minisupercomputers, while more mainframe vendors, including IBM, Amdahl, NAS, and Unisys, offer integrated vector hardware and attachments.

To broaden its market base and bring new customers into the fold, Control Data has been offering a line of 910 scientific workstations and departmental processors. This strategy has proven fruitful. To date, half the buyers of 930/932 systems have been new accounts. The compact, air-cooled departmental systems, introduced in 1987, represent the Cyber mainframe operating environment in a smaller modular package that fits easily into an office. But, of course, these smaller systems don't generate the profit margins of the big mainframe.

code to take better advantage of vector capabilities. Another software product, Afterburner, is a system utility that speeds up the execution of Fortran code.

PHYSICAL SPECIFICATIONS: Cyber 900 systems can operate at 50, 60, or 400 hertz (Hz). Cyber 932 models consume 1.6kVA at 60 Hz; Cyber 960/962 models consume 3.2kVA at 60 Hz and 13.2kVA at 400 Hz. Cyber 932, 960, and 960 models are all air cooled. Air-cooled systems operate at room temperatures ranging from 60 to 90 degrees Fahrenheit at a relative humidity of between 20 and 80 percent.

	Width (in.)	Ht. (in.)	Depth (in.)	Wt. (lb.)
Control Data Systems				
932 Series	**24.0**	**45**	**41**	**467**
960/962 Series (maximum)	**175.5**	**76**	**27**	**NA**
with second IOU	**84.0**	**76**	**27**	**NA**

NA—Not available.

CONFIGURATION RULES

Cyber 900s come in single-processor configurations, expandable to two-processor systems. Each model within a series is also field upgradable to the next largest system. All the following systems models require system consoles.

A minimally configured Model 932-11 or 932-31 features eight megabytes of main memory, five peripheral processors, three external data channels, three integrated controller interface channels, and space for five special-purpose adapters.

A minimally configured Model 932-32 features two central processors, 16 megabytes of main memory, five peripheral processors, three external data channels, three integrated controller interface channels, and space for five special-purpose adapters.

A minimally configured Model 960-11 or 960-31 features 64 megabytes of main memory, 32 kilobytes of cache memory, 20 peripheral processors, and twenty-four 12-bit Cyber 170 data channels.

The following system models all require both system consoles and power supplies.

A minimally configured Model 960-32 features two central processors, 64 megabytes of memory, 32 kilobytes of cache memory, 20 peripheral processors, and twenty-four 12-bit data channels.

A minimally configured 962-11 features one central processor, 32 megabytes of main memory, 32 kilobytes of cache memory, 10 direct memory access (DMA) peripheral processors, and support logic for eight 16-bit DMA channels.

A minimally configured Model 962-31 features 1 central processor, 64 megabytes of main memory, 10 DMA peripheral processors, and support logic for eight 16-bit DMA channels.

A minimally configured Model 962-32 features 2 central processors, 64 megabytes of main memory, 10 DMA peripheral processors, and support logic for eight 16-bit DMA channels.

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To remain competitive and satisfy the growth needs of existing users, CDC replaced or otherwise enhanced all its medium and large systems. Control Data continues to identify IBM and Digital Equipment Corporation as its major rivals for obvious reasons. IBM and Digital continue to dominate the low- and midrange markets, while IBM dominates the high end. These two vendors have also gone after Control Data's technical computing markets.

Cyber 930/932 departmental systems compete against the IBM 9370 midrange systems and Digital VAX 8250/8350 and 6200 mid-level VAX systems. These systems fall within roughly the same price/performance range. To make its low-end systems more attractive, CDC increased performance without increasing the price. The 932 systems, which replace the earlier 930s, now have a performance range from 2.0 to 5.6 million instructions per second (MIPS). The range represents a 70 percent performance increase over the earlier 930 high-end model.

The Cyber 960 midrange systems replace the no longer marketed Cyber 800 models. The new systems are up to 50 percent faster and 30 percent cheaper than the 800s. They compete against the high end of the IBM 4381 line and the low end of the 3090 line. They also compete against the VAX 8800. The 960/962 systems are rated at 8.9 to 26.7 MIPS, compared to 8 to 15 MIPS for comparable IBM systems.

In addition to hardware changes, Control Data continues to add more pieces to its grand connectivity strategy. Similar to IBM and Digital, Control Data has been embracing products that meet industry standards such as UNIX, ORACLE, and TCP/IP. UNIX, the centerpiece of the company's connectivity strategy, remains a missing link. It will become available during the fourth quarter of 1989, the latest revised introduction date.

Amdahl already offers a native UNIX for its mainframes, while IBM offers AIX/370, a version of UNIX that can only run as a guest under VM. Unisys, NAS, and other mainframers also have elaborate plans for UNIX in various stages of development. Standards, of course, make it possible for users to connect CDC hardware to competing systems or to port existing software applications developed on one system to another system without running into conversion and compatibility problems.

The strategy reduces development and conversion costs, raises productivity, and saves users money. It also encourages users who maintain multivendor shops to incorporate Control Data products into their operations. With more users demanding compatibility, these latest connectivity strategies among mainframes have become basic to industry survival.

INPUT/OUTPUT CONTROL

Control Data uses logically independent peripheral processors (PPs) to handle input/output (I/O) functions. This leaves the central processors almost entirely free to handle user programs. Peripheral processors are part of a separate input/output unit (IOU) configured with Cyber mainframes.

In addition to peripheral processors, Control Data offers a variety of channel speeds and interface options to support peripherals with different channel speeds and capabilities. Standard Cyber 170-type channels transfer at three megabytes per second, the standard transfer speed of most older peripherals. Cyber 170 direct memory access (DMA) channels transfer at 3 or 15 megabytes per second and support most Cyber 170-generation devices. Additionally, DMA channels can be configured with intelligent standard interface (ISI) and intelligent peripheral interface (IPI) devices. ISI DMA channels transfer at up to 12 megabytes per second, and IPI DMA channels transfer at 10 megabytes per second. Control Data and non-Control Data devices are available supporting these ISI or IPI transfer rates.

One input or output operation on each I/O channel can be overlapped with computing in the central processor and peripheral processors. All channels can be active at the same time.

Cyber 932 models feature a single IOU containing up to 5 PPs, expandable to 10, and 6 data channels, expandable to 12. Maximum data transfer rate per single channel is 10 megabytes per second. Aggregate transfer rate is 80 megabytes per second.

Cyber 960/962 models feature one or two IOUs. For 960 models, the primary IOU contains 20 standard PPs and 24 standard Cyber 170 channels. Users can optionally add up to 10 DMA PPs and up to 10 DMA channels. A second IOU contains 10 DMA PPs and eight DMA channels. Users can also optionally add 10 DMA PPs and 10 DMA channels.

The primary IOU on 962 models contains 10 DMA peripheral processors and eight DMA channels. Up to 10 DMA PPs and up to 10 DMA channels can be optionally added. A secondary peripheral processor contains 10 DMA PPs and eight DMA channels. Up to 10 DMA PPs and up to 10 DMA channels can be added.

Maximum Cyber 960/962 data transfer rate is 15 megabytes per second for a single channel. The aggregate channel rate is 180 megabytes per second.

MASS STORAGE

For information about Cyber 900 mass storage devices, please refer to Table 2.

INPUT/OUTPUT UNITS

For information about Cyber 900 magnetic tape units and printers, please refer to Table 3.*Loosely Coupled Network (LCN)* is designed primarily for sites using a number of large-scale computers from various vendors. It permits the interconnection of a variety of computer mainframes. Additionally, through the use of one to four Network Access Devices (NADs), the LCN provides communications capability between a local host and satellites. Up to four trunk connections per NAD, operating at a data transmission rate of 50 megabits per second, can be configured to provide redundant paths and higher performance. The LCN

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ADVANTAGES AND RESTRICTIONS

For reasons described in the preceding paragraphs, Control Data now talks about its systems and its connectivity plans in the same breath. The two are inextricably linked. Most new product offerings now play some role within the company's TCE connectivity strategy. To make the concept work, Control Data developed a modernized hardware platform compatible with de facto industry standards for connectivity.

At the hardware level, Control Data has increased memory capacities with the use of denser 1-megabit and 256-bit chips and has speeded up processing with new, denser logic gates. The newest semiconductor technologies have permitted the company to package its new systems in more compact air-cooled configurations. The new modular hardware designs reduce floor space and power and cooling requirements.

The departmental 932 models use a rack-mounted design that includes processors and integrated tape and disk peripherals. The 932s make the Cyber architecture available to departmental users and companies wanting to avoid the expense and complexity of a large-system environment. The air-cooled systems were designed to fit into an office environment.

With the delivery of the Cyber 960/962, the company totally redesigned its midrange systems. Unlike the older liquid-cooled Cyber 800s, the new models are air cooled, eliminating the cost of water chillers. The new modular design permits more efficient data exchange among circuit boards through the use of forced connectors. The overhauled design makes the new systems much faster while eliminating the hand wiring of the previous systems.

Users can migrate to larger Cyber systems within a series either through a field upgrade to the next level processor or through the addition of a second, identical processor. But an upgrade from one series to another requires a processor swapout.

All the new systems are compatible with NOS/VE, the company's strategic operating system. This means applications developed on any given Cyber machine can be migrated to any other machine without a conversion. Users who had older Cyber 170 models enjoy the same software compatibility protection through the use of CDC's dual-state architecture offered with the 960 Series. The feature is not available with the departmental 930/932 machines. Since these lower end models are pitched to customers new to the CDC environment, the dual-state requirement is probably not missed. With dual-state modes, Cyber 170 system users operating under NOS can upgrade to a Cyber 900 system running NOS/VE without the need to convert any applications programs.

In addition to the proprietary NOS/VE operating systems, UNIX will play a key connectivity role when it finally becomes available. Other significant elements include supports IBM, CDC Cyber, ETA10, Digital VAX-based VMS and UNIX systems, and Cray-based COS system interfaces.

The *Control Data Distributed Communications Network (CDCNet)* establishes an Ethernet-based, 10-megabit-per-second local area network. CDCNet features let users link Cyber systems with non-Cyber systems. Ultimately, users can extend the CDCNet network into wide area networks using CDCNet Device Interfaces. CDCNet supports TCP/IP, NJE, HASP, and IBM 3270 protocols as well as asynchronous terminal pass-through for multivendor connectivity. CDCNet is based on the Open Systems Interconnection (OSI) reference model.

CDCNet distributes power and manages the network through microprocessors called Device Interfaces (DIs). The DIs can be used in different configurations depending on network needs. They can route transmissions via least-cost algorithms. Using this approach, if one of the DIs goes down, the system will automatically reroute the transmission via another path and choose the least expensive one.

Four DIs are available: the Mainframe Device Interface (MDI), the Terminal Device Interface (TDI), the Network Device Interface (NDI), and the Mainframe/Terminal Device Interface (MTI). The MDI lets a Cyber 900 host connect to Ethernet and is also responsible for host interface protocols. The TDI permits the connection of user terminals and workstations to the host system and performs all terminal handling functions. It supports up to 32 communications lines, either asynchronous at up to 38.4K bps or synchronous at up to 128K bps. The NDI can connect a remote CDCNet to a local CDCNet by medium-speed links such as HDLC or X.25 virtual circuits. It can also act as a gateway to connect CDCNet to outside networks, such as IBM SNA networks, X.25 public data networks, and Digital DECnet. MTI is an entry-level unit designed for users with fewer than 32 terminals or workstations. As the number of terminals grows, the MTI can be reconfigured into an MDI and a TDI connected by Ethernet. Additional DIs can be added as needed.

Each DI includes at least one System Main Memory (SMM) board containing a megabyte of random access memory (RAM) with a cycle time of 312 nanoseconds. Up to five SMM boards can be installed in a DI. If additional performance is required, a Private Memory Module (PMM) can be added. The PMM contains 128 kilobytes of memory with a 140-nanosecond read cycle. Only one PMM can be installed in a DI.

The Ethernet Serial Channel Interface (ESCI) permits a DI to interface with an Ethernet multiplexer or transceiver via transceiver cables. The ESCI includes one Ethernet controller chip, one Ethernet serial interface chip, one Motorola 68000 microprocessor, 16 kilobytes of RAM, and 16 kilobytes of read-only memory (ROM). The Ethernet transceiver is compatible with IEEE 802.3 specifications.

Line Interface Modules (LIMs) provide an interface between a DI and user terminals, workstations, modems, and printers. The LIMs connect to a Communications Interface Module (CIM), which controls transmission between the DI and the LIM. A DI supports up to eight LIMs.

SOFTWARE

OPERATING SYSTEM: Control Data's newest operating system is the *Network Operating System/Virtual Environment (NOS/VE)*. It has an extremely large address space with a virtual memory byte address of 31 bits per segment and 4,096 segments per task, allowing each task to have up to 8.8×10^{12} bytes. Unlike the older NOS 2.5.1, NOS/VE

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CDCNet, Control Data's networking architecture, and the Control Data Loosely Coupled Network (LCN).

CDCNet lets users interconnect Cyber host systems with non-CDC systems. CDCNet supports TCP/IP, the standard for connecting workstations and mainframes, and also conforms to the Open Systems Interconnection (OSI) reference model, a proposed networking standard. CDCNet lets users build distributed local area networks conforming to the IEEE 802.3 Ethernet model.

Control Data's LCN lets customers construct a 50-megabit-per-second backbone network interconnecting CDC hosts with other CDC systems, ETA supercomputers, IBM mainframes, Digital VAXs, and Cray-based COS systems.

In a related connectivity area, Control Data introduced a VMS-to-NOS/VE migration toolkit for VMS users. The product lets users migrate applications from a VAX/VMS environment to a NOS/VE environment.

Other connectivity facilities are contained in Officeware, introduced with the 930/932 systems, and IM/VE Information Management facilities. Desktop/VE, for instance, lets Apple Macintosh users access a Cyber 900.

On the software side, CDC has markedly increased the number of commercial/business applications that can run on the Cyber 900 Series. Control Data has been attempting to shed its restrictive image as a manufacturer of machines that are strictly number crunchers for scientific applications. The general-purpose business applications written for the Cyber 900 Series have steadily grown and is being encouraged through CDC's Independent Software Vendor program.

In an attempt to address more than just technical computing markets, CDC has been emphasizing more commercial applications such as data base management and office automation. According to the company, more than one third of its worldwide business today is outside the purely engineering/scientific realm. In 1987, the company enhanced its IM/VE product line with the introduction of three new modules—IM/Control, IM/Smart, and IM/Fast—in addition to Officeware, a package of office automation tools furnished by customer demand.

The relatively limited capacity of Cyber systems' disk drives is a distinct disadvantage. The highest capacity disk drive, Model 895, has a storage capacity of only 2.44 gigabytes, while IBM, Amdahl, NAS, and independent suppliers now offer triple-capacity (7.56 gigabytes) disk products in addition to double-capacity (5.04 gigabytes) disks.

USER REACTION

The Datapro 1987 survey of general-purpose mainframe computer users yielded responses from four users of the

uses 64-bit words (eight 8-bit bytes); 31-bit addressing for real memory; and variable page size from 2 kilobytes to 64 kilobytes, which is incremented in powers of two.

***NOS/VE* 1.3.1, introduced in April 1988, is the latest version of the Cyber operating system. Progress has led to improvements in three features: production, connectivity, and applications development. New production features include scheduling enhancements, user/project validation (and control), logon security, and mass storage management. Additions in the connectivity feature consist of mainframe clustering and CDCNet improvements. Applications development has been boosted by Fortran and Lisp compiler performance improvements and the addition of Ada/VE compiler—the approved standard computer language of the U.S. Department of Defense.**

NOS/VE extends the concept of virtual memory to the I/O subsystem. Both program and I/O data can be retained in real memory, reducing the number of mainframe requests to disk storage. Virtual I/O also relieves programmers from managing their own I/O memory.

NOS/VE multitasking allows users to break a program into a series of tasks that is run synchronously or asynchronously. Program and data structures are automatically separated into segments to maintain security and maximize data sharing in multiuser environments. The use of segments and links between data and programs allows all programs, data, utilities, and procedures to be fully reentrant. Users share the same copy of compilers and editors for more efficient use of real memory.

Character handling instructions include ASCII native mode (eight-bit bytes), decimal arithmetic (packed and unpacked), move character string, translation of character set (EBCDIC to ASCII and vice versa), and the scan and/or edit of character strings.

The entire operating system is written in Cyber Interactive Language (Cybil), rather than Assembler, and uses a combination command language/job control language called system control language (SCL). Because SCL is a high-level language, it allows both keyword and positional parameters with range and type constraints. All filenames under NOS/VE consist of up to 31 characters and include a 256-byte label that the user writes or displays.

NOS/VE supports full message and brief message modes, a help facility, and on-line manuals that can be site modified. NOS/VE also features symbolic debugging, on-line manual generation, full-screen editing, source code and object code utilities, and job performance monitors.

NOS/VE security is provided through a ring concept, which uses a hardware isolation technique that subdivides the segments into a hierarchy of privileged access. There are 16 rings (0 to 15), of which 15 are valid. Ring 0 is used to indicate an unlinked process and causes an interrupt to a handler that then dynamically links the module to the current process. The rings allow codes that have different levels of privilege to occupy the same address space.

The second property of the rings is the call inward/return outward mechanism. Any module may call a module in a lower ring; however, the called module can only respond if the ring bracket includes both the caller and the callee. The reverse process is not allowed; this stops a privileged application from "spying" on a less privileged application and data. A lower ring cannot initiate the link; it services less privileged requests only and can never issue requests. All files require a password.

NOS/VE also features *UNIX System V (VX/VE)* as an NOS/VE subsystem. The VX/VE UNIX shell supports

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Cyber 180 Model 830 low-end system. All four systems were installed between June and December 1985. (When this report went to press, results for the 1988 survey were still being processed. Watch for the new results in a future issue.)

Three users represent educational institutions, while the fourth is part of a manufacturing concern. Three cite education and scheduling as their primary applications. Other applications (each cited once) are manufacturing, engineering/scientific, and health care/medical. Two of the Cyber systems were configured with between 32 megabytes and 64 megabytes of main memory; the third had between 16 megabytes and 32 megabytes; and the fourth had from 8 megabytes to 16 megabytes. Two sites had between 1.2 gigabytes and 4.8 gigabytes of disk storage installed; a third between 4.8 gigabytes and 10.0 gigabytes; and a fourth between 100 megabytes and 600 megabytes.

In addition to asking the users about their current configurations, the survey asked about plans for future acquisitions. Of the four Control Data users, three say they would add more hardware, and three say they plan to add software and to expand their data communications facilities. All of the survey respondents had implemented a disaster recovery plan, and three had established an information center.

The users were asked to rate their systems as Excellent, Good, Fair, or Poor in 14 separate categories. Cyber systems ratings are summarized in the following table.

	Excellent	Good	Fair	Poor	WA*
Ease of operation	1	3	0	0	3.25
Reliability of system	3	1	0	0	3.75
Reliability of peripherals	1	3	0	0	3.25
Maintenance service:					
Responsiveness	2	2	0	0	3.50
Effectiveness	1	2	0	0	3.33
Technical support:					
Troubleshooting	0	3	0	0	3.00
Education	1	2	1	0	3.00
Documentation	0	2	2	0	2.50
Manufacturers software:					
Operating system	0	3	1	0	2.75
Compiler & assemblers	0	4	0	0	3.00
Application programs	0	3	0	0	2.75
Ease of programming	0	2	2	0	2.50
Ease of conversion	0	2	2	0	2.50
Overall satisfaction	0	3	0	0	3.00

*Weighted Average on a scale of 4.0 for Excellent.

The ratings indicate a high degree of satisfaction with the Cyber systems, primarily within the hardware area. Less satisfaction is noted in software areas. All four respondents say the machines performed as expected, and all four say they would recommend their systems to other users. □

UNIX System V kernel calls, utilities, runtime libraries, documentation, and support files. The VX/VE C compiler has been optimized for Cyber 900 hardware. A full-featured, standard C runtime library is provided to link VX/VE users with NOS/VE. Programs written in C for other processors can be transported to NOS/VE through the C compiler.

In addition to the VX/VE UNIX shell, Control Data plans to offer a native UNIX operating system for all Cyber systems during 1989. The system will be based on AT&T's System V and will be compliant with the planned POSIX standard.

PROGRAMMING LANGUAGES: **NOS/VE supports Ada/VE, Cobol, Fortran, Basic, APL, Pascal, C, Lisp, Prolog, and Cybil.**

DATA BASE MANAGEMENT: ***IM/Data Base Management (IM/DM)*** **is a relational data base management system that integrates structured and unstructured data. IM/DM features integrated screen management; an integrated, fourth-generation-level command system; full concurrency and recovery systems; and security and privacy mechanisms. IM/DM lets users query, update, and edit the data base and perform system maintenance using English-like statements. Additionally, users can create, retrieve, edit, and delete individual records using custom formats which appear on their terminal screen.**

Cobol and Fortran programs can be developed to interface with the IM/DM data base. Data base administrators can design data base structures and initialize and load data base files.

A text management feature lets users store text in addition to fixed-format numeric or categoric data.

DATA MANAGEMENT: ***Information Management/ Virtual Environment (IM/VE)*** **is a modular system comprising IM/DM (described in the DATA BASE MANAGEMENT section), IM/Quick, IM/Personal, IM/Access, IM/Control, IM/Smart, and IM/Fast. In addition to IM/VE, Control Data mainframes can also run the ORACLE data base management systems from Oracle Corporation.**

IM/Quick is a decision-support system with query, manipulation, and report generation capabilities. It is targeted for use by administrative and managerial personnel.

IM/Personal provides for the distribution of applications between a personal computer and a Cyber 900 mainframe. The program can also run as a self-contained applications development system on a personal computer.

IM/Access bridges IM/Personal on the personal computer and IM/DM on the mainframe. It couples the data in the two computers so that updates performed in the personal computer can be transmitted to the mainframe. At the mainframe level, IM/Access also generates data models, screens, and reports that reflect those already defined on the personal computer.

IM/Control is a system-level data dictionary that provides a central repository for describing, maintaining, relating, controlling, and reporting on the multitude of facts that data base administrators, system designers, and programmers need. It tracks and controls data elements and their attributes and the complex relationships that exist in large data base environments. IM/Control can automatically generate IM/DM data descriptions as well as extensive reports for such activities as determining impact analysis.

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Usually employed in data base applications, it also provides extensions to handle types of data unique to a given environment.

IM/Smart is a fourth-generation applications development tool designed to improve programmer productivity. Program developers can design and specify programming logic for a given application without having to use procedural approaches contained in conventional programming languages such as Fortran and Cobol.

IM/Fast is a general-purpose transaction control system for environments where interactive applications with rapid response requirements must coexist with others that are less time critical. Administrators of large transaction systems can use IM/Fast to build, control, and maintain the relationships and interactions between the various tasks that make up a sophisticated transaction system. It controls user access to application resources by matching transactions to terminals and workstations to maximize system responsiveness according to the needs of the particular applications.

ORACLE, which runs on NOS/VE systems, includes the basic relational data base; applications development and report programs; Fortran, Cobol, and C interfaces; and distributed data management products such as SQL*Star and SQL*Net. ORACLE uses ANSI standard SQL, the standard for application compatibility and user interfaces.

DATA COMMUNICATIONS: Data communications software is incorporated into CDCNet, which is described in the COMMUNICATIONS section.

PROGRAM DEVELOPMENT: The *NOS/VE Programming Environments*, which supports Fortran, Cobol, C, and Pascal, combines compilers, debuggers, and reference aids. The Programming Environments package allows programmers to develop, debug, and install NOS/VE applications without any knowledge of NOS/VE or the system command language.

Programming Environments includes a full-screen editor for creating and editing source code and a full-screen debugger for locating and correcting errors. Compilation errors are identified automatically and error messages are displayed. The system also automatically, generates graphs and charts that show program performance. NOS/VE Programming Environments also features a full-screen interface to permanent files; on-line software manuals; a help facility; compiler templates; and programming-language skeletons that provide a properly formatted, syntactically correct model from which to build a program.

The *NOS/VE Professional Programming Environment (PPE)*, which supports Fortran and Cobol, combines advanced programming utilities in a comprehensive, integrated software package that is screen oriented and function key driven. Programming utilities include full-screen editing and debugging, source and object code libraries, on-line documentation, and Help. This interface allows teams of programmers to develop large applications without requiring any in-depth knowledge of NOS/VE.

In addition, PPE provides benefits for the multiprogrammer environment: change control which tracks when, why, and by whom changes were made; support for selective recompilation of only those subroutines that have been modified; the ability to always provide the current version of the application for testing and integration; source code integrity that ensures that source text is not changed by two or more programmers at the same time; and the ability to specify alternate source and binary libraries for shared code during program loading. In addition to helping programmers achieve significant productivity gains in developing large applications, PPE also serves as a migration tool. Its full-screen interface allows developers with little or no knowledge of NOS/VE to migrate applications from operating systems of competing vendors.

UTILITIES: Cyber 900 utilities include On-Line Debug, On-Line Manual Generation, Full Screen Editor, Source Code Utility, Object Code Utility, and File Management Utility.

OTHER SOFTWARE: Officeware is an office automation facility that includes word processing, spreadsheet capabilities, business graphics, records management, electronic mail, calendaring/scheduling, and networking. Officeware can be used on standalone microcomputers and terminals that connect to a Cyber system.

Transaction Facility (TAF) provides multitasking and recovery and also allows for batch transactions. TAF applications include energy management systems, on-line banking, and billing.

Cyber On-line Text (Context) produces fully integrated, complete technical documentation that can be accessed sequentially or randomly.

Scientific/engineering application packages include APAS (electric utilities), Apex IV (mathematical language), APT-IV Enhanced (numerical control), CD-2000 (computer-aided design), CDC-SynthaVision (geometric modeling), Cyberspice (electronic/electrical design), GPSS V (general-purpose simulation system), GTICES Strudl II (structural design), ICEM (computer-aided engineering and manufacturing), IMSL (mathematical library), McIDAS (environmental control), MSSI (Cyber data base central system), PDS/MaGen (modeling and report generator), Pert/Time, Plato (computer-aided instruction), Seismic Processing/Interpretation System, Simscript 2 (discrete event simulation), Tigs (graphics system), Uniplot (plotting system), and Unistruc (structural analysis).

CDC also offers a range of general computing packages covering business management, finance, word processing, education, and multiple industries.

PRICING AND SUPPORT

POLICY: Cyber 900 products are available on a purchase-only basis, while most Control Data peripheral equipment can be purchased or leased on a one-year or three-year basis. Mainframes carry a one-year warranty. Users can only lease Cyber mainframes through a third-party leasing organization. Quantity discounts are also available for certain eligible products purchased in volume. Customers who lease their systems can also take advantage of purchase conversion plans. The purchase option price is determined by multiplying the monthly rental charge by the applicable purchase option factor. Contact Control Data for the latest purchase option factors.

SUPPORT: The basic monthly maintenance charge provides full on-call maintenance service for any nine consecutive hours per day between 5 a.m. and 8 p.m., Monday through Friday, excluding local holidays. Options are available for extended maintenance at additional cost. Product group designations are used to determine extended period maintenance rates. Cyber mainframes and peripherals generally fall under Product Group H. Rates are determined using fixed percentages associated with specific, extended hours. These percentages are multiplied by the basic monthly maintenance charge. The plan extends maintenance to 24 hours per day Monday through Friday

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on an on-site or on-call basis. Maintenance is also extended to Saturday and Sunday, excluding local holidays, for additional cost.

Software is licensed and is offered on an "as is" basis. Software support is priced separately. Each product is designated as a Class 1, Class 2, Class 3, or Class 4 product in terms of support. Class 1 support is equivalent to the Central Enhancement and Maintenance (CEM) support previously offered. Class 1 support includes corrective codes, updates, enhancements, and rights to successor products. Class 2 support is reserved for future use. Class 3 support is the same as Class 1 except that corrections, improvements, and enhancements may not be verified using current configuration environments and latest released levels of the software products. No support is available for Class 4 products. Unless otherwise specified, all software products listed in the accompanying price list are Class 1 products.

Software is designated as Use Group A, Use Group B, or Use Group C. Use Group A products may be used on a specific mainframe at a specific site for the customer's own use or to provide services to others. If the designated mainframe becomes inoperative, the software may be used on another one of the same model. Use Group B products are restricted to internal use by the customer. Use Group C products are available only to nonprofit educational institutions. Unless otherwise specified, software products listed in the accompanying price list are Use Group A products.

Software licenses are obtained either by paying a onetime paid-up license fee or by paying a recurring monthly fee. Customers with multiple systems are eligible for the Distributed System Software License (DSSL), which is charged for each copy of a given software product. Support is furnished to a designated support location (single charge for multiple copies). Under the DSSL, the designated support location is granted the right to copy and distribute software products and support service elements for use on specific, eligible processors. There is a separate charge for support services, except for the full software license, which includes support in the monthly charges.

TYPICAL CONFIGURATIONS: The systems described below illustrate two typical Cyber 900 configurations. The quoted prices include the necessary hardware but do not include software.

MODEL 932-11:

Central Processor (includes 8 megabytes of main memory, 5 IOPs, and 6 I/O channels)	$ 59,900
One 19002-11 Operator Console	4,900
One 7221-11 Tape Adapter	6,000
One 9730-1 Tape/Disk Subsystem (1600/6250 bpi, 25/75 ips)	49,200
One 537-1 Band Printer (700 lpm)	13,090
TOTAL PURCHASE PRICE:	$133,090

MODEL 960-31:

Central Processor (includes 64 megabytes of main memory, 32 kilobytes of cache, 20 PPs, and 24 I/O channels)	$1,057,500
One 19003-1 Operator Console	7,750
One 10513-740 Power Supply (40kVA)	24,230
One 895-1 Disk Subsystem (2.4-gigabyte capacity)	40,600
One 895-2 Disk Unit (2.4-gigabyte capacity)	30,100
One 7165-22 Disk Controller	56,000
Two 698-10 Tape Subsystems (1600/6250 bpi, 200 ips)	163,000
One 585-1 Line Printer (2,000 lpm)	42,500
TOTAL PURCHASE PRICE:	$1,421,680

EQUIPMENT PRICES

		Purchase Price ($)	Monthly Maint. ($)
PROCESSORS			
932-11	Central Processor; includes 1,048,576 words (8MB) of main memory, five peripheral processors, three external data channels (EDC), three integrated controller interface (ICI) channels, and space for five special-purpose adapters; requires operator console	59,900	350
932-31	Central Processor; includes 1,048,576 words (8MB) of main memory, five peripheral processors, three EDCs, three ICI channels, and space for five special-purpose adapters; requires operator console	125,900	550
932-32	Dual Central Processors; include 2,097,152 words (16MB) of main memory, five peripheral processors, three EDCs, three ICI channels, and space for five special-purpose adapters; require operator console	213,800	960
960-11	Central Processor; includes 8,388,608 words (64MB) of main memory, 4,096 words of cache memory, 20 peripheral processors, and twenty-four 12-bit Cyber 170 data channels; requires system console and power supply	705,000	1,925
960-31	Central Processor; includes 8,388,608 words (64MB) of main memory, 4,096 words of cache memory, 20 peripheral processors, and twenty-four 12-bit data channels; air-cooled systems require console and power supply	1,057,500	2,888

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		Purchase Price ($)	Monthly Maint. ($)
PROCESSORS (Continued)			
960-32	Dual Central Processors; include 8,388,608 words (64MB) of main memory, 4,096 words of cache memory per processor, 20 peripheral processors, and twenty-four 12-bit data channels; require system console and power supply	1,671,000	4,725
962-11	Central Processor; includes 4,194,304 words (32MB) of main memory, 4,096 words of cache memory, 10 direct memory access (DMA) peripheral processors, and support for eight 16-bit DMA channels; requires system console and power supply	533,500	1,601
962-31	Central Processor; includes 8,388,608 words (64MB) of main memory, 4,096 words of cache memory, 10 DMA peripheral processors, support for eight 16-bit DMA channels; requires system console and power supply	951,750	2,743
962-32	Dual Central Processors; include 8,388,608 words (64MB) of main memory, 4,096 words of cache memory per processor, 10 DMA peripheral processors, support for eight 16-bit DMA channels; require system console and power supply	1,570,250	4,526
PROCESSOR UPGRADES			
19107-2	Model 930 with five peripheral processors to Dual Processor 932-32 with five peripheral processors; 19107-1 and 19101-16 are prerequisites	79,900	330
19107-3	Model 930 with 10 peripheral processors to dual 932-32 with 10 peripheral processors; 19107-1 and 19101-16 are prerequisites	84,900	330
19107-21	Model 932-11 to Model 932-31	66,000	200
19107-22	Single-processor 932 models to dual-processor 932-32; 19101-16, and 19107-21	79,900	330
19407-11	Model 960-11 to 960-31	352,500	963
19407-12	Single-processor 960 or 962 models to dual-processor 960-32 or 962-32, respectively; 19407-11, 19401-64, 19407-13 are prerequisites	618,500	1,783
19407-13	Model 962-11 to Model 962-31; 19401-64 is prerequisite	306,250	902
	Channel and Peripheral Processor Options:		
19103-2	I/O Cluster Increment for Models 932-11, 932-31, and 932-32; adds five peripheral processors, three EDCs, and three ICI channels	29,500	80
19403-3	DMA I/O Expansion for Models 960-XX, or the 19403-1 Secondary I/O Subsystem; includes five DMA peripheral processors and support logic for five DMA channels	90,000	100
19403-12	DMA I/O Increment for Models 962-XX, or the 19403 Secondary I/O Subsystem; includes five DMA peripheral processors and support logic for five DMA channels	115,000	100
19403-13	DMA I/O Expansion for Models 962-XX, or the 19403 secondary I/O Subsystem; includes five DMA peripheral processors and support logic for five DMA channels	90,000	100
19403-14	Secondary DMA I/O Subsystem for Models 960-XX or 962-XX; includes 10 DMA peripheral processors and support logic for eight DMA channels	225,000	200
19403-21	ISI/DMA Channel for 962-XX, or 19403-XX; includes a single intelligent subsystem interface DMA channel	NC	NC
19403-22	C170/DMA Channel includes a single Cyber 170 DMA channel for 962-XX, and 19403-XX	NC	NC
19403-23	IPI/DMA Channel; includes a single IPI DMA for 962-XX, and 19403-XX	NC	NC
	Power Supply Options:		
19104-1	Battery Backup for Models 930-XX and 932-XX, 9836 Disk Subsystem, or the disk element of a 9730 Tape/Disk Subsystem; requires 19104 option	3,500	20
10513-725	Motor-Generator for 960-XX and 962-XX; 25kVA, 60 Hz	18,595	57
10513-740	Motor-Generator for 960-XX and 962-XX; 40kVA, 60 Hz	24,230	64
	Operator Consoles:		
19002-11	Operator Console for Models 932-XX; includes ANSI-compatible keyboard, 20MB fixed disk, diskette, color monitor, two serial interface ports, and specialized local console software	4,900	50
19002-12	Remote Operator Console for Models 932-XX; includes ANSI-compatible keyboard, 20MB fixed disk, diskette, color monitor, serial interface port, and remote console software	4,900	50
19003-1	Operator Console for 960-XX; includes ANSI-compatible keyboard, 40MB fixed disk, diskette, color monitor, nine serial interface ports, parallel I/O port, and specialized console software	7,750	65
19003-2	Operator Console for 962-XX; includes ANSI-compatible keyboard, 91MB fixed disk, diskette, color monitor, nine serial interface ports, one parallel port, and specialized console software	7,900	69

T&M—Time and materials.
NA—Not available.
NC—No charge.

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		Purchase Price ($)	Monthly Maint. ($)
MEMORY			
19101-16	Memory Increment for Models 932-11 and 932-31; increases memory from 1,048,576 words (8MB) to 2,097,152 words (16MB)	8,000	80
19101-32	Memory Increment for Models 932-XX; increases memory from 2,097,152 words (16MB) to 4,194,304 words (32MB)	16,000	120
19101-128	Memory Increment for Models 932-XX; increases memory from 8,388,608 words (64MB) to 16,777,216 words (128MB)	64,000	320
19401-64	Memory Increment for Model 962-11; increases central memory from 4,194,304 words (32MB) to 8,388,608 words (64MB)	112,000	240
19401-128	Memory Increment for Models 960-XX, 962-XX; increases central memory from 8,388,608 words (64MB) to 16,777,216 words (128MB); Model 962-11 requires 19401-64 prerequisite	224,000	480
19401-192	Memory Increment for Models 960-XX and 962-XX, increases central memory from 16,777,216 words (128MB) to 25,165,824 words (192MB); requires 19401-128 as prerequisites	224,000	480
19401-256	Memory Increment for Models 960-XX and 962-XX; increases central memory from 25,165,824 words (192MB) to 33,554,432 words (256MB); requires 19401-192 as prerequisites	224,000	480

		Purchase Price ($)	Monthly Maint. ($)	1-Year Lease ($)	3-Year Lease ($)
MASS STORAGE					
885-11	Disk Storage Unit; 2 independent spindles; 692M 6-bit characters per spindle; provides access for one controller per spindle	40,732	208	1,605	1,475
887-1	Disk Storage Unit; 2 independent intelligent hydra drives per cabinet; 550MB formatted capacity per disk; for Models 990E and 995E	120,000	425	5,330	4,800
895-1	Disk Storage Unit; 4 independent spindles; 611M 8-bit characters per spindle; contains control logic for up to three 895-2 units	40,600	325	2,915	2,680
895-2	Disk Storage Unit; 4 independent spindles; 611M 8-bit characters per spindle	30,000	240	2,110	1,940
9730-1	Tape/Disk Subsystem; includes one 9639 magnetic tape transport and two 9836 nonremovable disk storage units, control, and cables in single cabinet; each disk has formatted capacity of 414M 8-bit characters; tape unit operates at 25 ips in start/stop and streaming, and 75 ips streaming; for 930 models	49,200	330	NA	NA
9836-1	Disk Storage Option; includes 2 disk storage units and one control module; 414M 8-bit characters of formatted capacity per disk	28,800	175	NA	NA
9836-2	Disk Storage Subsystem; includes cabinet for 2 disk storage units, one control module, power supplies, and cables; 414M 8-bit characters of formatted capacity per disk for Models 930-11 and 930-31	31,200	175	NA	NA
9836-3	Disk Storage Subsystem; includes cabinet for 4 disk storage units, 2 control modules, power supplies, and cables; 414M 8-bit characters of formatted capacity per disk for Models 930-11 and 930-31	58,400	350	NA	NA
9853-2	Disk Storage Subsystem; includes cabinet for 2 disk storage units, one control module, power supplies, and cables; 1152M 8-bit characters of formatted capacity per disk for Models 932-XX	63,090	173	3,463	3,186
9853-3	Disk Storage Subsystem; includes cabinet for 4 disk storage units, 2 control modules, power supplies, and cables; 1152M 8-bit characters of formatted capacity per disk for Models 932-XX	121,680	346	6,680	6,145
7155-11	Mass Storage Controller; controls up to four 885-11 disk units; single channel	32,000	159	1,170	1,080
7155-12	Mass Storage Controller; two channels	38,500	174	1,364	1,257
7165-22	Mass Storage Controller; two dual-channel units	56,000	406	3,150	2,895
10396-1	Two Channel Access Option for Model 885-11 Disk Storage Unit; provides a second controller connection to both 855-11 spindles to make it equivalent to the 855-12	3,420	17	91	86
10397-1	Additional Channel Option; up to three per 7155-1X	6,500	16	194	177
10399-1	885 Four-Drive Expansion Option; allows 7155 controller to access up to four additional 885 Disk Units	15,550	45	458	423
MAGNETIC TAPE UNITS					
698-10	Magnetic Tape Subsystem; includes two tape units; 1600PE/6250GCR bpi, 200 ips	81,500	820	3,620	3,260
698-11	Magnetic Tape Subsystem; same as 698-10 except that tape units and controller require 380/415 volts, 3 phase, 50 Hz power	81,500	820	3,620	3,260
698-12	Magnetic Tape Subsystem; same as 698-10 except that tape units and controller require 220/240 volts, 3 phase, 50 Hz power	81,500	820	3,620	3,260

T&M—Time and materials.
NA—Not available.
NC—No charge.

Control Data Cyber 900 Models 932/960/962

		Purchase Price ($)	Monthly Maint. ($)	1-Year Lease ($)	3-Year Lease ($)
MAGNETIC TAPE UNITS (Continued)					
698-20	Magnetic Tape Subsystem; allows an additional Cyber I/O channel to access any one of the magnetic tape units of a 698-10 plus two more tape units at a time	81,500	820	3,620	3,260
698-21	Magnetic Tape Subsystem; requires 380/415 volts, 3 phase, 50 Hz power, and 698-11	81,500	820	3,620	3,260
698-22	Magnetic Tape Subsystem; same as 698-20 except that tape units and controller require 220/240 volts, 3 phase, 50 Hz power; also requires 698-12	81,500	820	3,620	3,260
698-30	Magnetic Tape Unit; add-on magnetic tape unit for Models 698-10 and 698-20; up to 6 additional units are allowed within a 1-by-8 configuration and up to 4 are allowed within a 2-by-8 configuration	21,100	285	940	844
698-31	Magnetic Tape Unit; same as 698-20 except controller and tape units require 220/240/380/415 volts, 3 phase, 50 Hz power	21,100	285	940	844
9639-1	Magnetic Tape Transport; 1600PE/6250GCR bpi; 25 ips start/stop and streaming modes, and 75 ips streaming mode	18,000	130	NA	NA
9730-1	Tape/Disk Subsystem; please refer to above Mass Storage section for specifications	49,200	330	NA	NA
10482-1	Dual Magnetic Tape Control Switch for 698-1X tape subsystems; allows 2 magnetic tape controllers to be interconnected to make a maximum 2-by-8 configuration	4,800	69	215	192
PRINTERS					
533-1	Line Printer; 300 lines per minute (lpm)	5,700	132	280	255
537-1	Line Printer; 700 lpm, 136 print positions	13,090	165	NA	NA
585-1	Band Printer; 2,000 lpm	42,500	400	1,575	1,370
COMMUNICATIONS EQUIPMENT					
2601-X	CDCNet Basic Device Interface (DI) Cabinet; includes power supply, cooling fan, and master processor board	3,625	70	202	145
2604-1	System Main Memory Board; 1 megabyte	2,395	0	256	184
2605-1	128KB Private Memory Module; increases local memory in master processor board from 16KB to 144KB	1,995	0	124	89
2607-1	Mainframe Channel Interface; allows a DI to be coupled to a Cyber 170 channel	3,195	0	178	128
2608-5	Ethernet Serial Channel Interface; allows a DI to be coupled to and service an IEEE 802.3 Ethernet that complies with CDCNet protocols	1,855	0	104	75
2609-1	Communications Interface Module; provides processing power and a connecting mechanism to support up to 8 Line Interface Modules	1,355	0	76	55
2610-1	RS-449 Line Interface Module; provides 2 independent ports for terminals or modems	600	0	34	24
2612-1	RS-232 Line Interface Module; provides 4 ports; 50 bps to 38.4K bps asynchronous and up to 56K bps synchronous	500	0	34	24
2617-1	V.35 Line Interface Module; provides 2 ports; 50 bps to 38.4K bps asynchronous and up to 72K bps synchronous	600	0	34	24
2620-21X	Mainframe Terminal Device Interface; includes basic DI cabinet with master processor board, 1-megabyte System Memory Module, Private Memory Module, Mainframe Channel Interface, and Communications Interface Module	12,565	70	834	600
2621-200	Mainframe Device Interface NOS/VE; includes basic DI cabinet with master processor board, 1-megabyte System Memory Module, Mainframe Channel Interface, and Communications Interface Module	11,070	70	738	531
2622-2XX	Terminal Device Interface; includes basic DI cabinet with master processor board, 1-megabyte System Memory Module, Mainframe Channel Interface, and Communications Interface Module	9,230	70	635	458
2623-201	Network Device Interface; includes basic DI cabinet with master processor board, 1-megabyte System Memory Module, Ethernet Serial Channel Interface, and Communications Interface Module	9,230	70	635	458
2630-3	Ethernet Transceiver; allows a nonintrusive tap to be made to an Ethernet coax cable; complies with IEEE 802.3	375	1	NA	NA
2631-2	Ethernet Multiplexer; allows connection of up to 8 Ethernet Serial Channel Interfaces	1,795	25	83	60
2632-1	Ethernet Repeater; provides connection between 2 Ethernet trunk cables to extend an Ethernet local area network	1,795	25	83	60
2650-X	Three-DI Cabinet Assembly; provides mounting for 3 Device Interfaces	2,095	T&M	117	84
9261-2X	Communications Package for Models 932-XX; includes integrated communications adapter (2629-2), terminal device interface (2622-20X), and RS-232 Line Interface Module (2612-1)	13,480	85	NA	NA

T&M—Time and materials.
NA—Not available.
NC—No charge.

Control Data Cyber 900 Models 932/960/962

WORKSTATIONS		Purchase Price ($)	Monthly Maint. ($)	1-Year Lease ($)	3-Year Lease ($)
910B-3YY	Three-Dimension Graphics Workstation; 32-bit deskside engineering workstation includes controller for one or two hard disks, four async ports for interface to plotters and printers and for communications with larger system; requires cartridge or Ethernet connection, UNIX operating system and related software				
	The following submodels include all the features listed above plus these additional features:				
	910B-315 Entry-Level 3D Workstation; includes 4-megabyte memory, one 182-megabyte disk, 8-bit planes, Ethernet controller, and 19-inch monitor	25,545	293	NA	NA
	910B-320 Integrated 3D Graphics Workstation; includes floating-point hardware, 8-megabyte memory, 182-megabyte disk, Ethernet controller, 12-bit planes, and 19-inch monitor	48,545	440	NA	NA
	910B-337 Mid-Range 3D Graphics Workstation; includes 4-megabyte memory, 182-megabyte disk, Ethernet controller, 8-bit planes, and 19-inch monitor	43,545	440	NA	NA
	910B-340 Fully Configured 3D Graphics Workstation; includes floating-point hardware, 8-megabyte memory, 182-megabyte disk, cartridge tape, Ethernet controller, 32-bit planes, and 19-inch monitor	60,645	845	NA	NA
910B 5YY	RISC-Based 3D Graphics Workstation; 32-bit deskside engineering workstation includes 12.5MHz co-processor for improved floating-point performance, controller for 1 or 2 hard disks, 4 async ports for printer/plotter interface and link to larger system; requires cartridge, Ethernet connection, and UNIX				
	The following submodels include all the features listed above plus these additional features:				
	910B-520 Integrated RISC-Based 3D Graphics Workstation; includes 8 megabytes of memory, two 182-megabyte disks, and 16-bit planes	74,900	555	NA	NA
	910B-537 Entry-Level RISC-Based 3D Graphics Workstation; includes 8 megabytes of memory, one 182-megabyte disk, and 8-bit planes	69,900	490	NA	NA
910P-5AA	Cartridge Tape Drive for 910B-5YY; unit has a capacity of 40 to 60 megabytes	2,000	20	NA	NA
910X-OAA	Cartridge Tape Drive for designated 910B-3YY systems; has a capacity of 40 to 60 megabytes	2,100	59	NA	NA
910P-5AB	Applications Memory; provides an additional 4 megabytes of random access memory for 910B-5YY	5,000	40	NA	NA
910P 5AD	Additional 182-Megabyte Disk for 910B-537	6,000	50	NA	NA
910X OAB	Add-on Disk Drive for designated 910B-3YY systems; 72-megabyte capacity, unformatted	5,000	88	NA	NA
910P 5AP	Digitizer Tablet with Stylus for 910-5YY systems	1,500	35	NA	NA
910P-5CA	Eight-bit Plane Color Display Memory; provides additional eight planes of color display memory	2,000	15	NA	NA
910P-5GS	High-Performance Graphics Upgrade; provides a totoal of 96-bit planes including Z buffer; applies to 8-bit plane systems without Z buffer	20,000	NA	NA	NA
910P-5GT	High-Performance Graphics Upgrade; provides a total of 96-bit planes including Z buffer; applies to 16-bit or 24-bit plane systems with Z buffer	10,000	NA	NA	NA
910X-OAC	Disk Upgrade for designated 910B-3YY systems; replaces the 72MB disk and controller with a 182MB disk and controller	6,000	94	NA	NA
910X-OAD	Additional Hard Disk for 910B-3YY Systems; 182MB unformatted capacity and transfer rate of 1.25MB per second	6,000	76	NA	NA

T&M—Time and materials.
NA—Not available.
NC—No charge.

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SOFTWARE PRICES

		Onetime Charges		Monthly Charges		
		Basic License ($)	DSSL License ($)	Full License ($)	DSSL License ($)	Support Charge ($)
	Operating System Software:					
W931-16	NOS/VE Basic System Software Package, standalone; CPU 932-11	33,085	28,122	1,407	738	539
W933-16	CPU 932-3X	56,263	47,824	2,399	1,259	918
W850-16	CPU 960-11, 962-11	176,757	176,757	6,817	4,208	2,609
W860-16	CPU 960-31, 960-32, 962-31, 962-32	222,562	222,562	8,584	5,299	3,285
W931-17	NOS/VE Commercial System Software Package, standalone; CPU 932-11	32,256	27,418	1,375	721	526
W933-17	CPU 932-3X	54,978	46,731	2,349	1,233	898
W850-17	CPU 962-11, 962-11	174,323	174,323	6,723	4,150	2,573
W860-17	CPU 960-31, 960-32, 962-31, 962-32	219,490	219,490	8,465	5,226	3,239
W931-04	NOS/VE Compiler Software Package; CPU 932-11	20,963	17,819	808	424	309
W933-04	CPU 932-3X	33,380	28,373	1,287	676	492
W850-04	CPU 960-11, 962-11	66,234	66,234	2,555	1,577	978
W860-04	CPU 960-31, 960-32, 962-31, 962-32	83,471	83,471	3,219	1,987	1,231
W931-14	NOS/VE Operating System; CPU 932-11	23,904	20,318	1,076	564	412
W933-14	CPU 932-3X	41,832	35,557	1,882	988	720
W850-14	CPU 960-11, 962-11	145,656	145,656	5,618	3,468	2,150
W860-14	CPU 960-31, 960-32, 962-31, 962-32	183,372	183,372	7,073	4,366	2,707
W931-05	VX/VE under NOS/VE; CPU 932-11	12,420	10,557	452	293	107
W933-05	CPU 932-3X	17,712	15,055	645	492	153
W850-05	CPU 960-11, 962-11	30,420	30,420	1,107	845	262
W860-05	CPU 960-31, 960-32, 962-31, 962-32	36,432	36,432	1,325	1,012	313
	Languages and Compilers:					
W931-20	Fortran/VE; requires W8XX-01/W990-01; CPU 932-11	11,827	10,053	456	239	174
W933-20	CPU 932-3X	18,816	15,994	726	381	278
W850-20	CPU 960-11, 962-11	32,256	32,256	1,244	768	476
W860-20	CPU 960-31, 960-32, 962-31, 962-32	40,656	40,656	1,568	968	600
W931-22	C/VE; requires W8XX-01/W990-01; CPU 932-11	9,331	7,932	339	220	80
W933-22	CPU 932-3X	14,818	12,595	539	350	128
W850-22	CPU 960-11, 962-11	23,292	23,292	848	647	201
W860-22	CPU 960-31, 960-32, 962-31, 962-32	29,304	29,304	1,066	814	252
W931-23	Cobol/VE; requires W8XX-01/W990-01; CPU 932-11	10,853	9,225	418	220	160
W933-23	CPU 932-3X	17,304	14,708	667	350	255
W850-23	CPU 960-11, 962-11	29,694	29,694	1,145	707	438
W860-23	CPU 960-31, 960-32, 962-31, 962-32	37,422	37,422	1,443	891	552
W931-24	Basic/VE; requires W8XX-01/W990-01; CPU 932-11	8,467	7,197	326	171	125
W933-24	CPU 932-3X	13,482	11,460	520	273	199
W850-24	CPU 960-11, 962-11	24,528	24,528	946	584	362
W860-24	CPU 960-31, 960-32, 962-31, 962-32	30,912	30,912	1,192	736	456
W931-25	APL/VE; requires W8XX-01/W990-01; CPU 932-11	8,636	7,340	334	175	128
W933-25	CPU 932-3X	13,755	11,692	531	278	203
W850-25	CPU 960-11, 962-11	23,562	23,562	909	561	348
W860-25	CPU 960-31, 960-32, 962-31, 962-32	29,694	29,694	1,145	707	438
W931-26	Prolog/VE; requires W8XX-01/W990-01; CPU 932-11	6,989	5,940	270	141	103
W933-26	CPU 932-3X	11,124	9,456	429	225	164
W850-26	CPU 960-11, 962-11	20,328	20,328	784	484	300
W860-26	CPU 960-31, 960-32, 962-31, 962-32	25,578	25,578	987	609	378
W931-27	Cybil/VE; requires W8XX-01/W990-01; CPU 932-11	6,989	5,940	269	141	102
W933-27	CPU 932-3X	11,074	9,413	427	224	163
W850-27	CPU 960-11, 962-11	19,026	19,026	734	453	281
W860-27	CPU 960-31, 960-32, 962-31, 962-32	23,982	23,982	925	571	354
W931-28	Lisp/VE Interpreter; requires W8XX-01/X990-01; CPU 932-11	7,829	6,654	302	158	115
W933-28	CPU 932-3X	12,440	10,574	480	252	184
W850-28	CPU 960-11, 962-11	22,722	22,722	875	541	335
W860-28	CPU 960-31,960-32, 962-31, 962-32	28,602	28,602	1,103	681	422

NA—Not available.

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		Onetime Charges		Monthly Charges		
		Basic License ($)	DSSL License ($)	Full License ($)	DSSL License ($)	Support Charge ($)
W931-30	NOS/VE Programming Environments; CPU 932-11	3,192	2,713	123	65	47
W933-30	CPU 932-3X	5,544	4,712	214	112	82
W850-30	CPU 960-11, 962-11	8,148	8,148	314	194	120
W860-30	CPU 960-31, 960-32, 962-31, 962-32	10,248	10,248	395	244	151
W931-34	Pascal/VE; requires W8XX-01/W990-01; CPU 932-11	5,342	4,541	206	108	78
W933-34	CPU 932-3X	8,484	7,211	327	172	125
W850-34	CPU 960-11, 962-11	15,498	15,498	598	369	229
W860-34	CPU 960-31, 960-32, 962-31, 962-32	19,530	19,530	753	465	288
	Data Management:					
W931-41	IM/DM under NOS/VE; provides kernel, data base, and system administrator; CPU 932-11	18,245	15,508	70,432	369	270
W933-41	CPU 932-3X	26,624	22,630	1,027	539	393
W850-41	CPU 960-11, 962-11	64,848	64,848	2,501	1,544	957
W860-41	CPU 960-31, 960-32, 962-31, 962-32	81,690	81,690	3,151	1,945	1,206
W931-50	IM/Quick; requires W8XX-01/W990-01; CPU 932-11	11,760	9,996	454	238	174
W933-50	CPU 932-3X	20,580	17,493	794	417	304
W850-50	CPU 960-11, 962-11	25,872	25,872	998	616	382
W860-50	CPU 960-31, 960-32, 962-31, 962-32	32,592	32,592	1,257	776	481
W931-51	IM/Control; requires W8XX/W990-1, -02, -03, -13 and W8XX/W990-40 or -41 and -45; 932-11	9,240	7,854	357	187	137
W933-51	CPU 932-3X	16,170	13,745	624	327	239
W850-51	CPU 960-11, 962-11	20,328	20,328	784	484	300
W860-51	CPU 960-31, 960-32, 962-31, 962-32	25,578	25,578	987	609	378
W931-52	IM/Smart; requires W8XX/W990-01, 02, 03, or -13; CPU 930-11, 932-11	16,800	14,280	648	340	248
W933-52	CPU 932-3X	29,400	24,990	1,134	595	434
W850-52	CPU 960-11, 962-11	36,960	36,960	1,426	880	546
W860-52	CPU 960-31, 960-32, 962-31, 962-32	46,536	46,536	1,795	1,108	687
W931-31	NOS/VE Professional Programming Environment; CPU 932-11	3,990	3,392	154	81	59
W933-31	CPU 932-3X	6,983	5,936	270	141	103
W850-31	CPU 960-11, 962-11	10,164	10,164	392	242	150
W860-31	CPU 960-31, 960-32, 962-31, 962-32	12,726	12,726	491	303	188
	Officeware; 512-user Cyber version; it supports IBM PC or selected dumb terminals connected via RS-232; workstations must be connected to Cyber to function					
W931-140	CPU 932-11	28,000	NA	1,213	NA	280
W930-140	CPU 932-3X	34,000	NA	1,473	NA	340
W850-140	CPU 960-11, 962-11	39,600	NA	1,716	NA	396
W860-140	CPU 960-31, 960-32, 962-31, 962-32	59,400	NA	2,574	NA	594

NA—Not available. ■