Computer Automation SyFA System

MANAGEMENT SUMMARY

Computer Automation announced its first packaged commercial system, SyFA (System For Access) in May 1976. Until then, the company had always been an OEM-only house, supplying computers, memories, and interfaces to the rapidly expanding system-builder OEM market. SyFA was designed and developed by the Commercial Systems Division of Computer Automation.

SyFA is an interactive, time-sharing, file-oriented business computer system capable of supporting up to 24 independent users. Specifically, SyFA has been created for multi-divisional corporations, each with different data processing requirements, that wish to have multi-user time-shared systems at various remote locations and *also* wish to use these systems occasionally as remote batch or interactive terminals to a larger centralized host computer system—preferably without disturbing any of the 24 interactive users.

In addition to handling the 24 on-line concurrent users, SyFA can also support up to 16 concurrent system utilities, such as sorts or compilations, and perform one remote job entry task and two spool-to-printer tasks.

SyFA is built around a slightly modified version of CA's 2/60 Megabyter. Not many details concerning these modifications have been released, but CA claims that certain existing instructions of the 2/60 Megabyter (Report M11-168-101) have been enhanced to yield the performance levels required for use in SyFA systems.

The basic SyFA system, which CA calls a network processor configuration, includes 64K bytes of core memory, one asynchronous multiplexer with 8 terminal ports, power supplies, 9-slot chassis, the SyCLOPS oper-

Computer Automation has extended the capabilities of its SyFA distributed data processing system with mass storage, data transfer, and communications enhancements. The system can support up to 24 concurrent users and simultaneously function as a remote batch or interactive terminal to a large host computer. SyFA packaged systems begin at $45,000 for the basic system with 10 megabytes of disk storage.

CHARACTERISTICS

MANUFACTURER: Computer Automation, Inc., 2181 Dupont Drive, Irvine, California 92713. Telephone (714) 833-8830.

Computer Automation entered the market with the Naked Mini OEM minicomputer in 1971 and remained a strictly-OEM manufacturer until the end of 1975. The company has recently been partitioned into three distinct divisions: the Naked Mini Division, the Industrial Products Division, and the Commercial Systems Division. The Naked Mini Division is responsible for the development and marketing of Computer Automation's LSI-2 minicomputer series, the LSI-3 and LSI-4 microcomputers, and specialty systems based on these computers. The Industrial Products Division markets the CAPABLE line of circuit testers to other manufacturers in the electronics industry. The Commercial Systems Division produces and markets the SyFA system.

MODEL: SyFA.

DATE ANNOUNCED: Officially introduced in May 1976.

DATE OF FIRST DELIVERY: March 1976.

NUMBER INSTALLED TO DATE: 200.

The SyFA system is an integrated hardware/software complex created specifically for the network communications and distributed processing needs of large businesses. It provides concurrent interactive communications between as many as 24 terminals and the central processor. The basic SyFA system can be augmented with memory extensions to 304K bytes, one or two high-speed printers, a magnetic tape unit, from one to eight 10-, 80-, or 300-megabyte disk drives, and communications hardware to form systems that range in price from $45,000 to over 400,000.

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ating system, the SyBOL language, and SyFA utility programs and programming aids. Memory can be expanded to a maximum of 304K bytes in 32K-byte increments. The asynchronous multiplexer and interface can be used with any RS-232C terminals at distances of up to 3000 feet and with any RS-232C modems for remote terminal usage.

The SyFA system can be configured with three types of disk drives: the DSK-10, DSK-80, and DSK-300. The DSK-10 is a 10-megabyte cartridge disk drive with a formatted data capacity of 8.1 megabytes. Three additional 8.1-megabyte drives can be added to the controller supplied with the basic system. Storage can be further augmented by substituting 80-megabyte disk pack drives (DSK-80) or 300-megabyte drives (DSK-300). These large drives have a formatted capacity of 56 megabytes and 220-megabytes, respectively. Up to eight such drives can be attached to a SyFA system for a total disk subsystem capacity of 448 megabytes or 1760 megabytes, respectively.

A SyFA system can also include a 9-track, 25-ips magnetic tape unit. The MAG-800 is an 800-bpi unit, while the MAG-1600 is an 800/1600-bpi switch-selectable unit.

The basic SyFA system does not include a printer, but CA offers the PRT-503 165-cps serial printer and the PRT-2230 300-lpm and PRT-2260 660-lpm line printers as options.

Terminals can be any asynchronous RS-232-type units, although CA strongly recommends the use of its own SyFA Information Station. This 1920-character CRT terminal features a keyboard that matches the one found on the IBM Selectric typewriter. The CA keyboard not only uses the Selectric key format, but has been engineered to have the same feel as the IBM-manufactured units and to sit on a table top at the same angle. The CRT display unit is detachable and connected to the keyboard by a retractable cord, a nice innovation. At least one of these CA display terminals should be included as the system console. Other display terminals can be used for this function, but system messages will not be properly received on non-CA displays because of differences in the cursor positioning commands.

SyFA software includes SyCLOPS, the SyFA Concurrent Logic Operating System. SyCLOPS is a virtual-storage, multi-tasking system with 24 variable partitions, two printer spoolers, demand paging, and dynamic resource allocation. SyCLOPS has extensive file access capabilities, including random, sequential, and indexed access methods. The indexed access method is a superset of the familiar indexed sequential access method (ISAM).

Output for the printer can be sent directly to a printer, if available, or spooled on disk. Each user can create a spool file for later output. Despooling occurs on a first-in/first-out basis. Spooling occurs automatically if the printer is not available, and despooling occurs as soon as the printer becomes available. More than one printer can be attached to a SyFA system. With two printers on a system, one is dedicated to despooling while the other is used for both direct printing and despooling.

SyBOL, the new business-oriented programming language, has its roots in COBOL, as the "BOL" suffix implies. It

DATA FORMATS

BASIC UNIT: 16-bit word or 8-bit byte.

FIXED-POINT OPERANDS: 16-bit words consisting of 15-bit integer and one sign bit. Negative numbers are in two's-complement form. Larger fixed-point operands can be implemented through the use of variable-length byte string instructions.

FLOATING POINT OPERANDS: No hardware facilities; two-word or three-word formats through software subroutines only.

INSTRUCTIONS: One-, two-, or three-word instructions with 11 different formats. Single-word memory reference instructions have a four-bit op code, an eight-bit address field, and three bits to specify address mode. Double-word memory reference instructions have a three-bit op code, a four-bit iteration count, a 15-bit operand address, and indicator bits to specify direct/indirect address mode, etc. Three-word instructions include two 16-bit byte addresses for decimal arithmetic operations and block character moves. Byte-immediate instructions have a four-bit operation code and an eight-bit immediate operand. Conditional jump instructions have a four-bit op code, a six-bit displacement, a five-bit field to indicate test conditions, and one bit to specify jump direction (forward/backward).

Single-register shift and register change instructions have an eight-bit control field that specifies source, operation, and location of results, a three-bit shift count (zero for register change) and a five-bit instruction type indicator. The double-register shift instructions are similar to the single-register shifts except that the shift control count field is four bits and the op code is seven bits. Control instructions have a one-bit instruction type indicator, a seven-bit op code, and an eight-bit halt or instruction counter.

I/O instructions have a two-bit instruction type indicator, a six-bit op code, a five-bit device address, and a three-bit function code. Block I/O instructions are similar to I/O types except for a three-bit instruction type indicator and an additional 15-bit base address field. Automatic I/O instructions use three words; the first has the same format as the I/O instruction, and the next two words hold a 15-bit byte/word count and a 15-bit address pointer.

INTERNAL CODE: ASCII.

MAIN STORAGE

STORAGE TYPE: Core.

CYCLE TIME: 1.2 microseconds. Effective cycle times are substantially less with odd/even interleaving.

CAPACITY: The modified 2/60 Megabyter CPU can address up to 1,048,576 bytes, but the SyFA operating software currently supports a maximum of 311,296 bytes. Memory increments are 32,768 bytes.

CHECKING: None.

STORAGE PROTECTION: None.

RESERVED STORAGE: About 20 of the first 256 words (scratchpad or page 0) are normally reserved for device/interrupt addresses. These reserved words can be moved into page 1.

CENTRAL PROCESSOR

The SyFA CPU is a modified version of Computer Automation's Model 2/60 Megabyter. Modifications to the CPU include enhancements to the existing instruction set that make it more useful for business data processing and data communications. For more specific details on the SyFA processor, see Report M11-168-101.

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PERIPHERALS/TERMINALS

DEVICE	DESCRIPTION	MANUFACTURER
MAGNETIC TAPE EQUIPMENT		
MAG-800	Transport and controller; 9-track, 25 ips, 800 bpi, 10.5-inch reels	Kennedy
MAG-1600	Transport and controller; 9-track, 25 ips, 800/1600 bpi, 10.5-inch reels	Kennedy
PRINTERS		
PRT-503	Serial Printer; 132 positions, 9 x 7 dot matrix, 64 ASCII characters, 14.87-inch paper, two-channel VFU, automatic motor control and paper runaway detection; 165 cps	Centronics
PRT-2230	Line Printer; 132 positions, drum, 64 ASCII characters; 300 lpm	Dataproducts
PRT-2260	Line Printer; 132 positions, drum, 64 ASCII characters; 600 lpm	Dataproducts
TERMINALS		
SyFA Information Station	CRT Display/Keyboard; 12-inch screen, 1920 characters, 24 lines x 80 characters, 5 x 7 dot matrix, 96 ASCII characters, upper and lower case, keyboard detachable with retracting cord; 75 to 9600 bps	Computer Automation

contains nearly all the standard COBOL verbs, such as GO TO, CALL, RETURN, MOVE, ADD, SUBTRACT, MULTIPLY, DIVIDE, DISPLAY, OPEN, CLOSE, READ, and WRITE. However, SyBOL also includes several enhancements, including an extensive set of file-oriented verbs. In addition to the OPEN, CLOSE, READ, and WRITE mentioned previously, SyBOL includes other file-oriented verbs such as PREPARE, READ RANDOM, READ INDEXED, READ SEQUENTIAL, WRITE SEQUENTIAL, WRITE RANDOM, WRITE EOF, LOCK, UNLOCK, DELETE, UPDATE, and INSERT. Other significant features of SyBOL include fixed-point decimal arithmetic (16 places), extensive character string manipulation functions, use of immediate operands, and full video screen controls.

CA also offers both FORTRAN and BASIC compilers for use on the system, but these can be used in single-user mode only. Emulators for remote job entry systems include the IBM 2780, IBM 3780, and IBM 360/20 HASP workstations and the ICL 7020. An IBM 3270 terminal emulator is also available, and SNA/SDLC communications (IBM 3790 emulation) has recently been announced. These emulators can be executed concurrently with user programs, but only one emulator can execute at a time.

Included with the SyFA software package are 19 system utilities. On a SyFA system with 64K bytes of memory, only one utility can be run at a time, although it can execute concurrently with user programs. Additional utilities can be supported with each extra 16K-byte memory expansion. Thus, a maximum 304-byte system can support up to 16 concurrent utility programs in addition to the 24 concurrent SyBOL programs. The utilities include: INDEX, which builds key files for use with the indexed access method; a SORT program; FILCPY, which copies a disk file from one pack to another; FILPRT, which lists a disk file; VTOC, which prints or displays the volume table of contents for disk files; COMP, which compiles all SyBOL source programs; FORMAT, which prepares disk packs for software access and checks for faulty packs; DSKCPY, which generates a backup copy of an entire disk pack; REORG, which reorganizes disk files by copying them

INSTRUCTION REPERTOIRE: The SyFA CPU features 224 instructions, including 42 single-word memory reference instructions, 3 double-word memory reference instructions, 10 byte-immediate instructions, 13 conditional jumps, 12 single-register shifts, 4 double-register shifts, 52 register change instructions, 18 control instructions, 27 I/O instructions, 4 automatic I/O instructions, and 2 block I/O instructions.

In addition to the basic set described above, there are 37 specialized instructions, including four additional specialized stack instructions designed to facilitate re-entrant subroutines; two additional string manipulation instructions; two decimal string instructions, which permit hardware operations on strings of decimal numbers and facilitate business applications; four bit manipulation instructions that permit setting, resetting, complementing, and testing of any bit in memory; and a hardware cyclic redundancy check character instruction that can generate and check cyclic redundancy and longitudinal redundancy check characters in 15 microseconds.

Included among the 42 single-word memory reference instructions are 15 stack instructions which allow any memory location to serve as a stack control pointer and maintain a stack elsewhere in memory. Any number of routines can maintain any number of stacks anywhere in memory. The stack instructions also make it possible for different stack pointers to access the same stack, which means that data in a single stack can be accessed at the top or bottom, or any point in between, concurrently.

INSTRUCTION TIMINGS: All times are in microseconds, for full-word, fixed-point operands and direct addressing mode.

Load/Store:	**2.4**
Add/Subtract:	**2.4**
Multiply/Divide:	**12.8/15.1**
Compare and Branch:	**1.2**

PHYSICAL SPECIFICATIONS: The basic two-bay SyFA system cabinet is 46.6 inches wide, 40.75 inches deep, 30.5 inches high, and occupies 13.16 square feet of floor space. The PRT-2230 300-lpm printer and the PRT-2260 600-lpm printer each occupy 5.90 square feet of floor space. All other components either mount in cabinets or require table-top space.

Power for SyFA systems is nominally 117 VAC, 60 Hertz. A minimum service of 30 amperes is recommended. The following list shows the power consumption of various SyFA system components.

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onto another pack and removing gaps between data fields; and LIST, which conditionally lists the contents of selected files according to parameters supplied by the user.

SyFA also offers a full complement of programming aids, including a text editor, an interactive debugger, a screen management system, and a code generator. These programming aids can be used by any number of terminal ports concurrently.

USER REACTION

During February 1978, Datapro interviewed 6 SyFA users selected at random from a list of 15 users supplied by Computer Automation. The 6 users had a total of 21 SyFA systems. One of the users had employed SyFA for only four months, while the remaining five had been using their systems for over a year—two of them for almost two years.

Three of the installations were small. The SyFA system in each consisted of one SyFA CPU, one printer, and an average of two CRT's. Two of the systems had dual 10-megabyte disk drives, and the third was employing dual 80-megabyte disk drives. These systems were performing basic accounting functions and such business tasks as credit union accounting, contracts, warranties, and field service monitoring and reporting.

The three larger installations had multiple SyFA systems with both local and remote CRT's providing input for a variety of accounting and business tasks, as well as industrial process control.

An automobile manufacturing and sales corporation had six SyFA systems with a pair of 80-megabyte disk drives and multiple printers on each. Two of the systems analyzed records for parts testing from remote sites and produced test report summaries. Four of the systems processed sales, orders, and inventory control from 3500 dealers, each with a CRT tied in to one of the four SyFA systems. Material inventory control was communicated from system to system.

A large chemical company was using 10 SyFA systems, each with 6 CRT's, one dual 80-megabyte disk drive, and one printer, for purchasing, production, and process control.

The third large installation was a service bureau that provided accounting services to automobile dealerships and rest homes. The company had 2 CPU's, 4 local CRT's, and 16 remote CRT's linked to the systems over telephone lines. Each system employed dual 80-megabyte disk drives and one printer. Each remote station also had a printer.

Tabulated below are the results of the SyFA user survey.

	Excellent	Good	Fair	Poor	WA*
Ease of operation	5	1	0	0	3.8
Reliability of mainframe	4	2	0	0	3.7
Reliability of peripherals	5	1	0	0	3.8
Responsiveness of maintenance service	4	1	0	0	3.8

*Weighted average on a scale of 4.0 for Excellent.

CPU	Basic SyFA CPU	700 watts
DSK-10	8.1-megabyte disk drive	400 watts
DSK-80	56-megabyte disk drive	700 watts
DSK-300	220-megabyte disk drive	1020 watts
PRT-503	Serial printer	300 watts
PRT-2230	300-lpm printer	525 watts
PRT-2260	600-lpm printer	680 watts
CRT	CRT display/keyboard	45 watts

Operating environment for SyFA systems is generally 60 to 80 degrees F., at 35 to 80 percent relative humidity (non-condensing), although the serial printers and the CRT display/keyboard units can tolerate 40 to 90 degrees F. and 10 to 80 percent relative humidity.

INPUT/OUTPUT CONTROL

I/O CHANNELS: The MaxiBus supports 5 data transfer methods with 58 parallel lines. The methods are high-speed block I/O, programmed I/O, conditional I/O, automatic I/O, and DMA. The standard block I/O feature allows data transfer over the MaxiBus at 411,000 words per second; with programmed I/O, the maximum data rate is 130,000 words or bytes per second. Programmed I/O direct to memory is also possible at a rate of up to 90,000 words or bytes per second. The automatic I/O provides cycle-stealing data transfer at up to 80,000 words per second under interrupt control. Direct memory access provides up to 1,020,000 words or bytes per second for a single memory bank and up to 1,666,000 with interleaved memories. Up to 128 direct memory channels are provided, and a total of up to 248 devices can be attached.

SIMULTANEOUS OPERATIONS: Memory modules are odd/even interleaved, permitting the initiation of a memory operation to a contiguous memory location while an operation to the first location is still in progress.

SyFA disk controllers are microprocessor-based and can accept and execute separate head-positioning requests for all attached disk drives.

CONFIGURATION RULES

SyFA systems are initially supplied with 64K bytes of memory. Using 32K-byte modules, up to 256K bytes of additional memory can be installed on systems configured with DSK-80 and DSK-300 Drives, although only 240K bytes are available to the user. Memory cannot be expanded on DSK-10 systems. The first 16K bytes of add-on memory are reserved for system diagnostic purposes. A maximum of 304K bytes of main memory is currently supported by the SyCLOPS operating system.

Eight terminal ports are provided in the basic system, and multiplexer extension modules can be added for a total of 24 terminal ports. Each terminal port can be shared with a printer that connects directly to the SyFA display. Any terminal or printer with an asynchronous RS-232C interface can be used with the system. One synchronous communications interface can also be added to the system.

Terminals located up to 1000 feet from the system can be connected directly to the terminal ports. Beyond 1000 feet, a Bell 103 or equivalent modem must be used.

The minimum packaged SyFA system includes one DSK-10 cartridge disk drive and controller. Up to four drives can be connected to the controller. A disk controller for DSK-80 or DSK-300 disk pack drives can be substituted. The DSK-80 controller can accommodate up to four DSK-80 drives, and two controllers can be included in a SyFA system. The DSK-300 controller can accommodate up to four DSK-300 drives, and two controllers can be attached. DSK-10, DSK-80, and DSK-300 disk drives cannot be intermixed in a system.

Up to two serial or line printers can be connected to a SyFA system.

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	Excellent	Good	Fair	Poor	WA*
Effectiveness of maintenance service	4	1	0	0	3.8
Technical support	4	0	0	0	4.0
Operating system	4	2	0	0	3.7
Compiler	6	0	0	0	4.0
Ease of programming	6	0	0	0	4.0
Overall satisfaction	6	0	0	0	4.0

*Weighted average on a scale of 4.0 for Excellent.

These users were very well satisfied with the SyFA systems, as their ratings clearly indicate. The only problems they mentioned were minor start-up difficulties that had been taken care of promptly by Computer Automation's maintenance and support personnel.

In particular, CA's SyFA Support Center received strong positive comments. Five of the users had maintenance contracts, and the sixth was about to sign up because of the vendor's excellent service during the initial support period.

All of these users felt that their SyFA systems were well suited to the requirements of their particular applications, and largely because of this they had experienced no major problems, nor did they anticipate any.

Based on the highly positive reactions of these SyFA users, it appears that CA was well prepared to enter the end-user market. It may well be that in the near future we will be hearing more from CA's Commercial Systems Division.□

MASS STORAGE

DSK-10 8.1-MEGABYTE CARTRIDGE DISK SUBSYSTEM: Includes one DSK-10 cartridge disk drive, with one fixed and one removable IBM 5440-type cartridge, and one DSK-10 controller for up to four DSK-10 drives. The formatted capacity of each DSK-10 drive is 8.1 megabytes, recorded at 256 bytes per sector, 20 sectors per track, on 400 tracks with 6 spares. The disk controller can accept and simultaneously process head-positioning requests for all attached drives. Average rotational delay is 12.5 milliseconds, and average head-positioning time is 40 milliseconds. Data transfer rate is 312K bytes per second. Maximum on-line capacity using DSK-10 drives is 32.5 megabytes. The Model DSK-10 cartridge disk drives are manufactured by Pertec.

DSK-80 56-MEGABYTE DISK PACK SUBSYSTEM: Includes one DSK-80 disk pack drive and a DSK-80 controller for up to four DSK-80 drives. The formatted capacity of each DSK-80 drive is 56 megabytes, using a CDC 9877-type 5-platter disk pack. Data is recorded on five surfaces in 256-byte sectors, 56 sectors per track, on 823 tracks per surface. The disk controller can accept and simultaneously process head-positioning requests for all attached drives. Average rotational delay is 8.3 milliseconds, and average head-positioning time is 30 milliseconds. Data transfer rate is 1.2 million bytes per second. The SyFA system can accommodate two DSK-80 controllers for a total of eight DSK-80 drives. Maximum on-line capacity using DSK-80 drives is 448 megabytes. The Model DSK-80 disk pack drives are manufactured by CDC.

DSK-300 220-MEGABYTE DISK PACK SUBSYSTEM: Includes one DSK-300 disk drive and a DSK-300 controller for up to four DSK-300 drives. The formatted capacity of each DSK-300 drive is 220 megabytes, using a CDC 9883-91-type disk pack. Data is recorded on 19 surfaces in 256-byte sectors, 56 sectors per track, on 823 tracks per surface. The disk controller can accept and simultaneously process head-positioning requests for all attached drives. Average rotational delay is 8.3 milliseconds, and average head-positioning time is 30 milliseconds. Data transfer is 1.2 million bytes per second. The SyFA system can accommodate two DSK-300 controllers for a total of eight DSK-300 drives. Maximum on-line capacity using DSK-300 drives is 1760 megabytes. The Model DSK-300 disk drives are manufactured by CDC.

INPUT/OUTPUT UNITS

In addition to the standard SyFA peripheral devices listed in the Peripherals/Terminals table, users can also add any of those offered for use with Computer Automation LSI-2 Series minicomputers (Naked Mini or Megabyter). These non-standard units are not supported by the SyCLOPS operating system, but utilities included in the system support these units on a stand-alone basis. Readers should consult Report M11-168-101 for detailed specifications and prices of these peripherals.

COMMUNICATIONS CONTROL

Three controllers, one asynchronous, one bisynchronous, and one SDLC, have been developed specifically for the SyFA systems.

ASYNCHRONOUS MULTIPLEXER SUBSYSTEM: Includes one control unit for up to eight asynchronous lines. Expansions are optionally available for 16 lines and 24 lines. User terminals can be any asynchronous RS-232C device. The subsystem transfers data entirely under program control, using four separate vectored interrupts: transmit, receive, carrier, and ring. Transmit and receive rates are individually strap-selectable for each line and can be any standard rate between 37.5 and 9600 bits per second. Word length and number of stop bits are also individually strap-selectable for each line. User terminals can be either directly connected or coupled through standard RS-232C modems.

SYNCHRONOUS COMMUNICATIONS FACILITY: Includes a single-line controller for any RS-232C modem. The synchronous line interface features program-controlled character recognition for up to eight characters; automatic parity insertion, selectable through strapping; full- or half-duplex operation; full modem controls; and strap-selectable data rates to 19.2K bps. All data transfers are through the CPU auto-I/O facilities. The unit can interface any medium-speed, synchronous Bell system or equivalent modem.

SDLC COMMUNICATIONS PROCESSOR: Provides a single synchronous line for SNA/SDLC communications. When used in conjunction with the SyFA SNA-3790 software emulator, the SDLC processor provides complete IBM 3790 communications controller emulation. The SDLC processor contains a microprocessor to allow the off-loading of SNA/SDLC overhead functions from the SyFA CPU. All SNA commands are supported. SDLC protocol is fully supported, including bit-stuffing, CRC checking, and message framing. Transmission speeds are up to 9600 bps in full-duplex operation.

SOFTWARE

SyFA is a software/hardware system assembled for multidivisional organizations that require both distributed processing networks and stand-alone independent processing for such applications as data entry, interactive information retrieval, file updating and reporting, and program development. Two major software packages have been developed by Computer Automation for SyFA: the SyCLOPS multi-tasking operating system and the SyBOL business-oriented language, created for an on-line, interactive environment.

OPERATING SYSTEM: *SyFA Concurrent Logic Operating System (SyCLOPS)* is a virtual-storage multi-tasking operating system capable of supporting up to 24 variable

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user partitions. It features demand paging and dynamic allocation of resources, including disk file space. In addition to the 24 user partitions, SyCLOPS can support up to 16 batch utilities, a communications emulator, and two printer spoolers. SyCLOPS requires 34K bytes of memory, leaving 30K bytes of the basic system memory available for user programming. SyCLOPS also requires 43K bytes of disk storage.

User programs are divided into two components, a procedure division and a data division. Procedure divisions are brought into memory one page at a time, while entire data divisions are maintained in memory. Program pages are equal to one disk sector in size. Procedure divisions can be shared between several users without requiring multiple copies in memory. Data divisions of user programs are overlaid only when the procedure division has terminated execution.

SyCLOPS provides for common data to be shared between programs. In most situations, a new program being brought into memory causes the previous program, including the accompanying data, to be completely written over. Data to be passed on to the incoming new program can be designated COMMON and will remain intact for the new program's use.

When any user program is terminated or overlaid, SyCLOPS automatically closes any open files, including spool files, and releases any line printer being used by the outgoing program.

SyCLOPS also permits the concurrent execution of up to 16 system utility programs, in addition to the 24 possible user programs. This situation can occur if certain users wish to perform a sort or a compilation, or produce a copy of a file, while other users are executing applications programs. On a SyFA system with 64K bytes of memory, only one background utility can be executing at any one time. Each additional 16K-byte memory expansion supports one additional concurrent utility. A maximum 304K-byte system supports up to 16 concurrently executing system utilities. Expanded memory can also be utilized by normal application programs.

Under SyCLOPS, a procedure file can be established that momentarily suspends the requesting user's program and starts the requested utility into execution. Once the utility is under way, the user can return to the suspended application program and continue. Procedure files can be constructed by any SyBOL program and activated as part of the program stream. The suspended program is reactivated through a "rollback" system instruction.

Files and filing play leading roles in the SyFA system. A 254-byte sector is the basic data unit. Data files made up of these sectors can be either contiguous or fragmented into discontinuous groups. The operating system keeps track of noncontiguous groups, and their discontinuity is transparent to the user.

Logical records can cross sector boundaries and require only as much space as they actually occupy. Logical records can begin and end in the middle of physical sectors. The SyCLOPS operating system will automatically and dynamically fit user files into the least possible disk space.

SyCLOPS also permits space compression and record truncation to obtain the most efficient use of disk space. Any sequence of two or more consecutive spaces in string literals, string variables, or hexadecimal literals is replaced by a special marker character followed by a space count. The same action occurs for leading spaces in numeric variables. Decompression for output to a printer or display is automatic.

Truncation can also be performed on space-compressed records. Unbroken sequences of spaces at the end of a record are not written at all. On output, the trailing spaces are automatically made null characters by the system.

When a new disk file is prepared, the system automatically allocates 120 contiguous sectors for that file. Either a specific drive, or any drive, can be requested. When this primary allocation is exhausted, secondary allocations of 240 sectors are added automatically as needed. In the event that no 240-sector block is available, the system looks for the largest block available, decreasing the block size by 20 sectors until a fit is found. Up to 61 secondary allocations of any size can be made to a disk file. However, a new allocation to a contiguous sector is not considered a secondary allocation. Hence, a file can be as large as 8.1 megabytes. Disk space is automatically deallocated and freed for system reassignment when the limits of the file have been determined.

SyCLOPS supports three file access methods: random, indexed, and sequential. Indexed access is considered the primary mode, while random and sequential access have been included for users who require the fastest retrieval rates and do not require the complexity of indexing. Under SyCLOPS, indexed files can have any number of key files associated with them. Retrieval by partial key is also permitted.

Files can be flagged "read only" or "do not delete." No other specialized access restrictions can be imposed on *files* through SyCLOPS or the SyBOL language, but there are elaborate security schemes that limit access to *programs* that use the files. Under these provisions, passwords can be defined and limitations established as to which terminal can start specific programs and thereby access specific files.

LANGUAGE: *SyFA's Business-Oriented Language (SyBOL)* is best described as a COBOL-like language modified to support CRT displays and on-line keyboard editing in a real-time multiprogramming environment. COBOL is batch-oriented and has no provisions for these latter features. SyBOL retains the input structure of COBOL, i.e., short statements resembling the English language. These statements are entered in free-form fashion, and the SyBOL editor scans the input and creates the familiar label, verb, operand, and comment fields.

SyBOL source programs have the same general structure as COBOL programs, including the separate data and procedure divisions. Each variable not specified to be a number is considered to be a string variable. Strings are carried in 8-bit ASCII form and can be up to 127 characters long. SyBOL numbers are carried in fixed-point decimal form and can be up to 16 positions long, including the decimal point and negative sign. The system automatically suppresses leading zeroes.

SyBOL is designed to permit most of the file-handling functions possible with COBOL, but without requiring the complex file definition specifications. In addition, SyBOL has verbs specifically for controlling printers and display terminals.

COMMUNICATIONS SOFTWARE: An extensive collection of remote job entry and terminal emulator packages is available for SyFA systems. The list includes the IBM 2780, IBM 3780, IBM 360/370 HASP workstation, IBM 3270, IBM 3790 (SNA/SDLC), and ICL 7020. The emulator packages can be run concurrently with all SyFA applications and utilities, but only one emulator can be in operation at a time.

The 3270 emulation package permits a SyFA Information Station to be incorporated into an IBM 3270 network, allowing the terminal to communicate with any IBM 360/370 host system. It is possible to switch these CA-manufactured CRT display units between 3270 mode and normal SyFA mode at any time, with up to 15 stations operating in 3270 mode at a time.

UTILITIES: The SyFA software package includes 19 system utility and service programs. Included in the system utilities are the SyBOL compiler, file search, a volume table of contents (VTOC) utility, a file printout program, a key-file

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builder, a sort, a disk copy utility, a copy and reallocate utility, and a disk pack formatter. Among the programming aids are a text editor, an interactive debugger, a screen management system, and a code generator. These programs are actually SyBOL programs that can execute on any number of ports simultaneously. The system utility and service program requires 2K to 7.4K bytes of memory and 14.3K bytes of disk storage.

PRICING

POLICY: Computer Automation offers the SyFA system on a purchase-only basis. Installation and maintenance are separately priced. There is no stipulated warranty period on the SyFA system, and users must execute a maintenance agreement for service. Service is provided by CA's field-service organization. No leasing program has been announced at this time.

Support for the SyFA system includes both preventive and corrective maintenance, regularly scheduled training courses at CA's Irvine, California facilities, and a special "hot line" to the SyFA Support Center. The latter service is intended to aid in solving any technical support or maintenance problem and provides a direct line to a SyFA technical specialist.

EQUIPMENT: The following systems are representative of the low end, midpoint, and high end of the SyFA line. All systems include the SyCLOPS operating system, the SyBOL business-oriented language, and the SyFA system utilities.

SMALL SINGLE-USER SYSTEM: Includes a SyFA CPU with 64K bytes of memory and an 8-port asynchronous multiplexer, one DSK-10 8.1-megabyte cartridge disk drive, one SyFA Information Station, one serial printer, a 9-slot chassis, power supplies, and a 2-bay cabinet. Purchase price of this configuration is $56,250, and the monthly maintenance charge is $410.

MEDIUM-SCALE EIGHT-USER SYSTEM: Includes a SyFA CPU with 64K bytes of memory and an 8-port asynchronous multiplexer, two DSK-10 8.1-megabyte cartridge disk drives, eight SyFA Information Stations, one 600-lpm printer, a 9-slot chassis, power supplies, a 2-bay cabinet, a synchronous communications controller, and the IBM 2780 RJE emulator software package. Purchase price of this system is $102,500, and the monthly maintenance charge is $840.

LARGE-SCALE 24-USER SYSTEM: Includes a SyFA CPU with 64K bytes of memory and a 24-port asynchronous multiplexer, four DSK-80 56-megabyte disk pack drives, 24 SyFA Information Stations, two 300-lpm printers, a 9-slot chassis, power supplies, a 2-bay cabinet, a synchronous communications controller, and the IBM 2780 RJE emulator software package. Purchase price of this configuration is $212,750, and the monthly maintenance charge is $1,730■

EQUIPMENT PRICES

		Purchase Price	Installation Charge	Monthly Maint.
NETWORK PROCESSOR				
15010	SyFA Network Processor Configuration; includes CPU with 64K bytes of core memory, one asynchronous multiplexer with 8 terminal ports, power supplies and 9-slot chassis, SyCLOPS operating system, SyBOL language, and SyFA utility programs and programming aids	$ 29,000	$ 517	$ 207
PACKAGED SYSTEMS				
	Each of the following packaged systems includes the SyFA Network Processor Configuration (above), from one to eight disk drives with appropriate controller(s), and an appropriate system enclosure			
15201	System with one DSK-10 Disk Drive	45,000	750	325
15202	System with two DSK-10 Disk Drives	55,500	900	410
15203	System with three DSK-10 Disk Drives	66,750	1,100	495
15204	System with four DSK-10 Disk Drives	77,250	1,250	580
15101	System with one DSK-80 Disk Drive	56,000	1,000	400
15102	System with two DSK-80 Disk Drives	73,500	1,225	515
15103	System with three DSK-80 Disk Drives	91,750	1,500	630
15104	System with four DSK-80 Disk Drives	109,250	1,725	745
15105	System with five DSK-80 Disk Drives	131,500	2,150	905
15106	System with six DSK-80 Disk Drives	149,000	2,375	1,020
15107	System with seven DSK-80 Disk Drives	167,250	2,650	1,135
15108	System with eight DSK-80 Disk Drives	184,750	2,875	1,250
15301	System with one DSK-300 Disk Drive	71,000	1,000	435
15302	System with two DSK-300 Disk Drives	103,500	1,225	585
15303	System with three DSK-300 Disk Drives	136,000	1,450	735
15304	System with four DSK-300 Disk Drives	168,000	1,675	885
15305	System with five DSK-300 Disk Drives	205,000	2,050	1,080
15306	System with six DSK-300 Disk Drives	237,000	2,275	1,230
15307	System with seven DSK-300 Disk Drives	270,000	2,500	1,380
15308	System with eight DSK-300 Disk Drives	302,000	2,725	1,530
MEMORY				
	Initial factory or field memory expansion beyond 64K bytes to:			
11096	96K bytes	7,500	195	65
11128	128K bytes	9,900	265	90
11160	160K bytes	13,900	385	130
11192	192K bytes	16,300	455	155
11224	224K bytes	20,300	575	195
11256	256K bytes	22,700	645	220
11288	288K bytes	26,700	765	260
11320	320K bytes	29,100	835	285
	Subsequent memory expansion:			
	32K-byte memory upgrade	4,000	120	40
	64K-byte memory upgrade	6,400	190	65

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EQUIPMENT PRICES

		Purchase Price	Installation Charge	Monthly Maint.
MASS STORAGE (field upgrades)				
DSK-10	Additional 8.1-megabyte Disk Drive	10,500	150	85
	Additional 8.1-Megabyte Disk Drive and third enclosure bay	11,250	200	85
DSK-80	Additional 56-Megabyte Disk Drive	17,500	225	115
	Additional 56-Megabyte Disk Drive and third enclosure bay	18,250	275	115
	Additional 56-Megabyte Disk Drive with additional DSK-80 Controller, and fourth enclosure bay	22,250	425	160
DSK-300	Additional 220-Megabyte Disk Drive	32,500	225	150
	Additional 220-Megabyte Disk Drive with additional DSK-300 Controller	36,500	375	195
PRINTERS				
12503/ 4/5*	PRT-503 Serial Printer; 80 positions, 100 cps	8,500	100	55
12230	PRT-2230 Line Printer; 132 positions, 300 lpm	16,000	175	55
12260	PRT-2260 Line Printer; 132 positions, 600 lpm	19,500	200	55
TERMINALS				
18000	CRT Display Station; 24 lines x 80 characters; includes detachable keyboard and 50-foot cable	2,750	50	30
COMMUNICATIONS EQUIPMENT				
13016	Multiplexer Extension Module; provides 8 additional terminal ports; maximum of 2 per system	4,800	75	25
13024	Multiplexer Extension Module; provides 16 additional terminal ports; maximum of 1 per system	9,600	150	50
17016	SDLC Communications Processor; provides one synchronous line for SNA/SDLC communications	7,500	125	50
17017	Synchronous Communication Facility; provides one synchronous interface, RS-232C; maximum of one per system	4,000	75	30
MAGNETIC TAPE UNITS				
14800	MAG-800 Tape Transport and Controller; 9-track, 25 ips, 800 bpi, 10.5-inch reels	8,275	50	25
14160	MAG-1600 Tape Transport and Controller; 9-track, 25 ips, 800/1600 bpi (switchable), 10.5-inch reels	15,000	90	45
CHASSIS AND HARDWARE ACCESSORIES				
25001	Expansion chassis; provides 5 slots; includes power supplies; required if entire SyFA configuration exceeds 9 card slots	3,500	200	30
25009	Terminal Desk; attaches to system enclosure	300	NC	NC
22004	Stand for PRT-503 printer	250	NC	NC
22005	Paper Rack for PRT-503 printer	85	NC	NC
22003	Variable Top-of-Forms Option for PRT-2230 or PRT-2260	250	NC	NC

SOFTWARE LICENSE PRICES

99991	FORTRAN IV	3,000	300	30
99992	BASIC	2,000	200	20
93790	IBM SNA-3790 Emulator	7,500	1,000	125
92780	IBM 2780 Emulator	1,500	200	35
93780	IBM 3780 Emulator	2,000	250	40
93270	IBM 3270 Emulator	5,000	550	100
90360	IBM 360/370 HASP Workstation Emulator	2,500	300	50
97020	ICL 7020 Emulator	3,000	350	60

*The PRT-503 can be ordered for use as a port printer (12503) connected to a port on the multiplexer, as a shared-port CRT printer (12504) plugged directly into the SyFA Information Station, or as a system printer (12505) eligible for software spooling.