Formation 4000 Information System

MANAGEMENT SUMMARY

The Formation 4000 Information System is a powerful minicomputer system consisting of processor, controllers, and peripherals. The Formation 4000 offers IBM System/370 program compatibility via a unique "Program Equivalent" (PE) architecture. The Formation 4000 is a 32-bit minicomputer that uses microprocessors to emulate the IBM 370 channels and controllers. The peripherals and their controllers are minicomputer devices. The hardware is quite different from IBM's hardware; however, to the software it appears equivalent.

Formation is marketing the F/4000 to knowledgeable users as a distributed data processing stand-alone system, and an OEM system. A key aspect of Formation's marketing philosophy is the total hardware and software support available for the F/4000. Formation's goal is to provide a complete end-to-end computer system, rather than just parts of a system.

The Formation 4000 is designed for ultra-high reliability. The system provides a separate System Control Processor that runs diagnostics on all modules, checking their condition each time the system is started and monitoring them while the system is running. Another key to the reliability is the unique fail-soft capability. The user has a choice of duplicating any one module or all the modules of the system (full redundancy). These added modules enhance the performance of the system. If a failure occurs, the system will shut down, automatically reconfigure itself, and start running with minimal degradation. Formation also provides a complete remote diagnostics feature for hardware and software maintenance from a central control location. Other features of the Formation 4000 ▷

The Formation 4000 is a powerful 32-bit minicomputer system that features program compatibility with the IBM System/370, and performance similar to the IBM 4331.

MODELS: Formation 4000 Models 100, 200, and 300.

CONFIGURATION: The F/4000 can have from 256K bytes to 8 megabytes of memory, up to 4 "program equivalent" channels, up to 8 disk and tape drives, and up to 10 communications adapters.

COMPETITION: Hewlett-Packard HP 3000; IBM System/370, 4300 Series; Magnuson M80 Series; Wang VS systems.

PRICE: Purchase prices range from $42,500 for the F/4000-100 to $85,500 for the F/4000-300.
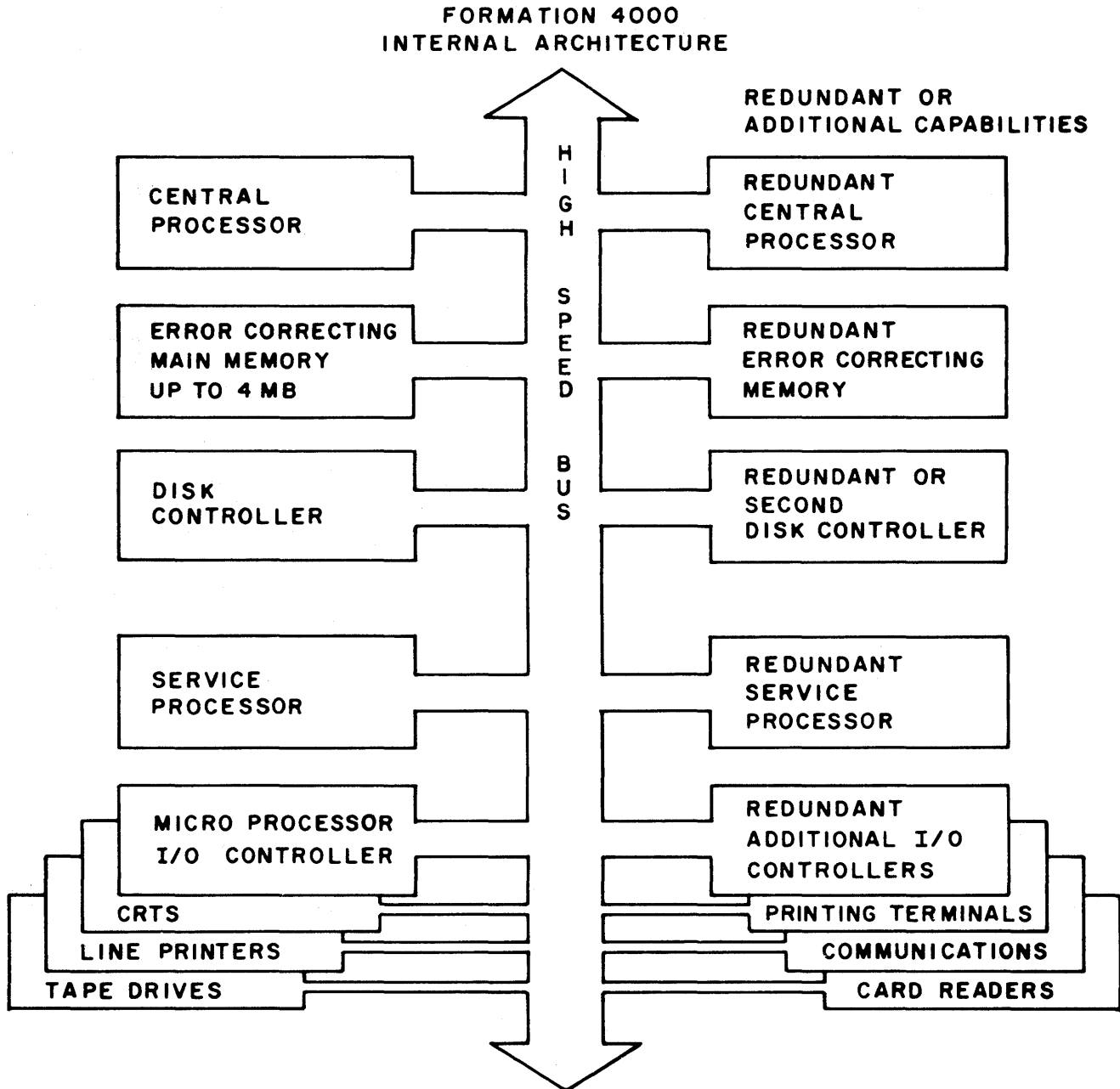
CHARACTERISTICS

MANUFACTURER: Formation Incorporated, 823 East Gate Drive, Mt. Laurel, NJ 08054. Telephone (609) 234-5020.

Formation, Inc. was founded in 1970 to provide consulting services to the information processing industry. The Formation 4000 Information System, announced in March 1980, is a complete system consisting of processor, controllers, and peripherals with a unique redundancy capability designed into the system. The Formation 4000 system offers "Program Equivalent" (PE) architecture, which uses microprocessors to emulate the IBM System/370 ▶
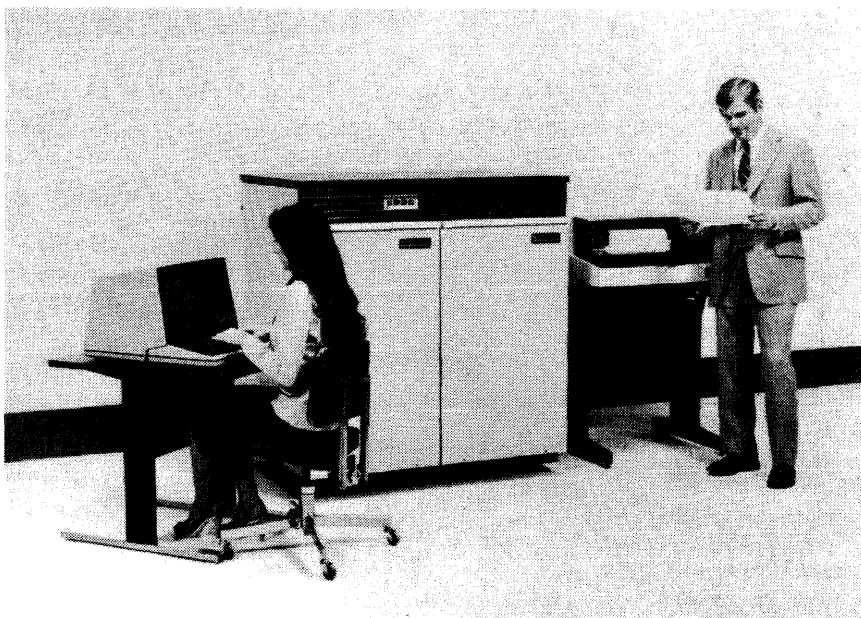
The Formation 4000 Information System offers performance capabilities equivalent to the IBM System/370. The Formation 4000 shown has a central processor with 512K bytes of memory, a System Control Processor, a 1-megabyte floppy disk, a disk controller with two 70-megabyte disk drives, a magnetic tape controller with one magnetic tape drive (not shown), a unit record processor with a 300-lpm printer, and three CRT terminals. This system is priced at $118,900 with a monthly maintenance fee of $790.

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FORMATION 4000
INTERNAL ARCHITECTURE

REDUNDANT OR
ADDITIONAL CAPABILITIES

H
I
G
H

CENTRAL
PROCESSOR

REDUNDANT
CENTRAL
PROCESSOR

S
P
E
E
D

ERROR CORRECTING
MAIN MEMORY
UP TO 4 MB

REDUNDANT
ERROR CORRECTING
MEMORY

B
U
S

DISK
CONTROLLER

REDUNDANT OR
SECOND
DISK CONTROLLER

SERVICE
PROCESSOR

REDUNDANT
SERVICE
PROCESSOR

MICRO PROCESSOR
I/O CONTROLLER

REDUNDANT
ADDITIONAL I/O
CONTROLLERS

CRTS

PRINTING TERMINALS

LINE PRINTERS

COMMUNICATIONS

TAPE DRIVES

CARD READERS

▷ designed to provide dependability are the use of solid-state error-correcting memory, sealed disk "Winchester" technology, low power components, and extensive use of LSI circuitry.

MODELS

The Formation 4000 system is available in three packaged models: the F/4000-100, F/4000-200, and F/4000-300. The entry level F/4000-100 package is equipped with central processor/shared disk controller, a memory controller, a system control processor, a one-megabyte floppy disk, and a 300-bps modem. The Model F/4000-200 consists of a central processor, a separate disk controller, a memory controller, a system control ▷

channels and controllers. Consequently, although the hardware is quite different from its IBM counterpart, the F/4000 appears to the software to be equivalent. Therefore, the software runs as if it were on an IBM System/370, and no changes are required to any system control programs or application programs.

MODELS: Formation's 4000 Information System includes three models: an entry level F/4000-100, a mid-range F/4000-200, and the top-end F/4000-300 that provides full hardware redundancy. All three models are capable of running IBM DOS/VS, DOS/VSE, OS/VS1, VM/370, VM/SP, and MVS operating systems.

DATE ANNOUNCED: March 1980.

DATE OF FIRST DELIVERY: February, 1981. ▶

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▷ processor, a one-megabyte floppy disk, and a 300-bps modem. The F/4000-300 packaged model offers the user complete system redundancy. The F/4000-300 package contains two central processors/shared disk controllers, two memory controllers, a system control processor, a one-megabyte floppy disk, and a 300-bps modem.

Each of the three models may be expanded by adding:

- Central Processor
- Memory modules of 256K bytes or 1 megabyte.
- Integrated Disk Controller
- One-megabyte Floppy Disk
- 70-, 100-, or 635-megabyte Disk Drives
- Integrated Magnetic Tape Controller
- 72K- or 200K-byte Magnetic Tape Drives (1600 bpi)
- System Control Processor
- Unit Record Processor
- Card Reader (300 cpm)
- Character Printer (180 cps)
- Line Printer (300, 600, or 1000 lpm)
- Local Communications Processor
- Asynchronous Communications Adapter
- Binary Synchronous Communications Adapter
- Byte Multiplexer Channel
- CRT Terminals

MEMORY CAPACITY

The Formation 4000 supports up to two memory controllers, each of which can accommodate up to four memory arrays of the same size. The F/4000 offers memory arrays in two sizes: 256K bytes or 1 megabyte. The maximum memory capacity for the F/4000 is 8 megabytes. Main memory corrects single-bit errors and detects most multiple-bit errors.

INPUT/OUTPUT CONTROL

There are no hardware channels in the Formation 4000 except for an optional byte multiplexer. However, via the Program Equivalent feature the system appears to have 4 IBM 370 channels. Channel 0 is a Byte Multiplexer and Channels 1, 2, and 3 appear as Block Multiplexer Channels to the software. The Input/Output is accomplished through intelligent controllers that interface minicomputer peripherals to the system central bus.

The F/4000 system can have two disk controllers (F4830); each controller supports up to four 70-, 100-, or 635-megabyte disk drives. The F/4000 supports two tape controllers (F4803), and up to four 72K- or three 200K-byte magnetic tape drives can be attached to each controller. The unit record processor supports one line printer and/or one card reader. The F/4000 can support four unit record processors and up to ten integrated local communications processors (LCP). Each LCP (F4272) has four ports to which CRTs or printer terminals can be attached. The F/4000 supports up to ten binary synchronous adapters (F4700), up to six asynchronous adapters (F4702), up to four byte multiplexers, and up to 16 channels and 64 addresses. ▷

▶ DATA FORMATS

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

FIXED-POINT OPERANDS: Can range from 1 to 16 bytes (1 to 31 digits plus sign) in decimal mode; 1 halfword (16 bits) or 1 word (32 bits) in binary mode.

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

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

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

MAIN STORAGE

TYPE: Dynamic NMOS; 16K or 64K bits per chip.

CAPACITY: Memory is available in either 256K or one-million-byte increments. A memory controller supports four increments of the same type, such as four 256K increments (one million bytes) or four increments of one million bytes for a total of four million bytes per memory controller. The F/4000 supports two memory controllers; however, both controllers must have the same capacity if fail-soft operation is required.

CYCLE TIME: Memory cycle time is 800 nanoseconds. Memory refresh is required every 2 milliseconds. This normally occurs during idle F-Bus times, but memory can demand bus access to refresh if adequate cycles are unavailable.

CHECKING: Parity is checked on all read and write operations between the memory and the central processor. When data is stored, a 7-bit error-correcting code is substituted for the byte parity bits. When data is retrieved, single-bit errors are detected and corrected automatically, and most multiple-bit errors are detected and signaled so appropriate action can be taken.

STORAGE PROTECTION: The Store and Fetch protection feature, which guards against inadvertent overwriting and/or unauthorized reading of data, is equivalent to the standard feature on the IBM System/370 models.

The F/4000 system is made up of highly microcoded modules which emulate the IBM 370/138 processor and controllers. The controllers interface minicomputer-type peripherals directly to a central bus (F-Bus). This approach eliminates the hardware channels, but allows all system and application software to function as if the channels and multiplexers were included.

The system consists of a 32-bit central processor, memory, system control processor, disk controller, I/O controllers, and peripherals. The three models (100, 200, and 300) are field-upgradeable, and feature a wide choice of peripherals.

CENTRAL PROCESSOR

The F/4000 uses 2901-type bit sliced microprocessors to emulate all the standard features of the IBM 370/138 including: virtual storage capability by dynamic address translation, System/370 Commercial Instruction Set, store and fetch storage protection, byte-oriented operands, clock ▶

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▷ SOFTWARE

Although the hardware is quite different from IBM hardware, Formation via its Program Equivalent (PE) architecture has made the F/4000 system look to the software as if it were a System/370. A major advantage of the F/4000 is that it accommodates the IBM DOS/VS, DOS/VSE, OS/VS1, VM/370, VM/SP, and MVS operating systems. The microcoded VM assists are included on all F/4000 models. Applications programs that run on an IBM System/370 Model 138 should run on the Formation 4000 without modifications.

Formation has developed a Transaction Management System (TMS) for the F/4000 that runs under the IBM VM operating system. TMS is a data base management and transaction processing system that features VM/370 environment, a complete data base management system, automatic start-up (operator-less execution), report handling, security management, automated backup and restore of software, menu selection for transactions, and a simulation capability. Applications are written in either Formation's Business Programming Language (BPL) or Cobol. The Transaction Management System will run on either a Formation 4000 system or an IBM 370 system.

For the manufacturing community, Formation developed FORMAN, a transaction-oriented manufacturing resources planning system. Designed to operate in a VM environment under TMS, FORMAN keeps a close monitor on all aspects of a manufacturing operation. The system can even simulate events for better planning, and can be used to train new employees.

COMPETITION

The Formation 4000 systems are being marketed as distributed data processing systems, stand-alone systems, and OEM systems. The Formation 4000 system is designed to compete with the IBM System/370 Model 138 and the IBM 4331. It also competes in performance with the IBM System/38, IBM 8100 Information System, Wang VS Systems, and Hewlett-Packard's 3000 Series. The first shipments of the Formation 4000 occurred in the first quarter of 1981.

USER REACTION

Datapro contacted six F/4000 users from a list supplied by Formation. All six had the Model 100, one had a Model 200 on order and one had six Model 300s. The average installed time was about eight months, and the majority of the users purchased their systems. Only two users reported replacing another computer arrangement with the F/4000; one had an IBM 4331-1 and the other was using a service bureau. Four of the companies were computer services firms, the fifth was in the insurance business, and the sixth was a facilities management firm. Applications for the four computer firms included software development and project management; for the insurance company, group pensions were the chief activity; and typical financial applications were running on the facilities management ▷

▶comparator and CPU timers, time-of-day clock, interval timer, control registers, machine check handling, channel command retry, channel indirect addressing, extended precision floating point, console audible alarm, console file, external control mode, program event recording, and virtual machine assist.

The central processor control store consists of 8K words of 64 bits each. The system utilizes an 8K-word writable control store (WCS) module. The microcode is loaded automatically from the system floppy disk immediately upon completion of the automatic self test. An additional 8K-word WCS is used for shared CPU/disk cotroller operation.

The same electronic modules are used for the central processor and integrated disk controller. In the minimum configuration (F/4000-100), the central processor and disk controller functions share the same electronics. A maximum of four shared central processor/disk controller modules is supported. A minimum of two modules can be designated as the CPU and two modules can be designated as disk controllers for any active configuration; however, for fail-soft purposes the modules may be redesignated at IMPL time as long as the maximum configuration is not exceeded. In a two-CPU system, the second CPU functions as an attached processor.

All modules on the system including the central processor, disk controller, memory, service processor and I/O processors are interconnected via a common 4-byte wide (F-Bus) connection. Throughput on the F-Bus is five megabytes per second. Parity is maintained on the F-Bus and on internal data paths.

SYSTEM CONTROL PROCESSOR

A separate electronics module set within the system cabinet is designated the System Control Processor (SCP). The SCP is designed to run diagnostics on all system modules prior to each IMPL of the system. Only those modules that pass these diagnostics are enabled to the "active" state on the F-Bus. Multiple configurations can be stored on the system floppy disk (connected to the SCP).

The SCP also monitors the state of the F-Bus and can detect most system failures. If a failure occurs, the system can automatically be halted and IMPLed following another diagnostic test by the SCP.

All diagnostically detected errors as well as I/O and memory errors, including soft errors, are recorded on the system floppy disk by the SCP and are available for review via either the local or remote console.

The SCP provides for four terminal I/O ports. The first is dedicated to the local console position and the second to a modem for remote support. The system comes standard with a 300-bps asynchronous modem which can be used for remote hardware and software support. An optional 1200-bps modem is available. Since the system contains no control panel other than an on/off key and power and status lights, all the operator panel functions are handled via menu driven screens on the CRT console or remote console. Initiation of remote console support requires operator intervention, and all operations are duplicated on the local console.

Two additional I/O terminal ports are available on the SCP and can be used for local support of CRT terminals and/or printers in the same manner as if attached to the Local Communications Processor. The SCP also provides the support of an optional customer accessible floppy disk for program or data storage. This floppy is accessible to 370-level software. ▶

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company's system. The number of terminals per system ranged from 6 to 14. Main memory ranged from one to four megabytes. Three were operating under VM/SP, two on OS/VS1 under VM, and one was running MVS (which is not currently supported by Formation). Interestingly, there was only one Cobol user; the majority were using APL with an occasional Assembler, Pascal, or Fortran. Without exception, each user was very pleased with the F/4000, and most had plans for some upgrades in 1982, be they hardware or software, or both. Relatively few negative comments were expressed. All users said the system performed as expected, and would recommend it to others. The user ratings on the Formation 4000 are contained in the following chart.

	Excellent	Good	Fair	Poor	WA*
Ease of operation	6	0	0	0	4.0
Reliability of mainframe	4	1	1	0	3.5
Reliability of peripherals	4	2	0	0	3.7
Maintenance service:					
Responsiveness	3	3	0	0	3.5
Effectiveness	2	4	0	0	3.3
Technical support:					
Trouble-shooting	3	3	0	0	3.5
Education	0	2	0	0	3.0
Documentation	3	3	0	0	3.5
Manufacturer's software:					
Operating system	4	2	0	0	3.7
Compilers & assemblers	4	2	0	0	3.7
Applications programs	4	2	0	0	3.7
Ease of programming	2	3	0	0	3.4
Ease of conversion	3	0	0	0	4.0
Overall satisfaction	4	2	0	0	3.7

*Weighted Average based on 4.0 for Excellent.

As the ratings indicate, the Formation 4000 is held in high regard by its users. The head of a computer services firm in the southeast told us his F/4000 is "amazingly solid," and is planning to add color terminals and possibly upgrade to the Model 300 in the near future. He has experienced virtually no problems with the system, especially since it is running under MVS. He has recommended the F/4000 "many times" to his colleagues.

Another computer services firm, this time in the northeast, reported their F/4000 regularly achieves 95+ percent uptime, even though they work it "very hard." This increased activity has prompted them to order the Model 200 upgrade, due for installation soon.

The DP manager of a northeastern insurance company told us her F/4000 had some early startup problems, mostly hardware, but the system functions very well now. She is well satisfied with the system, and would recommend it to others.

Another northeastern computer services firm was an early F/4000 user, and is selling the F/4000 as part of a turnkey project management system for Fortune 500 companies. The project manager told us the system runs OV/VS1 under VM and a wide variety of proprietary software. The equipment is "fantastic," and he has experienced virtually no problems since installing the system a year ago.□

CONTROL STORAGE

The F/4000 provides for writable control storage. The control store consists of one 8K-word by 64-bit module for the central processor function and a second 8K-word by 64-bit module for the disk controller function. Both modules must be present for shared operation.

Writable control storage uses 4K by 1, MOS static RAM (70-nanosecond access) organized in an 8K by 64-bit configuration.

INPUT/OUTPUT CONTROL

I/O CHANNELS: The F/4000 system appears to have four IBM 370 Channels. Channel 0 is a Byte Multiplexer and Channels 1, 2, and 3 appear as Block Multiplexer channels. These channels appear to the software as their IBM counterparts; however, there are no hardware channels in the F/4000, except for the optional byte multiplexer (F4110). The F/4000 is therefore "program equivalent" not "plug-compatible." Input/Output is performed through intelligent integrated controllers that interface minicomputer peripherals to the system F-Bus. The system's aggregate I/O data rate is that of the F-Bus; 5 megabytes/second.

CONTROLLERS: All controllers for the F/4000 are integrated and plug into the backplane of the F/4000. The controllers (except the disk controller) are Z80-based and microcoded to appear to the software as the equivalent IBM controllers.

F4830 DISK CONTROLLER: Utilizes the same electronics assemblies as the central processor, and by the addition of increased control store functions, as a shared disk controller/central processor. A maximum of two disk controllers per system are supported, each capable of supporting up to four 70-megabyte disk drives, four 100-megabyte drives, or four 635-megabyte drives. The controller appears to the software as an IBM 3830 attached to a Block Multiplexer channel supporting 3340-70, 3330, or 3350 data modules. Rotational Position Sensing (RPS) is a standard feature. Separate central processor and disk controller electronics are standard on the F/4000-200 model. A separate disk controller can be added to the F/4000-100 model via the expansion backplane. The F/4000-300 supports a maximum of two disk controller configurations.

F4803 MAGNETIC TAPE CONTROLLER: the integrated magnetic tape controller plugs into the standard backplane. Each controller is Z80-based and contains the control electronics to interface up to four tape drives. The controller appears as an IBM 3803 controller attached to a Selector channel supporting IBM 3420 tape drives. The F/4000 supports up to two F4803 magnetic tape controllers, each of which can support up to four F4420 or three F4420-5 tape drives.

F4821 UNIT RECORD PROCESSOR: The Unit Record Processor supports one F4203 line printer and one F4504 card reader and plugs into the standard system backplane. The F/4000 supports up to four Unit Record Processors. The Unit Record Processor is Z80-based and contains the control and channel electronics so that the printer and card reader appear as an IBM 3203 or 1403 printer and 3504 card reader attached directly to integrated attachment features.

F4272 LOCAL COMMUNICATIONS PROCESSOR: The integrated local communications processor (LCP) plugs into the standard system backplane. Each LCP supports 4 ports which can be used to directly attach Formation's F4277 terminals and/or F4203-1 printers. A maximum of ten LCPs is supported; 3 LCPs plug into the standard system backplane and more can be plugged into F4603 expansion backplane.

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▶ Terminals appear to the system as local IBM 3277s connected to an IBM 3272 controller through a Byte Multiplexer Channel. Printers appear as IBM 1403 printers connected through a Byte Multiplexer Channel. Terminals and printers can be remotely located up to 3000 feet from the CPU via RS-422 hard-wire connections.

F4700 BINARY SYNCHRONOUS COMMUNICA-TIONS ADAPTER: This module provides EBCDIC Binary Synchronous (BSC) protocol capabilities equivalent to the IBM 270X Synchronous Data Adapter Type II. The F4700 features transparent mode of operation, limited conversational mode, error index byte, multipoint network capabilities, automatic polling, and tributary station support. The F4700 occupies one standard backplane slot in the system backplane, and up to ten F4700s can be supported. Each F4700 allows two communications lines to be connected to the F/4000, with a maximum aggregate data rate of 19.2 kilobits per second. One line may be used at 19.2 kilobits per second or two lines at a maximum rate of 9600 bits per second. The F4700 operates with user-supplied synchronous RS-232-C/V24 modems. Switched or private lines and point-to-point or multipoint configurations are supported. Local BSC terminal controllers can be attached directly to the F4700 Communications Adapter without using a modem. Additional features of the F4700 include Business Machine Clocking, New Sync, Constant or Switched RTS operations, and Auto Answer.

F4702 ASYNCHRONOUS COMMUNICATIONS ADAPTER: This unit provides asynchronous communications capabilities to the F/4000. It is equivalent to the IBM System/370 Model 138 Integrated Communications Adapter and 270X-type adapters for support of the Telegraph Adapter Type II feature. The F4702 consists of an integrated control unit that connects the F/4000 to remote asynchronous devices through communications lines, including up to one autodial unit. The F4702 plugs into the standard system backplane and occupies two slot locations. Each F4702 allows 16 communications lines to be connected to the F/4000, with a maximum aggregate data rate of 76.8 kilobits per second when all lines are active. Each line can transfer data at programmable rates from 50 to 19,200 bits per second. A maximum of six F4702s can be present on the system at any one time. Redundancy can be provided by means of two F4702s attached to a single modem through an EIA switch. An optional version of the F4702 supports both asynchronous and bisynchronous communications.

F4110 BYTE MULTIPLEXER: This unit allows the user to connect any IBM or IBM plug-compatible device to the F/4000 that is typically connected to the IBM System/370 Byte Multiplexer Channel. The F4100 occupies two standard F-Bus slots in the F/4000 backplane. Each F4110 has 16 subchannels and can recognize 16, 32, or 64 addresses on the F/4000 Channel 0 Byte Multiplexer. The aggregate data throughput for the F4110 is 20K bytes/second in burst mode and 10K bytes/second in byte-interleave mode. Up to four F4110s are supported.

MASS STORAGE

Three disk drives of varying storage capacities are available with the F/4000. All employ Winchester technology, with the read/write heads and magnetic disk media enclosed in a closed-loop, filtered container. All disk models are non-removable. Each of the disk drives may be ordered with an optional "dual port" capability. While only one port may be active for any system configuration, the configuration may be changed automatically through the System Control Processor each time the system is IMPLed.

F4348 DISK DRIVE: The F4348 Disk Drive has a 70-megabyte capacity. The F4348 appears to the system to be an IBM 3348-70. Up to four F4348 disk drives are supported per

controller. The average head positioning time is 30 milliseconds and the data transfer rate is 1.012 megabytes/second. Included with the standard F4348 is a cabinet housing up to two drives. Two other versions of the F4348 are available. The F4348-1 is a rack-mountable version of the 70-megabyte drive, designed to be mounted as a second drive in an existing F4348 disk cabinet. The F4348-2 is also rack-mountable, designed to be mounted in the bottom of the magnetic tape drive cabinet. The F4348 Option 001 drive provides 135 megabytes of storage when operating under the Formation-enhanced VM/370 environment.

F4330 DISK DRIVE: The F4330 Disk Drive has a 100-megabyte capacity. The F4330 is program equivalent to an IBM 3330-1 drive. Up to four F4330 disk drives are supported per controller. The average head positioning time is 30 milliseconds and the data transfer rate is 1.2 megabytes/second. Included with the standard F4330 is a cabinet that can house up to two drives. Like the F4348, two rack-mountable versions of the F4330 are available. The F4330-1 is mountable is an existing F4330 disk cabinet. The F4330-2 can be mounted in the bottom of the magnetic tape drive cabinet.

F4350 DISK DRIVE: This unit has a 635-megabyte capacity. The F4350 is program-equivalent to two logical IBM 3350 units. The average head positioning time is 25 milliseconds and the data transfer rate is 1.2 megabytes/second. A stand-alone cabinet is included with the F4350. A maximum of four F4350 drives are supported per controller.

F4540 FLOPPY DISK SUBSYSTEM: This optional floppy disk drive connects to the standard internal floppy disk system, and supports six IBM diskette formats. A maximum of two F4540 Floppy Disk Drives are supported on the F/4000.

INPUT/OUTPUT UNITS

MAGNETIC TAPE DRIVES: The F/4000 supports two types of magnetic tape drives of varying speeds. Each of the tape drives is available with or without a formatter; one formatter is required per tape controller. The drives are connected to the F4803 Magnetic Tape Controller, which can support up to four devices. All units are program compatible with their IBM counterparts.

F4420/F4420A TAPE DRIVES: The F4420 Magnetic Tape Drive is a 72K-bits/second tension-arm drive mounted in its own cabinet. Operating at a speed of 45 ips, the F4420 uses 1600 bpi, phase-encoded recording standards. The F4420 has a maximum reel capacity of 2400 feet.

The F4420A includes the formatter and acts as the master for the F4420 slave units. The F4420A connects to the F4803 Magnetic Tape Controller, while the F4420 drives are connected in a daisy-chain configuration. Each controller supports a maximum of four tape drives: one F4420A and three F4420 units.

F4420-5/F4420A-5 TAPE DRIVES: The F4420-5 Magnetic Tape Drive is a 200K-bits/second, vacuum-column drive mounted in its own cabinet. The F4420-5 operates at a speed of 125 ips. Like the F4420, the F4420-5 supports a data density of 1600 bpi, and can handle up to 2400-foot tape reels.

The F4420A-5 contains the formatter and acts as the master; up to two F4420-5 slave units can be connected in a daisy-chain configuration. A maximum of three F4420-5 tape drives are supported per controller; one F4420A-5 and two F4420-5 units.

F4277 TERMINAL: The F4277 CRT terminal is a 26-line by 80-character display that includes a keyboard as a standard feature. Twenty-four lines are available for the user and two lines are dedicated for system and terminal status. Normal and high-intensity display modes are supported. ▶

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▶ The F4277 terminal keyboard has a 10-key numeric pad and 12 Program Function keys in addition to a standard typewriter keyboard.

The F4277 supports all IBM 3277-2 standard features and appears to the software as a 3277 connected to a 3272 controller. The F4277 can be hardwire connected to the Local Communication Processor or System Control Processor up to 3000 feet away using the standard RS-422 interface.

PRINTERS: Four printer models are available: the F4203-1 Character Printer, F4203-3 Line Printer, F4203-6 Line Printer, and the F4203-10A Line Printer.

F4203-1 CHARACTER PRINTER: A 132-column, 64-character, 180-character-per-second dot matrix printer. It has a tractor feed and supports 10 characters-per-inch spacing. Paper widths of up to 15 inches and 6-part forms are supported.

The F4203-1 is intended to handle the printing requirements of distant CRT terminals or system print needs where relatively low print volume exists. The terminal emulates most of the features of an IBM 1403 or 3203 line printer, and offers more compatibility than the usual 3286 or 3287. It appears to the software as a directly connected 3203. The F4203-1 can be hardwire connected to the Local Communication Processor or System Control Processor up to 3000 feet away using an RS-422 interface included as a standard feature.

F4203-3, F4203-6, AND F4203-10A LINE PRINTERS: These units provide for 300-, 600-, and 1000-lines-per-minute output, respectively. All printers are the same except for their speed. The units are band printers with standard 64-character sets capable of handling character spacing of 10 characters per inch, 6 or 8 lines per inch, paper widths of 3 to 16 inches, and up to 6-part forms. The printers emulate an IBM 1403 or 3203 line printer and appear to the software as directly-connected 3203s. The 4203-3, -6, or -10A printers are connected to the Unit Record Processor via a 25-foot cable; an optional 100-foot cable is also available. A sound-absorbing acoustic cabinet is also available as an option on the -3 and -6 printers and comes standard on the -10A.

F4504 CARD READER: This device reads 400 standard 80-column punched cards per minute, and has a hopper capacity of 500 cards. The reading mechanism consists of fiber optics and electronic light sensors. The F4504 supports EBCDIC and card image formats. An End-of-File card is supported to permit multiple files to be read without operator intervention. One F4504 Card Reader is supported per F4821 controller.

RELIABILITY/MAINTAINABILITY

A key to the F/4000's reliability is its unique redundant, or fail-soft, capability. Fail-soft modules enhance the performance of the system during normal operation and, if certain failures occur, enable the system to automatically reconfigure itself and restart with minimal degradation. Thus, system operation can continue even if a module of the system fails. The user can duplicate any or all modules of the system, which ensures full fail-soft capability.

Also offered is a separate System Control Processor (SCP) that runs power-on confidence tests, checking the condition of all modules each time the system is started, while monitoring their condition during system operation.

For hardware and software problems, a remote diagnostics capability is available. This feature can be used to diagnose problems from any F4277 Display Terminal equipped with the remote support option. From the remote terminal, the system can be powered on or off and the machine can be reIMPLed. Both voltage and temperature can be monitored

remotely. All remote operations can be duplicated on the local terminal.

Software and microcode system problems can be analyzed and often corrected immediately via the remote terminal. For hardware problems, the field engineer can more accurately pinpoint the causes before visiting the site to determine what repairs and replacement parts are required.

Other features contributing to the reliability of the F/4000 include the use of solid-state, error-correcting memory, sealed Winchester-type disk technology, low power components, and extensive use of large scale integration (LSI) circuitry.

SOFTWARE

Formation offers complete functional compatibility with IBM 360/370 software. Operating systems supported include DOS/VS, DOS/VSE, OS/VS1, MVS, VM/370, or VM/SP. These operating systems execute without modification on the F/4000.

Programs written to run on an IBM System/370 using DOS/VS, DOS/VSE, OS/VS1, MVS, VM/370, or VM/SP System Control Programs and utilizing the available peripherals should run on the F/4000 provided there is no time-dependent code.

In addition to supporting these IBM operating systems, programming languages like Cobol, Fortran, PL/1, RPG II, and APL, and the large variety of IBM system software available, Formation has developed its own family of software products. The Transaction Management System, the BPL language, and the FORMAN manufacturing system all provide effective business management tools.

Transaction Management System

The Formation Transaction Management System (TMS) extends the capabilities of VM/370. Formation has used IBM's VM/370 and CMS as a base to build its own system level software. Seeking to address on-line data base-oriented transaction processing applications, Formation has created a set of software tools named the Transaction Management System (TMS). TMS is made up of a group of subsystems and monitors. The monitors execute in their own virtual machines and, like the nucleus of an operating system, are always present. The subsystems are software tools that can be invoked by the transaction programs at run time or can be used to define structures and screens ahead of the application execution.

BUSINESS PROGRAMMING LANGUAGE (BPL): A language subsystem that can be used to do application work under TMS. BPL is very similar to PL/1. Special syntax has been added to handle screens, the data base, and report generation. At present, the BPL runs the source code through a translator to create a PL/1 source program; then the PL/1 compiles the program. BPL programs are developed under CMS, and a predefined EXEC handles the subsequent processing. For those shops using Cobol for their applications, the F/4000 can run CPL, an extension of Cobol.

DATA BASE MANAGEMENT: Formation has defined its own data base strucure and manager. The structure is defined by a Data Description Language (DDL).

DDL is a set of declarations created by CMS and processed by a DDL translator under CMS. The language allows for the definition of fields, groups of fields, records, and keys (primary and alternate); and relationships among fields belonging to different records in different files.

The structure allows for one parent-multiple children as well as one child-multiple parent kinds of linkages. Multiple levels ▶

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▶ of parent-child relationships can exist. It is possible to retrieve a parent record based on a known child. The construction of the data base is a network model.

Retrieval is possible on a multitude of criteria, such as sequential, keyed, and relational (those based on complex relationships). The relational retrieval gives the data base a unique feature. Selection expressions involving non-keyed fields are also supported.

Security is definable to the field level. Retrievals and upates are possible by fields, thus providing data independence for applications programs.

Transaction logging is done by the DB manager to make recovery from a catastrophic failure as simple as possible (re-entry of on-line transactions should not be needed). Total back-up and restoration of data sets is also provided. Audit trails are maintained and are available for subsequent examination and reporting.

DATA BASE MONITOR: TMS manages all its stored, disk-based data as part of one data base. The entire data base is under control of a single process—the Data Base Monitor.

The monitor is resident in its own virtual machine. This monitor and its virtual machine are always present in the TMS environment. It receives requests from the application programs and manages all disk activity. The monitor interfaces with CP (Control Program—part of VM/370) to create and manipulate disk files. The access method used is VSAM. The monitor wil reference the run-time tables created by the DDL translator. Security is checked at run time to the field level. The monitor prevents any inconsistencies that could be created by concurrent updates of the same record. The monitor acts similarly to prevent situations generally known as the "deadly embrace" wherein programs "lock" one set of resources and wait on each other to release the other set.

TERMINAL MONITOR: Since TMS is intended for an on-line environment, it is assumed that all interfaces to the external world are via terminals being used by the end user.

All terminals are managed by the Terminal Monitor. The terminal monitor displays menus, and the user selects additional menus or transaction screens. The screens provide an easy-to-use environment to enter data, inquiries, requests for old reports, and other specific action.

Corresponding to each transaction is an applications processing program. The terminal monitor provides a consistent interface between the user and the applications program.

Menus and screens are defined using the screen definition language of BPL or CPL. The translation then creates the tables that the terminal monitor and application programs need at run time.

A key feature of the terminal monitor is its security management. The user defines, using a separate utility program, a matrix of terminals, menus, and transactions. This enables the terminal monitor to bring up on a given terminal a particular menu screen, thus limiting that terminal to a specific set of transactions.

APPLICATION MONITOR: Each application program runs under the supervision of the Applications Monitor. Each execution of an applications program causes a new virtual machine to be created with a copy of the monitor and the program. The monitor manages the communications between the program and terminals and between the program and data base. Since the terminal and data base management are defined in their own monitors, the interfaces that application programs have to meet are uniform and consistent, leaving the programmers free to concentrate on the application.

Automated Operator: In keeping with its philosophy of catering to non-DP personnel, an automated operator is available that will perform routine functions such as IPL upon power-on. This should eliminate the need for full-time operators.

What-If: Users can obtain a copy of the data base for the sole purpose of posing "what-if" questions. If a particular interaction is satisfactory to the user, the actual data base can then be updated. Existing users of the data base are not affected during the simulation activities. Multiple simulations can be supported. Training mode is a subset of What-If mode and can be used to design specific training exercises.

FORMAN™

FORMAN is a Formation-developed system for planning and controlling the operations of a discrete manufacturing company. A terminal-oriented system, FORMAN is designed to generate master schedules, plan procurement and fabrication schedules, plan capacity requirements, maintain shop floor control, control inventory, and analyze costs. Up to 46 terminals can be supported under FORMAN.

FORMAN provides the information-handling functions needed to perform various jobs, which are covered by the transaction statements in one or more of the module menus. Each transaction is identified by a number which is keyed into the keyboard to start the desired action. The specific actions available include adding items, revising them, and changing transactions (a combination of actions); close, which deletes item from active memory but not permanently; delete, which permanently removes items; and copy, which permits the transfer of items into other file areas.

FORMAN's Material Requirements Planning (MRP) capabilities can be operated in three different modes: 1) Transaction Driven Net Change, 2) Batch Net Change, and 3) Regenerative. The Transaction Driven mode is the normal mode of operation, and responds to a wide variety of situations. Entry of data affecting the requirements plan triggers the necessary calculations. The new plan is available immediately, and the system remains available to users during replanning. In Batch Net Change mode, the system holds the data until the user initiates the MRP function. The Regenerative mode can be used to generate an entirely new set of schedules when there is a major change in business plans, order policy, or material or capacity availability.

Since FORMAN runs under TMS, it has both a simulation mode and a training mode. The simulation mode allows the user to ask "what-if" questions. The information in FORMAN's data base can be used, without disturbing it or denying it to other users, to explore the consequences of different planning or scheduling options.

The training mode data base contains information about a typical manufacturing operation. The trainee can then be instructed in the use of modules and transactions while operating on that special information. Training can take place at one work station without disturbing normal work flow at other work stations.

PRICING

MINIMUM F/4000 SYSTEM: F/4000 Model 100 with 1 megabyte of memory, 100 megabytes of disk storage, a 45-ips tape drive, 180-cps printer, and console. The purchase price is $90,800 and monthly maintenance costs $489.

TYPICAL F/4000 SYSTEM: F/4000 Model 100 with 2 megabytes of memory, 200 megabytes of disk storage, a 45-ips tape drive, 300-lpm printer, remote communications adapter, system console, and ports for 10 local terminals. Purchase price is $133,900 and monthly maintenance is $822. ▶

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▶ MAINTENANCE: The normal maintenance period is 8 a.m. through 5 p.m., Monday through Friday, excluding nationally recognized holidays. An extended maintenance period plan is available.

Where service is required outside of contracted periods, the Formation maintenance plan provides for up to two hours of on-site work at a fixed rate. Work beyond two hours will be billed at the following rates:

EXTENDED MAINTENANCE PERIOD CHARGES

	8 Hrs	12 Hrs	16 Hrs	20 Hrs	24 Hrs
Mon-Fri (excluding national holidays)	BMMC*	30%	35%	40%	45%
All Saturdays in month	10%	12%	14%	16%	18%
All Sundays and holidays in month	10%	12%	14%	16%	18%

*BMMC—Basic Monthly Maintenance Charge.

HOURLY RATES

Monday-Friday during normal maintenance periods, except holidays	$60.00 per Hour
Monday-Saturday outside normal maintenance period, except holidays	$70.00 per Hour
Sundays and holidays	$80.00 per Hour

EQUIPMENT PRICES

PACKAGED SYSTEMS

Model no.	Description	Purchase Price	Basic Monthly Maintenance Charge
F/4000-100	CPU with 256K bytes of memory, shared disk controller, System Control Processor with floppy disk & 300-bps modem mounted in a single cabinet with a 26-slot backplane	$42,500	$150
F/4000-200	CPU with 256K bytes of memory, separate disk controller, System Control Processor with floppy disk & 300-bps modem mounted in a single cabinet with both a 26-slot and 8-slot backplane	54,000	180
F/4000-300	2 CPU/Shared Disk Cotnrollers with 512K bytes of memory for each CPU, one System Control Processor with floppy disk and 300-bps modem mounted in 2 adjacent cabinets	85,500	295

PROCESSOR OPTIONS

Model no.	Description	Purchase Price	Basic Monthly Maintenance Charge
F 4100	Central Processor	12,000	40
F 4260	System Control Processor	6,500	50

ADD-ON MEMORY

Model no.	Description	Purchase Price	Basic Monthly Maintenance Charge
F 4502-1	256K-byte Memory Module	3,000	12
F 4502-2	1-megabyte Memory Module	12,000	48

MASS STORAGE

Model no.	Description	Purchase Price	Basic Monthly Maintenance Charge
F 4830	Integrated Disk Controller	15,000	50
F 4348	70-megabyte Disk Drive	15,000	100
F 4330	100-megabyte Disk Drive	15,000	100
F 4350	635-megabyte Disk Drive	30,000	230■
F 4540	1-megabyte Floppy Disk Drive	2,000	35

MAGNETIC TAPE UNITS

Model no.	Description	Purchase Price	Basic Monthly Maintenance Charge
F 4803	Integrated Magnetic Tape Controller	4,000	28
F 4420	72K-byte Magnetic Tape Drive, 45-ips, 1600 bpi PE	10,000	68
F 4420A	72K-byte Magnetic Tape Drive master unit, same as F 4420	13,500	80
F 4420-5	200K-byte Magnetic Tape Drive, 125-ips, 1600 bpi PE	14,000	120
F 4420A-5	200K-byte Magnetic Tape Drive master unit, same as F 4420-5	17,500	130

PRINTERS AND CARD READER

Model no.	Description	Purchase Price	Basic Monthly Maintenance Charge
F 4821	Integrated Unit Record Processor	2,500	12
F 4203-1	180-cps Character Printer	3,400	58
F 4203-3	300-lpm Line Printer	9,000	185
F 4203-6	600-lpm Line Printer	12,000	215
F 4203-10A	1000-lpm Line Printer	21,000	225
F 4504	300-cpm Card Reader	6,000	58

COMMUNICATIONS

Model no.	Description	Purchase Price	Basic Monthly Maintenance Charge
F 4272	Local Communications Processor	2,500	12
F 4277	CRT Terminal with Keyboard	2,400	25
F 4700	Communications Adapter	3,000	22
F 4702	Asynchronous Communications Adapter	6,000	22
F 4110	Byte Multiplexer	4,500	24

SOFTWARE PRICES

		Purchase Price	Basic Monthly Maintenance Charge
Transaction Management System		35,000	350
FORMAN, as included with F 4000 system		45,000	450■